Wilmington Harbor, North Carolina

Wilmington Harbor Navigation

Improvement Project

Integrated Section 203 Feasibility Study and Environmental Report

APPENDIX S

Quality Control Report

February 2020

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1 Economics Appendix

Comments on the Economics Appendix were provided by Larry Prather, former Assistant Director of Civil Works (Legislation and Planning), USACE and Chief, Navigation Planning Branch, USACE.

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Jerry Diamantides, Ph.D.
Senior Economist
David Miller & Associates
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Dear Jerry,

I'm pleased to respond to your email copied below. I'm delighted that you found my recommendations useful. I have reviewed your responses and the modifications to the Economics Appendix.

Two aspects have been central to resolving uncertainties about the identification of the National Economic Development Plan. These were the without project condition assumption that Wilmington would be dropped from US East Cost-Asia containerized services and the consistency of with project benefit estimates with the ***Principles and Guidelines***.

Based on your responses and the Appendix modifications, I'm pleased to find that both key issues have been successfully resolved. This assures your defense of the NED plan identification. I can safely say that I could join you in defending this analysis. In addition, all minor or editorial concerns are resolved.

I commend your tenacity, diligence and outstanding analysis in complying with the Principles and Guidelines. The Port of Wilmington will be grateful for the rigor of your work in defending the Federal interest in their project. Good job!

Sincerely,

Larry J. Prather
Reviewer

Wilmington Harbor

Jerry Diamantides <jdiamantides@dma-us.com> Fri, Jan 31, 2020 at 9:11 AM
To: Larry Prather <larry.j.prather@gmail.com>

Larry,
Please see my responses to your comments and the revised Economics Appendix.
The parts of the Economics Appendix that have changed most importantly are 1.8.2.3 Existing Conditions Wilmington Fleet and section 4, which includes the revised benefits analysis based on the willingness to pay for transportation services.
I look forward to your insights. I believe I have performed the analysis you suggested.
Jerry

Jerry Diamantides, Ph.D.
Senior Economist
David Miller & Associates

Wilmington Harbor Navigation Improvement Project
Economics Appendix
Comments

General Comments.

1. Overall the report is well written and attractive. It presents information on Wilmington port and the east coast to Asia services critical to informing the investment decision at Wilmington. These general comments attempt to summarize the critical implications of the review of the economic analysis.

2. **Principles and Guidelines standards for benefit estimation.** Examining the full origin to destination costs (or the delivered price of commodities including full transportation costs) is critical to conducting the economic benefit analysis and to providing information to readers and reviewers sufficient to judge the accuracy of the analysis and underlying assumptions. This cost analysis approach is prescribed in the steps of the Evaluation Procedures Section VII—NED Benefit Evaluation Procedures: Transportation (Deep-Draft Navigation, Principles and Guidelines. Paragraph 4.1 Plan formulation acknowledges this in saying, "Transportation cost savings are calculated as reductions in the cost of transporting goods from their ultimate origin to their ultimate destination." The analysis should focus on ways to incorporate full origin to destination transportation cost comparisons to better support the assumptions and benefit analysis. This comment is a recurring theme in the sequel. However, see General Comments 4 and 5 for additional perspective on analytical challenges.

3. Identification of the NED Plan. The recommendation of this document and the identification of the NED plan turn on two assumptions that are not strongly supported by underlying analysis.

a. The **without project assumption** that the Port of Wilmington would not be included as port of call in the without project condition US East Cost – Asia (USEC-Asia) container service with the associated assumption that all Wilmington hinterland Asia service movements as projected would use other ports remaining in the Asia services (specifically Savannah) at the expense of truck haul distances and costs that exceed current truck haul distances and costs currently incurred to ship via Wilmington. These additional truck costs are the source of with project benefits; they become the cost-reduction benefits of an improved channel at Wilmington.

b. The **with-project assumption** is that Wilmington would be included as a port-of-call in USEC-Asia services at a with-project depth of 47 feet and that all projected Wilmington hinterland USEC-Asia service traffic that would otherwise use Savannah in the without project conditions will use Wilmington at the establishment of a 47-foot draft at Wilmington's . Project benefits are the added overland truck costs that would have to be incurred in the without condition to access the USEC-Asia services through Savannah. The NED plan is this 47-foot channel because there are no benefits for channels less than 47-feet deep and negative estimated benefits for greater depths.

Essentially, the entire analysis and the identification of the NED plan turn on these two assumptions. More detailed comments in the sequel focus attention on the need to support these assumptions by

comparing full origin to destination costs transportation costs among alternative port routings between the with and without project conditions. Without such analyses or without other strong evidence why the assumptions are accurate in the absence of such cost comparisons, readers and reviewers will be challenged to verify the appropriateness of the assumptions of the economic analysis. **Response: see subsequent revisions to the analysis.**

4. **Acknowledgement of significant challenges to responding to these comments.** The current P&G framework for analysis may not be well suited to the realities of container trades. Clearly, the P&G analysis works best when transportation is a dedicated service which is a form on "non-joint production." However, more often than not, transportation services are provided through joint production. This is true when backhauls are non-zero, but particularly true when characterized by interdependence that is the essence of containerized shipping. Scheduled container services are the joint production of transportation to and/or from the ports of call included in the service. In this case, the USEC-Asia container services jointly produce transportation to and/or from Charleston, Savannah, Wilmington, etc. Understanding the derived demand market for transportation services must take this into account, but there are few good models for transforming fully allocated costs into rates for the services. If one examines the on-line quote citations for the Qingdao to USEC-Asia range of ports, the rates quoted are identical among the USEC ports belonging to the service. A little reflection dictates that understanding the production function for transportation services, costs of services and pricing of services are interrelated among the ports of the service in a complex way that defies the simple movement by movement analysis contemplated in the P&G. Solving the problems of the marginal port to a service – like Wilmington – requires a complex market analysis that depends on how adding the service affects the costs and prices of transportation to or from the other ports within the service – how the market works to make the decision to add or not add the port of call and to reset the equilibrium prices for transportation to and from the other ports in the service. These complex features of the problem make very attractive the almost elegant approach of making the benefit analysis depend solely on the reductions in overland transportation costs that would be enabled by deeper channels at Wilmington. Unfortunately, without additional details, the approach evades the critical questions of painting an accurate picture of the without and with project conditions and, the depths at Wilmington that will capture various levels of benefits. The problem may be unsolvable with the available data and tools. (See

5. **Need for more powerful models.** A coherent method for estimating the benefits for an improved Wilmington Harbor would be to implement a mathematical programming model that minimizes the total transportation cost bill (all movements, origin to destination including overland) for the commodity movements belonging to the US East Coast (USEC) to Asia services. This model would incorporate the critical technological interdependence among the several ports and movements relevant to the NED account. The model would permit plotting minimum total USEC-Asia service costs against depths at Wilmington. The model would also provide for boundary solutions (Wilmington traffic essentially zero) when minimizing total service cost while assigning projected existing movements to other ports. The curve would permit computation of net benefits to Wilmington as reductions in minimum total service transportation costs. This solution would achieve reasonable consistency with the P&G standard of founding benefits on reductions in transportation costs while coping with the inherent interdependence and joint production aspects of the container service. **Response: There is an inherent problem with this approach identified in the comment, which is that data on containerized cargo shows that cargo is not**

distributed in a "total transportation cost minimization" framework. Analyses of containerized data always show boxes that take a more costly route than would be calculated by a total transportation cost minimization model. Unfortunately, USACE apparently has not implemented such an analytic capability. Such models would be costly and face calibration challenges. However, there isn't an obvious shortcut that is likely to be satisfying. USACE should work on this problem. The most common application of HarborSym might be thought of as a single port variant of the more general model required to optimally invest in channels. These applications often assert as an assumption that traffic diversions among ports are not important. The system implications of container service are avoided and estimates of reductions in transportation cost are made simple — perhaps deceptively so. "No inter-port/intra-service diversions" is a dubious assumption as this analysis shows. Given the importance of container services and their inherent inter-port interdependence to channel investments USACE should give expeditious attention to an appropriate extension of existing models. An associated need would be to formulate port improvements for systems of ports related to container services. **Response: Concur, analysis of port improvements as improvements to a system of ports as opposed to improvements to individual unrelated ports would be required. However, nearly all USEC ports have already been evaluated and recommended for construction. If we consider the USEC ports as a system of ports, USACE has improved all of the ports within the USEC system, with the exception of Wilmington. The system has been improved as a step function with improvements occurring incrementally over time – first New York, then Savannah, then Boston, Charleston, etc. The last incremental improvement to the system would be Wilmington.**

Specific Comments

1. Paragraph 4.1 No Action Alternative.

a. In the without project condition. all USEC-Asia service containers projected based on current Wilmington traffic are assumed to move to and from Wilmington hinterland origins and destinations via the port of Savannah at the overland transportation costs (truck costs) estimated in paragraph 2.6.2 Without-project Landside Transportation Costs). The choice of Savannah for all without project movements is not based on comparing transportation costs from origin to destination with corresponding origin to destination transportation costs assuming use of the other ports in the service. In fact, Charleston will have a substantial draft advantage over Savannah in the projected future without project condition and for some of the Wilmington hinterland origins/destinations, the overland transportation costs to Charleston are less than the overland costs to Savannah. This suggests that Charleston may be more cost competitive than Savannah for these movements. In selecting Savannah as the port for moving Wilmington hinterland movements, the report notes that Savannah has a time advantage, but any time advantage would be small compared to the overall length of the total cycle time including the containership voyage. **Response: The report has been revised to identify time and cost advantage of using Savannah over Charleston – two to four-day advantage for imports, same vessel for exports. Savannah's advantage is also based on the additional capacity at Savannah, which is capable of absorbing Port of Wilmington hinterland cargo. A sensitivity analysis has been performed for split between CHL and SAV.**

b. Despite assuming significant overland costs for existing Wilmington hinterland movements in the without project condition, the analysis does not examine the impact of these substantial cost increases on the choice of sources (origins) of movements. It is possible that some origins would shift in the face of the loss of port-of-call status at Wilmington and the added substantial costs. The cost challenge to using existing patterns to satisfy demand might be particularly relevant to container exports which tend to move on the service at much lower ocean rates relative to exports (owing to the export-import imbalance on the service and associated empty backhauls). For these export movements, the added overland costs would be large proportionate to the current ocean freight rates and could threaten the continued competitiveness of these movements compared to alternative origins or destinations. **Response, cost challenge may be that exports can no longer compete internationally and the lost values of exports is an NED loss. The assumption that exports remain competitive with the additional overland cost is a conservative assumption of the analysis.**

c. The without project condition assumption that Wilmington will be excluded from the ports of call for the USEC-Asia Services raises the question of how Wilmington movements were modeled in the evaluation of the deepening of the ports of Savannah and Charleston. If the cost of including Wilmington is indeed prohibitively inconsistent with sustaining competitive service transportation costs, then that result should have been evident in these two evaluations through application of the HarborSym model. **Response, USACE typically does not include shifts of cargo and the two studies in question did not consider how traffic would flow when Wilmington is five feet shallower than the next shallowest port on a rotation.** The report should discuss the results of these two port evaluations and the evidence they shed on the assumption that Wilmington will be excluded as a port of call in the future without project condition. **Response: If the USEC ports on the USEC-Asia services were evaluated as a system, then depth changes at CHL and SAV would have been included in the analysis, but because each port was evaluated in isolation impacts to Wilmington cargo were not assessed.**

d. The reasonableness of without project condition assumptions would be more reliably assessed within the context of a complete analysis of origin to destination transportation costs rather than considering only the overland costs and speculating on routing and sourcing choices. If data other than transportation costs from origin to destination dominate the choices of routings or sources, that data should be presented. **Response: Waterborne costs have been added to the full to the full origin to destination cost**

2. Paragraph 4.52 Preliminary Alternative Plan Evaluation.

a. The analysis allocates zero benefits to channel depths less than 47 feet on the premise that a valid criterion for assuming the restoration of Asia services to Wilmington in the with-project condition is reducing the depth differential “down to differences in operating drafts under existing conditions.” This is essentially an assumption with no underlying comparison of origin to destination transportation costs (see General Comment 2), or analysis supporting that

competitive market forces would result in the restoration of Wilmington as a port of call in the USEC-Asia services. **Response: Analysis has been revised to show that waterborne unit costs affect deployment decisions**

b. Left unexamined is whether the cost structure of Asian services would support Wilmington as a port of call at depth less than 47 feet or even how much of the traffic diverted in the without condition should be allocated to Wilmington at 47 feet. Charleston will have a 52-foot channel and may remain competitive with Wilmington even with overland trucking charges. **Response: Report has been revised to show that waterborne savings for deeper loading at CHL is not sufficient to outweigh overland costs. Included is data showing that not all cargo takes the shortest route** In other words, even if the assumed restoration of port-of-call status at a 47-foot depth is valid, the analysis has not demonstrated that all the diverted traffic would be economically recaptured to Wilmington at that depth. Some movements might have a lower cost through one of the other ports of call. **Response: This is not the case because of the overwhelming expense of landside transportation.** To comply with the P&G, the analysis should examine Wilmington hinterland movements to compare estimates of the full origin destination costs of moving through other ports in the USEC-Asian service with the estimates of the full origin to destination costs of moving through Wilmington under the array of with project alternative depths. **Response: Concur, additional information has been provided.**

c. The analysis would better support the identification of benefits for alternative channel depths and therefore the NED plan if based on differences in transportation costs from origin to destination (or differences in delivered prices where the source might shift because of transportation differences inherent in the without project condition. **Concur. Additional calculations now include overland transport costs and compare to depth savings at CHL for each origin and destination to see if any would shift to CHL. Note that for the design vessel max loaded draft id 48 feet so additional depth at CHL or SAV is a small increment (one foot).**

d. It is unclear why Savannah's maximum draft was chosen as the criterion for determining the minimum draft at Wilmington consistent with membership as a port of call in the USEC-Asia services. **Analysis has been revised to highlight cost differentials at alternative depths.** If naïve draft comparisons are indeed indicative of viability of port-of-call status, one might argue that other draft criteria definable from the current ports of call in the service would measure "economic distance from the service" as well as the lower edge of the service represented by Savannah. The flowing tables show the arbitrary nature of solely using draft comparisons as a criterion for determining the minimum draft consistent with with-project port of call status for Wilmington. While the range of the minimum drafts is tight as one should reasonably anticipate using naïve draft comparisons to decide the issue of port-of-call status, it's clear that these draft comparisons are fraught with conceptual challenge and make the NED plan uncertain. Should it be deeper than 47 feet? **Response: Perhaps, but the port is looking for only the minimum depth required to shift the cargo.** Obviously, the economics of being a port-of-call member of the services is more complicated than the relationship of maximum port draft to the maximum port drafts of the other ports of call in the service. **Response: This is a very good point and I**

have added it to my narrative – it's not the draft – it's about the resulting costs – analysis has been revised to show this

Port	Max Existing Draft	Max W/O Draft
Jacksonville	40	47
Savannah	43	48
Charleston	45	52
Boston	40	48
Average	42	48.75
Median	41.5	48
Minimum	40	47
Maximum	45	52

Maximum Wilmington Draft Without Project: 41

Standard	Max Draft Difference Existing with Max Draft Wilmington - 41 feet	implied Maximum Draft for With Project Port of Call	Physical Channel Depth for With Project Port of Call
Savanaah	-2	46	47
Average	-1	47.75	48.75
Median	0.5	48.5	49.5
Minimum	1	48	49
Maxmum	-4	48	49

e. In addition to these concerns is the need to explain how the market for transportation services would preserve the Wilmington port-of-call given the assumptions in the analysis. Under the assumptions of the analysis, USEC-Asian service movements originating or terminating in the

Wilmington hinterland, use another port (Savannah) in the without project condition. If so, the shippers of these movements have a willingness to pay the complete origin to destination transportation costs through Savannah. The question not examined in the analysis is why the carriers providing the Asian services would have any incentive to provide a Wilmington service if market participants are willing to pay the higher transportation costs through Savannah?
Response: Yes – this is an excellent point and it's all about capturing the benefits. Will they raise the waterborne costs to capture the benefits? This is why USACE tries to use resource costs and not prices in their analyses. Presumably the only reason to offer a Wilmington port of call to shippers who are otherwise willing to pay the higher transportation costs is that competitive shippers will force such an offering. The analysis should address this issue and look for clues from this analysis about how traffic volumes and movements will vary by channel depth.
Observation – they are doing it today Is the scale of investment to enter a container service like the USEC-Asia service a potential "barrier to entry" that could serve to contract the size of the service (in terms of ports of call)? How do all these considerations bear on the reasonableness of the without project assumptions?

Additional Response for Discussion:

Under existing conditions, the Wilmington Harbor project and the Savannah Harbor Project have a similar project depth of -42 feet MLLW. The two USEC-Asia services, which call at the port of Wilmington, also call at the Port of Savannah. Large vessels calling at both ports use tidal advantage. Savannah has a greater tidal advantage that Wilmington. The deepest observed operating draft for containerships at Savannah is 42 feet. The deepest observed operating draft for containerships at Wilmington is -41 feet.

Vessel operating characteristics, which display vessel deployment and loading decisions made by vessel operators, have been explored in previous USACE deep draft navigation studies. The Savannah Harbor Expansion Project Feasibility Study (USACE 2012) identified the waterborne transportation cost per TEU per 1,000 miles as a decision point for vessel operators to switch to larger vessels with lower operating costs. Table 38 of the Economics Appendix (presented below) shows that at deeper channel depths carriers switch to larger vessels, which are able to load more deeply and take advantage of economies of scale, thereby lowering unit costs. This concept of switching vessel size based on unit costs can also be applied to the operator's decision to include a port as a port-of-call.

available for cargo at each sailing draft. Table 38 shows the estimated unit cost by vessel class by channel depth. Entries shaded in yellow identify the breakpoints or depth where it makes economic sense for a shipper to deploy a larger vessel to the route.

Table 38: Unit Cost in Tonnes per Thousand Miles

World Region Route	Vessel Classes	Channel Depths (feet)					
		42	44	45	46	47	48
FE (Suez) ECUS	PX MPD	$ 2.31	$ 2.31	$ 2.31	$ 2.31	$ 2.31	$ 2.31
	PPX1 MPD	$ 2.02	$ 1.85	$ 1.81	$ 1.81	$ 1.81	$ 1.81
	PPX2 MPD	$ 2.04	$ 1.87	$ 1.80	$ 1.73	$ 1.72	$ 1.72
ECUS MED	PX MPD	$ 2.07	$ 1.99	$ 1.99	$ 1.99	$ 1.99	$ 1.99
	PPX1 MPD	$ 2.02	$ 1.85	$ 1.78	$ 1.76	$ 1.76	$ 1.76
	PPX2 MPD	$ 2.04	$ 1.87	$ 1.80	$ 1.73	$ 1.67	$ 1.67
FE (Panama) ECUS	PX MPD	$ 2.46	$ 2.46	$ 2.46	$ 2.46	$ 2.46	$ 2.46
	PPX1 MPD	$ 2.02	$ 1.92	$ 1.92	$ 1.92	$ 1.92	$ 1.92
	PPX2 MPD	$ 2.04	$ 1.87	$ 1.82	$ 1.82	$ 1.82	$ 1.82
FE ECUS EU PEN	PX MPD	$ 2.38	$ 2.38	$ 2.38	$ 2.38	$ 2.38	$ 2.38
	PPX1 MPD	$ 2.02	$ 1.86	$ 1.86	$1.86	$ 1.86	$ 1.86
	PPX2 MPD	$ 2.04	$ 1.87	$ 1.80	$ 1.76	$ 1.76	$ 1.76
FE ECUS MED PEN	PX MPD	$ 2.27	$ 2.27	$ 2.27	$ 2.27	$ 2.27	$ 2.27
	PPX1 MPD	$ 2.02	$ 1.85	$ 1.78	$ 1.78	$ 1.78	$ 1.78
	PPX2 MPD	$ 2.04	$ 1.87	$ 1.80	$ 1.73	$ 1.69	$ 1.69
RTW	PX MPD	$ 2.07	$ 2.00	$ 2.00	$ 2.00	$ 2.00	$ 2.00
	PPX1 MPD	$ 2.02	$ 1.85	$ 1.78	$ 1.76	$ 1.76	$ 1.76
	PPX2 MPD	$ 2.04	$ 1.87	$ 1.80	$ 1.73	$ 1.67	$ 1.67
ECUS EU GULF PEN	PX MPD	$ 2.07	$ 2.06	$ 2.06	$ 2.06	$ 2.06	$ 2.06
	PPX1 MPD	$ 2.02	$ 1.85	$ 1.78	$ 1.76	$ 1.76	$ 1.76
	PPX2 MPD	$ 2.04	$ 1.87	$ 1.80	$ 1.73	$ 1.67	$ 1.67

The Charleston Post-45 Feasibility Study (USACE, 2015) projected operating draft distributions for the design vessel (PPX3) at various project depths at Charleston. Figure 26 from the Economics Appendix displays the cumulative distribution functions for operations drafts for the design vessel at project depths of 45 ft, 48 ft, 50 ft, and 52 feet (presented below). Note that the design vessel for the Charleston Post-45 Study is the same vessel as the Wilmington Harbor Design Vessel. Combining the vessel operator's deployment and loading decisions, as developed in the Savannah and Charleston studies, can be used to evaluate vessel deployment decisions under alternative project conditions at Wilmington Harbor.

Questions to facilitate review of revised report.

Without project condition

Regarding the without-condition assumption of suspended USEC-Asia service at Wilmington.

As the report notes, Wilmington is served by two USEC-Asia services – both instituted since the bankruptcy of the previous carriers.

These two services have useful depictions in the service maps for the Port of Savannah (attached).

- It is interesting that the EC2 service employs rather muscular ships -- 10 vessels with Ave TEU capacity of 8,450 TEU. The scale of shipping falls approximately into the PPX2 range of the vessels of Table 1-17 in the Economics Appendix.

- The ship scale of the other service to Asia serving Wilmington is much smaller. On the TP10/AmberJack service there are said to be 10 vessels of Ave TEU capacity of 4,700 TEU. This vessel size roughly equates to PX vessel size (Panamax) in Table 1-17.
- Points (perhaps arguable)
  - The EC2 service would appear to be a very close substitute for the TP10/Amberjack service based on the Asian ports served. It would appear possible to serve most of the Asia ports with EC2.
  - The EC2 service depends on vessels that appear to have some likelihood of remaining in the fleet for some years to come
  - The EC2 service would appear to be dominated by the large-scale imports to the port of NY/NJ and the general import imbalance on the Asian trades (although Wilmington has rough balance)
  - Average drafts for the PPX2 vessels in Table 1-17 are roughly 46 feet. Max drafts would be greater
- The determination that Wilmington will fall out of USEC-Asia services was based on cost structures for a vessel in the class PPX3Max which has, according to Table 1-17 a much greater average capacity (12, 725 TEU) and average draft (50 feet)
- While this vessel size (PPX3Max) will obviously be a highly competitive vessel in the east coast US to Asia services given the array of other port channel dimensions included in the without condition, the relevance of the line haul costs of this vessel as deployed in making the case for Wilmington's demise in the Asian service should be subject to further scrutiny. The suggestion that the hypothesis should be subject to further scrutiny is based on:
  - The current services are profitable
  - Transportation is a derived demand
  - Demand for transportation services depends on variables other than transportation price such as the size and timing of shipments (e.g. number of TEUs presented for shipment on a weekly basis). Movements might be viable in services deploying vessels with higher unit costs (as they are viable in such ships now) into the future based on shipment size and timing
  - Carriers make decisions about service based on profitability of an array of calls not on maximizing vessel size class. Vessel size class is only one, albeit important, criterion for operating a vessel service
  - Wilmington is a very small player in the container trade as it is and will face other obstacles to sustaining service that may well transcend draft constraints: "Wilmington's share of the total East Coast container market was 1.35 percent in 2016, down from 1.55 percent the year prior. Import share fell from 1.41 percent to 1.12 percent. Export share fell from 1.75 percent to 1.69 percent." https://www.joc.com/port-news/us-ports/alliance-add-trans-pac-service-wilmington_20170314.html

Response: Please see the revised section 1.8.2.3 Existing Conditions: Wilmington Fleet Servicing Asia, especially Table 1-24 and associated discussion which includes the fleet scheduled to call from Jan20 through April20 and includes the press release announcing 13,000 TEU vessels entering the EC2 fleet. The fleet on both ASIA services calling at Wilmington today has an average TEU capacity of more than 10,000 per vessel.

- It remains unanalyzed and unanswered why a service like the EC2 cannot remain profitable for some time into the without project condition future for Wilmington and serve as the transportation service for most of the Asia movements in that scenario. The dominance of NY/NJ imports on this service is likely to sustain an operation of this kind with adequate capacity at the constrained depth at Wilmington. Or more aptly, the analysis of this alternative should show that the EC2 cannot persist and serve Wilmington's Asia needs well into the future without project condition or that the TP10/Amberjack could not be scaled up modestly to serve Wilmington needs for some time into the future. Growing volumes at the other ports would obviously suggest that slack draft constraints currently might tighten in the future and squeeze Wilmington out of the service. However, subjecting Wilmington to an analysis solely relying on drafts and unit costs of a "design vessel" could be construed as biasing the analysis by casting benefits for improvements in terms of costly overland transportation to an alternative port. The determination that Wilmington will fall out of the service to Asia is also based on comparisons of Weighted Average $/TEU/1000 miles at various draft constraints and I would like to have additional explanation of how this analysis works.

Response: Please note that the size of the current (2020) fleet for these two services has an average vessel TEU capacity of 10,070 for the EC2 service and 10,286 for the ZCP service. The scaling up of the old TP10/Aberjack service displays the point made in the analysis, which is that competing services will have similar size vessels in the long run. Also please note how quickly these changes are happening – see Table 1-24 comparing vessel sizes on the two services from 2018 to 2020.

I concur with your assessment that "Growing volumes at the other ports would obviously suggest that slack draft constraints currently might tighten in the future and squeeze Wilmington out of the service." This is what we project for future without-project conditions.

The weighted average costs are used to show the cost burden to the carrier, if Wilmington were to remain a port of call. The benefits analysis has been revised, based on your insights, and is now driven by the willingness-to-pay by importers and exporters as expressed by the potential transportation cost savings they would realize by using Wilmington as opposed to an alternative port.

Clarifications related to Weighted Without-Project Condition TEUs and $/TEU (e.g. Tables 2-7 and 4-1)

- Page 52 says, "The weighted average number of TEUs on board and the weighted average cost per TEU per 1,000 miles (Table 2-7) were calculated for the design vessel at future without-project condition vessel draft distributions at Wilmington and at the prior and next ports of call on the two Asia services as identified in Table 2-2."
- The description suggests there are draft distributions for the ports of Boston, Savannah and Jacksonville like the arrival draft distribution depicted for Charleston in Figure 2-2. But these draft distributions are not shown in the report. It is also confusing as to when an arrival or departure draft distribution would be relevant to the computations in the report. It is also unclear where these prior and next port draft distributions come from as in the case of the Figure 2-2 which is applicable to Charleston only. Please share the relevant draft distributions.

  Response: The draft distribution at Charleston was used as a proxy for draft distributions at Boston, Savannah, Wilmington, and Jacksonville because the Charleston draft distribution was

for the same design vessel at similar project depths. Please note that the draft distributions and resulting weighted average operating costs are used to explain the cost burden to the carrier if Wilmington remained as a port of call.

- In Table 2-7, it is apparent that the weighted average TEU (bottom of TEU column, e.g. 8221) are computed as the sum of "TEU's on board." Also, that weighted average $/TEU/1000 miles at the bottom of each column e.g. $35.23) is computed as the weighted sum of the preceding $/TEU/1000 miles in the rows above where the weights are derived from the TEUs on board as a proportion of the total TEUs on board. However, the source of the numbers in the table is unclear to me. For each row and column of Table 2-7 please provide an explanation of how the entries were computed and the source of the data for the computation.

  Response: The number of TEUs on board are calculated based on the weighted average Asia cargo weight (weighted by the import and export tonnage at Wilmington in 2018. An immersion factor was calculated the standard formula and ocean water density. The box weight used was 2 tons per twenty-foot box.
- What is the interpretation of the figures computed in the bottom stub of Table 2-7? Apparently, this is some kind of draft restricted loading and cost for a PPX3Max vessel at the three ports in question. But what do these weighted averages mean? What does "TEUs on board" at the various drafts mean?

  Response: The interpretation of the bottom row of Table 2-7 is that the design vessel calling at Wilmington in the without-project condition, would have a vessel operating draft distribution ranging from 32 feet to 41 feet, which means that on average the vessel would have 6,006 TEUs on board and the vessels operating cost per 1,000 miles would be $47.45 (based on the -42 foot channel and using the Charleston draft distributions as a proxy for observed PPX3Max draft distributions at Wilmington). The same calculations are performed for Boston, Savannah, and Jacksonville (prior and next ports) based on the project depths at those ports. The implication is that carriers can carry more cargo per call at lower operating costs if they by-pass Wilmington.

- The cost comparisons derived from Table 2-7 would appear to be fully loaded cost comparisons of line haul or ocean operating costs when fully loaded to the draft restrictions of the various ports. I would like to see the actual computations.

  Please note that these are not fully loaded operating costs. The weights are based on the Charleston cumulative distribution, i.e., the weights are based on the number of times the vessel calls at the various operating drafts (32 feet through 41 feet in the Wilmington example).

- It is unclear how the numbers derived in Table 2-7 are determinative of vessel choices or service decisions. Vessels may clearly operate between ports of call on a service at less than maximum drafts and the services may be profitable. EC2 under existing conditions provides evidence that the ships in that service must be operating at drafts well within the draft constraints of the harbors after the vessels leave NY/NJ and **probably at less than** the draft constraints of the intermediate harbors. That would seem to be intuitive. Fully loaded vessels would carry import flows to NY/NJ and then proceed to Boston, Wilmington, etc. at vessel drafts compatible with

the ports. Draft distributions for the ships moving on the service are necessary to draw conclusions.

Response: Concur. It is assumed that the operating draft distribution developed for the Charleston Post-45 study reflects these operational conditions.

- It is unclear how the use of the ocean or line haul operating costs computed in the report can characterize the inefficiency of operating with a certain port on a given service. It's possible that a port's draft restrictions might be strongly correlated with the line haul of ocean costs of a service if it's part of that service but it is probably more relevant how the port's draft restriction affects operations within the port range or among the ports in the service. A vessel will arrive into or depart out of the port service range with a given draft that will determine the $/TEU/1000 miles line haul or ocean costs. It's reasonable to assume that a vessel operating from or to a port range will load as deep as possible given the port depths on both ends of the voyage permit if the other characteristics of the movements (volume per unit of time) make using greater drafts economic. That doesn't mean that a vessel will load to max available draft at every port included in the service or that the max draft line haul costs computed at the draft restriction at a particular port can be used to explain whether a port is included in the service with a given design vessel. The flow volume of a movement may not require deeper loadings, etc.

  Response: Please note that the operating draft distribution does not indicate that the vessel is loading as deeply as possible, but the draft distributions need to reflect the depth constraints at each port by truncating the distribution.

- A usual hypothesis is to assume a distribution of vessels will be used on a service. Yet the analysis of the report tests assumptions about the USEC-Asia services (whether Wilmington will continue to figure in the two services) based on draft constrained loadings for one vessel class: PPX3Max. Why is this a reasonable approach to determining the ports that will belong to a given service? Is this the only vessel class that will be included in the USEC-Asia services relevant to Wilmington?

  Response: Please refer back to previous responses on vessel size. The convergence on a single vessel class for services calling at very similar ports – note that both services have almost exactly the same ports of call – has already happened with the average vessels size today for the EC2 service being 10,070 and the ZCP service being 10,286. It is logically assumed that this trend will continue into the PPX3Max calls with the announcement that the EC2 service will transition to 13,000 TEU vessels in 2020. Also, please not ethat the same carrier, HMM, has just brought into service the first of the 24,000 TEU vessels (Asia to Europe service).
- Please explain how the weighted average cost computed in the tables are relevant to the determinations these data are used for.

  Response: Project benefits are now based on Wilmington's hinterland Asia cargo importers and exporters willingness to pay for transportation services, based on your suggestions.

- Same questions for the weighted average $/TEU/1000 miles (Table 3-1) for the alternative with-project depths at Wilmington. How are these numbers derived, what services are they based on and how are they relevant to determining the inclusion of Wilmington in the services or the per ton costs of movements to and from Wilmington as part of the services?

  Response: I believe this question has been answered above.

- At what depth at Wilmington do movements become economic for movement by the services using a PPX3Max vessel or any vessel class? This question appears to remain unanswered as it was in the previous review. The current analysis rests on the premise that there is a strong correlation between the proportions in the right-most column of Table 4-1 and the actual proportions of traffic that will use Wilmington at the corresponding with project depths. It's not obvious that this strong correlation is the case. Why isn't another such distribution that one might derive for a representative vessel not just as relevant?

  Response: Concur. This aspect of the analysis has been problematic all along. I believe this issue has been resolved by the use of willingness to pay as the basis for benefits, please see the revised Section 4 of the Economics Appendix.

- Table 4-8. Please explain how the costs in this table were computed? Were these costs computed using the HarborSym model or some other method?

  Response: The DDNPCX ran HarborSym based on data I provided. All waterborne costs are based on HarborSym modeling.

- Why not test the viability of Wilmington USEC-Asia movements? by:
  - Running the HarborSym for Wilmington and the other ports in the range for the without project array of depths for the ports in the service other than Wilmington
  - Run the model for the without condition which is all traffic including Wilmington hinterland through Savannah. This will establish a base line total cost of operating a given service in the without project condition.
  - Array the Wilmington hinterland movements by ranking them based on the overland savings per TEU to access Wilmington as opposed to Savannah. This represents a willingness to pay to use Wilmington ignoring any cost differences at the two ports.
  - Add movements from this array (higher savings movements first) to successive runs of HarborSym shifting movements from Savannah to Wilmington and posit the cost-per TEU faced by the movements. One might reasonably allocate all the increase in total service costs to the Wilmington movements and divide by TEUs at Wilmington to characterize the costs that must be covered by Wilmington movements.
  - If the willingness to pay to pay to access Wilmington is at least as great as the net cost increase (Wilmington ocean cost per TEU – Savannah ocean cost per TEU computed for the without condition) to ship via Wilmington, then allocate that movement to Wilmington.

- Note: At first the added cost per-TEU of ocean cost using Wilmington may exceed the wilingeness to pay measure but it seems that eventually that cost per TEU would fall making the hinterland movements with high willingness to pay have net savings to loading at Wilmington. Thus, while the total costs on the service would be rising with the addition of Wilmington to the service, the added cost allocable to loading at Wilmington would be declining with increased TEUs at Wilmington.
- Continue running the HarborSym model for successive ranked movements until the marginal movement has negative net savings at the given draft. This cut off point would determine the TEU's allocated to Wilmington at that draft and the benefit calculation would be straight forward.
- See the attached diagram for a graphical representation of this technique.
- Repeat the process for each alternative draft.
- Array the benefits for each draft to create a schedule of benefits that can be compared to the cost array for building harbors of various depths to produce a net benefit schedule. Pick the NED plan.
- This method is tractable even if one assumes (without further test) that no traffic on the relevant services will use Wilmington in the without condition. The Corps should have systems data for commodities and vessel conditions on the USEC to Asia services. Such method is preferred because it approximates the requirements of the Principles and Guidelines. (See a slightly more rigorous description of this method in the file: "potential solution.docx"

Response: This is basically what has been done in the revised analysis. Please see the revised section 4 of the Economics Appendix.

- The allocation of traffic to the various depths at Wilmington in Table 4-1 is intriguing but can't be demonstrated to capture the allocation of traffic and benefits to different with project depth at Wilmington based on a movement by movement allocation based on with and without project unit transportation costs as required by the *Principles and Guidelines*.

  Please review the revised section 4 of the Economics Appendix. The analysis has substantially changed in that benefits are now derived from the willingness-to-pay for transportation services. I have attributed this change to reviewer input in a footnote. If you think that's inappropriate, I will remove it. But, credit belongs where credit is due. The analysis is now improved because without-project depth constraints and associated increases in operating costs justify the carrier's shifting away from Wilmington, and willingness to pay and relaxation of depth constraints in the with-project condition are the source of benefits.
- Question: How is backhaul treated in the current analysis. It appears that the movements in the dominant direction of traffic would determine the ocean borne costs with backhauls catching an essentially costless ride (except for any handling differences) on the vessel trip in the opposite direction. This would also seem to imply the same for

loaded truck backhauls. If a round trip movement is used for movements in the dominant direction, don't those movements determine the truck haul roundtrips, too with the other direction hauls catching a costless trip on the recycle?

Response: Backhauls are a concern for HarborSym and the landside analysis. For HarborSym, which the DDNPCX ran using data provided by the NCSPA, I believe you are correct in that one direction is used to determine vessel operations and costs, but I believe round-trip costs are calculated for total waterborne transportation costs in HarborSym.

Truck back hauls are a slightly different issue. I know how many loaded containers and I know how many empty containers, but no one keeps track of back hauls for trucks. Our analysis only calculates benefits for loaded boxes and we calculate benefits based on round trip costs. We use 1.85 containers per truck haul based on port data for container sizes. We are implicitly assuming that the number of back hauls with loaded boxes in each direction (which would reduce benefits) is offset by not including any benefits for the empties (31% of total Asia TEUs) moving through the port, which also have to be trucked from the hinterland to the port and visa versa.

- This is a source frustration that we should talk about. I would like to be able to help you finish this study and defend it to USACE. But I remain skeptical that shortcutting the full analysis will be acceptable to establish the NED plan. I am very open to be convinced otherwise.

  Response: Thank you for the opportunity to discuss improving the economic analysis. I believed it is now much improved due to this review process.
- I am troubled that I have reached the same conclusion about this analysis that I reached the first time and also know that there is no currently available method to do the job correctly.

2 Cost Estimating

Comments on project cost estimating were provided by Wally Brassfield, Construction Estimating Services, LLC. Mr. Brassfield has over 40 years of construction cost estimating experience including 13 years estimating for small business heavy construction and specialty contractors. From 1989 to his retirement at the end of 2004, Mr. Brassfield served as the Division cost engineer for the US Army Corps of Engineers, Northwestern Division (NWD). At NWD he was responsible for coordinating and oversight of the five NWD District cost estimating organizations located at Seattle, WA, Portland, OR, Walla Walla, WA, Omaha, NE and Kansas City, MO.

1. This is a review of the planning estimate for the Moffatt & Nichol contract for deepening of the Wilmington harbor. The documents used for this review include:

A. Drawings

9232-06C-TYPICAL SECTIONS-Layout1; AdvPLANS_WH-IOB-_4Oct2017; Appendix A - Channel Figures(reduced); Channel Widening – Revised; and WHOOB-FY16_Adv_Plans.

B. Cost summary/quantities: VOLUMES with Disturbed Areas and Dredge Areas-Rev 20181217. This Excel file is used to calculate construction cost of the various channel deepening depths.

C. Dredging estimates part 1 and 2 (for review). These are based on a modified CEDEP program calculations. Dredge costs are estimated assuming excavated materials are deposited in the designated ocean disposal site; and used as beach nourishment. Dredge estimates are based on 1. Cutter dredge excavating sand and rock loaded on scows by spider barge; 2. Hopper dredge; 3. Cutter dredge to beach nourishment; and 4. Mechanical dredge with rock bucket and scows to disposal.

D. Port of Wilmington Section 203 Navigation Channel Improvement Integrated Feasibility Study and Environmental Impact Statement, Preliminary Draft Project Management Plan. Section 9 provides requirements for cost estimating documents for the project. The cost estimate construction cost summary Excel sheet are acceptable as preliminary reconnaissance level cost estimates as required by paragraph 9.2. Also, this paragraph stipulates the use of CEDEP which implies it is acceptable for the designers to use this program.

2. The project cost must be calculated by a total project cost summary (TPCS). As defined by the cost estimating guidance. Therefore, the total project cost from the Excel sheets would be shown on the (TPCS) and contingency, engineering, construction administration costs would be added to determine the total project cost summary (TPCS). The TPCS would be used along with the economic analysis to determine the project benefit/cost (BC) ratio.

3. The development of contingency percentage used in the TPCS of the preliminary level cost estimate could be calculated using the Corps abbreviated costs schedule risk analysis (CSRA) rather than the formal CSRA needed for the feasibility report estimate. Some items to be considered are A. What happens if the rock must be drilled and shot; B. What effect on the project cost would be caused by the designated ODMDS unsuitable for dredge material disposal; C. What would be the acquisition plan for the project would there be multiple contracts or single contract. D. What is the risk of only one cutter dredge capable of dredging rock.

4. Some miscellaneous dredging estimate comments. A. Mechanical dredging would be required around the mooring and docking areas of the port; B. A review of the typical cross-sections indicates the 150-foot channel increase occurs on one side of the channel. These include baldhead shoal reach 2, Smith Island reach, and battery island reach. It is recommended that this be accomplished with a mechanical dredge; C. The shore crew for the beach nourishment are subject to land labor laws. Generally, the crew would work two shifts per day 10 hours per shift seven days per week. Therefore, they are subject to overtime pay; D. Suggest increase floating pipeline from 450 feet to 1500 feet between the cutter dredge and the spider barge; E. Provide complete description on tab A of the CEDEP estimates. For example, type of work being performed (excavating cutter dredge to spider barge to scows, stationing of reach and haul distance to disposal; F. Cutter barge to beach nourishment will require the use of submerged pipeline because the line must cross the navigation channel from one side to the other.

5. The executive summary of the project management plan indicates the designer/port will submit the project to the assistant secretary of the Army for civil works to submit to Congress for project funding. If the project were to be designed by the Corps processes the project cost would be certified by a Corps representative. It is unclear how this is to be accomplished by the design team. Suggest this be explored and resolved rather than waiting to send the project for funding.

Wallace W. Brassfield, P. E.

Jerry Diamantides <jdiamantides@dma-us.com>

RE: WHNIP

1 message

Shelden, Jeff <JShelden@moffattnichol.com> Mon, Jun 24, 2019 at 10:00 AM
To: "jdiamantides@dma-us.com" <jdiamantides@dma-us.com>, "Jessup, Sean" <SJessup@moffattnichol.com>

No formal response, but Sean and Sam did consider / address all the comments in their revision.

Best regards,
Jeff Shelden, P.E.
Moffa_ & Nichol
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P 919.781.4626 **x.** 12135 | **F** 919.781.4869 | **C** 919.656.0640
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Connect with us: Website | Facebook | LinkedIn | Twi_er

From: Jerry Diaman_des [mailto:jdiamantides@dma-us.com]
Sent: Monday, June 24, 2019 9:52 AM
To: Shelden, Jeff <JShelden@moffattnichol.com>; Jessup, Sean <SJessup@moffattnichol.com>
Subject: Re: WHNIP

Jeff,
Did you find out if we can state that all comments were resolved, or if we can include responses?
Thanks
Jerry
Jerry Diaman_des, Ph.D.
Senior Economist
David Miller & Associates
1637 Brookfield Road
Berlin, VT 05602
802 223 2040

On Wed, Jun 19, 2019 at 9:55 AM Shelden, Jeff <JShelden@moffattnichol.com> wrote:
Here are Wally's review comments. I'm checking with Sean to see if he ever responded formally or just addressed
these in his revisions.

Best regards,
Jeff Shelden, P.E.
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3 Ship Simulation Modeling

Ship simulation modeling was reviewed by Dennis Webb former USACE Research Hydraulic Engineer, Navigation Branch, Engineer Research and Development Center, Vicksburg, MS.

April 15, 2018
Dennis Webb
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Mr. Eric Smith
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Dear Mr. Smith,

Thank you for the opportunity to participate in Moffatt & Nichol's (M&N) feasibility level simulations for the Port of Wilmington, NC. The simulations were conducted in Wilmington January 24 – 30, 2018. I was able to personally observe nearly all the 64 piloted simulations, missing only a few the afternoon of the final day. My evaluation of the simulation setup, vessel models, and environmental conditions was included in my letter reviewing M&N's proposal to conduct these simulations dated January 15, 2018.

I have completed my review of M&N's draft report. I provided some minor comments and observations in the .pdf file. The report and data analysis are significantly more robust than those I authored for screening simulations while I was lead of the U.S. Army Corps of Engineers simulator in Vicksburg, MS.

The simulation program was appropriate for feasibility level simulations. It included multiple representatives from the Wilmington maritime community. Four river pilots and one docking pilot conned the ownship during the simulations. Based upon observations during the simulations, we were able to modify databases and simulate additional channel widths and alignments.

I concur with the findings of this report. Based upon these preliminary simulations, the proposed channel layout appears to meet the navigation requirements. In addition, several areas show promise of further optimization during the full simulation program. If I can be of further assistance for this study, please contact me.

Dennis W. Webb

Dennis W. Webb, P.E. D.NE
Webb Simulation Consulting, LLC

Comment Number	Page	Reviewer	Comment	Proposed Resolution
1	1	Dennis Webb	*With regard to the wording "real-time desktop vessel simulator":* Desktop has a negative connotation in the COE, probably due to me and my experiences with earlier autopilot simulations. The COE seems to be embracing the concept of Feasibility Level Simulations. I would use the term "real-time, manned, Feasibility Level simulation study."	Incorporated.
2	1	Dennis Webb	*Suggested text...(new paragraph at end of Section 1.0)* The Feasibility Level simulations are tentatively scheduled to be conducted (something general here such as mid-FY18). M&N will conduct a full, formal simulation on the channel layout selected via the feasibility process at a later date (or something general again).	Incorporated.
3	3	Dennis Webb	*Referring to the text: The existing channel begins as 900 ft wide at the pilot boarding station and narrows to 500 ft...* Please check this. It looks to me like it begins at 500 ft and widens to 900 ft as it approaches the first bend.	These dimensions have been corrected.
4	8	Dennis Webb	The design ship has a draft of 43 ft for a 47 ft channel. The model has a draft of 41 ft. Would we be better off using a 45 ft channel for the same underkeel clearance for handling? Or, how much effort would there be to increase the model draft to 43 ft? I think what you've proposed is fine for feasibility. In order to answer the question before it is asked, maybe a sentence should be added explaining this?	We do not have access to a vessel model with an even keel design draft of 43 ft. Container Ship 13 has a partial load condition trimmed to 36/43 ft - fore/aft. We may obtain a different vessel model (or have one modified) to provide the design draft for future simulation efforts on this project. However, this was not considered necessary for this feasibility level study. We considered decreasing the channel depth to 45 ft to simulate the appropriate underkeel clearance. However, 47 feet is the middle of the range being considered for the deepening project, and seemed to be the most appropriate depth for this exercise. In parallel to your review, we have added a few additional simulations to evaluate the existing channel with the upgraded turning basin. These simulations will use a vessel with 38ft draft, which provides the design underkeel clearance of 4ft. We can use these simulations if necessary to discuss underkeel clearance. However, underkeel clearance is not the focus of this study. The discrepancy in draft between the model and design drafts is noted in Section 2.2.1.
5	8	Dennis Webb	*Referring to Additional Simulations…* I would say "A full simulation program will be performed" A full program can be defined later but I think wording should reflect a more formal approach to the COE.	Incorporated.
6	8	Dennis Webb	*Referring to the following sentence: "The new channel is proposed to extend further out to sea than the existing channel to reach water that is consistently deeper than the maintained channel depth."* Will it extend on the present course or will it jag to the southeast at station 494+00?	The following text has been added to the end of this paragraph to clarify: The reach offshore of the current pilot boarding station (Sta 490+00) will have a heading of approximately 30° (inbound), which, is approximately 16° shifted from Bald Head Shoal Reach 3 (14°). The purpose of this heading change is to reach deeper water in the most direct path and reduce dredging costs.

7	9	Dennis Webb	When there is only one alternative, I would state that "There is only one proposed modification. Alternatives 1 and 2 are identical for this section."	The following explanation is now provided before the list of reach modifications: Except where otherwise noted, only a single design configuration was considered for each channel reach
8	9	Dennis Webb	*Regarding the widening of Smith Island Channel only on the red side.* I'll add a statement in my letter that this has precedence in the COE and site the Turkey Island Cutoff DGPS study I did for Norfolk.	Noted.
9	13	Dennis Webb	*Regarding the following sentence: "The match with the design vessel is sufficiently close for the desktop channel validation."* Once again I'd go with Feasibility Level rather than desk-top. My letter will verify that the design ship match is consistent with COE Feasibility Level simulation studies.	Incorporated.
10	13	Dennis Webb	*Regarding the use of the existing tug fleet...* I assume the pilots think the existing tugs will turn the larger ships?	The following text has been added to the discussion of tugs: Initial input from Glenn Turbeville of McAllister Towing Wilmington provided an optimistic perspective that the existing tug fleet should be adequate for handling the larger 12,400 TEU vessels. The adequacy of the existing tug fleet for handling these larger vessels will be discussed with the pilots throughout the simulation effort.
11	14	Dennis Webb	*Regarding passing vessels…* I would add another paragraph. The use of an auto-piloted vessel to simulate two-way traffic with a piloted ship is acceptable for Feasibility Level simulations. Two piloted ships will be used for the final simulation program.	Incorporated.
12	15	Dennis Webb	*Regarding the need (or not) to distinguish between Panmax and Handy Sized vessels…* I would explain that this is because the ships are docked parallel to the channel and thus beam, not length, is the critical dimension.	The text was modified to read as follows: For the purposes of this study, there is no need to distinguish between Handy Sized vessels that have Panamax width and true Panamax vessels, because these vessels are moored parallel to the channel. Thus, beam, not length, is the critical dimension.
13	15	Dennis Webb	*Regarding the performance of all simulations at MLLW…* Maybe add This is standard practice for most channel design simulation studies. Extenuating circumstances, such as the need to "ride the tide", are not present in this effort.	Incorporated.

14	15	Dennis Webb	*Regarding the use of separate tidal models for each channel configuration…* If both Alt 1 and 2 are modeled separately, state so here. Usually for Feasibility studies, currents are not modeled specifically for proposed condition. I usually just change the bathymetry to reflect the different channel footprints. If necessary, a little "engineering judgment" could be applied. My only area of concern would be the Battery Island curves. This has been pretty much standard practice since we started doing screening. I always stated this assumption in my proposal along with the fact that the channel selected during screening will be hydro-modeled to provide currents for the full study.	The following paragraph was incorporated to explain the approach for tidal current modeling: Separate hydrodynamic models have been developed for the different project alternatives. Although this is not typically considered necessary for Feasibility Level studies, this was considered appropriate for this study to characterize the significant changes to the channel around the Battery Island curves. Any modifications to the channel during the feasibility level study will be reflected in the hydrodynamic model for the full mission bridge simulations.
15	25	Dennis Webb	I suggest some explanation as to why the different start/end positions for Alts 1 and 2. I know it is to avoid double testing single alternative for Smith Island and Baldhead Shoal Reach, but others might not pick that up right away.	Incorporated. The following paragraph was added at the end of Section 3.3.1.1: As planned, the entrance turn testing for Layout #2 (Simulations 5 to 8, Table 3 1) will serve a dual purpose of testing the entrance turn and validating the offshore one-way channel width. In order to accomplish this, these simulations start/end further offshore than the four subsequent simulations that use Layout #1.
16	25	Dennis Webb	*Regarding the designations "inbound" and "outbound" for simulations with passing vessels...* I assume this means manned inbound and autopiloted outbound. You might want to clarify this.	The following footnote was added to these simulations to clarify: Direction of transit is indicated for the piloted vessel. When present, a passing autopiloted vessel transits in the opposite direction as the piloted vessel.
17	25	Dennis Webb	*Simulation matrix (channel width simulations)...* This is all a little confusing to me. Layout 2 will be one-way, right? If so I would refer back to runs 7 - 10. Consider using Layout 2 as the longer run rather than Layout 1. Move the starting point from 750 to something further out, maybe 450? Use that to evaluate one-way in the Baldhead 3. That way you don't have these 2000 ft runs to evaluate one-way transits and it gets rid of some set up time between runs. You could then eliminate runs 29-32. I think that will help out on time. Also, I'm not sure the 2000 ft runs (33-36) are long enough for proper setup for meeting.	*Note: all simulation numbers in the text below refer to the numbering in the .pdf initially transmitted for review. The updated matrix has been renumbered (with existing condition simulations added)* Good idea. Simulations 3 to 10 have been modified as follows: - Simulations 3 to 6 have been changed to use layout #2 instead of layout #1. This maintains the strategy noted above regarding different start and end points for Layouts #1 and #2. - Simulations 3 to 6 now show longer transits that should provide the necessary validation for the offshore one-way channel width. Of these four simulations, two (one inbound and one outbound) were selected to start/end out at station 400, before the offshore turn. The other two will start/end at station 600, which will still contribute to an understanding of the one-way channelwidth. - Simulations 7 to 10 have been changed to use layout #1. These are the shorter length simulations that avoid double testing the Smith Island and Baldhead Shoal Reaches. Simulations 29 to 32 have been removed. The purpose of these simulations was to validate the offshore one-way channel width, which now is accomplished with simulations 3 to 6. Simulations 33 to 36 (renumbered now) are retained to validate the offshore two-way channel width. Note that stationing is by units of 100ft, so simulations 29-36 are

18	25	Dennis Webb	*Simulation matrix...* Will the preferred layout be either Alt 1 or 2? Or, could it be a new alternative based upon lessons learned?	Within this particular simulation effort, the preferred alternative will be one of the alternatives tested, since we will not have time to modify the scenes between simulations. This note is only in reference to the entrance turn and proposes to consider additional simulations for the alternative for the entrance turn that is most appropriate for further study. It is certainly possible that the channel layout arrived at after this feasibility level study is a new alternative based on lessons learned.
19	26	Dennis Webb	The COE relies almost exclusively on the pilot assessment for Feasibility Level simulation studies. This is done to reduce costs and keep with SMART planning funding limits. Also, the databases are built with a lot of assumptions, which while still allow for mariner evaluation, do limit the interpretation of data.	Agreed/noted. *No change made to report text.*
20	Email Body	Dennis Webb	I wonder if it is necessary to test so many combinations of heading/current/wind. Perhaps for screening we could just run fair tide, since that is regarded as more difficult. Maybe we could just run inbound, ebb tide, wind from the SW and outbound, flood tide, wind from the	Understood. The number of simulations may be reduced based on feedback from the pilots during the simulation effort. However, the proposed matrix will be retained for planning/scheduling purposes.
21	Email Body	Dennis Webb	I'd like to be a little clearer on development of the Preferred layout. The two layouts for the Entrance Turn at Battery Island are vastly different. Maybe if we cut out some of the runs I previously mentioned we could add another alternative. I don't know if it is worthwhile or not, but maybe we should look at another plan half way between 1 and 2. 1 and 2 are far enough apart that it may be difficult to interpolate results. I'm not sure if this is economically worthwhile or not.	Understood. The two channel alternatives for the entrance turn provide brackets around the solution (4,000 ft radius based on input from the pilots and 3,000 ft radius based on staying as close to the existing turn as possible). It is understood that one possible outcome from this study is that we will need to consider an intermediate alternative. However, these two configurations were considered necessary to bracket the solution, and it seemed best to limit channel alternatives to two for this first simulation effort.
22	Email Body	Dennis Webb	If possible, I would like the overall figure that was divided into figures A-1 thru A-14 so I can look at the stationing better. Do you have it as a CAD file or a large .pdf?	Our CADD department will package the appropriate .dwg files, and we will transmit them for your reference/review.

4 Hydrodynamic Modeling

Coastal Hydrodynamics LLC
PG 517 Oaklawn Dr.
Metairie LA 70005

Ioannis Y. Georgiou, PhD,
504-931-5178
iygeorgiou@gmail.com

CHLLC-M015 June 3, 2019

MEMO

To: Jeff Shelden, PE

From: Ioannis Y. Georgiou, PhD, PG

Coastal Hydrodynamics LLC

Re: Channel Deepening Feasibility Study and EIS, Cape Fear River, NC (Model Results of production Runs, and Tidal creek salinity modeling) – responses to review

This Memo communicates to the authors that the responses to reviewer comments for **Model Results of production Runs, and Tidal creek salinity modeling** Memos are satisfactory. No further action is required.

CHLLC-M013 April 3, 2019

MEMO

To: Jeff Shelden, PE

From: Ioannis Y. Georgiou, PhD, PG Coastal

Hydrodynamics LLC

Re: Channel Deepening Feasibility Study and EIS, Cape Fear River, NC (Review of the tidal Creek Salinity Modeling Production Runs)

General Comments:

The purpose of this study was to quantify the "Project impacts on salinity zone changes potentially affecting tidal wetland community composition and mitigation in the tidal creeks..." The Delft3D model is used for the quantification in terms of change in salinity between the FWP and the FWOP; however, no guidance is given for what would significantly change the community composition. No mitigation is suggested since the relative changes are judged to be small. Only surface salinities are considered. The report does not say whether the tributaries experience stratification. If so is this impacted by the project?

The main calibrated Hydro Model was used to provide boundary conditions for a local model with greater refinement. What is the vertical spacing of the z-layers and what is a typical horizontal grid size in the areas of interest? The cell size appears to be about 100 m with the thalweg is represented by one cell width?

The thalweg follows something like a square wave pattern for Town Creek in the model. Did this cause any issues in the model? For example did this lead to greater vertical mixing?

There are large tidal flats that undergo wetting and drying with only one or maybe two vertical layers. Is the lateral salinity in the surface layer nearly constant?

What is the rationale for the gird truncation for the headwaters of the streams? Is it computational efficiency? What are the implications?

Is the initial condition based on time-mean results from the full Hydrodynamic model or the results at a certain tidal phase?

Table 2 and subsequent results show that the existing condition is modelled as a reference, i.e. no project

and no RSLR. There is another case that could be of interest, i.e. project plus no RSLR; this could represent the near term impacts better than the RSLR scenarios.

Tables 3-9: It is interesting and reasonable that the highest relative impacts occur during low flow/dry conditions compared to typical high flow. Is this due to the 'flushing' effect of runoff in the high flow case?

The Conclusions are supported by the text but a comment might be added that over the 50 years the absolute change in salinity could be significant for both FWP and FWOP. Thus a shift in the marsh type could occur irrespective of the project.

CHLLC-M012 April 3, 2019

MEMO

To: Jeff Shelden, PE

From: Ioannis Y. Georgiou, PhD, PG Coastal

Hydrodynamics LLC

Re: Channel Deepening Feasibility Study and EIS, Cape Fear River, NC (Model Results of Production Runs)

Overview:

This is an extension of an earlier memorandum that described the application of the calibrated Delft2D morphology and sediment transport including longshore transport. This memo includes the following project impacts: water levels, currents, salinities, temperatures and water quality due to the channelization of the navigation channel of the Cape Fear River and its entrance. Two options are considered: 1) Future without project (FWOP), 2) Future with project (FWP). The project involves deepening the entrance channel to 49 ft and the River to 47 ft. A 2-ft over dredge is added to the project depths.

The report considers multiple aspects of the system in the evaluation of possible impacts, for instance, salinity impacts in the Cape Fear River and in the entrance zone, dissolved oxygen (DO), potential water level changes, changes in the ambient currents, temperature changes, and shoaling changes. The raw data from the computer runs in terms of the absolute changes for FWOP and FWP are presented along with the differential impacts of the FWP relative to the FWOP. The differential approach emphasizes the relative impact of the project and tends to reduce the effect of model uncertainty since both the FWOP and FWP have very nearly the same uncertainty. These changes are computed for average and dry years as well as hurricane boundary conditions. The impacts with three severities of Relative Sea Level Change are included.

The relative water level changes vary with location; the maximum impact on Tidal range is 0.3 ft in the River at or near Battleship /Anchorage Basin. The model showed that the relative changes in Tidal range were not very sensitive to the Sea Level Rise Scenario. The relative changes in stage due to Hurricane Matthew were small; however, the change at Low Big Island Station seems high compared to the nearby stations.

The greatest impacts on currents are in the reach from Anchorage Basin to Snows Island and appear to be of the order of 9% depending on the SLR and flow condition for the 90%tile. Does this mean that for 10% of the time the local bed shear stress could increase by about 20%? If so, would this be a problem?

The impacts on salinity are: an increase of the order 3 ppt and an increase in the stratification in the reach of Battleship/Anchorage Basin.

The temperature impacts are small with the greatest increase of about 0.4^{o}C being in the winter in the Anchorage Basin. Since the maximum is in the winter it should not adversely impact the DO. The changes in Ocean and River temperatures over the next 50 years could be more significant than the impacts of this project.

The impact of the project on Dissolved Oxygen is very small and mostly restricted to winter. It is interesting and a bit counter-intuitive that the model shows lower DO impacts for dry compared to typical years.

The model indicated relative shoaling rates in the Anchorage Basin ranging from 11% for the low RSLR to 4% for the NRC III SLR. It would be useful to clarify these shoaling rates in terms of potential increases in dredging volumes.

The Conclusions of this memorandum are supported by detailed results for all of the variables modeled.

Specific Comments:

Page 4. The NRC Report is dated 1987; since then there have been up dates to the predicted ESLR. These updates raise the probability that the higher ESLR will occur compared to the 1987 Report. This may not be an issue in this impact study since the model showed very small relative impacts due to RSLR; however, the model should that relative changes in shoaling due to the project decrease as the RSLR increases.

Page 5. Figure 4. Spelling change “hydrograph” in caption. There is some confusion with this section but it is cleared up on page 14.

Page 6. *Dry* and *Normal* years are considered. Why wasn’t a *Wet* year included?

Page 28. The second and third paragraphs need to be more explicit in describing the 50%tile and 90%tile changes as Snows Marsh and the Anchorage Basin. It would be useful to indicate the change in maximum bed shear stress as well as the change in velocity; very roughly the maximum percentage impact on velocity is about 9% at the 90%tile but the shear stress impact is

about 20%. It might be helpful to indicate whether the maximum increases or decreases occurred on the ebb or flood tides.

Page 30. It would be useful to express the changes in salinity as a percent of the FWOP. What is the explanation for the more uniform distribution of salinity in the water column in the dry year? Could this be due to greater numerical diffusion in the model? The presentation of the results in Figs 15-18 is very instructive.

Page 36. Figure 19 etc. Spelling change “temperature” in caption.

Page 40. State whether the 0.3 mg/L change in DO is an increase or a decrease. Page 46.

Do these percentages apply to the changes in dredging volumes?

CHLLC-M011 February 13, 2019

MEMO

To: Jeff Shelden, PE

From: Ioannis Y. Georgiou, PhD, PG Coastal

Hydrodynamics LLC

Re: Channel Deepening Feasibility Study and EIS, Cape Fear River, NC (Entrance Channel Morphology Production Simulations)

General:

The memorandum describes the application of the calibrated Delft3D morphology model to assess the potential impacts of channelization of the navigation channel of the Cape Fear River and its entrance. Longterm wave climate and shoreline change were modeled using *GenCade* and recorded for selected transects along the coast both west and east of the channel entrance. The boundary wave forcing was an extended wave record (2004-2017) derived from station NDBC 41013. The calibrated model was used to estimate average net annual longshore transport rates and resulting shoreline erosion rates for scenarios with and without project implantation or river channelization. Relative Sea Level Rise has been considered but it is not exactly clear how this was implemented or used in the model. The *GenCade* modeling and the results analyses of the model output indicate that the proposed channelization will not significantly change the shoreline erosion rate.

Finally, the morphology model was applied to estimate the shoaling in three reaches of the navigation channel for scenarios/cases with and without the project implementation. The modeling and resulting analyses indicate that the proposed channelization (future with project - FWP) will not significantly impact on the shoaling rate in the navigation channel relative to future without project - FWOP.

The memorandum does not have a Conclusions section, but the analyses of the model results/outputs indicate that the Project has minimal impact on the shoreline erosion rate west and east of the inlet, as well as a minimal impact on the shoaling in the navigation channel. The nature of the calibration process provides reasonable confidence in the result that only a minor difference can be expected between the FWOP and FWP over the life of the project. A note of caution should be added regarding the absolute shoaling rates over the life of the project, e.g. changes in the regional wave climate could significantly affect the magnitude of shoaling for both FWOP and FWP.

Specific Comments:

Page 1. The Project description could include information and statements regarding the widening and straightening under the FWP scenario.

Page 3. Three RSLR scenarios are presented for the end of the Project Life (2077); however, it is not clear how this information was incorporated into the modelling (GenCade or Delft3D- Morphology). Perhaps identify a location in the memo where the methodology can be described.

Page 4. NOAA WW3 and USACE WIS wave hindcast data are combined. Was a statistical comparison made of these records? Were the wind records statistically consistent, e.g. similar means, medians and standard deviations? (I understand some of this information were presented in a previous memo, but some re-iteration would benefit this memorandum).

Figure 4. Is there a wind rose that corresponds to this wave rose?

Figure 6 A scale and a north arrow would greatly benefit this figure. Does this photo represent 2016 per Section 4.1.1? It is not clear in the memo.

The wave rose presentations in Figures 7-21 could be enhanced if the local shoreline orientation was shown for each station; this would allow the reader to visually assess the relative potential for up drift and down drift longshore transport. This can be added in the figure caption for simplicity.

Figures 22-36. These figures represent the significant wave height without regard to direction. It would be interesting to look at the distributions in each of the major directions. However, in the context of the study objectives, this may not be important since the impact of the Project on the wave probability curves is almost negligible – some statements could help clarify that however.

Page 31. Section 4.1.1. Is the shoreline retreat due to RSLR included in the model? It seems that this would change with time since the RSLR is non-linear with time.

Page 31. Future beach re-nourishment is ignored. What is the historical record (if any) of beach re-nourishment in the study area?

Page 31 section 4.1.4. It is not clear what is meant by the term “inlet shoal volumes”.

Page 31 section 4.1.5. Can you define “Regional Contour”? This was defined in the shoreline morphology memo, but adding the definition here can go a long way.

Pages 31-32 section 4.1.6. Some clarification is needed here. This seems to imply that the model was run for multiple years (2004-2017). For how many years was the model run? Was a 50-year run made to capture the RSLR up to 2077?

The reference to ‘right’ and ‘left’ is a little confusing since it does not state that the viewer is looking offshore. Perhaps add additional (supplemental) descriptors?

Page 32. Define and briefly explain the consequence of a ‘pinned boundary condition’. I understand that this is described in the shoreline calibration model memo, but this would help make this a stand-alone document.

Page 32. Please define K_1 and K_2.

Page 32 section 4.1.8. Again it would appear that the model was run for 14 years? Is that the case? Was there an estimate on the impact in 2077? This is not clear in this memo.

Page 32 Results. What is the approximate uncertainty in the model estimates of longshore transport? Providing some ranges based on calibration and validation would improve this memo.

Page 33 and 34. Part of the annual retreat of the shoreline is attributable to RSLR and the most of the rest is due to the imbalance in the longshore transport and on-offshore processes. Do you know what fraction of the retreat is due to RSLR? For Bald Head the net longshore transport is zero at distance 4000 ft but there is still a retreat of 5 ft/year. Do you have an explanation for this rate? There is a similar point for Oak Island/Caswell beach at 39000 ft with a similar retreat of 5 ft/year. Is it possible to present the East and West components of the longshore transport as well as the gross longshore transport (similar to Figures 38 and 40)? The sediment being trapped in the navigation channel probably reflects the easterly transport component from Oak Island/Caswell Beach and the westerly component from Bald Head.

Page 35. In the morphology model, was the representative year wave and wind scenarios based on the combined 2004-2017 record or the calibration record? Was RSLR considered in these model runs? Three reaches of the navigation channel were evaluated (Baldhead Shoal 1, Baldhead Shoal 2 and Smith Island) with the model being run three times separately for 0.15, 0.2 and 0.25 mm sediment for FWOP and FWP. The selection of which model/combination results to use for each of the three designated reaches was based on the calibration results. The model selection affected the magnitude of shoaling but did not significantly affect the net difference in shoaling between FWP and FWOP as shown in Tables 2 and 3. It would be useful to show the observed annual values in Table 3 as a reference. The difference by reach between FWP and FWOP varies from about +10% to -8% which is probably well within the uncertainty of the model.

The Memorandum does not include a summary or ‘Conclusions’, perhaps adding some would improve the readership.

CHLLC-M010 February 11, 2019

MEMO

To: Jeff Shelden, PE

From: Ioannis Y. Georgiou, PhD, PG Coastal

Hydrodynamics LLC

Re: Channel Deepening Feasibility Study and EIS, Cape Fear River, NC (Entrance Channel Morphology Modeling)

General:

This report memo presents a good description of the development of a morphological model for the entrance zone of the Cape Fear River. The morphological model is based on the Delft3D Flow and Wave models. Both of these models have been previously calibrated; however, the resolution in the entrance zone of the Delft3D Flow model was not sufficient to define the shoaling patterns in the entrance channel so a new finer grid (of the order of 10m) was developed that was 'nested' within the original grid. The boundary conditions from the model with the original grid were transferred to the model with the 'nested' grid. The domain of the wave model was the same as the original model except that it had the new refinement in the entrance zone to compliment the morphological model of this study. The open boundary of the wave model is close to NDBC station 41013, which was used to define the external wave climate for the study.

The period of evaluation was one year; however, due to excessive run times required to run one year with 'real-time' wave and tide time series, a schematized approach was used to represent the annual effects of these variables on the shoaling in the entrance zone. The model with the 'schematized' waves and tides was run with morphological acceleration factors less than 20 and calibrated using US Army Corps of Engineers dredging data and bathymetric transect data.

The final model appears to be sufficiently well calibrated to be used to compare the relative impacts of various channel options. The final model was run with 3 separate grain sizes (0.15, 0.2 and 0.25 mm) and at each site the 'grain size' run that best matched the observation was recommended. It is not discussed in the report as to why a multiple grain size model was not adopted, beyond simulation run times?

Specific Comments:

Page 1. It is not clear whether the 'nested' model was run simultaneously (online) with the original model or was the original model run completed first and the relevant boundary data extracted and used in the 'nested' model. The memo states that this is a general capability within the Delft modeling suite, but perhaps adding a sentence that is specific to this application would help clarify.

Page 2. It is stated that the refined grid size is about 10m. What is the approximate grid size of the original mesh within the 'nest domain? This is less of an issue if online coupling was used. If the large domain model was run first and then the nested grid, were the boundary condition data linearly interpolated to the finer mesh?

Is there any special treatment of the longshore transport to account for the better estimation of the surf zone in the refined grid compared to the original grid?

In describing the grid extent (for the nested grid used) there is reference to locations (eg Southport, AIWW connection) that are not shown in Figure 1. If this memo is intendent to stand alone, perhaps adding these on the map, or provide a reference in the text would ad clarity.

Pages 3 & 4. The study has prioritized the bathymetric data to give the highest weight to data since 2015 when the terminal groin was constructed. Was the 2015 survey of Olsen made too soon after the completion of the terminal groin to fully represent the new bypassing effects on the bathymetry?

Pages 6 & 7. *Tides*: The differences in Figure 5 are about +0.1 m and -0.2 m over one spring- neap period. Although most of the channel does not indicate a difference between the approaches, could these differences be significant if extrapolated to one year? Was the sensitivity of the morphology to the correction *Corr* tested beyond the fortnight real-time comparison?
What assumption was made for river flows for this simulation test?

Pages 7- 14. *Waves*: I agree that the 1st method of weighting wave height to potential longshore transport would be more subjective than the 2nd method since the offshore wave angle in the CERC formula is based on an equivalent constant shore angle.

Pages 14-15. *Winds*: The assumption of spatially uniform winds based on NDBC 41013 for the given domain should not introduce large errors in the relative impacts with and without the channel modifications. It is not clear how the mean wind speed was computed for each class in Table 3. Was this calculation done in the process in Figure 7?

It was shown earlier (Figure 5) that tide and flow alone can cause sediment movement in the entrance zone. What is the justification for ignoring the period with no wind or with offshore winds?

Page 15. *Morfac*: The limit of 16.7 for the *morfac* should not cause a significant error. For riverine systems, a *morfac* up to 40 seems to be satisfactory.

Is there a seasonal justification for selecting a certain sequence of wave directions?

Pages 16-17. Grain size: Are there grain size data for the dredged materials from the various sites? Was the coarse sediment present in the dredge material? Except for the longer run times it is not clear why a multiple class model was not considered. Was this necessitated due to the limitation of Delft3D in specifying spatially variable grain sizes?

Page 18. *Calibration*: The original grid models for flow and waves were previously calibrated. Were the hydrodynamic results of the 'nested' model compared with the original outputs in the entrance zone?

Page 19. Which of the parameters in Table 4 were varied in the calibration of the model? What ranges of these parameters were tested? Are the presented parameters basically the default values? It is not clear how the parameters were changed to improve the model calibration. I understand that an important part of the calibration was the initial sediment thickness introduced in Figure 10.

Pages 21& 22. It is difficult to directly identify/recognize shoaling patterns in Figure 11. Would it be possible to show these as difference plots as you have for the model in Figure 12 for the one-year simulation? Or perhaps adjust the orientation to match that in Figure 12. Regardless, qualitatively the model is behaving correctly.

Pages 25-27. The overall performance of the model in estimating the observed total shoaling rate is good but the shoaling at specific locations depends on the 'grain size' run that was selected as representative of shoaling at that location. Perhaps the range of the results could be considered a measure of the uncertainty. It seems that a multiple grain size model run might have avoided the need to assign different 'grain size' model run to each location.

Page 28. Paragraph 2. I am a little confused by the last sentence; I understood that the model was run separately for 3 size classes (0.15, 0.2 and 0.25 mm) for the whole domain and the run that best agreed with the observations was selected as representative of a specific site. Are there field data to show that this grain size of the best run is dominant at the specific site?

I agree with the final conclusion regarding use of the model for comparing shoaling patterns for the various channel changes with the existing case.

Coastal Hydrodynamics LLC
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CHLLC-M009 January 29, 2019

MEMO

To: Jeff Shelden, PE

From: Ioannis Y. Georgiou, PhD, PG

Coastal Hydrodynamics LLC

Re: Channel Deepening Feasibility Study and EIS, Cape Fear River, NC (Water Quality Model Calibration and Validation) – responses to review

This Memo communicates to the authors that the responses to reviewer comments for the Water Quality Modeling calibration are satisfactory.

CHLLC-M008 December 30, 2018

MEMO

To: Jeff Shelden, PE

From: Ioannis Y. Georgiou, PhD, PG Coastal

Hydrodynamics LLC

Re: Channel Deepening Feasibility Study and EIS, Cape Fear River, NC (Water Quality Model Calibration and Validation)

This Memo summarizes peer review comments for the Water Quality Model Calibration and Validation Memo, prepared by Moffatt and Nichol (M&N) for the North Carolina Ports as it relates to the Channel Deepening Feasibility Study and EIS for the Cape Fear River, North Caroline (NC). The Water Quality Model Calibration and Validation Memo outlines the model skill, data sources used in the model setup, initial and boundary conditions, and other data sources used to calibrate the model. The Memo does not cover or show results from project scenario simulations.

General comments: The approach to the development of a water quality model for this estuary is based on a state of the art hydrodynamic model (Delft3d-FLOW) and an associated water quality model DELWAC which has not been as widely applied. Some of the output variables such as salinity, TSS and temperature are not automatically transferred into the DELWAC model and therefore must be recomputed. The DELWAC grid is formed by aggregating the Delft3D grid.

The general approach was to calibrate using a dataset from late summer and validate using a) a spring dataset and b) a long term data set. A range of metrics were applied to indicate the ability of the model to simulate a total of 19 state variables (some were later dropped) related to water quality.

An introductory statement, in addition to the project objectives, regarding the specific objectives for the water quality model would be helpful; for example, a ranking of the state variables by order of importance in the evaluation of the Project could be included. Something like the third paragraph of the conclusions would work.

Also the inclusion of the Redfield Ratio based on field measurements of bio-available N and P would support the later argument that the estuary is likely Nitrogen limited. This should be done for the upper and lower portions of the domain.

Specific comments:

P 1-10 A statement should be added indicating any assumptions that were made regarding atmospheric loads of nutrients for wet or dry deposition. This is probably very small in the upper reach but may be important in the lower reach of the model.

P 11-12. Only salinity shows stratification. How close to the bed did the CTD scans extend? Could there be a low DO zone near the bed?

P 19-23. What was the level of nutrient treatment at the WWTPs? For example were the plants operated for nitrification and/or phosphorus removal? What is the justification for TP = 0 when no data are available?

P 24 etc. Tributary loading: It is assumed that Water Quality concentrations are constant in the streams, i.e. they do not vary with the runoff. This appears to be a possible source of uncertainty in the results since at all but one of the basins there is a strong runoff event during the calibration period. Figure 1 from Roblin (2008) shows a typical response of N-NO3 to Runoff for the Amite River in the Pontchartrain Estuary (Louisiana).

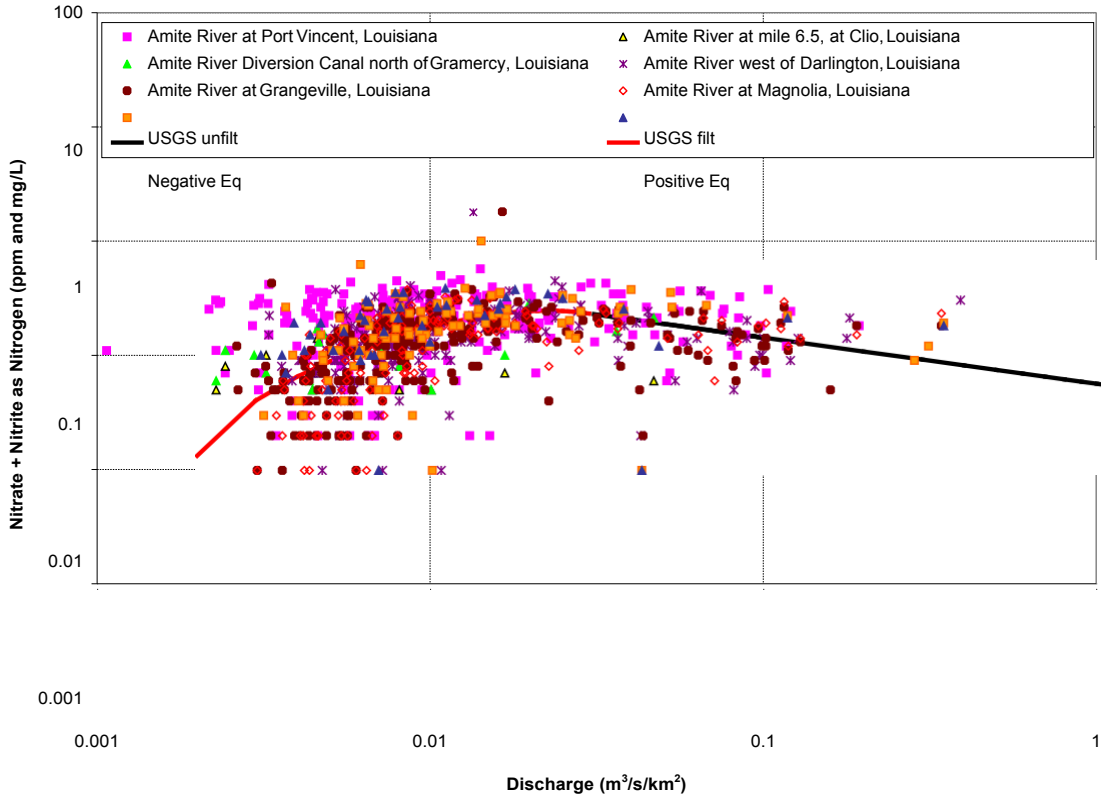


Figure 1. Relationship between nitrate + nitrite as nitrogen concentration and discharge for the Amite

River (R. Roblin MSc "Water Quality Modeling of Freshwater Diversions in the Pontchartrain Estuary", MSc Thesis, Univ. of New Orleans, 2008).

P 29. Use of the station M18 for the seaward boundary condition makes sense and avoids the need to move the boundary further offshore. It is stated that light penetration may be greater in the lower reaches due to the effect of salinity on the settling of suspended solids. Was there a flocculation process in the model? Or was this manually changed based on the measured Secchi depths?

P 34 and 40. Calibration Results: When the PO4 sorption simulation became unstable, the sorption variable was turned off. Was this a time step issue or a model formulation problem? Does DELWAC have an option to use partition coefficients to calculate labile PO4 from the TP variable as in EFDC?

"*Total phosphate (PO4t) and available silica (SA) are partitioned into dissolved and particulate forms via equilibrium partitioning, thus, requiring only total concentrations for each of those state variables.*"

It appears that a partitioning of about 1/3 would have been good enough as the ratio of {Bio available P: TP}.

The report reasons that since the system is likely Nitrogen limited, the PO4 issue is not critical to the algal production. It would be helpful if this argument was supported by giving the Redfield Ratio based on the available observations of bio available N and P. This should be provided for the upper and lower reaches of the estuary.

P 39. A simple temperature model has been used and appears to be giving good results; however, this omits the domination of long wave heat loss at night and could result in a day-night bias in the results.

P 40. I couldn't find the 'scatter plots' in the Appendices. By scatter plots I mean Model versus Measurements plots.

P 43-44 Figure 15: The flood events during the late summer calibration period may have produced a higher N loading in some of the tributaries (see the flow effect in Figure 1.)

P 44. What are the land uses in the various drainage basins? Is the land use similar in the gaged and ungauged basins?

Some of the model results and continuous DO records appear to be both over-estimated and out of phase (see example Figure 2.) Is there an explanation for the out of phase effect? For example, is this a storm runoff effect due to increased organic loading?

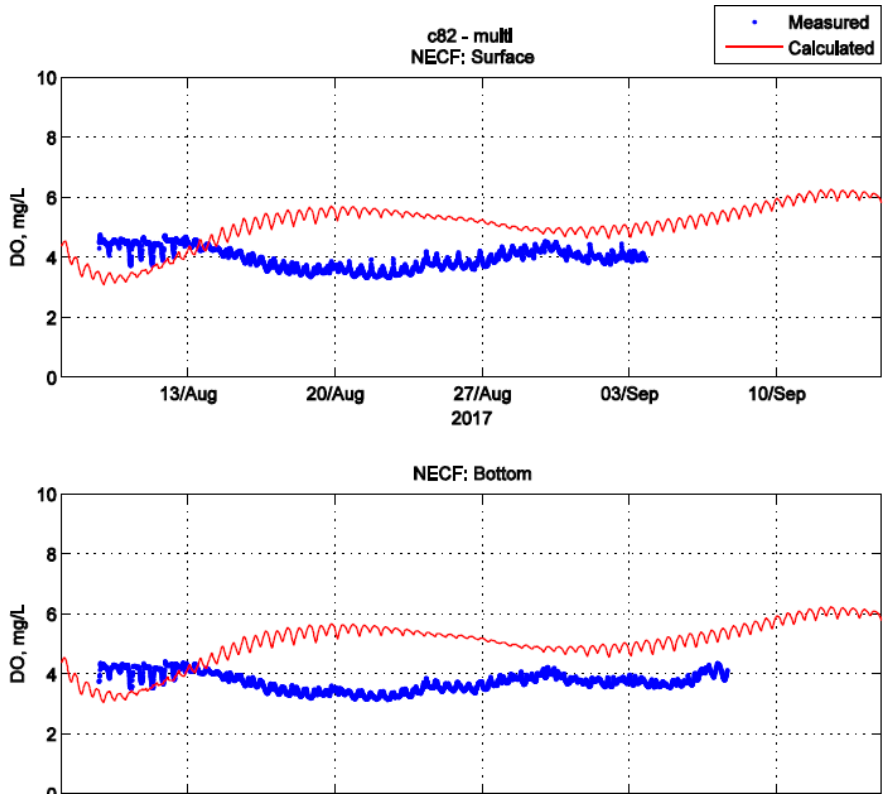


Figure 2. Extract from Calibration Results.

The model does a good job of simulating the mean water temperature but it is seems to miss the diurnal temperature stratification (for example Figure 3). Is there an explanation for this? For example, does the model have too much numerical diffusion in the vertical or is this the result of the changes in the relative importance of long wave and short wave radiation during a 24-h period?

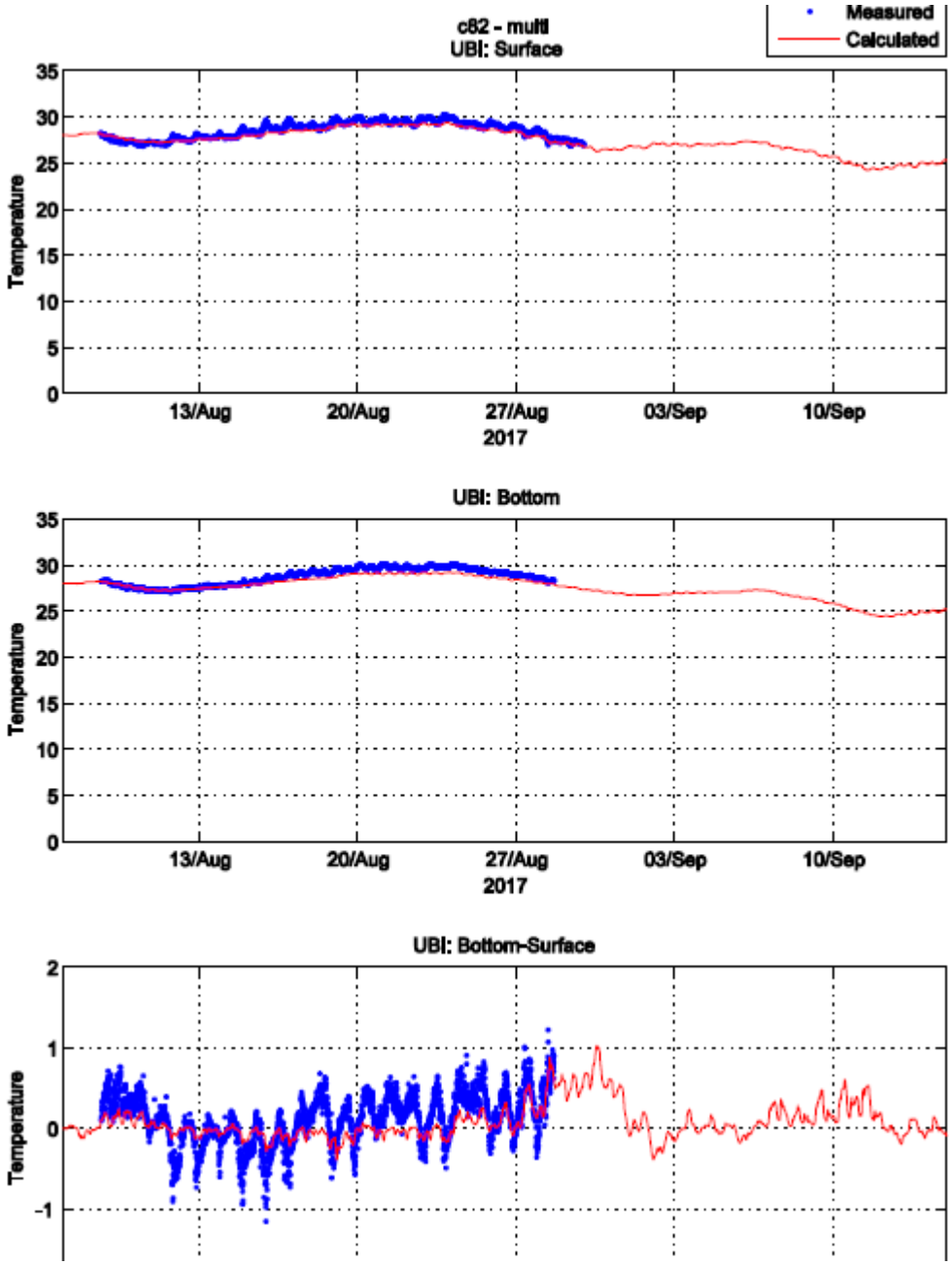


Figure 3. Surface and bottom temperatures.

A similar smoothing effect is observed in the DO results (see for example Figure 4.) Both the observed surface and bottom DO show roughly diurnal variations as expected but these are smoothed out in the model. What is the explanation? It is interesting that the Bottom-Surface seems to have semi-diurnal period? Maybe the tidal boundary condition could be included in the report.

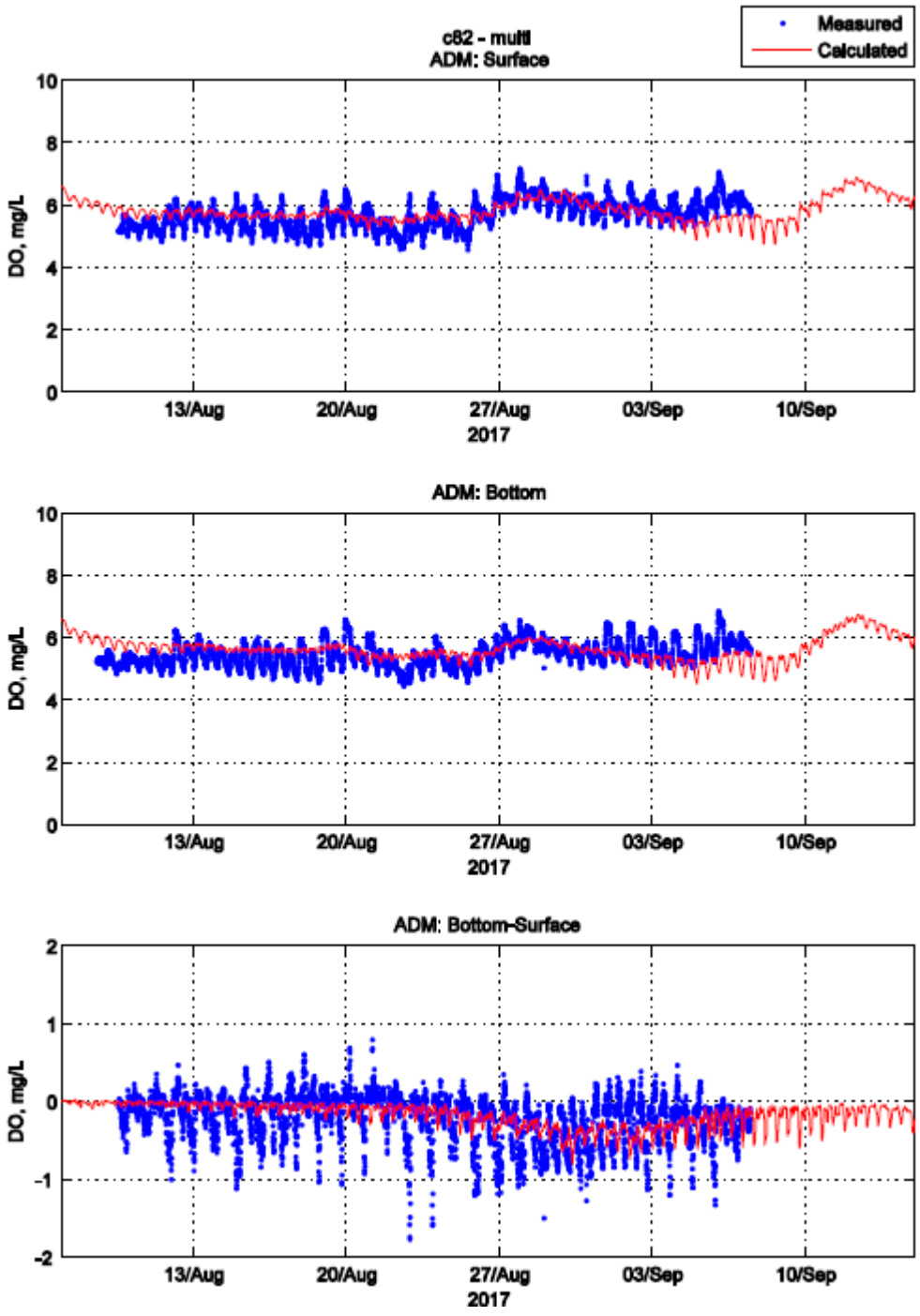


Figure 4. Surface and bottom DO

P 47 etc. Spring Validation: Except for PO4, the validation confirms that the calibration is acceptable to excellent based on the LCFRP; however, most of the RPS does not exist due to instrument failure. The temperature that was available at RPS showed that this part of the model was well validated. It is interesting that in some cases the validation statistics are better than the calibration statistics. Was the spring period free of strong runoff events?

P 167 e.g.: Are the roughly 12 h fluctuations shown in several outputs, due to tides? See for example Figure 5.

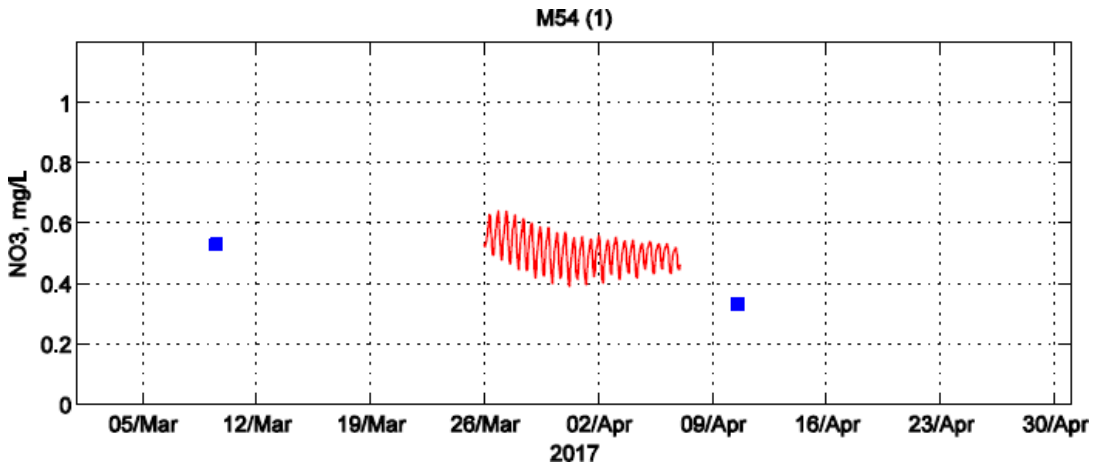


Figure 5. Semi-diurnal fluctuations?

P 144-182: The modelled values of Temperature, DO and Chl-a are generally in agreement with the range of the measured data for the spring; however, a lot of the data are outside of the spring simulation period.

P 49 etc. Long term validation:

P 50 Flow conditions: The methodology for the development of the representative annual hydrographs is based on long term records; this is a reasonable approach.

Appendix C: The DO and Temperature Validations are quite good. The Chl-a model and field data are in fairly good agreement; the model is sufficiently validated to serve as a basis for comparison to indicate Project impacts.

Appendix C. Long term runs: Where was the salinity measured in the water column (for example, in Figure 6 from page 250 of the report?) The model is showing strong stratification but is difficult to see if the same effect is present in the measured data.

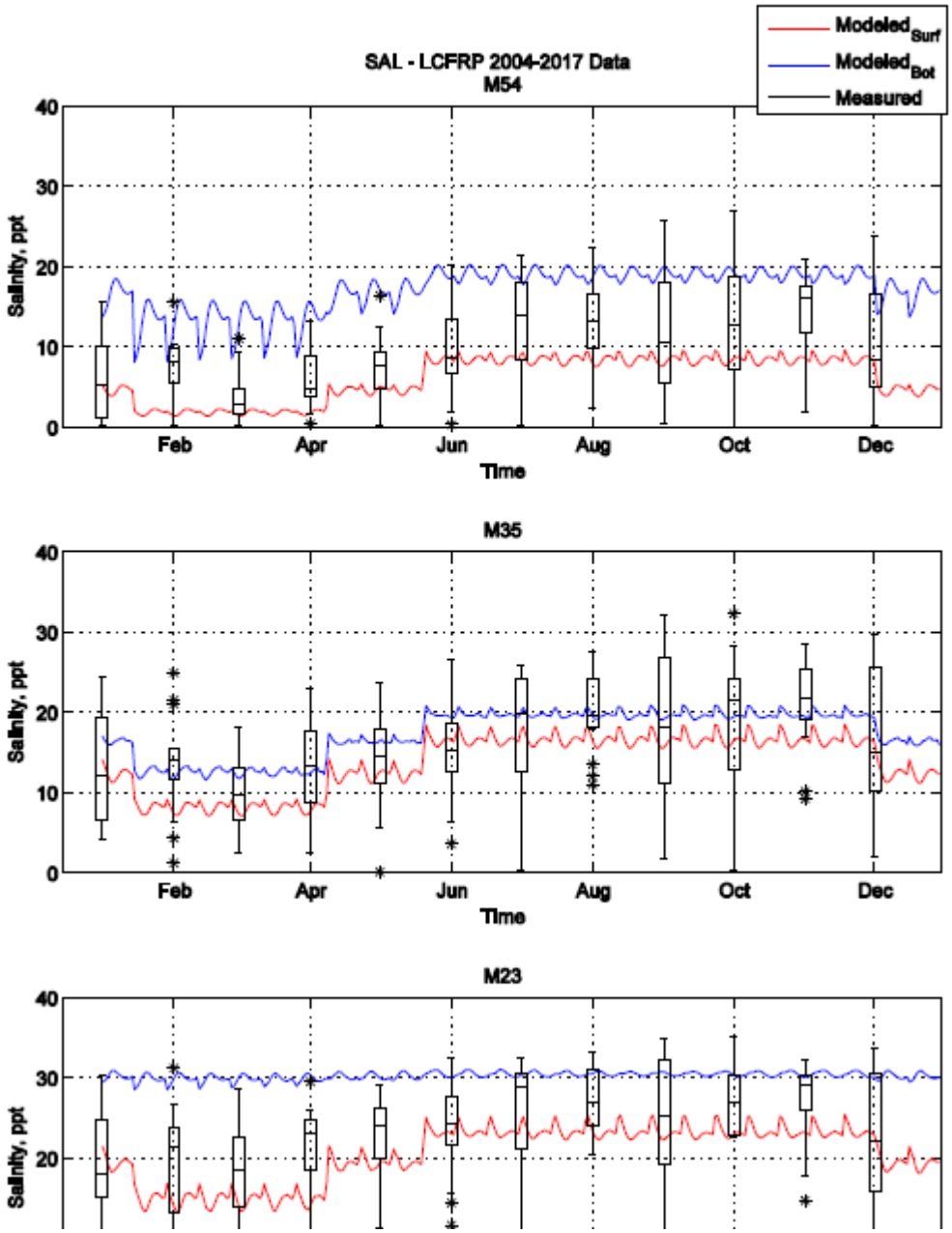


Figure 6. Salinity Stratification.

P 58. Sensitivity to Annual Flow:

P 61. In the following statement, it is interesting that greater stratification occurs at high freshwater flows. This is contrary to large systems like the Mississippi River where the opposite occurs; the high flows suppress the intrusion of the saltwater wedge. I assume that the ratios of magnitude of the tidal flows to riverine flows are much greater in the CF and Chesapeake Estuaries than in the Mississippi River. The increased organic loading at high flows is reasonable. Increased stratification would decrease the diffusion of surface DO to the bottom.

Quote…

> Comparison of DO for the dry year relative to the typical year shows that both years follow the same seasonal trend, but overall, the warm season DO of the dry year is higher than that of the typical year primarily for the mid-estuary. This result seems counter-intuitive to experience with rivers, where low summer water flow rate, or discharge, often results in lower DO compared with higher summer flow rate. However, estuaries can respond quite differently to discharge rate than rivers. For example, it is well known that the summer hypoxia (or dead zone) of Chesapeake Bay is usually greater for high flow years (https://www.chesapeakebay.net/state/dead_zone). This result is attributed to greater vertical stratification associated with higher freshwater flow and greater mass loadings of nutrients (and organic matter) that create oxygen demand and fuel algal blooms, which settle as detritus that exerts higher oxygen depletion below the pycnocline.

P 61. The significant figure in the following mass estimates should be rounded off to indicate their accuracy:

Quote….

> carbon, which also directly contributes to DO depletion via mineralization. The annual total mass loading of total nitrogen into the Cape Fear River system model is 9,748 and

P 63-64. Conclusions: The conclusions are well supported by the findings of the study. The fourth paragraph discusses an apparent over-estimation of DO in NECFR which is attributed to the lack of data on organic loading, e.g. organic nitrogen (ON). Why was ON especially identified as the main reason for the over-prediction? Is the DO in the NECFR likely to be affected by the Project? Does this loading significantly impact downstream reaches? If so would it be useful to treat the organic loading for WECFR as a calibration parameter?

CHLLC-M007 August 10, 2018

MEMO

To: Jeff Shelden, PE

From: Ioannis Y. Georgiou, PhD, PG Coastal

Hydrodynamics LLC

Re: Channel Deepening Feasibility Study and EIS, Cape Fear River, NC (Sediment Transport Model Calibration)

This Memo summarizes peer review comments for the Sediment Transport Model Calibration Memo, prepared by Moffatt and Nichol (M&N) for the North Carolina Ports as it relates to the Channel Deepening Feasibility Study and EIS for the Cape Fear River, North Caroline (NC). The Sediment Transport Model Calibration Memo outlines the model skill, data sources used in the model setup, initial and boundary conditions, and other data sources used to calibrate the model. The Memo does not cover or show results from project scenario simulations.

Overall comments: The calibration methodology used field turbidity data acquired over a typical span of neap-spring tides (15 days) at four transects to adjust sediment erosion and deposition parameters in the model to match the vertical sediment profiles collected during the synoptic studies when hydrodynamic, salinity and TSS data were collected. In addition, the model was also applied to estimate the annual net deposition in the Anchorage Area. Although, it is not specified as such, the comparison of the field and model estimates of the net annual deposition, appears to be a validation of the model since the parameters in the profile matching are not changed for the net deposition runs. The uncertainty of predicting the net annual deposition in the Anchorage area is of the order of 10% which is quite acceptable.

Overall the model seems to be well calibrated; however, some questions remain as discussed in the following section.

It would be useful to add a comment/justification for the selection of DELFT3D and more specifically the need for the 3D option. Ideally the audience would have read the hydrodynamic memo prior to reading the sediment transport memo, but it helps the memo to be standalone if there is mention of the

stratification and its role on sediment and why the use of the 3D option was selected – and of course reference the hydrodynamic memo. In addition, more details on the model design/set up would be helpful if provided, possibly in an appendix. For example, what was the horizontal and vertical grid type and resolution, especially in the Anchorage Area? I know from reviewing the hydrodynamic memo that the horizontal grid is curvilinear, but the resolution is not mention in this memo, and weather there was an aspect ratio in the vicinity of the anchorage – as literature shows that curvilinear grids with high aspect ratios may have some issues with under-estimating secondary flows. Also, the vertical resolution and grid type is not reported - was the grid sigma or z type? Finally, it is not clear whether the hydro-sediment model was coupled with salinity; having reviewed previous memos I know that a curvilinear grid was used, and that a salinity model exist, but it's not clear if in the sediment transport salinity is available. The stratification effects, the dampening of turbulence energy and the resulting density effects of the hydrodynamics can have implications of the settling velocity and thus depositional regions in the mode. Plus, if it is coupled, saying it is strengthens the model rigor.

Model performance metrics have not been applied in this calibration. The metrics in the Hydrodynamic memo could be modified and applied to this case. Is that something that the authors are planning to do?

Ideally a more rigorous validation process should have been followed; however, the net deposition comparison can partially serve as a validation, which is ok.

A statement about uncertainty and sources of error should be added to the Conclusions.

Specific comments:

Mention is made of current data but nothing is shown in the memo. Perhaps cite the hydrodynamic memo (is that possible?) as the field data is referred to and shown in that memo.

I am assuming that Temperature or DO data will be used for the water quality modeling efforts.

I found the treatment the 'mud' too brief. Often 'mud' is considered in silt and clay classes. How many cohesive classes were used? How were they assigned? Was the salinity based clay flocculation option in DELFT3D used? I think the approach to the sandy sediments in the downstream reach is reasonable since they are located far from the area of interest. Did the STORET data include sand, silt, and clay classification? The flow-TSS data have an acceptable correlation at only one of the USGS River Stations, i.e. B8360000. The other two stations do not have positive correlations. Does an error in these boundary TSS values significantly affect the estimation of the net deposition in the Anchorage Area?

How many bed samples were collected? What was the composition of these samples?

Why was the Simmons' TSS data used rather than the Q-TSS correlation based on the STORET data?

How were the USGS flows and concentrations transferred from their station locations to the model

input points?

What is the justification for zero sediment concentration at the open boundary? Is it because of proximity, ie distal, and as such no sediment influx?

How was the settling velocity of 0.0005 m/s determined? It seems that silt and clay have been combined into one class with no flocculation option. Is that correct? Please classify, as this will have direct implications to the model validation. For instance, stratification within the estuary may flocculate clay and enhance settling.

The profile calibration results are very good except at location TR03. A reason is offered for the poor agreement at transect TR03, i.e. ship activity. Was there ship activity on both the flood and ebb observations? Please clarify. Also, is it possible that the calibration parameters at this transect are different from those at the other transects? TR03 seems to be a relatively narrow cross section and should have behaved in a similar way as the other sections. On the other hand, is ship induced resuspension a possible mechanism that could explain the higher net deposition in the field surveys compared to the model? How frequent are the ship passages? Inclusion of ebb and flood bed shear maps at spring and neap tides would help to interpret the sediment profiles. Are the ebb and flood velocities and bed shear stresses at TR03 comparable to the other transects? Information on this topic will strengthen the validity of the results with respect to model skill.

Visually the calibration results look good but it would be useful to include some performance metrics for the calibration, e.g. RMSE and Bias error or equivalent.

The MORFAC values are reasonable and should not introduce significant errors in the morphology compared to MORFAC = 1.

Page 23 etc. The frequency based approach to computing the annual net deposition is good but maybe the authors could add a more extensive explanation as to how the 0.3, 0.3, 0.3 and 0.1 classes were assigned.

Page 28 Add an explanation of how the 436 m^3/s was adjusted to 1000 m^3/s. Is this for spring or neap tide?

Page 32. Figure 41. Where is this located relative to the Anchorage area? i.e. upstream or downstream or within?

The Conclusions are generally supported by the model-field comparisons of TSS but it is recommended that these comparisons are quantified.

CHLLC-M006 August 01, 2018

MEMO

To: Jeff Shelden, PE

From: Ioannis Y. Georgiou, PhD, PG

Coastal Hydrodynamics LLC

Re: Channel Deepening Feasibility Study and EIS, Cape Fear River, NC (Salinity Model Calibration)

This Memo summarizes peer review comments for the Salinity Model Calibration Memo, prepared by Moffatt and Nichol (M&N) for the North Carolina Ports as it relates to the Channel Deepening Feasibility Study and EIS for the Cape Fear River, North Caroline (NC). The Salinity Model Calibration Memo outlines the model skill, data sources used in the model setup, initial and boundary conditions, and other data sources used to calibrate the model. The Memo does not cover or show results from project scenario simulations.

Overall comments: The salinity model calibration provides a reasonable assessment of the model skill using standardized metrics defined by many modeling studies, such as mean error, root mean square error, normalized error, mean absolute error and the correlation coefficient and index of agreement as described by Wilmott (1982), Wilmott et al. (1985), as well as using visual qualitative comparisons of model and observed shorelines. Some departures between model and observations do exist, specifically when comparing CTD profiles in the lower part of the estuary, but departures from measurement are not alarming. The model has the ability to capture adequate stratification during both calibration and validation, and thus seems appropriate for use in scenario simulations. When there is departure between observations and model derived salinity, the authors in this memo address the issue with sufficient justification.

The calibration/validation methodology used field salinity data acquired over a spring (March) and late summer period. The summer measurement period lasted about one month and involved 5 continuous recording stations with surface and bottom locations as well as CTD vertical sampling at 16 locations. The spring campaign used 2 continuous recording stations but only the downstream station had surface and bottom since the bottom probe failed at the upstream station. A proportional extrapolation from USGS flows was used to obtain the freshwater input for ungauged areas. A strong set of calibration/validation metrics has been utilized. The methodology presented is appropriate for the

purposes of this model.

Overall the model seems to be well calibrated; however, some questions remain as discussed in the following section. The model reproduces the stratification effects very well. The detrended results and metrics are quite good. The memo asserts that part of the disagreement in the undetrended comparisons is

due to errors in the estimation of the ungauged freshwater input; I think this is a reasonable explanation for most of the difference. Even after detrending the model was not reproducing the spikes in salinity in the upstream reaches on the flood tide (Figures 11 and 12 versus 16 and 17). Although these spikes are small, they indicate a limitation of the salinity transport model.

The validation is based on 2 stations, one near the upper end (North) and one near the mouth (South). The agreement between model and field data is excellent at the station near the mouth; however, the normalized bias (over-prediction) error is about +37% at the upper station (North). These time series salinities in the validation case have not been detrended and it is possible that the bias is due to errors in the estimation of the freshwater input to the model for the ungauged drainage areas.

Since the freshwater input to the model is critical to reproducing the salinity gradients, it would be useful at the application stage to carry out sensitivity runs in which the proportionality factor between gauged and ungauged flows is changed. Alternately, this factor could be part of the calibration. Since the ungauged areas are nearer to the coast, it is likely that these areas will experience different per square km direct runoff compared to the more inland drainage areas (upstream of the USGS Stations).

After adding salinity and calibrating the model, it would be advisable to verify the hydrodynamic model by rerunning some of the original calibration datasets. A salinity gradient from 35 psu to 0 could affect the hydraulic grade line.

It would be useful to add a few sentences summarizing the horizontal and vertical grid resolution. By examining the outputs I concluded that a z-level discretization was used in the vertical but this should be stated along with the resolution.

A statement about uncertainty and sources of error should be added to the Conclusions.

Below are specific comments and recommendations for the various sections of the memo.

Section 2.2 and 2.3 Measurements

On page 6 and 7 memo states nearly continuous observations for salinity. At the end of the first paragraph on page 7, salinity is collected at 1-minute intervals and the table 1 verifies interval to be either 1 or 10 minutes. Are these discrete measurements or are they averaged over a window? Please clarify.

3.1.1 Offshore boundary conditions

Was the elimination of the northern boundary included in the updating hydrodynamic calibration? If so, please ignore.

At the end of the paragraph in page 11, the inclusion of subtidal effects, by including additional pressure (water level) gradients makes sense and perhaps does have the desirable effect. But how was the “correct” amount of added water level selected? Were tidal records used to determine?

P13 The uniform vertical salinity at the open boundary is a good assumption and may prevent local

unrealistic density currents.

It appears that the ungauged drainage areas exclude the open water areas in the model domain. If this is the case, it should be stated. Otherwise there would be double counting due to the inclusion of rainfall and evaporation.

Figure 7 shows that the initial salinity condition is weekly stratified – was this level of stratification selected based on observations using the CTD profile data? It appears linear interpolation between bed and surface values used in the Initial Conditions set up?

P20 What were the ranges of eddy viscosities and diffusivities that were tested? The k-e model computes the turbulent vertical eddy viscosity with molecular kinematic viscosity provided by the user. Did you try assigning 10^{-6} m^2/s instead of 0.00005 m^2/s for the background eddy viscosity (Table 3)? The horizontal parameters in Table 3 are relatively small considering the depth and width of the channel; however, these are calibration values for the given grid. How sensitive was the modelled salinity to these horizontal parameters?

Section 4.3. Perhaps you could add a statement that ME is a bias error which is positive if the model tends to over-predict the values.

Section 5.1.1

Pages 12-29 showing surface and bottom salinity calibration – salinity calibration appears very robust, considering the dynamics of the system, and the spring-neap and tidal-induced variation in salinity. Results are corroborated with summary statistics shown in Table 4.

Model skill with subtidal signal removed looks very good.

Section 5.1.3 3D Profile results

It is interesting that some of the time series show model under-prediction (Figures 16 and 17 for bed with flood tide) while the CTD casts show consistent over-prediction. Can you explain this?

In Figure 19, it appears that the model is doing a great job at reproducing stratification with a low over-prediction in the lower part of the water column. Figure 20 looks much better considering the results in figure 19.

Conclusions

P44 Section 6 3rd line: … 'high' might be an overstatement – maybe 'good' or 'reasonable' would be better.

The model – per authors – does appear to have good model skill, and able to capture the salinity gradients

through the estuary correctly, as well as the stratification at several locations throughout the basin within acceptable limits and this memo shows statistical results from the skill to document that.

Additional minor points

Was there a reason for using a 1 minute sampling rate for the spring and 10 minutes for the summer field campaigns?

Section 2.3 refers to the data from the CTD casts along the channel centerline as ‘3D data’; I would refer to these data as 2D data since they are profiles. Also the memo occasionally uses ‘data’ as singular rather than plural.

There may be a few typos that a spell check can find.

CHLLC-M005 July 28, 2018

MEMO

To: Jeff Shelden, PE

From: Ioannis Y. Georgiou, PhD, PG

Coastal Hydrodynamics LLC

Re: Channel Deepening Feasibility Study and EIS, Cape Fear River, NC (Shoreline Change Modeling Calibration and Validation)

This Memo summarizes peer review comments for the Shoreline Change Modeling Calibration and Validation Memo, prepared by Moffatt and Nichol (M&N) for the North Carolina Ports as it relates to the Channel Deepening Feasibility Study and EIS for the Cape Fear River, North Caroline (NC). The Shoreline Change Modeling Calibration and Validation Memo outlines the model skill during each step, identifies sources of data used in the process and available data types for initial and boundary conditions used in the model. No future scenarios are tested or shown in this Memo.

Overall comments: The shoreline change modeling calibration and validation is for the most part sufficient, and the memo provides a reasonable assessment of the model skill using metrics defined by the Coastal Inlets Program, as well as using visual qualitative comparisons of model and observed shorelines. When departures between model and observations exist, particularly during model validation, the authors provide an explanation to support the results. Other concerns include the use of the reservoir model along inlets, and specifically the flood-ebb delta correlation derived using inlet along the Florida coast; how transferable is the correlation to a less mature shoreline and across an inlet that exhibits very dynamic morphology. Finally, since GenCade cannot handle cross-shore transport, what are the consequences when simulations with storms are considered and how would those environments be identified in the scenario simulations to ensure potential impacts are correctly identified.

Below are specific comments and recommendations for the various sections of the memo.

Section 2.3 Modeling calibration

In section 2.3.4 (beach fills) on page 9 there are statement regarding the 2012 shoreline and the possible absence of a nourishment project. The authors sate the the impact to Bald Held Island is anticipated to be small due to the small quantity. I am assuming they refer to a sand volume (which is not listed). But can the authors also state if the footprint of the nourishment was also small.

At the end of this paragraph, page 9, authors state their assumptions with respect to this emergency fill was assumed to be towards the end of the shoreline segment with an width based on the equilibrium beach

width – How was this estimated? Using aerial photographs, other? Please clarify.

Section 2.3.5 (inlet shoal volumes)

The use of the reservoir model is ok, however, how true in the assumption that tidal prism does correlate well with F-T-D. While mostly ok for florida, and for rather continuous shorelines interrupted by an inlet, application of this to Cape Fear inlet may not be the most ideal situation. Also, once sand is transported to the backbarrier or flood delta, there are too few mechanisms that would transport the sand back to the ocean. How transferable are the results of Carr and Betts (1999) from Florida, to north Carolina, and specifically for this inlet. It's a good first order approach, but I caution with the interpretation of the results for the scenario simulations.

On page 11 end of paragraph, authors mention that there is little bypassing – What are the implication of using the equilibrium TP and correlation with F-T-D since bypassing is small? I would imagine that with all the dredging that takes place through the terminal lobe, the ebb-delta will be a continual sand sink.

2.3.7 Regional contour

Please change inhomogeneities to non-homogeneities

End of this paragraph, authors discuss selectin of the offshore contour to maintain a curved shoreline. It appears that the contour is not equidistant from the shore, which is fine. But, how was this position selected? Was it based on depth, distance from the shore? or other sediment, wave characteristics and properties. Please clarify.

2.3.9 lateral boundary conditions

On page 14, authors discuss the selection of a pinned lateral boundary. Was this selection influenced or driven by long-term shoreline data showing that it is indeed relatively stable compared to the remaining shoreline segment? What do we know about longshore sediment transport at this location?

Page 15 – statements on longshore transport between different studies as shown in figure 9. Why are the predicted OCTI rates much lower? Did the study use different methodology?

2.3.11 calibration – shoreline change.

At the end of page 16, authors state that the dynamics of the cape fear spit are very difficult to capture with a line. While true, what are the consequences for under or over-predicting sediment transport and shoreline change at this site relative to the study objectives? What other data, studies are out there where some uncertainty (or feedback) can be used to ensure gencade results are reasonable. Perhaps the sediment transport direction and the dynamics of the spit are de-coupled from the main study objective, which is the sediment dynamics nearing the inlet. Some justification would go a long way.

Figure 11 page 18 is a little difficult to follow. Perhaps add on figure 8 some identifiable marks to make figure 11 more relatable to the shoreline segment modeling. Same comment for Figure 12.

Section on Longshore Sediment Transport

Perhaps consider adding either a summary table showing these rates discussed in this section, or modify figure 8 and add arrows and numbers to show direction and magnitude of transport for better communication of figures 13 and 14. It's not terribly important, but it could communicate better to the audience.

On page 22 toward the end when table 6 is presented – what contributes to better model performance when the western part of Oak Island is omitted? Is there historical shoreline data (longer-term) that could explain this? Could the pinned option of lateral boundary be the reason for this behavior? Furthermore, since the role of storms is mentioned in this discussion and previously assessed, some discussion on the consequences when extrapolating results from this model during conditions where cross-shore transport may be important.

CHLLC-M004 May 19, 2018

MEMO

To: Jeff Shelden, PE

From: Ioannis Y. Georgiou, PhD, PG, Coastal Hydrodynamics LLC

Re: Channel Deepening Feasibility Study and EIS, Cape Fear River, NC (Hydrodynamics Model Calibration)

This Memo summarizes peer review comments for the Hydrodynamic Modeling Calibration Memo, prepared by Moffatt and Nichol (M&N) for the North Carolina Ports as it relates to the Channel Deepening Feasibility Study and EIS for the Cape Fear River, North Caroline (NC). The Hydrodynamic Modeling Calibration Memo outlines the available agency data and newly collected data available for calibration, outlines the model setup including grid, boundary conditions for all hydrodynamic parameters, and finally details the model performance against observations for water levels, velocity profiles and discharges at selected location. No scenarios are tested or shown in this Memo.

Overall comments: The hydrodynamic modeling calibration and validation is sufficient, and the memo provides a thorough assessment of the model skill, and on occasions where there is departure from observed conditions, an explanation, along with sufficient information to support that explanation are always offered. Perhaps my biggest concern is that the tidal prism is under-predicted somewhat. Although not a critical issue, as most of the exchange is represented by the model well including water levels, velocity and in many instances discharge, the memo doesn't mention what the consequences maybe resulting from this under-prediction, with the exception of salinity. Perhaps consider adding some statements that assures the audience that this under-prediction is not alarming and why.

Below are specific comments and recommendations for each section.

Section 2.0 METOCEAN DATA

In section 2.3 (precipitation) and in Figure 13, the record analyzed or plotted in not reported. Similarly, it is important to use an appropriate length or period for the scenario simulations unless wet/dry years are part of the simulation matrix.

In section 2.4 (River Discharge) please revise captions for Figures 15-17, to day …….statistics of daily ***discharge*** data…

In Figure 17, station 02108000 it appears that the maximum discharge occurring in September does not coincide with the sept tick mark. This is perhaps of the way the averaging was performed, but other months seem to coincide.

In figure 19 water levels (tides) are shown for a period of ~5 days. Are these the only available data? It would be interesting to see if available the entire spring-neap cycle, because there is obvious asymmetry variation in the 5 days shown. Also, are these spring tides? From figure 20, the velocity magnitude data suggest that 3/28-3/30 was spring tides, but it is suggested to report it.

In figures 21-22, how close are the U and V components to the channel alignment/azimuth. I am assuming that U is easting velocity and v is northing velocity. It would be interesting to report, and perhaps use the streamwise velocity in the model calibration.

Figures 27 and 28 show a good flow balance from the synoptic ADCP surveys. At junction where transects TR4-5-6 were conducted it appears that the full flood and ebb cycles were captures and that is significant. Similar nearly complete cycles are present at transects TR7-9-10.

In section 4.2.1 (tidal boundary conditions) memo reports tidal extraction from Egbert et al., 1994 and Erofeeva, 2002 at several locations that fall within proximity of the model boundary to drive the model. The memo states the use of Neumann at the north and west boundaries, and tidal constituents at the other two east and south boundaries. However, it is not clear if there is phase and amplitude variation forced on these two tidal boundaries, assuming significant variation exists.

In section 4.2.3 equation 1 is used to scale the ungauged streams by a proportional term derived from the gauged streams. However, the report does not specify how many ungauged streams were used as part of the model boundary conditions. For instance, scaling ungauged streams with a smaller or larger gauged stream watershed area may yield different result. Perhaps explain if more than one calculations were performed, and an averaged was used, if that one-point scaling was performed due to lack of gauged stream data.

In section 5.2 (model configuration) the memo states that river discharge was one of forcings in the model. Analysis shown in Table 5 shows that 15min and daily data are available. Was the 15 min discharge used during calibration?

The last sentence in the same section states that the bottom roughness was the main calibration parameter, and that a variable roughness was used. I suggest referencing the range of values used and how those values were selected.

In section 5.3 (calibration and validation) on third paragraph page 48 there is mention of velocity comparisons between the model and observations not compared at the same time-step because of velocity phase differences. This point is not very clear. Do the authors mean that the model output frequency is different from the frequency of available velocity data or available at different intervals? This is my interpretation and it is fine, but the approach is not clear.

In the following paragraph were validation is discussed, the authors mention that during hurricane Mathew the model was forced with astronomical tides and superimposed measured water level. It is not clear how this was accomplished. Wouldn't the measured water level already contain both the tidal and sub-tidal signal (storm surge)? Where astronomical tides added? Please clarify. Regardless, I agree that the model re-produced Hurricane Matthew very well.

Within Figures 40 through 44 statistical metrics are presented that show model skill. The methodology for

comparing a continuous (model) with a dis-continuous signal (observations) is not very clear.

CHLLC-M003 May 7, 2018

MEMO

To: Jeff Shelden, PE

From: Ioannis Y. Georgiou, PhD, PG, Coastal Hydrodynamics LLC

Re: Channel Deepening Feasibility Study and EIS, Cape Fear River, NC (Wave Modeling)

This Memo summarizes peer review comments for the Wave Modeling Memo, prepared by Moffatt and Nichol (M&N) for the North Carolina Ports as it relates to the Channel Deepening Feasibility Study and EIS for the Cape Fear River, North Caroline (NC). The Wave Modeling Memo outlines the approach for conducting wave modeling, data use for initial and boundary conditions, the calibration and validation of the model, and a basic interpretation of the results. No scenarios are tested or shown in this Memo.

Overall comments: The wave modeling calibration and validation is sufficient, and the memo provides a thorough assessment of the model skill, and on occasions where there is departure from observed conditions, an explanation, along with sufficient information to support that explanation are always offered.

Below are specific comments and recommendations for each section.

2.0 Model Development (bathymetry)

Figure 2 shows the overall (composite) bathymetry used in the offshore modeling. Perhaps, since Table 1 shows that some datasets at approximately 10 years apart, reference that most recently available bathymetry was selected where available. Although implied it is not explicitly stated.

Introduction

The length and detail of the introduction section is appropriate, no further questions of recommendations are present.

3.0 Model calibration

Section 3.2.3 water levels – in the first paragraph, NOAA station number 8658163 is not shown on a map or figure. The paragraph ends with a statement cautioning the use of the gauge at Wrightsville, NC. The paragraph ends abruptly without providing a resolution on the use of this gauge. Was it/was not used? Figure 6 shows a time-series and a low pass filter of the same gauge. Please clarify.

3.3 model calibration results

On page 8 the metrics equations are used without any citations. This is not that big an issue because they are commonly used, but could be beneficial to the reader.

Calibration for the waves (tables 4-6) appears to be robust, with the exception of the peak direction. MAE seems ok, within the directional spreading threshold, but RMS for one or two stations appears to be higher. I see that in the next paragraph an explanation if offered, and further analysis shows that two wave systems are operating at these locations. After inspection of Figure 10, it is obvious that the model slightly overestimates the big(gger) events at Oaklsland and OCP1 stations.

On pg 16 the report details additional analysis that appears to have improved the predictions which is great. It would be interesting to know if this improvement changed the breaker angle, or location of breaking wave energy to highlight whether small disagreement offshore yield different results nearshore.

4.1.3 water levels – it is not clear in this section how many boundaries are open (1 or all 3?), and are waves and water levels applied as constant (in space) at all boundaries. I am sure this does not affect the calibration results, but it's recommended to add in the report.

On pg 22 it seems that the Oak Island ADCP continues to be an issue. I agree with authors that it is possible that the deployment depth possibly is different to the one reported. Figure 21 documents that further. Although not a terribly important point, since some improvement was similarly achieved with similar analysis performed during the calibration, I have the following concern. The orientation of the coast is such that a RMS or MAE of 15-20 degrees could significantly change the net longshore transport pattern if the dominant direction and density has a southeasterly component. The memo does not show long-term wind/wave roses from these deployments of the offshore to establish the connection, so I recommend some caution when performing the shoreline morphology analysis and calibration therein.

Summary and conclusions

In the summary and conclusions where the suggestion of changes in bathymetry being partly the reason for the small disagreement between model predictions and observations appears sufficient; however, a statement as to how the improvement (performed during both calibration and validation) improved local waves along the coast may help strengthen the argument and ensure model robustness.

CHLLC-M002 May 7, 2018

MEMO

To: Jeff Shelden, PE

From: Ioannis Y. Georgiou, PhD, PG, Coastal Hydrodynamics LLC

Re: Channel Deepening Feasibility Study and EIS, Cape Fear River, NC (Modeling Framework)

This Memo summarizes peer review comments for the Modeling Framework report, prepared by Moffatt and Nichol (M&N) for the North Carolina Ports as it relates to the Channel Deepening Feasibility Study and EIS for the Cape Fear River, North Caroline (NC). The modeling framework outlines the modeling procedures, selection of models, data collected and/or analyzed and other related analysis as part of the overall components of the study.

Overall comments: The modeling framework report provides essential and often sufficient detail in most sections. .

Below are specific comments and recommendations for each section.

Executive Summary

The proposed modeling framework has adequate models to address issues raised by the port, and of concern to an environmental impact assessment resulting from project construction. The selection of the Delft3D suite is sound, as this modeling suite has several advantages including being in the public domain, but also in terms of capability. The couplings and feedbacks suggested in the framework are appropriate choices, including the Louisiana Coastal Master Plan module for wetland morphology. One question I have is whether the wetland morphology module is available to the public (e.g. the source code) or if this something that M&N coded internally for this effort. Furthermore, would this be applied on a spatially explicit scale (e.g. the model domain) and at what frequency (i.e. annually or other?). Some statements to establish this in the methods would suffice.

The second paragraph of the summary discusses existing meteorological and oceanographic data used to calibrate and validate the models, and the modeling framework states water quality modeling will take

place, yet there is no mention of temperature in this paragraph which is needed for water quality modeling. Perhaps this was an omission.

Introduction

The length and detail of the introduction section is appropriate, no further questions of recommendations are present. One small formatting suggestion is to move section 1.2 on page 11 to the next page.

Metocean data collection

In the third paragraph, and occasionally other parts of the document there is mention to "calibration and validation", but in this instance, there is mention to "calibration and verification". It is recommended using calibration and validation, rather than verification for consistency.

At the end of section 2, before section 2,1 there is reference to collected data. It is not clear if the data is new, in addition to previously existing historical data.

Section 2.2.2 hindcast data; it is suggested to show these stations on fig 2.2; while NOAA stations referenced in table 2.2 are shown, the USACE stations are not shown.

Section 2.4 – river discharge; in the second paragraph, the tidal limit is reported to be around this station. I trust that this is ok as long as the evaluation was done during low runoff/discharge flows. Please clarify.

On Pg 20 there is mention of estimating ungauged watershed discharge for areas a,b,c but the report does not detail ow, or reference a method (ie cite) that will be used to estimate the runoff volume.

Section 2.6 salinity – there is mention of the STORE WQX database or data. Please use full name before acronym.

Figure 2.7 the stations within the estuary seem a little cluttered – not a problem in particular but a zoom insert could solve that.

Section 2.8 precipitation and evaporation; while average evaporation for the state is referenced, evaporation over the project region is unknown, and the authors state that analytical methods will be used. A reference as to the method used would be appropriate here.

2.9 bathymetry and topography; please define or cite C-MAP by Jeppesen.

Also, the further bullet in this section there is reference to the ADCIRC grid data for the upstream river channels and wetlands; is there a format citation for that effort?

Section 2.1 – reference to McKim and Creed does not have a year.

Section 2.13 – water control structures; there is no mention of a schedule for the control structures. Is that something that could vary significantly, will this be address in the model? Ie are there control structure operations during some of the scenarios where it could impact the estuary?

Section 3.0 review and analysis of numerical models

The description and the advantages and disadvantages for each model are sufficiently detailed and not exhaustively detailed, which I imagine was the intent. My general recommendation is to try to include a citation where a disadvantage is reference, because it strengthens the argument/statement. I am not concerned with presence of absence of a GUI which is obvious and straight forward, but other that arise from M&N experience, or that resulted or derived from M&N application in other studies. It's beneficial for the audience to see that.

Section 3.3.1 model setup at the end of tidal BC on pg 54, ….tidal constituents at the offshore boundaries may require adjustment. Do the authors mean adjusting the BC until internal WL are obtained? Please clarify.

Initial conditions: same pg 54, reference to a "short spin up" without any reference. What is short, and how is it determined for this system? It's important for the system to reach dynamic equilibrium before any analysis is performed on the results.

Section 4.3.3 evaluations of alternatives; third paragraph pg 55, reference to storms that will be selected based on analysis of NOAA tide station and historical data. Perhaps elaborate on the requirements, or objectives when establishing those storms.

Section 4.5 analysis for the morphological model – there is reference to dredging record analysis to determine historical sedimentation rates and use in the calibration. While I understand how this is done, perhaps a more detailed analysis methodology is needed. This should definitely be included in the sediment transport memo, and optional if authors make the modification for this memo.

Section 4.5.3 evaluation of alternatives – seasonal (6 mo) simulations and additionally a few storm scenarios (How many storms?). Also, it is stated here that the primary output of interest from this model is the shoaling and erosion rates, identifying the maintenance dredging required for each scenario. Is maintenance dredging the only interest? The other question I have is weather fine-grain sedimentation/erosion patterns would change within the estuary relative to the base condition or during storms with a deeper channel in place. Lastly, is the 6 month window adequate to assess that? Can that have feedbacks to water quality?

Section 4.6.2 model calibration – it is not obvious in the memo what period and for how many years the calibration will take place for the shoreline model.

Section 4.8.3 evaluation of alternatives – a couple of questions regarding the duration of the simulations. Is there a concern or interest to understand and simulate the transition for high to low flow, or vise versa as part of the analysis? What are the potential water quality concerns beyond the 6 month window. Is it not clear in the framework whether a synthesis will be produced to bring all the results together, or if any adaptive modeling strategies will be followed? If everything works out that's great, but often results maybe difficult to discern, generating additional work and possibly triggering an approach that may require a few simulations to be longer than anticipated. Are any such plans

considered?

5 OASACW and USACEHQ Concurrent Policy Review Assessment

Wilmington Harbor Navigation Improvement Project
Section 203 Feasibility Study/Environmental Report, dated June 2019

Policy Review Assessment – July 2019

Review Assessment
A concurrent review was conducted by the Office of the Secretary of the Army for Civil Works (OASACW) and the Headquarters, US Army Corps of Engineers (USACE) staff. This review was conducted to determine whether the study and the process under which the study was developed, each comply with Federal laws and regulations; a determination of whether the project is feasible; and identification of any conditions that the Secretary may require for construction of the project. Specific comments on the report are included as below. In summary, the report would need significant revisions before it would be considered to be legally and policy sufficient. Significant review comments were identified, which could preclude the Secretary from making a positive determination of project feasibility in accordance with section 203 of the Water Resources Development Act (WRDA) of 1986, as amended. Issues identified during the review pertain to plan formulation, project economics, evaluation of sea level change, and completeness of the National Environmental Policy Act (NEPA) documentation.

A back check of the responses was conducted as significant policy issues remain, particularly without the context of a revised draft report.

A. Plan Formulation

1. Objectives

Concern: As written, the planning objectives are unclear and could potentially lead to the pre-selection of an alternative plan. The first two objectives, "reduce access restrictions and accommodate efficient loading," do not identify the effect desired, which is used to measure and compare alternatives. Typically, objectives for deep draft navigation studies would have an effect to reduce the transportation costs, which would then result in cost reduction benefits as noted in ER 1105-2-100. In this instance, the objectives are not linked to a method to analyze beneficial contributions to national economic development. The third objective, "Maintain the Port of Wilmington as a port-of-call for USEC-Asia services from 2027-2076," seems to be a corporate objective rather than a planning objective. As written, it is not quantifiable or measureable against other plans, and seems to have been used to eliminate potential measures or alternatives that include light loading by establishing a minimum depth for the deepening alternatives.

Basis of Concern: ER 1105-2-100, Section 2-3.a.(4) indicates: Objectives must be clearly defined and provide information on the effect desired (quantified, if possible), the subject of the objective (what will be changed by accomplishing the objective), the location where the expected result will occur, the timing of the effect (when would the effect occur) and the duration of the effect. Additionally, ER 1105-2-100, Section 2-3.c.(1) indicates that "alternative plans shall be formulated to identify specific ways to achieve planning objectives within constraints, so as to solve the problems and realize the opportunities that were identified in Step1." In this instance, as the objectives were not correctly written, the planning process and selection of a plan would be inherently flawed.

Significance of Concern: *High, as it seems that depths between 42' and 46' were eliminated from consideration due to flawed objectives.*

Action Needed to Resolve the Concern: Revise the objectives to be policy compliant and conduct a new iteration of plan formulation and evaluation.

Sponsor Response:

Path to resolution:
Present reviewer with alternative set of objectives, such as:

- Reduce origin-to-destination transportation costs;
- Improve the navigability of the channel for the existing and projected future fleet; and
- Develop an environmentally acceptable and sustainable alternative.

Objectives have been revised as presented below and used in a revised plan formulation and evaluation.

4.3.1 Planning Objectives

In addition to the Federal objective, project-specific planning objectives have been identified, and these objectives guided the plan formulation process in this study. Objectives must be clearly defined and provide information on:

- the effect desired (quantified, if possible);
- what will be changed by accomplishing the objective;
- the location where the expected result will occur, and
- the timing of the effect (when would the effect occur) and the duration of the effect.

Based on the problems posed by channel dimensions and the opportunities available through channel improvements (as detailed in Sections 4.1 and 4.2), the following planning objectives have been established to assist in the development of management measures and evaluation of alternative plans:

Objective 1: Reduce origin to destination transportation costs at the Port of Wilmington and contribute to NED from 2027 to 2076.

Objective 2: Reduce navigation restrictions to the Port of Wilmington for the projected future fleet from 2027 to 2076.

Objective 3: Develop an alternative for navigation improvements that is environmentally acceptable and sustainable from 2027 to 2076.

Review Assessment: Without a revised report, it is not possible to evaluate the revised objectives due to the lack of context; however, observations can be made just be reviewing the draft response. The objectives, while improved, are still not sufficient in regard to policy. Objective 2 does not indicate what would be changed by accomplishing the objective. Objective Number 3, develop an alternative, is a study task blended with a constraint.

Action Taken: Planning Objectives have been revised in Section 5.3.1 Planning Objectives of the Main Report. The revised planning objectives are also copied below:

Consistent with the Federal objective identified in Section 4.3 Federal Objective, project-specific planning objectives have been identified, and these objectives guided the plan formulation process in this study. Planning objectives must be clearly defined and provide information on:

- the effect desired (quantified, if possible);
- what will be changed by accomplishing the objective;
- the location where the expected result will occur; and
- the timing of the effect (when would the effect occur) and the duration of the effect.

Based on the problems posed by channel dimensions and the opportunities available through channel improvements (as detailed in Sections 4.1 and 4.2), the following planning objectives have been established to assist in the development of management measures and evaluation of alternative plans:

Planning Objective 1: Contribute to NED by reducing origin to destination transportation costs, at the Port of Wilmington from 2027 to 2076;

Planning Objective 2: Contribute to NED by reducing trucking miles and trucking costs for the Port of Wilmington's hinterland cargo, from 2027 to 2076; and

Planning Objective 3: Contribute to NED by reducing waterborne transportation costs at the Wilmington Harbor Federal navigation project by accommodating the transit of larger and more efficient vessels, from 2027 to 2076.

2. Screening Criteria

Concern: Section 5.2. Pages 128.-130. Many of the criteria that are listed are unnecessary and could potentially eliminate solutions for the identified problems. The criteria that were listed, technical, economic, environmental, social, etc., should actually be used to establish assumptions for projecting the planning setting in the future with project settings; however, in this instance, by using these elements incorrectly as screening criteria, it seems that the plan formulation and evaluation process may have been unnecessarily restricted. Additionally, some of the elements, such as "the selected plan should be consistent with local, regional, and state goals for water resources development," are not required for USACE Civil Works projects.

Basis of Concern: ER 1105-2-100, E-10.c.(3)(b) indicates that the planner should "specify the significant technical, economic, environmental, social and other elements of the planning setting to be projected over the period of analysis. Also, the planner should "discuss the rationale for selecting these elements."

Significance of Concern: *Medium, as improper utilization of these criteria could have affected the formulation and evaluation of measures/alternatives.*

Action Needed to Resolve the Concern: Correctly utilize these criteria in the future project condition and eliminate any screening criteria that may errantly or artificially constrain the planning process. Review the study plan formulation to ensure that potential measures and/or alternatives were not errantly eliminated from consideration.

Path to resolution: Present reviewer with revised set of screening criteria. Use the standard four criteria from the P&G: Completeness, effectiveness, efficiency, and acceptability.

Response: Text has been revised to focus on the four primary criteria.

5.2 Plan Formulation and Screening Criteria

Management measures were identified and evaluated in the development of alternative plans that address the problems of navigation restrictions and increased transportation costs in the without-project condition. Management measures were evaluated with respect to their ability to meet the planning objectives based on the four general criteria for plan formulation that are identified in the Principles and Guidelines (1983):

- Completeness: does the alternative provide and account for all necessary investments or actions to ensure the realization of the planning objectives;
- Effectiveness: does the alternative contribute to achieving the planning objectives;
- Efficiency: is the alternative the most cost-effective means of addressing the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment; and
- Acceptability: is the alternative plan acceptable in terms of applicable laws, regulations, and policies.

Review Assessment: Without the context of a revised draft report, it is not possible to make any conclusions in regard to the response.

Action Taken: Screening criteria have been revised. The revised criteria are presented in section 6.2.1 Management Measures Screening of the Main Report and copied below:

Management measures were evaluated with respect to their ability to meet the planning objectives based on the four general criteria for plan formulation that are identified in the Principles and Guidelines (1983):

- Completeness: does the alternative provide and account for all necessary investments or actions to ensure the realization of the planning objectives;
- Effectiveness: does the alternative contribute to achieving the planning objectives;

- Efficiency: is the alternative the most cost-effective means of addressing the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment; and
- Acceptability: is the alternative plan acceptable in terms of applicable laws, regulations, and policies.

Each measure was screened to determine if the measure should be retained for further, more detailed, evaluation. Screening was based on each measure's ability to perform based on the metrics identified below. Note that none of the measures in question would be able to realize all the planning objectives and therefore a completeness metric was not developed. The management measures advanced for more detailed evaluation would be combined into preliminary alternatives prior to additional evaluation.

Effectiveness Metrics

- Potential to meet planning objectives
  - 1 indicates the measure is very unlikely to support meeting the planning objectives
  - 3 indicates the measure is very likely to support meeting the planning objectives
- Magnitude of transportation cost savings
  - 1 indicates the measure is very unlikely to generate transportation cost savings
  - 3 indicates the measure is very likely to generate transportation cost savings

Efficiency Metrics

- Preliminary costs
  - 1 indicates that the costs of implementing the measure are likely to be very high compared to other measures
  - 3 indicates that the costs of implementing the measure are likely to be very low compared to other measures
- Preliminary benefits
  - 1 indicates that the preliminary benefits of the measure are likely to be very low
  - 3 indicates that the preliminary benefits of the measure are likely to be very high
- Preliminary net benefits
  - 1 indicates that the preliminary net benefits of the measure are likely to be very low
  - 3 indicates that the preliminary net benefits of the measure are likely to be very high

Technical Feasibility Metrics

- Technically feasible
  - 1 indicates that the technical requirements of the measure would make it very difficult to implement
  - 3 indicates that the technical requirements of the measure are commonly implemented in the industry and there are no foreseen difficulties with implementation at Wilmington Harbor

Acceptability Metrics

- Environmental impact
  - 1 indicates that the measure will likely have an environmental impact that will require extreme mitigation measures
  - 3 indicates that the measure will likely have an environmental impact that can be mitigated using common mitigation practices
- Meets applicable laws and regulations
  - 1 indicates that the measure will very likely not meet applicable laws and regulations
  - 3 indicates that the measure will very likely meet applicable laws and regulations

3. Screening of Measures

Concern: The screening of measures for the study is flawed. According to Table 5-1 on page 134, a stepped channel would meet all 3 project objectives; however, the measure was then eliminated from consideration. Additionally, the Table indicates tidal advantage is carried forward even though it does not meet the third objective. What is the criteria for retaining measures? Do they need to meet all 3 of the objectives, or just one? This issue is related to the non-compliant study objectives as mentioned previously.

Basis of Concern: ER 1105-2-100, Section 2-3.d.(2) indicates the following: "Criteria to evaluate the alternative plans include all significant resources, outputs and plan effects. They also include contributions to the Federal objective, the study planning objectives, compliance with environmental protection requirements, the P&G's four evaluation criteria (completeness, effectiveness, efficiency and acceptability) and other criteria deemed significant by participating stakeholders."

Significance of Concern: *Medium, as the study plan formulation may not include all reasonable alternatives.*

Action Needed to Resolve the Concern: After revision of the project objectives, conduct a new iteration of the formulation and screening of management measures.

Path to resolution: Revise formulation and screening based on revised objectives and criteria; provide more explanation as to why stepped channel doesn't work.

Response: The following table has replaced the preliminary screening table

Table 5-1

Preliminary Screening

Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Channel Deepening	Incomplete, may be combined with channel widening and berth deepening to fully realize planning objectives	Effective when combined with berth deepening	Efficient	Acceptable	Meets the primary planning objective and the NEPA purpose and need	Yes	
Stepped Channel	Incomplete	Ineffective	A stepped channel does not realize the planning objectives	Acceptable	Containerships use the full channel depth inbound and outbound, so deepening only for one direction would not address restrictions in the other direction	No	Only reduces restrictions in one direction. Both directions need reduced restrictions.

Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Turning Basin	Incomplete	Ineffective	Increasing the turning basin dimensions to more than the currently permitted basin does not realize the planning objectives	Acceptable	The turning basin as currently permitted supports the primary planning objective and NEPA purpose and need	No	Increasing the turning basin dimensions to more than the currently permitted basin is unnecessary to realize the primary planning objective and the NEPA purpose and need
Anchorage basin	Incomplete	Ineffective	Increasing the anchorage basin dimensions does not realize the planning objectives	Acceptable	The turning basin is located within the anchorage basin. Increasing the anchorage function is not needed	No	Increasing the anchorage basin dimensions does not contribute to realizing the primary planning objective and the NEPA purpose and need
Channel widening to reduce navigation restrictions	Incomplete but may be combined with channel and berth deepening to	Effective	Efficient	Acceptable	Channel widening is required for the design vessel to regularly use the channel	Yes	

Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
	achieve planning objectives						
Channel widening to accommodate vessel meeting	Incomplete but may be combined with channel and berth deepening to achieve planning objectives	Effective	Inefficient	Acceptable	Meeting of the design vessel and another post-panamax vessel is projected to occur infrequently	No	The benefits of building a meeting area for two post-panamax vessels would be less than the cost of construction and maintain the meeting area

Non-Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Reduce vessel speed	Incomplete	Ineffective	Inefficient	Acceptable	Vessel speed often cannot be reduced due to the need to maintain maneuverability and to reduce crabbing in the channel	No	Reducing vessel speed does not contribute to realizing the primary planning objective and the NEPA purpose and need
Additional tug assistance	Incomplete	Ineffective	Inefficient	Acceptable	Additional tugs are included in		Additional tug assistance does not

Non-Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
					the without and with-project conditions as required for the design vessel		contribute to realizing the primary planning objective and the NEPA purpose and need
Relocate aids to navigation	Incomplete but can be a component of channel widening.	Effective in some channel reaches	Relocating aids to navigation can be a very efficient way to widen the channel	Acceptable, but must be approved by USCG	There are channel reaches in the Entrance Channel and at Bald Head where deeper water is adjacent to the existing channel	Yes	
Tidal advantage	Incomplete	Effective	Efficient	Acceptable	Use of tidal advantage is an existing practice that is projected to be used in the without and with-project condition	Yes	

Non-Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Lightering	Incomplete	Ineffective	Inefficient	Unacceptable	Lightering containerships at sea is potentially dangerous and not practiced. Lightering other types of vessels is unnecessary because they are not restricted by existing channel conditions	No	Lightering does not contribute to realizing the primary planning objective and the NEPA purpose and need

Local service facility Improvements	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out

Local service facility Improvements	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Container Terminal Improvements	Incomplete. Must be combined with channel improvements and berth deepening	Ineffective	Inefficient	Acceptable	Terminal improvements have been completed, which are sufficient for the design vessel and planned improvements are sufficient for projected commodity flow	No	Terminal improvements beyond recently completed improvements and planned future improvements do not contribute to realizing the primary planning objective and the NEPA purpose and need
Relocate cargo terminals	Incomplete. Must be combined with channel improvements and berth deepening	Effective	Inefficient	Unacceptable	Development of a new container terminal at Southport was investigated prior to this study and it was determined to be prohibitively expensive and environmentally damaging	No	The construction cost and environmental degradation associated with a new terminal make the measure infeasible

Local service facility Improvements	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Berth Deepening	Incomplete but must be combined with channel deepening to achieve planning objectives	Effective	Efficient	Acceptable	Berth deepening is necessary for the realization of channel deepening benefits	Yes	
Bulk Terminal Improvements	Incomplete	Ineffective	Inefficient	Acceptable	Bulk vessels are not restricted under the without-project condition	No	Bulk terminal improvements do not contribute to realizing the primary objective or the NEPA purpose and need
Breakbulk/General Cargo Improvements	Incomplete	Ineffective	Inefficient	Acceptable	Breakbulk and general cargo vessels are not restricted under the without-project conditions		Breakbulk and general cargo terminal improvements do not contribute to realizing the primary objective or the NEPA purpose and need

Review Assessment: The analysis remains flawed. A measure, by definition, is not an alternative and should not outright be judged as incomplete. Although it is possible for a stand-alone measure to function as an alternative, measures such as deepening should not be deemed "incomplete" because they have not been combined with other measures to form an alternative.

Also, what is the criteria for retaining a measure or eliminating one? Some have been deemed incomplete, but were retained. Others were deemed incomplete, and were carried forward. In other cases, it seems that the P&G Criteria didn't matter as a measure was screened for infeasibility or cost. The report should be reviewed to ensure that all parts of the measure formulation and evaluation are consistent with federal policy.

Action Taken: The screening of measures has been revised in section 6.2.1 Management Measures Screening of the Main Report. The revised screening criteria are presented in the response to comment #3 above. The revised screening is presented in Table 6-1 Preliminary Screening of the Main Report and copied below:

Table 6-1 Preliminary Screening

Non-Structural Measures	Effectiveness	Efficiency	Technical Feasibility	Acceptability	Total	Retained
Reduce vessel speed	1	1	2	3	7	No
Additional tug assistance	1	1	2	3	7	No
Relocate aids to navigation	1	1	3	2	7	No
Tidal advantage	2	3	3	3	11	Yes
Lightering	1	1	1	1	4	No
Structural Measures	**Effectiveness**	**Efficiency**	**Technical Feasibility**	**Acceptability**	**Total**	**Retained**
Channel deepening	3	3	3	2	11	Yes
Stepped channel	1	1	3	2	7	No
Turning basin expansion	1	1	3	1	6	No
Turning basin deepening	3	3	3	2	11	Yes
Anchorage basin	1	1	3	2	7	No
Channel widening to reduce	3	3	3	2	11	Yes

navigation restrictions						
Channel widening to accommodate vessel meeting	1	1	3	2	7	No

Local Service Facility Improvements	Effectiveness	Efficiency	Technical Feasibility	Acceptability	Total	Retained
Container terminal improvements	1	1	3	2	7	No
Relocate cargo terminals	1	1	3	1	6	No
Berth deepening	3	3	3	3	12	Yes
Bulk terminal improvements	1	1	3	2	7	No
Breakbulk/General cargo improvements	1	1	3	2	7	No

Text describing the screening is presented in the following Main Report sections:

- 6.2.2 Non-Structural Measures
- 6.2.3 Structural Measures, and
- 6.2.4 Local Service Facility Improvements.

4. Assumptions/FWOP Condition

Concern: The report indicates that the vessels for USEC-Asia services would not call on the port in the future without project condition due to the high cost of light loading; however, no documentation from the shipping companies has been provided to support this project assumption, which has in turn been used to eliminate full examination of alternatives. As noted in ER 1105-2-100, Section E-10.c.(1)(a), basic assumptions for all studies are non-structural measures within the authority and ability of port agencies, other public agencies, and the transportation industry.

Basis of Concern: ER 1105-2-100, Appendix E, Section E-10.c.(1) indicates the following: "Assumptions specific to the study should be stated and supported."

Significance of Concern: *High, as the project assumptions/future without project conditions significantly affect the plan formulation and selection of a plan.*

Action Needed to Resolve the Concern: Fully document all assumptions for the study, providing letters or agreements where necessary to evidence conclusions. All assumptions, data, and other information must be specific to the current study and the port of Wilmington, unless it is clear that utilization of data or information from other studies will provide identical conclusions.

Path to resolution: present list of assumptions & discuss substantiation of each assumption. Assumptions:

- Turning basin complete;
- Duke wires raised;
- USEC port depths – Economics Appendix Section 2.3 & Economics Appendix Table 2-1;
- fleet shift to PPX3 (design vessel) – Economics Appendix Section 1.8.2; and
- design vessel by-pass Wilmington – Economics Section 2-3 & Economics Appendix Table 2-2;

HQ: Upgrade emphasis on terminal upgrades – ready for design vessel

Sponsor Response:

Text has been revised to include the following discussion of assumptions:

4.5 Study Assumptions

There are five assumptions that are integral to the problems and opportunities identified in this study:

1. Container terminal improvements currently under construction or in the design phase, including the turning basin expansion, will be completed to allow the design vessel and future cargo to use the terminal;
2. Federal channel deepening projects currently under construction at Savannah, Charleston, Boston, and Jacksonville will be completed and maintained to project depth, which will allow vessels to operate at the drafts required to realize the transportation cost savings calculated for those projects;
3. The future fleet for the two Asia services is represented by the design vessel;
4. Under without-project conditions, channel depth constraints, draft restrictions, and the resulting light loading of the design vessel for the two Asia services will cause the two Asia services to drop Wilmington as a port-of-call; and
5. Under with-project conditions, deeper channel depths at Wilmington will increase vessel operating drafts, reduce light loading, and increase vessel operating efficiency allowing the two Asia services to include Wilmington as a port-of-call.

Assumption 1 is substantiated by the ongoing construction and continuous funding for the terminal improvements as described in Section 2.26.1 Existing Conditions: Container Terminal and section 3.2.1 Future Without-project Conditions: Container Terminal. These without-project condition terminal improvements enhance terminal operations and efficiency regardless of improvements to the federal channel. The NCSPA is currently realizing benefits of larger and faster cranes, improved mooring facilities, and yard configuration. Planned future improvements will further increase the efficiency of cargo flow at the terminal.

Assumption 2 is substantiated by work plan construction funding that has been allocated to each of these authorized projects over the years. It is highly unlikely that projects with a history of work plan construction funding would not be completed and maintained as authorized.

Assumption 3 is substantiated by historical trends in the size of vessels transiting the Panama Canal (Section 2.28.2 Existing Containership Fleet and Tables 2-38 through 2-40) which indicates that prior to the expansion of the Panama Canal, 99% of containerships on the major Asia-USEC routes were Panamax vessels and after the expansion in 2015, vessels on these services are trending towards the neo-Panamax vessels (PPX3Max).

The shift towards PPX3 Max vessels on the two Asia services in question is also supported by the historical trend in carriers reducing the transportation cost per TEU by shifting to larger more efficient vessels. Tables 2-35 and 2-36 show the decrease in transportation cost per TEU and show how the fleet is adding predominantly larger and more efficient vessels.
The shift to PPX3Max vessels on the two services is further substantiated by statements by the carriers indicating that economic forces are driving them to use PPX3Max vessels on these two services when the USEC ports are able to handle them in an efficient manner and on a regular schedule (See Attachment X to the Economics Appendix).

The risk and uncertainty associated with Assumption 3 is addressed in a sensitivity analysis in which, one of the services remains a PPX3 vessel and the second service shifts to the PPX3Max vessel.

Assumption 4 is substantiated by the enormity of the inefficiency of having vessels light-loaded on 82% of calls and light-loaded by as much as seven feet. The vessel loading cumulative distribution functions developed for the design vessel used in the Charleston Post-45 Study, which is the same design vessel used for this study, were used to compare weighted average waterborne transportation cost per TEU per 1,000 nautical miles and also to compare the weighted average number of TEUs on board per vessel call. The draft restrictions imposed by the without-project condition channel depth at Wilmington increases the waterborne cost by 40% per TEU per 1,000 miles. The weighted average number of TEUs on board at Wilmington under without-project conditions is 2,605 TEUs fewer than the weighted average number of TEUs for the same vessel at Charleston or Savannah. Over the course of a single year, the two services would leave a combined 271,000 TEUs at the docks due to draft restrictions at Wilmington, which also affects the departure draft at the prior port and the arrival draft at the next port. It would take an additional 38 trips per year (under without-project draft restrictions), just to get this cargo to its destinations. It is economically infeasible for the design vessel to regularly call at Wilmington under without-project conditions.

The Economics Appendix Section XX displays the calculations used to support Assumption 4. The risk and uncertainty associated with this assumption is addressed in a sensitivity analysis in which the design vessel calls at Wilmington in the without-project condition.

Assumption 5, PPX3Max vessels on the two services in question will call at Wilmington under with-project conditions, is substantiated by historical precedent and economic rationality. Under existing conditions, channel depths at other USEC ports are very similar to Wilmington's depth (Table 3-1 Existing and Future USEC Port Depths) and vessel draft restrictions at these same ports are very similar to draft restrictions at Wilmington. Under existing conditions, the USEC ports-of-call for the two services in question can service the existing fleet with similar vessel loads and operating costs per TEU (Table 3-2 Waterborne Transportation Costs for Selected Vessel Drafts). Over many years under these historical conditions, Wilmington has developed a longstanding relationship with the carriers on these two services and managed to substantially increase the amount of cargo handled for these two services (New Table: Asia services TEUs over time). Under with-project conditions, channel depth and draft restrictions at the other USEC ports would again be similar to those at Wilmington (Table 3-2 Again with load per foot). Vessel loading and operating costs per TEU at the other USEC ports would also be similar to those at Wilmington (Revised Table 5-5). If future with-project operating and economic conditions are comparable to existing operating and economic conditions, then it is reasonable to assume that the two services would continue to call at Wilmington. The carriers have indicated that they would stay in Wilmington if the channel were deeper or return to Wilmington if the channel were deepened in the future.

Review Assessment: Without the context of a revised draft report and given the risk and uncertainty associated with the assumptions, it is recommended that additional effort be placed on improving the documentation of all study assumptions with supporting analysis.

Action Taken: Revised study assumptions may be found in section 5.5 Study Assumptions of the Main Report and copied below. In addition, the reviewer is directed to Attachment II of the Economics Appendix, which contains letters from six carriers on the two services in question supporting the basic without-project condition assumption that their vessels will not regularly call at the Port of Wilmington without-channel improvements.

There are five assumptions that are integral to the problems and opportunities identified in this study:
1. Container terminal improvements currently under construction or in the design phase, including the turning basin expansion, will be completed to allow the design vessel and future cargo to use the terminal;
2. Federal channel deepening projects currently under construction at Savannah, Charleston, Boston, and Jacksonville will be completed and maintained to project depth, which will allow vessels to operate at the drafts required to realize the transportation cost savings calculated for those projects;
3. The future fleet for the two Asia services currently calling at the Port of Wilmington is represented by the design vessel;
4. Under without-project conditions, channel depth constraints, draft restrictions, and the resulting light loading of the design vessel for the two Asia services will cause the two Asia services to drop Wilmington as a port-of-call prior to the base-year of the project (2027); and
5. Under with-project conditions, deeper channel depths at Wilmington will increase vessel operating drafts, reduce light loading, and increase vessel operating efficiency inducing the two Asia services to include Wilmington as a port-of-call.

Assumption 1 is substantiated by the ongoing construction and continuous funding for the terminal improvements as described in Section 2.26.1 Existing Conditions: Container Terminal and section 3.2.1 Future Without-project Conditions: Container Terminal. These without-project condition terminal improvements enhance terminal operations and efficiency regardless of improvements to the federal channel. The NCSPA is currently realizing benefits of larger and faster cranes, improved mooring facilities, and yard configuration. Planned future improvements will further increase the efficiency of cargo flow at the terminal.

Assumption 2 is substantiated by work plan construction funding that has been allocated to each of these authorized projects over the years. It is highly unlikely that projects with a history of work plan construction funding would not be completed and maintained as authorized.

Assumption 3 is substantiated by historical trends in the size of vessels transiting the Panama Canal (Section 2.5.2 Existing Containership Fleet and Tables 2-15 through 2-18) which indicates that prior to the expansion of the Panama Canal, 99% of containerships on the major Asia-USEC routes were Panamax vessels and after the expansion in 2015, vessels on these services are trending towards the neo-Panamax vessels (PPX3Max). This assumption is further substantiated by the 01Jan20 announcement by the THE Alliance that the vessels on the EC2 service will begin transitioning to 13,100 TEU vessels, which are equivalent in size to the design vessel, commencing in April 2020.

The shift towards PPX3 Max vessels on the two Asia services in question is also supported by the historical trend in carriers reducing the transportation cost per TEU by shifting to larger more efficient vessels. The Economics Appendix Section 2.5 Without-project Condition Status of Wilmington as a Port of Call on the EC2

and ZCP Services provides a detailed discussion of the relative efficiency of PPX3 Max vessels. Note that THE Alliance has announced the transition to 13,000 TEU vessels on the EC2 service, beginning in April 2020.

Assumption 4 is substantiated by the enormity of the inefficiency of having vessels light-loaded on 82% of calls and light-loaded by as much as seven feet. Sections 2.3 and 2.5 of the Economics Appendix provides the calculations displaying the relative inefficiency of calling at Wilmington under without-project conditions. The draft restrictions imposed by the without-project condition channel depth at Wilmington increases the waterborne cost by 40% per TEU per 1,000 miles. The weighted average number of TEUs on board at Wilmington under without-project conditions is 2,605 TEUs fewer than the weighted average number of TEUs for the same vessel at Charleston or Savannah. Over the course of a single year, the two services would leave at combined 271,000 TEUs at the docks due to draft restrictions at Wilmington, which also affects the departure draft at the prior port and the arrival draft at the next port. It would take an additional 38 trips per year (under without-project draft restrictions), just to get this cargo to its destinations. It is economically infeasible for the design vessel to regularly call at Wilmington under without-project conditions. Six carriers on the EC2 and ZCP services have provided letters supporting this assumption (see Economics Appendix: Letters of Support).

The future without-project assumption that the EC2 and the ZCP services will transition to the design vessel by the project base year of 2027 is developed in Economics Appendix Section 1.8.2 Existing Containership Fleet and Economics Appendix Sections 2.3 through 2.4:

- Section 1.8.2 Existing Containership Fleet
- Section 2.3 Without-project Conditions at other USEC Federal Navigation Projects
- Section 2.4 Without-project Condition Containership Fleet for the EC2 and ZCP Services

Assumption 5, PPX3Max vessels on the two services in question will call at Wilmington under with-project conditions, is substantiated by historical precedent and economic rationality. Under existing conditions, channel depths at other USEC ports are very similar to Wilmington's depth (Table 4-1 Existing and Future USEC Port Depths) and vessel draft restrictions at these same ports are very similar to draft restrictions at Wilmington. Under existing conditions, the USEC ports-of-call for the two services in question can service the existing fleet with similar vessel loads and operating costs per TEU (Economics Appendix Table 2-4 Operating Costs for Selected Vessel Drafts). Over many years under these historical conditions, Wilmington has developed a longstanding relationship with the carriers on these two services and managed to substantially increase the amount of cargo handled for these two services. Under with-project conditions, channel depth and draft restrictions at the other USEC ports would again be similar to those at Wilmington. Vessel loading and operating costs per TEU at the other USEC ports would also be similar to those at Wilmington (Table 4-1 of the Economics Appendix). If future with-project operating and economic conditions are comparable to existing operating and economic conditions, then it is reasonable to assume that the two services would continue to call at Wilmington.

B. Environmental

1. Number of Alternatives

Concern: The document only includes one implementation alternative. Normally, navigation improvement projects include increments of dredging depth in the detailed environmental analysis. According to the Principles and Guidelines, the recommended plan will contribute to national economic development consistent with protecting the Nation's environment. Environmental effects of the alternative plans must be considered and can drive the selection of the recommended plan; that's not possible if only one plan is considered. Reasonable

alternatives other than channel depth increments with less significant environmental effects, such as relocating facilities should be considered in the report in greater detail to compare the economic and environmental advantages and disadvantages. Decision makers need sufficient information to identify the recommended plan.

Basis of Concern: Principles and Guidelines; NEPA requires agencies to consider reasonable alternatives and the guidance for Studies of Water Resources Development Projects by Non-Federal Interests (ER 1165-2-209) requires Non-Federal Interests to evaluate reasonable alternatives.

Significance of Concern: *High.*

Action Needed to Resolve the Concern: Include additional alternatives in the detailed evaluation.

Sponsor Response:

Path to resolution: Need to get clarification on which alternative is reasonable when no other alternative passed the preliminary screening. Single alternatives are used in navigation EA's and for flood control projects. Also need to explain the extent of the environmental analysis, which focused on the proposed action. LPP (-48 feet) was not selected to avoid additional environmental effects.

HQ: More detail on Southport especially environmental is needed. Need to add more enviro to prelim screening. Make sure to address all reasonable alternatives. Need to give environmental the opportunity to influence plan selection.

Response: An Environmental Quality table that compares the impacts of incremental depth alternatives is under development and will be included in the preliminary alternatives analysis section of the revised Feasibility Study/Environmental Report back-check submittal document. An example from the preliminary draft Environmental Quality table is provided below. Note that that the table as presented is not complete, additional resources are being included, and "TBD" values are currently being assessed.

	Alternatives					
Resource	No Action	-44 ft	-45 ft	-46 ft	-47 ft	-48 ft
oundwater	Modeling results indicate negligible RSLR effects on groundwater flow and discharge patterns, and no increase in potential for salinity intrusion via downward surface water migration.	Interpolated modeling results indicate no measurable effects on groundwater flow and discharge patterns, and no increase in potential for salinity intrusion via downward surface water migration.	Interpolated modeling results indicate no measurable effects on groundwater flow and discharge patterns, and no increase in potential for salinity intrusion via downward surface water migration.	Interpolated modeling results indicate no measurable effects on groundwater flow and discharge patterns, and no increase in potential for salinity intrusion via downward surface water migration.	Modeling results indicate no measurable effects on groundwater flow and discharge patterns, and no increase in potential for salinity intrusion via downward surface water migration.	Interpolated modeling results indicate no measurable effects on groundwater flow and discharge patterns, and no increase in potential for salinity intrusion via downward surface water migration.

ater Levels **d Tides**	Modeling results indicate a maximum MHW increase of 4.1 inches in the lower estuary at Battery Island due to RSLR. Projected increases are progressively smaller through the estuary above.	Interpolated modeling results indicate a maximum relative MHW increase of 0.3 inch in the Anchorage Basin. Projected increases are progressively smaller through the up-estuary and down-estuary reaches above and below.	Interpolated modeling results indicate a maximum relative MHW increase of 0.7 inch in the Anchorage Basin. Projected increases are progressively smaller through the up-estuary and down-estuary reaches above and below.	Interpolated modeling results indicate a maximum relative MHW increase of 1.0 inch in the Anchorage Basin. Projected increases are progressively smaller through the up-estuary and down-estuary reaches above and below.	Modeling results indicate a maximum relative MHW increase of 1.3 inches in the Anchorage Basin. Projected increases are progressively smaller through the up-estuary and down-estuary reaches above and below.	Interpolated modeling results indicate a maximum relative MHW increase of 1.6 inches in the Anchorage Basin. Projected increases are progressively smaller through the up-estuary and down-estuary reaches above and below.
rrents	Modeling results indicate negligible RSLR effects on current speeds. Maximum projected changes are +/- 0.2 ft/s.	Interpolated modeling results indicate that channel deepening would have minor relative effects on current speeds. Projected maximum relative increases and decreases are +0.2 ft/s and -0.1 ft/s.	Interpolated modeling results indicate that channel deepening would have minor relative effects on current speeds. Projected maximum relative increases and decreases are +0.3 ft/s and -0.2 ft/s.	Interpolated modeling results indicate that channel deepening would have minor relative effects on current speeds. Projected maximum relative increases and decreases are +0.5 ft/s and -0.3 ft/s.	Modeling results indicate that channel deepening would have minor relative effects on current speeds. Projected maximum relative increases and decreases are +0.6 ft/s and -0.4 ft/s.	Interpolated modeling results indicate that channel deepening would have minor relative effects on current speeds. Projected maximum relative increases and decreases are +0.8 ft/s and -0.5 ft/s.
linity	Modeling results indicate that RSLR will cause maximum bottom and surface layer salinity increases of 0.7 and 0.5 ppt, respectively.	Interpolated modeling results indicate maximum bottom and surface layer relative salinity increases of 1.0 and 0.3 ppt, respectively.	Interpolated modeling results indicate maximum bottom and surface layer relative salinity increases of 2.1 and 0.6 ppt, respectively.	Interpolated modeling results indicate maximum bottom and surface layer relative salinity increases of 3.1 and 0.9 ppt, respectively.	Modeling results indicate that channel deepening would cause maximum bottom and surface layer salinity increases of 4.1 and 1.2 ppt, respectively.	Interpolated modeling results indicate maximum bottom and surface layer relative salinity increases of 5.1 and 1.5 ppt, respectively.
etlands *erpolated linity isopleth ifts were used delineate fected tidal odplain etland areas r the cremental pth ernatives. etland impact reages for e -44 to -46 d -48 ernatives are ing lculated via S and will be cluded in the ble.*	Model-projected upstream shifts in the 0.5 ppt salinity isopleth due to RSLR would affect ~278 acres of tidal freshwater wetlands. Projected surface salinity increases of ≤0.2 ppt would have negligible to minor effects on the composition of freshwater tidal wetlands in the isopleth shift zones.	Channel construction and maintenance would not have any direct impacts on wetlands. Interpolated upstream shifts in the 0.5 ppt salinity isopleth would affect ~TBD acres of tidal freshwater wetlands. Projected surface salinity increases of ≤0.3 ppt would have negligible to minor effects on the composition of freshwater tidal wetlands in the isopleth shift zones.	Channel construction and maintenance would not have any direct impacts on wetlands. Interpolated upstream shifts in the 0.5 ppt salinity isopleth would affect ~TBD acres of tidal freshwater wetlands. Projected surface salinity increases of ≤0.3 ppt would have negligible to minor effects on the composition of freshwater tidal wetlands in the isopleth shift zones.	Channel construction and maintenance would not have any direct impacts on wetlands. Interpolated upstream shifts in the 0.5 ppt salinity isopleth would affect ~TBD acres of tidal freshwater wetlands. Projected surface salinity increases of ≤0.3 ppt would have negligible to minor effects on the composition of freshwater tidal wetlands in the isopleth shift zones.	Channel construction and maintenance would not have any direct impacts on wetlands. Model-projected upstream shifts in the 0.5 ppt salinity isopleth would affect ~340 acres of tidal freshwater wetlands. Projected surface salinity increases of ≤0.3 ppt would have negligible to minor effects on the composition of freshwater tidal wetlands in the isopleth shift zones.	Channel construction and maintenance would not have any direct impacts on wetlands. Interpolated upstream shifts in the 0.5 ppt salinity isopleth would affect ~TBD acres of tidal freshwater wetlands. Projected surface salinity increases of ≤0.3 ppt would have negligible to minor effects on the composition of freshwater tidal wetlands in the isopleth shift zones.

rdbottom	Continuing maintenance of the currently authorized channel would not affect hardbottom communities.	Widening of the Baldhead Shoal entrance channel would have minor direct impacts on naturalized hardbottom rubble mounds in the old ODMDS.	Widening of the Baldhead Shoal entrance channel would have minor direct impacts on naturalized hardbottom rubble mounds in the old ODMDS.	Widening of the Baldhead Shoal entrance channel would have minor direct impacts on naturalized hardbottom rubble mounds in the old ODMDS.	Widening of the Baldhead Shoal entrance channel would have minor direct impacts on naturalized hardbottom rubble mounds in the old ODMDS.	Widening of the Baldhead Shoal entrance channel would have minor direct impacts on naturalized hardbottom rubble mounds in the old ODMDS.
AV	Continuing maintenance of the currently authorized channel would not affect SAV.	The -44 ft alternative would not affect SAV.	The -45 ft alternative would not affect SAV.	The -46 ft alternative would not affect SAV.	The -47 ft alternative would not affect SAV.	The -48 ft alternative would not affect SAV.
ell Bottom	Continuing maintenance of the currently authorized channel would not have any direct mechanical impacts on shell bottom. Sediment resuspension and redeposition during maintenance dredging would have short-term, localized effects on shell bottom communities.	No direct mechanical impacts on shell bottom. Short-term and localized sediment resuspension and redeposition effects during construction and maintenance dredging. Relative increase in dredging intensity and magnitude of resuspension effects during construction.	No direct mechanical impacts on shell bottom. Sediment resuspension and redeposition during construction and maintenance dredging would have short-term, localized effects on shell bottom communities. The relative increase in resuspension effects during construction would be slightly greater than the -44 ft alternative.	No direct mechanical impacts on shell bottom. Sediment resuspension and redeposition during construction and maintenance dredging would have short-term, localized effects on shell bottom communities. The relative increase in resuspension effects during construction would be slightly greater than the -45 ft alternative.	No direct mechanical impacts on shell bottom. Sediment resuspension and redeposition during construction and maintenance dredging would have short-term, localized effects on shell bottom communities. The relative increase in resuspension effects during construction would be slightly greater than the -46 ft alternative.	No direct mechanical impacts on shell bottom. Sediment resuspension and redeposition during construction and maintenance dredging would have short-term, localized effects on shell bottom communities. The relative increase in resuspension effects during construction would be slightly greater than the -47 ft alternative.

Review Assessment: To be determined once a revised draft report is submitted with more than one alternative being analyzed.

Action Taken: Revisions have been made throughout the Report to display the evaluation of all alternative plans. Section 6.5 Comparison of Final Array of Alternatives of the Main Report presents detailed comparisons across the final array of alternatives (six alternatives) for NED (section 6.5.2), RED (section 6.5.3), and environmental quality (section 6.5.4). The environmental quality assessment is presented in detail in Table 6-21 Environmental Quality – Direct and Indirect Effects of the Alternative Plans, which assesses effects to 34 categories of resources. Additional evaluation of effects to greenhouse gas emissions are presented in tables 6-22 through 6-24 of the Main Report.

2. Accuracy Effects Determinations

Concern: The report provides very good information to form the basis of effects determinations, but in many cases, it understates environmental effects in summary statements without fully and objectively relating impacts to the resource characterizations and analysis that preceded it. An example is the treatment of project effects on benthic habitats - which affects the impact analysis for many other resources, e.g. fisheries, threatened and endangered species. The project will change a substantial area of shallow subtidal habitat to deep subtidal habitat. The benthic community in those areas will change because of the physical and chemical changes to the habitat that result. Therefore, a conclusion such as the following for Atlantic sturgeon critical habitat

understates the effects, "Based on existing conditions within the new dredging areas, it is anticipated that the recovering benthic communities would provide prey resources similar to those of the existing communities. Therefore, it is expected that effects on foraging habitat PBFs would be short-term." By increasing the depth of shallow areas, the channel deepening and widening will produce a benthic community more similar to that of the existing deep channel bottom, which could be described and quantified by sampling and comparing both areas. This is a long term effect; overall, there will be less shallow subtidal habitat in the estuary and the benthic species composition of those areas will be affected over the long term because of the change in depth and frequency of disturbance.

Response: The soft bottom impact analysis sections (8.10.1 and 8.10.2) have been thoroughly revised to provide clarification of new vs existing channel dredging impacts and additional analysis of long-term effects based on a Wilmington Harbor benthic characterization and recovery study that was conducted for the 96 Harbor Act Project (Ray 1997). Changes to the soft bottom impact analyses in Sections 8.10.1 and 8.10.2 have been incorporated into follow-on fisheries, EFH, and protected species impact sections, as applicable. A portion of the revised soft bottom impact section is provided below.

8.10 Soft Bottom

Section 8.10.2 Effects of the TSP

Construction of the proposed Wilmington Harbor navigation channel improvements, inclusive of the channel slopes, would directly impact ~3,151 acres of soft bottom habitat over a three-year period; including ~2,226 acres of disturbed (periodically dredged) habitat within the existing channel and ~925 acres of relatively undisturbed (new dredging) habitat in the proposed channel widening and extension areas (Table 8-9). The new dredging acreages in Table 8-9 include areas between the existing channel top-of-slope and proposed channel top-of-slope, along with the channel bottom and side slopes of the offshore entrance channel extension reach. Based on projected post-construction maintenance intervals, soft bottom communities in both the existing channel and new dredging areas would experience periodic maintenance dredging disturbance every one to four years for the duration of the 50-year project. In relation to the No Action alternative, long-term maintenance of the new dredging areas under the TSP would increase the area of recurring soft bottom disturbance by ~925 acres; including 567 acres of estuarine soft bottom and 368 acres of marine softbottom.

Channel construction and subsequent maintenance events would remove benthic infaunal invertebrate communities along with the extracted sediments. The reestablishment of relatively stable benthic invertebrate communities would occur at rates similar to those described for maintenance dredging under the No Action alternative. However, the extent to which the recovered communities resemble those of pre-construction conditions in terms of taxa richness, abundance, biomass, and community structure would vary according to the extent of long-term habitat modification. Channel deepening would permanently alter the physical soft bottom environment through the conversion of relatively shallow bottom to deep bottom. At greater depths, decreased sunlight penetration and DO concentrations would be expected to have negative effects on benthic microalgal primary productivity and secondary benthic invertebrate productivity. Additionally, soft bottom habitats in the new dredging areas would be exposed to new or intensified periodic disturbances from maintenance dredging and ship prop wash.

The long-term effects of channel deepening and maintenance dredging on benthic communities in the CFR were previously investigated through a benthic characterization and recovery study that was undertaken by the USACE Waterways Experiment Station (WES) for the 96 Harbor Act Project (Ray 1997). The channel bottom, side slopes, and adjacent undisturbed flats were sampled along 14 transects, which were distributed throughout the inner and outer harbor in reaches representing 1, 2, and 3-year post-dredging conditions.

Similarly, the conclusions do not flow from the information that precedes the following case related to effects on sea turtle habitat and is repeated in many locations within the report, "Operations under the TSP would not be expected to increase the frequency of beach disposal events, as excavation to construct the channel reaches would effectively eliminate the need for a scheduled maintenance dredging event. Based on the proposed conservation measures, it is expected that any adverse indirect effects on sea turtle nesting habitat would be minor and short term." Increasing the depth and width of the project would increase the volume of sediment removed and the area affected by its disposal, including during future maintenance dredging. That is a long term effect.

Response: The sea turtle impact analysis section has been revised to clarify the short-term effects of construction-related increases in beach placement and the long-term effects of maintenance-related increases over the 50-year project life. In conducting federal Section 7 consultations for beach placement projects, the USFWS Raleigh Field Office quantifies direct impacts on sea turtle nesting habitat in terms of linear miles of beach placement. Although it is assumed that linear miles of beach placement would substantially increase during channel construction, a substantial portion of the additional material would almost certainly be used to construct a wider and higher berm with a longer project life, which would not increase nesting habitat impacts. The specific construction-related increase in beach placement miles will not be known until the beach project reaches design phase. In the case of post-construction maintenance dredging events, the projected increase in compatible material that would be available for beach placement is ~57,000 cy/yr. Thus, long-term maintenance-related increases in beach placement would be minimal.

Applicable revised text from the sea turtle impact analysis section is provided below.

8.14.5.2 Effects of the TSP
Beach Placement
During channel construction, the availability of compatible dredged material for beach placement would increase substantially in relation to the No Action alternative. Due to expanded beach placement, sea turtle nesting habitat impacts would increase substantially during channel construction. In the case of post-construction maintenance dredging events, the projected increase in beach compatible dredged material is ~57,000 cy/yr, thus indicating that long-term maintenance-related increases in beach placement would be relatively small.

Section 8.24.3.3 Benthic Communities seems to be describing the effects of maintenance dredging for improvement dredging: “New dredging in the channel expansion areas would remove the majority of the associated soft bottom benthic invertebrate infauna and epifauna, resulting in an initial sharp reduction in community levels of abundance, diversity, biomass, and availability of prey for predatory demersal fishes within the dredged areas. Dredging involves direct, short term impacts to softbottom communities in the dredge footprint during construction; however the communities are not expected to be negatively affected over the long term.”

Response: The above described revisions to the soft bottom impact analyses in section 8.10 have been applied to the cumulative effects analysis in Section 8.24.3.3. Additional analysis of cumulative effects on soft bottom communities has been included based on the above described Wilmington Harbor benthic characterization and recovery study.

Basis of Concern: NEPA regulations, Clean Water Act, Section 404(b)(1) Guidelines, Marine Protection, Research and Sanctuaries Act regulations

Significance of Concern: *Medium*

Action Needed to Resolve the Concern: Review the report and ensure that summary statements accurately reflect the magnitude of effects described in the preceding text, particularly, accurately describing long term or permanent effects vs. short term effects. Clearly distinguish the difference in effects between the new areas affected by improvement dredging and those that are regularly exposed to maintenance dredging.

Sponsor Response:

In addition to the above described revisions, information describing the timing, duration, and frequency of construction and maintenance activities has been added at the beginning of Section 8. Where applicable, the follow-on impact analysis sections have also been revised to clarify the timing, duration, and frequency of projected impacts. Applicable revised text from Section 8 is provided below.

8.0 Environmental Consequences

The timeframe of the effects analysis encompasses the projected three-year project construction period and the subsequent 50-year project life through 2077. The timing, location, and duration of various construction activities over the course of the three-year construction period would vary according to the construction sequence and annual environmental work windows that were previously described in Section 6.7. Post-construction maintenance of the federal navigation channel for the duration of the 50-year project would involve the continuation of current dredging and disposal practices and maintenance intervals for the existing channel reaches, with the addition of periodic maintenance dredging of the nine-mile offshore entrance channel extension reach.

Example of impact analysis revision from follow-on soft bottom impact section (8.10.1.2):

Construction of the proposed Wilmington Harbor navigation channel improvements, inclusive of the channel slopes, would directly impact ~3,151 acres of soft bottom habitat over a three-year period; including ~2,226 acres of disturbed (periodically dredged) habitat within the existing channel and ~925 acres of relatively undisturbed (new dredging) habitat in the proposed channel widening and extension areas (Table 8-9).

Based on projected post-construction maintenance intervals, soft bottom communities in both the existing channel and new dredging areas would experience periodic maintenance dredging disturbance every one to four years for the duration of the 50-year project. In relation to the No Action alternative, long-term maintenance of the new dredging areas under the TSP would increase the area of recurring soft bottom disturbance by ~925 acres; including 567 acres of estuarine soft bottom and 368 acres of marine softbottom.

Channel deepening would permanently alter the physical soft bottom environment through the conversion of relatively shallow bottom to deep bottom. At greater depths, decreased sunlight penetration and DO concentrations would be expected to have negative effects on benthic microalgal primary productivity and secondary benthic invertebrate productivity. Additionally, soft bottom

habitats in the new dredging areas would be exposed to new or intensified periodic disturbances from maintenance dredging and ship prop wash.

Review Assessment: Potentially resolved pending re-evaluation of a revised draft report.

Action Taken: The requested revisions have been made throughout the report. The environmental effects of the No Action alternative are presented in sections 4.7 through 4.21 of the Main Report. The environmental effects of the six alternative plans are presented in section 6.5 Comparison of Final Array of Alternatives of the Main Report. The detailed presentation of the environmental effects of the tentatively selected plan are presented in section 8: Environmental Consequences of the Main Report.

3. Presentation of Effects Determinations

Concern: In many cases, the report uses qualifying words, such as may, potentially, and just, to lessen the description of project impacts. For instance, Section 8.11.2.1 provides several examples highlighted in italics in the following paragraph:

"Temporary losses of benthic invertebrates in the new dredging areas may negatively affect the foraging activities of predatory demersal fishes (e.g., flounders, rays, spots, and croakers), *potentially* inducing fishes to seek out alternative soft bottom foraging habitats (Byrnes et al. 2003). It is expected that rapid recolonization of disturbed soft bottom habitats in the new dredging areas would provide substantial prey resources within a relatively short period of time. However, increases in depth and subsequent periodic disturbance from maintenance dredging *may* permanently shift community composition towards a more early successional benthic assemblage. At greater depths, lower DO concentrations and reduced sunlight penetration *may* limit the productivity of benthic communities as a prey resource for demersal fishes. However, the vast majority of the ~547 acres of estuarine softbottom habitat that would be affected by new dredging are located in relatively deep waters (97% >12ft and 99% >6ft) along the margins of the existing navigation channel, and thus are presently subject to frequent disturbance from strong tidal currents, ship prop wash, and maintenance dredging; as well as depth limitations on productivity. Therefore, the recovering communities would generally be expected to provide benthic prey resources that are similar to those of the existing communities. The proposed new dredging areas encompass *just* 5.9 acres of shallow (<6 ft) soft bottom habitat. In contrast, the Cape Fear River estuary contains an estimated 37,800 acres of shallow softbottom habitat in waters <6 ft and an estimated 188,549 acres of softbottom habitat in waters >6 ft (NCDEQ 2016). However, it is anticipated that the effects of prey loss on demersal fishes would be localized and short-term based on the following considerations: 1) early recruitment of opportunistic benthic taxa to the disturbed areas would provide substantial prey resources within a relatively short period of time, 2) demersal fishes are highly mobile and capable of seeking out alternative habitats, and 3) the distribution of alternative shallow soft bottom habitats within the overall project area is expansive."

Basis of Concern: NEPA – Planning Guidance Notebook. The NEPA requires that decision making should proceed with full awareness of the environmental consequences that follow from a major federal action that significantly affects the environment.

Significance of Concern: *Low.*

Action Needed to Resolve the Concern: Remove qualifiers to provide more objective predictions of effects.

Sponsor Response:

Path to resolution:
Preliminary Response: Will remove qualifiers and revise text accordingly.

Response: The qualifiers have been removed from the impact analysis sections. Revised Section 8.10.2.1 is provided below as an example of the changes that that have been applied throughout Section 8.

8.10 Soft Bottom
Section 8.10.2 Effects of the TSP

Construction of the proposed Wilmington Harbor navigation channel improvements, inclusive of the channel slopes, would directly impact ~3,151 acres of soft bottom habitat over a three-year period; including ~2,226 acres of disturbed (periodically dredged) habitat within the existing channel and ~925 acres of relatively undisturbed (new dredging) habitat in the proposed channel widening and extension areas (Table 8-9). The new dredging acreages in Table 8-9 include areas between the existing channel top-of-slope and proposed channel top-of-slope, along with the channel bottom and side slopes of the offshore entrance channel extension reach. Based on projected post-construction maintenance intervals, soft bottom communities in both the existing channel and new dredging areas would experience periodic maintenance dredging disturbance every one to four years for the duration of the 50-year project. In relation to the No Action alternative, long-term maintenance of the new dredging areas under the TSP would increase the area of recurring soft bottom disturbance by ~925 acres; including 567 acres of estuarine soft bottom and 368 acres of marine softbottom.

Channel construction and subsequent maintenance events would remove benthic infaunal invertebrate communities along with the extracted sediments. The reestablishment of relatively stable benthic invertebrate communities would occur at rates similar to those described for maintenance dredging under the No Action alternative. However, the extent to which the recovered communities resemble those of pre-construction conditions in terms of taxa richness, abundance, biomass, and community structure would vary according to the extent of long-term habitat modification. Channel deepening would permanently alter the physical soft bottom environment through the conversion of relatively shallow bottom to deep bottom. At greater depths, decreased sunlight penetration and DO concentrations would be expected to have negative effects on benthic microalgal primary productivity and secondary benthic invertebrate productivity. Additionally, soft bottom habitats in the new dredging areas would be exposed to new or intensified periodic disturbances from maintenance dredging and ship prop wash.

Review Assessment: Potentially resolved pending resubmittal.

Action Taken: Similar to above comment #3. The requested revisions have been made throughout the report. The environmental effects of the No Action alternative are presented in sections 4.7 through 4.21 of the Main Report. The environmental effects of the six alternative plans are presented in section 6.5 Comparison of Final Array of Alternatives of the Main Report. The detailed presentation of the environmental effects of the tentatively selected plan are presented in section 8: Environmental Consequences of the Main Report.

4. Mitigation Plan

Concern: The mitigation recommendations are not linked to an explicit consideration of the level of significance of the resources and impacts and may imply a greater commitment to mitigation than is justified.

Basis of Concern: Planning Guidance Notebook - Justification of mitigation features recommended for inclusion in projects shall be based upon analyses that demonstrate the combined monetary and non-monetary values of the last increment of losses prevented, reduced, or replaced is at least equal to the combined monetary

and non-monetary costs of the last added increment so as to reasonably maximize overall project benefits. In addition, an incremental cost analysis, to the level of detail appropriate, will be used to demonstrate that the most cost effective mitigation measure(s) has been selected. And, Non-monetary value shall be based upon technical, institutional, and public recognition of the ecological, cultural and aesthetic attributes of resources within the study area. Criteria for determining significance shall include, but not be limited to, the scarcity or uniqueness of the resource from a national, regional, state, and local perspective.

Significance of Concern: *Medium.*

Action Needed to Resolve the Concern: Recognizing that the cost effectiveness/incremental cost analysis would be premature at this stage, revise the mitigation plan section to clearly establish the significance of the resources and impacts following the procedures in ER 1105-2-100, then provide only those mitigation options (without commitments) that would be required to ensure that the recommended plan would not have more than negligible adverse impacts on ecological resources and may fully justified.

Path to resolution: An evaluation of mitigation measures is currently being performed with SAW and agencies.

Response: The mitigation plan, which is currently being revised and further developed, will incorporate the requested changes. The revised mitigation plan will be included in the revised Feasibility Study/Environmental Report back-check submittal document.

Review Assessment: Awaiting next submittal.

Action Taken: A preliminary Mitigation, Monitoring, and Adaptive Management Plan has been developed to ensure that the environmental consequences of the project can be appropriately mitigated. The preliminary plan is presented in section 8.25 Mitigation, Monitoring, and Adaptive Management Plan of the Main Report and is developed in more detail in Appendix N: Mitigation and Monitoring Plan. Mitigation, mitigation-related real estate acquisition costs, and monitoring costs are developed in the Cost Appendix (Appendix D) and included in total project costs (Table 6-10 in the Main Report). The Mitigation, Monitoring, and Adaptive Management Plan costs are sufficient to ensure that revisions to the plan during development of the DEIS will not have a substantive impact on the project's economic justification or congressionally authorized cost limits. The final Mitigation, Monitoring, and Adaptive Management Plan will be developed by USACE with support by the NCSPA during development of the DEIS.

5. Environmental Commitments

Concern: The report indicates that "The USACE commits to completing or implementing the following analyses and measures."

Basis for Concern: Studies of Water Resources Development Projects by Non-Federal Interests (ER 1165-2-209)

Significance of Concern: *High.*

Action Needed to Resolve the Concern: Revise the text to say, "8.25.6 Future Environmental Considerations – The following actions will be considered during the preparation of a NEPA document."

Sponsor Response:

Path to resolution: Revise text as requested.
HQ: editorial

Response: The requested revision to Section 8.25.6 has been made.

Review Assessment: Potentially resolved pending submission of a revised draft report.

Action Taken: The revised text may be found in section 8.25.8 Future Environmental Considerations of the Main Report and is copied below:
"The following actions will be considered during the preparation of a NEPA document."

C. Economics

1. Price Levels

Concern: The report correctly uses the FY 19 price level and discount rate. However, if future versions of the report cross into FY 20 then it will be necessary to update the recommended plan at that time.

Basis of Concern: Reference ER 1105-2-100 Appendix D-3.d.(2).

Significance of Concern: *Low. Reporting requirement not likely to impact plan selection.*

Action needed to resolve the concern: *This is a proactive comment for awareness and requires no action at this time. Appropriate updates should be made prior to the final report to ASA(CW).*

Sponsor Response:

Path to resolution: update to 2020 price level & discount rate prior to public release of FS/DEIS.

Response: Concur. The economic analysis has been revised to include FY20 price levels and discount rate.

Review Assessment: Resolved pending re-evaluation.

Action Taken: FY 2020 price levels and federal discount rate have been used throughout the analysis. For example, the following statement has been taken from section 6.5.1 Alternative Plan Costs in the Main Report: "Alternative plan costs are developed using FY 2020 price levels. Average annual equivalent costs and interest during construction are calculated using the FY 2020 discount rate of 2.75%."

2. Interest during Construction (IDC)

Concern: It is unclear from the economic analysis if IDC was calculated correctly.

Basis of Concern: IDC is an important economic cost that must be accounted for in plan selection and justification; ER 1105-2-100 Appendix D Para D-3.e. (11).

Significance of Concern: *Low to Medium. Not likely to impact plan selection or justification if it was calculated, but full extent of an incorrect calculation cannot be determined without additional information.*

Action needed to resolve the concern: Update the economic analysis to demonstrate that IDC was calculated correctly.

Sponsor Response:

Path to resolution: Provide IDC calculation. Provide example to demonstrate how IDC was calculated.

Response: Interest during construction was calculated for each month for the duration of construction based on the construction implementation plan identified in the feasibility report. Interest during construction calculations used the FY20 discount rate and include costs for PED, construction S&A, real estate acquisition, relocations, mitigation, and dredging.

Review Assessment: Resolved pending re-evaluation of revised report.

Action Taken: The following text is included in section 6.5.1 Alternative Plan Costs in the Main Report and is copied below: "Interest during construction (IDC) was calculated using the FY20 federal discount rate (2.75%). The construction schedule was used to identify a schedule of costs incurred during PED and construction. Costs were escalated by month up to the base year to calculate the investment costs of the project." Details on IDC development are included in the Cost Appendix: Appendix D.

3. Commodity Forecast for TEUs

Concern: The only benefitting containerized trade in the economic analysis is the USEC-Asia route. The commodity forecast presented for that one trade route far exceeds what could be supported by empirical data from the Waterborne Commerce Statistics Center (WCSC) for all
Port of Wilmington containerized trade. For example, Table 2-4 of the economic appendix shows the economic analysis assumes 272,615 TEUs for USEC-Asia traffic for 2025 and total Port TEUs of 425,328 (179,713 + 272,615) – see image below. However, the most recent WCSC data for 2017 for total Port TEUs is only 178,865. Even accounting for growth between 2017 and 2025, the forecast assumes a 137% ((425,328 - 178,865 / 178,865) increase of TEUs, as compared to WCSC officially collected data. It appears that the commodity forecast has been significantly overestimated. Correcting that error would result in a dramatic reduction in project benefits.

Table 2-4
Port of Wilmington Containerized Cargo Forecast (TEUs)

Region	Port	2025	2030	2035	2040	2045
Non-Asia	Wilmington, NC	179,713	223,554	252,930	286,168	323,772
Asia	USEC Alternate	272,615	339,119	383,682	434,101	491,145

Basis of Concern: Validity of assumptions that form a building block of the economic analysis.

Significance of Concern: *High. Directly impacts both plan selection and justification.*

Action Needed to Resolve the Concern: Correct the economic analysis to use appropriate number of TEUs for the benefitting USEC-Asia traffic or clearly explain and defend the dramatic difference in the number of TEUs used (i.e., between the WCSC data and that used in the analysis).

Path to resolution: Discussion concerning Economics Appendix Table 1-13. Explain impact of Hanjin, new service EC2, and Zim, and consolidation of services Zim/Maersk TP10/ZCP; Three year average as alternative (2017-2019)?

HQ: Need to more fully explain – bring this response to text

Sponsor Response:

Response: The discrepancy identified by the reviewer is based on the difference in the number of loaded vs. total containers, which includes empties. The 178,865 TEUs based on WCSC data matches exactly the data provided by the port for loaded containers. Empty containers are not included in the landside transportation cost calculations. The report has been revised to identify the difference in the total number of containers moved and the total number of loaded containers. The report has also been revised to focus on the total number of loaded containers. For the two Asia services, loaded containers account for 77% of TEUs and empty containers account for 23% of TEUs.

Review Assessment: Given the enormity of the analysis that relies on this value, the comment cannot be resolved without the presentation of the analysis. Suggest further coordination in advance of a revised report submittal.

Action Taken: The commodity forecast is developed in section 2.7 Containerized Commodity Projections of the Economics Appendix. The forecast for loaded TEUs only is presented in table 2-11 and the forecast for all TEUs (loaded and empty) is presented in Table 2-12. Benefits are calculated only for loaded TEUs.

4. Future Without Project Assumptions – Alternative Port (1)

Concern: The economic analysis assumes that the Future Without Project (FWOP) condition of no additional depth at the Port of Wilmington would result in a transfer of all USEC-Asia TEUs to alternative Ports and that the TEUs would then be trucked to their final destinations. This appears to be a faulty assumption in that the Port of Wilmington is currently still getting TEUs on smaller vessels even though most of the alternative east coast ports are already deeper than Wilmington.

Basis of Concern: Validity of assumption.

Significance of Concern: *High. This comment has direct impact on all of the economic benefits claimed.*

Action Needed to Resolve the Concern: Update the economic analysis using a more reasonable and defensible assumption of the FWOP as TEUs continuing to go through the Port of Wilmington.

Sponsor Response:

Path to resolution: Discuss Economics Appendix Tables 1-19 through 1-22. Show existing schedule and discuss.

HQ: discussed in other comments

Response: Please note that the statement "Port of Wilmington is currently still getting TEUs on smaller vessels" is not fully accurate. It is correct that smaller vessels call at Wilmington, but not on the two Asia services that provide benefits in the with-project condition. These services have been upgrading their fleets to larger vessels after the Panama Canal expansion allowed them to do so. Table 2-41 shows that, prior to the Panama Canal expansion (2009 & 2013 in the table) vessel calls on the Asia services were 99% Panamax vessels, which were the largest size vessel that could be on those services at that time. After the Panama Canal expansion (2018 & 2019 in the table), there is a shift to larger vessels with 74% of the vessel calls on these services for 2019 being PPX3 vessels. Tables 2-38 through 2-40 indicate that PPX3Max vessels, which are the neo-Panamax vessels, i.e., the largest vessels that can fit through the new locks at the Panama Canal, are a substantial component of the fleet – even with the existing draft restrictions at many USEC ports. If history is any indication of the future, neo-Panamax vessels would become the predominant size vessel using the Panama Canal in the future as the fleet transitions over time, in the same way that Panamax vessel predominated Panama Canal transits in the past. Note that the benefits calculated for this project require that only the two services in question transition to PPX3Max vessels, not that all services transition to these larger vessels. Also please note that the design vessel is among the smallest of the neo-Panamax vessels and was the same design vessel used for the Charleston Post-45 Study

Please note that the statement "most of the alternative east coast ports are already deeper than Wilmington" is not fully accurate. Boston, Jacksonville, and Savannah, which are the USEC prior and next ports in the port rotations for the two services in question (Table 2-42) are all currently under construction (see the FY19 USACE Construction Work Plan). These ports are still operating at their pre-construction channel depths (Boston 40 feet, Savannah 42 feet, and Jacksonville 40 feet – see Table 3-1). Wilmington's 42-foot channel depth is comparable with the existing depths at these other ports and currently operates with draft restrictions that are very similar to these other ports. When construction is completed at these other ports their channel depths will be substantially deeper than Wilmington's 42 feet (Boston 48 feet, Savannah 47 feet, and Jacksonville 47 feet – Table 3-1), which will upset the historical and existing balance of channel depths for the USEC ports on these two services. The thrust of the economic argument is that it will be economically infeasible for these two services to continue to incur the existing draft restrictions at Wilmington and thereby **NOT** take advantage of the port-construction deeper depths at Boston, Savannah, and Jacksonville. The economic justifications for the deepening projects at Boston, Savannah, and Charleston are based on carriers taking advantage of the deeper depths.

Review Assessment: Given the risk and uncertainty in utilizing non-trending assumptions and changing behavior in the market, suggest further coordination in advance of a revised report submittal.

Action Taken: The future without-project assumption of Wilmington's hinterland Asia cargo on the EC2 and ZCP services using Savannah as the primary alternative port is developed in Economics Appendix Section 2.3 through Section 2.5:

- Section 2.3 Without-project Conditions at other USEC Federal Navigation Projects
- Section 2.4 Without-project Condition Containership Fleet for the EC2 and ZCP Services
- Section 2.5 Without-project Condition Status of Wilmington as a Port of Call on the EC2 and ZCP Services

Additionally, letters from six carriers on the EC2 and ZCP services are included as an attachment to the Economics Appendix. These letters confirm the projection that carriers will not regularly call at Wilmington under without-project conditions.

5. Future Without Project Assumptions – Fleet Transition

Concern: The economic analysis assumes that the Future Without Project (FWOP) condition has a USEC-Asia transition to virtually all PPX3 and larger vessels. While it is acknowledged that the world fleet is transitioning to larger vessels with the opening of the newly expanded Panama Canal, it is not realistic to assume that 100% of the fleet for USEC-Asia will transition to the largest containership vessel classes. This is a critical assumption because if the fleet did not transition 100% as assumed and Panamax vessels remained in the fleet mix, then the assumption of FWOP TEUs leaving to alternative ports would not be valid (see comment on Future Without Project Conditions – Alternative Ports).

Basis of Concern: Validity of assumption.

Significance of Concern: *High. This comment has direct impact on all of the economic benefits claimed.*

Action Needed to Resolve the Concern: Update the economic analysis to document a more reasonable assumption of the FWOP as the USEC-Asia fleet having a distribution rather than an unrealistic assumption of 100% PPX3 and greater.

Sponsor Response:

Path to resolution: USEC-Asia was 100% 106-foot beam Panamax with the old locks. Add updated supporting data on vessel size – existing Wilmington Asa-USEC Fleet.

HQ: Note that not all vessels that call on Wilm are going to shift – just Asia services

Response: Please note that the realization of with-project benefits is based on the **two** USEC services currently calling at Wilmington transitioning to the design vessel, which is among the smaller of the PPX3Max vessel class (Tables 2-33 and 2-34). Project benefits do not require all vessels on Asia services to be PPX3Max vessels.

Tables 2-33 through 2-37 show that it is **not** the case that the vessels on those two services will" transition to the largest containership vessel classes" because there are 440 vessels in the world fleet as of 01Jan2019 that are larger than the design vessel (including vessels in design and under construction).

The statement that "Panamax vessels remained in the fleet mix" is not fully accurate. The fleet for the two Asia services in question **no longer includes Panamax vessels** as indicated by Table 2-41. In addition, Tables 2-38 through 2-40 indicate that Panamax vessels have been transitioned out of the Asia services fleet at other USEC ports also, not just for those services calling at Wilmington.

Overall, the without-project condition assumption that the TWO Asia services calling at Wilmington will transition to PPX3Max vessels is not unrealistic and is the most likely future condition (Please see comment A.4 concerning assumptions, which also addresses this issue.).

Review Assessment: Given the risk and uncertainty in utilizing non-trending assumptions and changing behavior in the market, suggest further coordination in advance of a revised report submittal.

Action Taken: The future without-project assumption that the EC2 and the ZCP services will transition to the design vessel by the project base year of 2027 is developed in Economics Appendix Section 1.8.2 Existing Containership Fleet and Economics Appendix Sections 2.3 through 2.4:

- Section 1.8.2 Existing Containership Fleet
- Section 2.3 Without-project Conditions at other USEC Federal Navigation Projects
- Section 2.4 Without-project Condition Containership Fleet for the EC2 and ZCP Services

In addition, please see the following 01Jan20 announcement by Hyundai Merchant Marine that states that the EC2 service will transition into a fleet characterized by the design vessel in April 2020.

Subject: PR News Service - Copy 12754 - HMM to deploy neo-panamax capacity on THE Alliance Asia/USEC service - EXCLUSIVE

news@prnewsservice.com +44 (0)1449 677380

COPY : 12754 DATE : 1.01.20

HMM to deploy neo-panamax capacity on THE Alliance Asia/USEC service - EXCLUSIVE

HMM is to progressively phase in neo-panamax vessels on to THE Alliance Asia/USEC EC2 service from the beginning of the second quarter 2020, as replacements for chartered vessels in the 10,000 teu capacity range

EC2 service :

Port rotation :

*Qingdao, Ningbo, Shanghai, Pusan, (Panama Canal), Manzanillo (Pan), New York, Wilmington, Savannah, Charleston, Manzanillo (Pan), (Panama Canal), Pusan, Qingdao

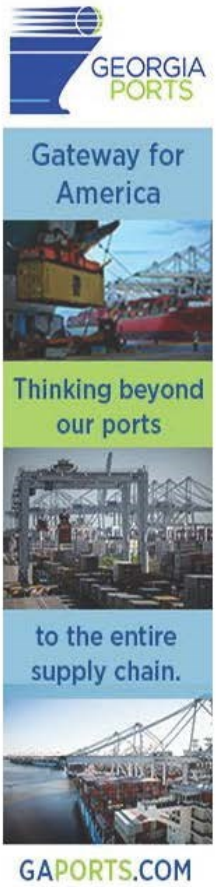
New weekly capacity : 13,100 teu

By July, HMM will deploy 11 x 13,000+ teu vessels as replacements for the 10,000 teu chartered vessels presently operating on the EC2 service

The first of the eleven vessels, the 13,154 teu Hyundai Victory, will phase in on the EC2 service on April 16th

Importantly, at least three of the 13,000+ teu vessels will be switching from the HMM Asia/Middle East (KME) service where they will be replaced by vessels in the 6,500 teu capacity range, cutting weekly capacity on that service by almost 50%

(See PR News Service, Copy 12752, December 30th)



6. Overstating of Landside Benefits

Concern: Please note Future Without Project (FWOP) Condition Assumption comments that question the validity of the transition to other ports.

Notwithstanding other concerns, if it is assumed that USEC-Asia TEUs would transition to alternative ports in the future FWOP condition, it appears that the benefits are significantly overstated. The reason for this is (1) all of the alternative ports have rail connections to the hinterland and rail was not considered as a land transportation alternative despite rail being significantly cheaper than trucking and (2) Wilmington is not the closest port to a number of the destinations, including Charlotte, which is almost a wash with Charleston.

Table B-2
Round Trip Distances Between Ports and Cities

	Round Trip Port Distance (mi)			
City	**Wilmington**	**Norfolk**	**Charleston**	**Savannah**
Fayetteville, NC	196	454	432	524
Raleigh, NC	284	390	572	666
Columbia, SC	396	778	224	318
Charlotte, NC	416	648	428	520
Winston-Salem, NC	450	508	596	688
Greenville, SC	574	854	404	496
Nashville, TN	1278	1412	1108	974
Cleveland, OH	1376	1080	1412	1506
Chicago, IL	2008	1794	1842	1934

Basis of Concern: Validity of assumption. Next Least Costly Alternative - ER 1105-2-100 Appendix E Page E -6 Paragraph E-3.a.(4)(a)(2)(c).

Significance of Concern: *High. This comment has direct impact on all of the economic benefits claimed.*

Action Needed to Resolve the Concern: Notwithstanding the other comments that could change the economic analysis and assuming the transition assumption remains, the economic analysis must be updated to only count landside costs for those TEUs where the Port of Wilmington is actually closer than alternative ports AND the analysis must include rail as a potential least cost alternative.

Sponsor Response:

Path to resolution: We can use a rail/truck split for alternative ports. However, rail is not used for short haul and nearly all savings are short haul and currently using truck – need to discuss. Always using least cost port is not realistic but we can see what that does to benefits by calculating cost savings only for cargo that has Wilmington as the least cost port.
HQ: See other comments

Response: The port of Savannah was selected as the most likely alternative port because, under without-project conditions, Savannah is the first port in the port rotation that is reasonably close to Wilmington's hinterland (Table 2-42). Other ports on this service include Boston and Jacksonville, which are too far from Wilmington's hinterland to reasonably be considered an alternative port. Charleston was not selected as an alternative port because it comes after Savannah in the port rotation (Savannah comes before Charleston in the port rotation in-part because Savannah has a larger share of cargo on the vessel than Charleston). The risk and uncertainty associated with this without-project condition assumption is addressed in a sensitivity analysis that uses Charleston as the alternative port (the project is economically justified using Charleston as the alternative port). Note that for any Wilmington hinterland cargo that is closer to the alternative port (whether it be Charleston or Savannah) the transportation cost for that cargo is greater in the with-project condition and is included in the transportation cost calculations as having a negative effect on with-project benefits. This occurs because it is never the case that 100% of cargo goes through the nearest port and the analysis was conducted for all cargo, not only benefitting cargo.

Rail is not considered as a least cost alternative because it is not a least cost alternative for the short haul distances between Wilmington's hinterland and the alternative ports. Rail service from Wilmington's hinterland to either Savannah or Charleston is inefficient and more expensive than truck service because there is limited cargo in any single area within the hinterland that would be used to make up trains, which means that cargo would need to be trucked to the rail yard (double handling) and the cargo would have to wait for a sufficient volume of cargo to arrive to build the train (time delay). The port of Wilmington currently has rail service that is under-utilized, even though it is subsidized with government funds, due to the transportation inefficiencies mentioned above. Rail is only an efficient alternative for cargo travelling the equivalent of multi-day truck distances, in which the inefficiencies of double handling and waiting for sufficient cargo to accumulate at the rail yard is more than offset by travelling 24 hours-a-day on a double-stacked train carrying 400 TEUs.

Review Assessment: Given the risk and uncertainty of the assumption on changed behavior of the shippers, suggest further coordination in advance of a revised report submittal.

Action Taken: The inefficiency and under-utilization of rail at the Port of Wilmington is discussed in Economics Appendix Section 2.9.2 Without-project Landside Transportation Costs. A sensitivity analysist hat uses Savannah as the alternative port for Wilmington's hinterland Asia imports (maintaining the time advantage) and using Charleston as the alternative port for Wilmington's hinterland Asia exports is developed throughout the document beginning in Economics Appendix Section 2.9.1 Without-project Waterborne Transportation Costs culminating in Table 5-11 Sensitivity Analysis Project Net Benefits. The sensitivity analysis results confirm the NED Plan.

7. Evidence for Supporting Assumptions

Concern: There are a number of assumptions used in the analysis that do not have sufficient evidence to support the assumptions. Two examples are the assumption that 100% of the vessel fleet for the USEC-Asia will be PPX3 or greater and that TEUs will transfer to other Ports. We are now going into the 4th year of the newly expanded Panama Canal and if the trends that are assumed are really underlying, there would seem to be evidence of it already starting to happen. However, Waterborne Commerce Statistics Center (WCSC) data does not support these conclusions. What has happened to Wilmington shipping since the Panama Canal third lock opened in 2016?

Basis of Concern: Validity of key underlying assumption.

Significance of Concern: *High. This comment has direct impact on all of the economic benefits claimed.*

Action needed to resolve the concern: Present clear evidence that validates the assumptions being made.

Sponsor Response:

Path to resolution: WCSC data is two years old. Need to provide additional supporting current data. We can show what has happened at Wilmington since new locks: Economics Appendix Tables 1-15 through 1-22 and current schedule.
HQ: see other comments

Response: The new Panama Canal locks opened on 26Jue2016, after having been delayed due to cracks in the Pacific side locks which required repair. Vessel schedules for the major liner services are set six months in advance and often further in advance because multiple carriers work together in official (contractually obligated) alliances that determine the number of TEU slots allocated to each member carrier. These slot allocations are negotiated periodically, as are the size and ownership of vessels being deployed on any service. The uncertainty concerning the opening of the new locks added to the time it would take the carriers to respond to the new lock capacity.

WCSC data for 2017 would not be expected to show anything but the very beginning of the transition to higher efficiency vessels. The reviewer's question "What has happened to Wilmington shipping since the Panama Canal third lock opened in 2016?" is directly answered by Table 2-41, which shows that the vessels on the two Asia services calling at the port of Wilmington **prior to the opening** of the new Panama Canal locks were **99% Panamax** vessels and in **2019 are 0% Panamax** vessels. Now that the lock capacity has been expanded, 74% of the vessel calls are PPX3-size vessels. There could be no stronger evidence of a transition to more efficient vessels. The same table also shows that there was an increase in vessel size for these services at Wilmington from 2018 to 2019.

Now that the new locks are fully operational, the constraint on the operational efficiency of neo-Panamax vessels is the existing channel depth and draft restrictions at USEC ports, which are being addressed by the construction identified in the current (FY19) and recent historical USACE Construction Work Plans. When construction is completed at Boston, Savannah, and Jacksonville the remaining constraint on the operational efficiency of the design vessel will be the channel depth and associated draft restrictions at Wilmington.

Review Assessment: Given the risk and uncertainty of the assumption on changed behavior of the shippers, suggest further coordination in advance of a revised report submittal.

Action Taken: Please note that the THE Alliance published a press release on 01Jan20 stating that it will transition vessels on the EC2 service to 13,100 TEU capacity vessels starting in April 2020 (see copy inserted into Action Taken for Economics Comment #5). Please see the same sections as identified for Comment #5. The future without-project assumption that the EC2 and the ZCP services will transition to the design vessel by the project base year of 2027 is developed in Economics Appendix Section 1.8.2 Existing Containership Fleet and Economics Appendix Sections 2.3 through 2.4:

- Section 1.8.2 Existing Containership Fleet
- Section 2.3 Without-project Conditions at other USEC Federal Navigation Projects
- Section 2.4 Without-project Condition Containership Fleet for the EC2 and ZCP Services

Also please see letters from six carriers on the EC2 and ZCP services are included as an attachment to the Economics Appendix. These letters confirm the projection that carriers will not regularly call at Wilmington under without-project conditions.

8. Overall Economic Feasibility and Selection of the NED Plan

Concern: Based on Economic comments 12-16, there is a high likelihood that neither -47FT nor -48FT are the NED plan. Further, project justification (positive NED benefits) at those depths is uncertain.

Basis of Concern: Cumulative effect on benefits resulting from the number of high significance concerns.

Significance of Concern: *High. Directly calls into question the NED plan and demonstrating economic feasibility as required for Sec 203 reports.*

Action Needed to Resolve the Concern: Update the economic analysis to use reasonable assumptions, determine the NED Plan, and document/support plan selection.

Sponsor Response:

Path to resolution: Need to resolve previous economic comments.

Response: The responses to the previous comments are being incorporated into the economic analysis and selection of the NED Plan. The updated economic analysis will be used to evaluate economic feasibility.

Review Assessment: Pending resolution and re-valuation of prior comments.

Action Taken: Please see responses to previous comments.

9. Sufficient Array of Alternatives to Identify the NED Plan

Concern: Reference Table 4-7 of the economic appendix. The economic analysis only evaluates -47FT and -48FT and identifies -47FT as the NED Plan because it has greater net benefits than -48FT. However, -47FT cannot be determined to be the NED Plan because a lesser alternative was not evaluated. The argument presented is that there are $0 in landside costs for -44FT, -45FT, and -46FT. This does not seem reasonable as there is no evidence that larger ships could not call on Wilmington harbor at those depths. Data for other east coast ports shows PPX3 and larger vessels calling at depths below -47FT. If this singular assumption did not hold true, the NED Plan would not be -47FT.

Basis of Concern: Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies 1983 Section VI; ER 1105-2-100 2-4.

Significance of Concern: *High. Directly calls into question the identification of the NED plan.*

Action Needed to Resolve the Concern: Update the economic analysis to show benefits for depths below -47FT and then identify the NED Plan.

Sponsor Response:

Path to resolution: Does this comment rely on previous comments? We can show total waterborne costs at -44 ft through – 47 ft, with and without Wilmington's -42-foot constraint to substantiate economic cost to carrier.

HQ: Write to the comment

Response: The economic analysis has been revised to include an incremental analysis for the design vessel calling at Wilmington under with-project conditions for -44, -45, -46, -47, and -48 feet.

Review Assessment: Resolved pending re-evaluation.

Action Taken: The alternatives evaluated in the analysis are identified in Section 6.4 Final Array of Alternatives of the Main Report. The description of the alternative plans is copied here:

"The alternatives that are the most effective in reducing unit transportation costs are alternatives that combine channel widening to allow regular transit of the design vessel and channel, turning basin, and berth deepening to allow greater vessel operating drafts. Note that berth deepening is a local service facility improvement that is the responsibility of the NCSPA and not a component of the federal General Navigation Features. The amount of channel widening was determined by ship simulation modeling of the design vessel and does not change appreciably for any of the action alternatives, therefore the action alternatives are identified by their incremental project depth:

- No Action Alternative – no improvements are made to the federal channel and economic conditions are described by the without-project condition;
- 44-foot Alternative – The channel, turning basin, and container terminal berths are deepened to -44 feet, the entrance channel is deepened to -46 feet and extended to meet project depth, the channel is widened to accommodate the design vessel based on requirements identified in ship simulation modeling;
- 45-foot Alternative – The channel, turning basin, and container terminal berths are deepened to -45 feet, the entrance channel is deepened to -47 feet and extended to meet project depth, the channel is widened to accommodate the design vessel based on requirements identified in ship simulation modeling;
- 46-foot Alternative – The channel, turning basin, and container terminal berths are deepened to -46 feet, the entrance channel is deepened to -48 feet and extended to meet project depth, the channel is widened to accommodate the design vessel based on requirements identified in ship simulation modeling;
- 47-foot Alternative – The channel, turning basin, and container terminal berths are deepened to -47 feet, the entrance channel is deepened to -49 feet and extended to meet project depth, the channel is widened to accommodate the design vessel based on requirements identified in ship simulation modeling; and
- 48-foot Alternative – The channel, turning basin, and container terminal berths are deepened to -48 feet, the entrance channel is deepened to -50 feet and extended to meet project depth, the channel is widened to accommodate the design vessel based on requirements identified in ship simulation modeling.

Alternative project depth increments start at -44 feet because there is no non-federal interest in a one-foot deepening resulting in a -43-foot channel. Alternative project depths increments are truncated at -48 feet because at this depth vessel operating drafts at Wilmington would be constrained at the same level as vessel

operating drafts at the prior and post US ports on the two services. A channel deeper than -48 feet would not be expected to provide additional benefits because vessel operating drafts would be constrained by depths at the prior and post US ports on the two services (Boston -48 feet, Savannah and Jacksonville -47 feet)."

Please also see Economics Appendix Section 3 Economic Evaluation of Measures, which evaluates the structural measures identified in plan formulation (further discussed in the Main Report) and Economics Appendix Section 4 Alternative Plan Economic Evaluation, which includes an economic evaluation of incremental channel depths. In addition, please see the Review Certification attached to the Economics Appendix that supports the economic evaluation and determination of the NED Plan.

10. Independent External Peer Review (IEPR)

Concern: IEPR is required for Section 203 project just like USACE led projects. Given the magnitude of the project implementation costs and the non-traditional economic analysis and the assumptions used, IEPR is recommended.

Basis of Concern: ER 1165-2-209.

Significance of Concern: *Medium to high. This comment has direct impact on all of the economic benefits claimed.*

Action Needed to Resolve the Concern: Conduct an IEPR or obtain an IEPR exclusion from the Chief of Engineers.

Sponsor Response:

Path to resolution: IEPR is being scheduled

Response: The non-Federal sponsor has been informed by the ASA(CW)'s office that an IEPR is not required at this time.

Review Assessment: Comment resolved at this time. IEPR will be undertaken as part of project implementation.

D. Climate Preparedness and Resilience

1. Climate Hydrology Analysis

Concern: The report lacks a discussion relevant information about observed and expected climate change impacts in hydrologic analyses developed for the study. These impacts combined with sea level change will profoundly impact the future with project conditions and inform cost and cost risk assumptions of future OMRR&R costs related to dredging.

Basis of Concern: ECB 2018-14 requires a qualitative analysis of climate-impacted hydrology to describe future conditions, which includes a literature review. Climate change information for hydrologic analyses includes direct changes to hydrology through changes in temperature, precipitation, evaporation rates and other

climate variables, as well as dependent basin responses to climate drivers, such as sedimentation loadings. For the Wilmington Harbor Section 203 study, this analysis would inform future potential changes to streamflow, precipitation and sedimentation in the project area which is currently lacking the report.

Significance of concern: Low to medium. The qualitative analysis required by this ECB should focus on those aspects of climate and hydrology relevant to the project's problems, opportunities, and alternatives, and include consideration of both past (observed) changes as well as projected, future (modeled) changes.

Future with project impacts on water quality should be informed by changes in water temperature and freshwater inputs. Sediment delivery and transport to the project area are impacted by these changes and would impact the shoaling rates developed in the analysis, adding uncertainty to future with project assumptions informed by the analysis conducted for the study.

Action Needed to Resolve the Concern: A policy compliant climate hydrology analysis should be performed using ECB 2018-14 guidance. The climate discussion should be summarized in the main report, with the detailed material included in Appendix A (Engineering). The results should be integrated into the key assumptions in the future with and without project assumptions, and inform any adjustments to risk register and current cost risk assumptions in the report.

Sponsor Response:

Path to Resolution:
A qualitative analysis of climate-impacted hydrology and any potential resulting impacts on the proposed project will be prepared and added to the report including the cost risk analysis.

Initially it appears that precipitation may increase resulting in higher flow rates. However, sediment concentrations are mainly a factor of land use and could not be predicted to change. Even if they do, modeling results show that sedimentation rates in the anchorage basin are primarily, but not completely, driven by its depth and width and tidal influences; not by the river flows and associated concentrations. Therefore, a limited cost risk will likely be assumed for this potential impact.

Increase flows would mitigate the increased salinity intrusion due to RSLR and the proposed project.

HQ: Work with Wilmington to be consistent with USACE requirements. This is an information requirement.

Response: A qualitative analysis of climate-impacted hydrology and any potential resulting impacts on the proposed project was prepared and added as Section 1.6 of the Engineering Appendix and a summary has been added to the Main Report section 10.7.1 Risk and Uncertainty Climate Change (provided below). Climate Change was added to the risk register in the Cost Appendix but was determined to be low risk.

10.7.1 Climate Change

The USACE's Engineering and Construction Bulletin (ECB) 2018-14, issued in September 2018, requires a qualitative climate hydrology analysis that discusses the relationships between climate, streamflows, and the USACE project, to ensure that changes in climate with the potential to significantly affect the project with respect to hydrology are identified, and the potential impacts are assessed with respect to the project over its life cycle. The USACE recommends that projects be evaluated for potential vulnerabilities to planning,

engineering and operational activities affected by climate change. Navigation and associated dredging projects like the TSP may be impacted.

ECB 2018-14 was developed by the USACE as an update to ECB 2016-25, Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects. The ECB provides guidance for incorporating climate change into the USACE planning process for long term projects. The analysis was performed for this project based on literature review and two USACE tools in accordance with this guidance. The full analysis is presented in the Engineering Appendix Section 1.6: Climate Change Impacts. The conclusions of the analysis are presented below.

The project itself is not expected to have a significant effect on climate change per se. Furthermore, potential climate change impacts do not impact the decision regarding the selection of the TSP. However, the project will be affected by the results of climate change. Increases in extreme precipitation events and resulting increases in streamflow have the potential to move more nutrients and sediment into the navigation channel. This combined with increases in air temperatures has the potential to impact water quality and dissolved oxygen (DO) levels through increases in oxygen demanding materials and nuisance algal blooms. Furthermore, increases in sediment transport may increase the need for channel maintenance in the future.

Review of the model results presented in Appendix A, though, indicates that the project impacts on water quality (DO) are most pronounced during the winter months when DO is at its highest levels (and temperature is lowest). Therefore, the potential impacts from increased temperatures and nutrients will likewise have the largest relative changes during the winter months when these impacts will not further adversely affect fishery resources under the with-project conditions as compared to without-project conditions.

With respect to the increase of salinity intrusion into the estuary due to the project (as well as future RSLR), increases in streamflow will actually be a mitigating factor reducing the potential impacts of the project on wetland vegetation composition and fishery resources.

Increases in streamflow and suspended sediment will likely increase potential maintenance dredging activities. If any changes in predicted future dredging volumes are observed, these will ultimately have to be incorporated into future dredge material management practices. However, given the project itself is expected to only increase these volumes by about 10%, climate change impacts should also be relatively minor and adaptive responses can be undertaken.

Review Assessment: The comment is resolved pending review of a revised feasibility report.

Action Taken: The summary response presented above may be found in section 9.8.1: Climate Change in the Main Report and a more detailed discussion may be found in section 1.6 Climate Hydrology Analysis of the Engineering Appendix (Appendix A).

2. Sea Level Change (SLC) Analysis

Concern: The report and analysis are not fully compliant with USACE policy on SLC.

Basis of concern: Review of the documents provided and analysis indicate that SLC was incorporated into analyses and discussion, in various sections of the main report; however, application and presentation is

piecemeal in the report and does not appear to inform performance and impact risk of TSP. Specific concerns by discipline/section follow.

Sea Level Change – The sea level rates are presented in section 2.6, presenting the 50 year project projections for the Wilmington, NC NOAA tide gauge. These projections are understating the changes in future water levels. Due to the alteration of the Cape Fear River Estuary (CFRE) by the federal navigation project over the last 150 years, the Wilmington tidal gauge has experienced an anomalously large increase in tidal constituents and tidal range since the current NOAA tidal gauge records in the 1930's. The tidal datum which is defined by the tidal range is not stable and is increasing at a greater rate than the mean sea level trend. The significance of this phenomena is that tide level and extreme water level projections should not be based on the published observed 2006 mean sea level trend (2.13 mm/year), but on the MHW trend, 4.26 mm/yr. (Zervas, 2013) This is approximately double the rate used in the study analysis, and result in a RSLR increase between 0.70 to 2.92 feet compared to 0.34 to 2.56 feet respectively.

Plan Formulation – Future without project and future with project discussions do not fully integrate impacts of climate change to hydrology and changes in sea level. Future changes in water levels, salinity intrusion due to RSLR and further channel alteration are likely understated. The section listing constraints does not include increases in water levels or induced flooding.

Economics/Planning – The non-structural measure "tidal advantage" should perform better under the intermediate/high scenarios since the tidal range is increasing. Has a sensitivity analysis been done showing performance of larger tidal ranges on tidal advantage?

Engineering Analysis/Hydrodynamic Modeling – Future without project, future with project modeling is likely underestimating impacts since the RSLR rates are low by a significant amount. Changes in flood risk for the with project condition was not investigated.

ER 1100-2-8162/Hydrodynamics – "As used in this ER, locations with oceanic astronomical tidal influence, as well as connected waterways with base-level controlled by sea level. In the latter waterways, influence by wind driven tides may exceed astronomical tidal influence. Coastal areas include marine, estuarine, and riverine waters and affected lands." In addition to the impacts of future conditions described in earlier comments, when assessing coastal storm risk in the estuary, wind loading should be considered.

NEPA/Impacts – The CFRE is a funnel shaped estuary, which has an increasing tidal range due to incremental deepening and channel maintenance over the last 150 years. Further deepening will increase these changes and create additional flood risk from coastal storms due to storm surge amplification (Familkhalili and Talke, 2016). Nuisance flooding frequency will likely increase as a result of the project. As the tide range expands, some stormwater drainage outfalls to Wilmington harbor will be impacted, resulting in decreased gravity drainage performance. Future salinity changes in the estuary have been underestimated. Future freshwater inputs from the watersheds may trend upward under climate change ameliorating the impacts of the deepening slightly.

Significance of concern: *High*.

Action Needed to Resolve the Concern: Coordinate with Navigation PCX, HH&C, CPR CoP's, vertical team for specific direction.

Sponsor Response:

Response:
The Sea Level Rise scenarios (Low, Intermediate and High) used in the modeling follow USACE guidance ER 1100-2-8162, Incorporating Sea Level Changes in Civil Works Programs and were calculated using the USACE on-line sea level calculator. They range from a 0.34' RSLR change to a 2.57' RSLR change through the Year 2077.

The change in tidal range is not due to climate effects, but rather due to the alteration of the Cape Fear River Estuary by federal navigation projects over the past 150 years. Thus, this trend in MHHW (and tide range) should not be expected to continue in the future in the absence of any future navigation projects and should not be used as the future sea level for the FWOP and FWP conditions.

With respect to potential project impacts that may affect flood risk and tidal ranges, Appendix A – Section 5.4.1 presents the potential FWP effects. They indicate that FWP will slightly increase the tidal prism with the largest increase of the tidal range occurring at the Anchorage Basin (~0.3 ft). The change in tide range, though, is disproportional as MHW increases up to 0.12 ft while MLW decrease up to 0.18 ft at that location. For the High SLR scenario, these values are minimally greater by approximately 0.01 ft for MHW and MLW, and by 0.02 ft for the tide range. The smallest changes occurred at the upstream riverine sites and downstream at the mouth of the Cape Fear Estuary.

Hurricane conditions, including wind effects, were also investigated with the maximum water level difference occurring at lower Big Island with an increase of 0.13 ft. At the Battleship (Wilmington), the difference was an increase of only 0.08 ft.

HQ: Flood risk not included as a constraint – residual risk. Reviewer did not see the methodology used to project tide range. Impacts to surge and gravity drains need to be addressed. Importance of how higher sea level rise will impact mitigation projects. Also potential for increased freshwater flow due to sea level rise to impact sedimentation. Look at ranges to see how O&M costs may be impacted. May use Florence data.

Review Assessment: The comment is unresolved. Anecdotal, physical data, and peer-reviewed studies support the comment on tidal range instability. The response also did not address impacts on future flood risk and impacts to storm water drainage which were not investigated in the report, nor was flood risk increases a planning constraint. The rest of the response did not fully address other parts of the comment (which covered several areas).

Action Taken: The Main Report has been revised to include section 9.8.2 Tidal Datum Instability, which is copied below. Additional graphic representations of the data are provided in the attached Technical Memorandum.

9.8.2 Tidal Datum Instability

Tidal range instability has been identified as a potential risk factor concerning future project performance. Historically, the river channel has been modified numerous times, and quite substantially, which has led to the observed changes in tidal datums (MHW, MLW) and mean tidal range. Previous analysis of tidal range at the Cape Fear River (Zervas, 2013) recognize this important point, and previous modeling efforts have shown that the prior deepening and widening of the river channel has increased the tidal range over time. It is this increase in tidal range due to previous channel

modifications that has then been manifested in the apparently higher historical rate of increase of MHW over MSL (which encompasses these periods of channel modifications) referenced anecdotally and in prior studies.

Going forward in time, though, it is expected that MHW should generally increase at the same rate as MSL increases absent any alterations to the river channel, which would reduce risks to project performance. To support this assumption, analyses of the water levels at Wilmington over the past four decades were performed. These analyses consisted of investigating two distinct time periods:

1. From April 2004 to December 2019 which represents the time since the most recent channel deepening / widening project; and

2. From January 1983 to July 2000 which represents the time between the most recent two channel deepening / widening projects.

It is noted that the most recent project was performed in phases between August 2000 and March 2004, so this time interval was not included in the two analysis periods. The prior deepening / widening project was completed in October 1982.

9.8.2.1 Tidal Analyses

The present tidal analysis was performed using hourly observations at the NOAA CO-OPS Station 8658120 Wilmington, NC. Continuous data was available from 1936 until the present. The analysis of tidal constituents and tidal datums was performed based on monthly and annual (January to December) intervals. The tidal datums values (MHW and MLW) were referenced to the local MSL. MSL values was computed as the arithmetic mean of observations over each interval. Mean tidal range was computed as thedifference between MHW and MLW.

As shown in Table 9-5 and Figure 9-2 the rate of increase during the aforementioned time periods for MHW and MLW is similar to the rate of increase of MSL. Specifically, it was observed that MHW is increasing at a slower rate (by 15–20%) than MSL during the periods when no major alterations were made to the river channel.

Table 9-5: Tidal Datum Rate of Change

Tidal Datum	1983-2000 (ft/yr)	2004-2019 (ft/yr)
MHW	0.006	0.033
MSL	0.008	0.039
MLW	0.008	0.043
Mean Range	-0.002	-0.010

Table 9-6 shows a notable change in the mean tide range as a result of the channel improvements that occurred between 2000 and 2004. This is especially clear in Figure 9-2 based on yearly data. Figure 9-2 a significant but gradual increase in the tidal range which occurred between 2000 and 2004 due to the most recent channel deepening / widening project.

Table 9-6: Tidal Datum Absolute Changes

Tidal Datum	1983-2000 (ft-MSL)	2004-2019 (ft-MSL)	Change (ft)	Change Relative to MSL (ft)

MHW	1.958	2.251	+0.293	+0.081
MSL	-0.017	0.195	+0.212	0.000
MLW	-2.242	-2.177	+0.065	-0.147
Mean Range	4.200	4.429	+0.228	n/a

Additionally, with respect to the modeling performed for the proposed project, a comparison can be made between the changes that occurred previously and the model predictions for the current project. One can expect similar in magnitude changes given the similar scopes of each project. In fact, Table 9-6 shows an increase in MHW of 0.081 ft compared to the model prediction of 0.12 ft; a decrease in MLW of 0.147 ft compared to the model prediction of -0.18 ft, and an increase in the tidal range of 0.228 ft compared to the model prediction of 0.31 ft. This provides a validation that the model is predicting similar tendencies and changes in magnitudes that are comparable to those measured previously for a similar magnitude of modifications to the river channel.

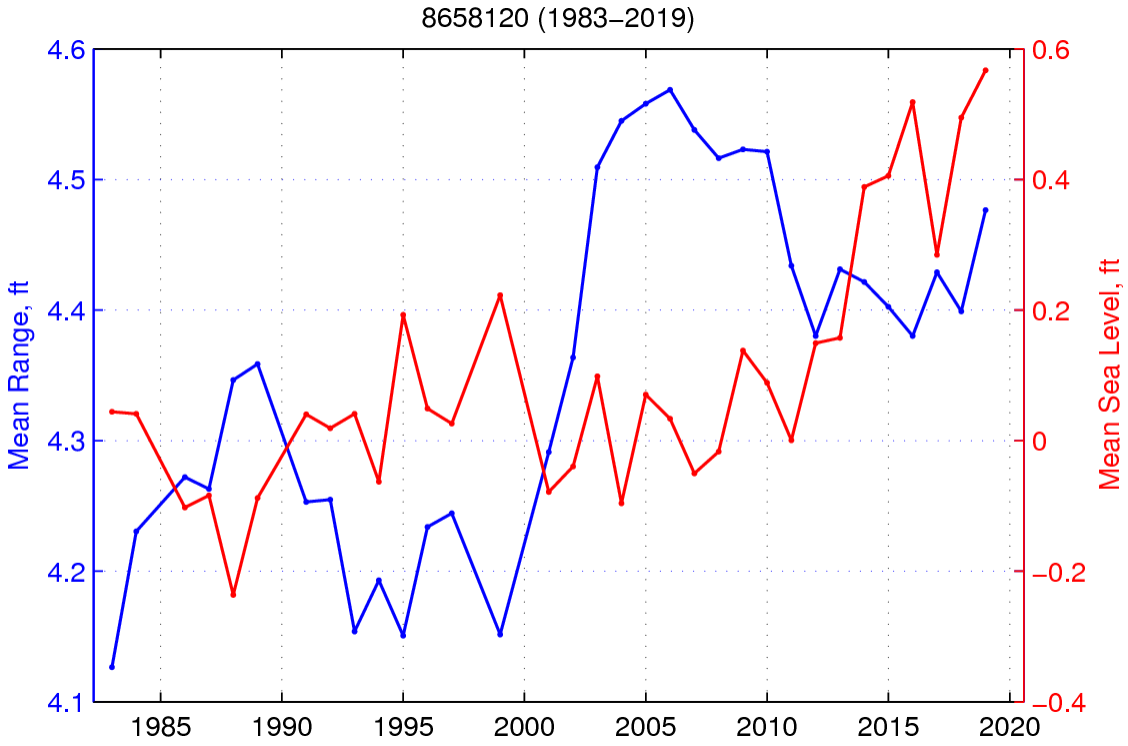


Figure 9-2
Variability of Mean Tidal Range Based on Annual Data

E. Counsel

1. Study Authority

Concern: The study authority cited in section 1.2 of the report is not cited correctly.

Basis of Concern: Section 203 of the Water Resources Development Act (WRDA) of 1986, Public Law 99-662 (33 U.S.C. 2231) was further amended by section 1152 of WRDA 2018, Public Law 115-270. Specifically, section 1152 amended subsections (c) and (e) of section 203.

Significance of Concern: Medium. The non-federal interest should understand the revisions to the study authority, as explained in the implementation guidance for section 1152 approved by the Assistant Secretary of the Army for Civil Works on 2 May 2019.

Action Needed to Resolve the Concern: The study authority cited in section 1.2 of the report should be updated to include the modifications to the authority made by section 1152 of WRDA 2018. The non-federal interest also should review the "Implementation Guidance for Section 1152 of the Water Resources Development of 2018, Studies of Water Resources Development Projects by Non-Federal Interests," dated 2 May 2019.

Sponsor Response:

Path to Resolution: Update study authority

Response: The study authority identified in the report has been revised as identified in the comment. The revised text now states

Study Authority

This study of potential navigation improvements to the Wilmington Harbor Federal navigation channel leading from the Atlantic Ocean to the Port of Wilmington, North Carolina has been prepared by the North Carolina State Ports Authority (NCSPA) under the authority granted by Section 203 of Water Resources Development Act (WRDA) of 1986 (P.L. 99-662), as amended.

Section 203 of WRDA 86, as amended, states:

> *SEC 203. STUDIES OF PROJECTS BY NON-FEDERAL INTERESTS.*
> *PUBLIC LAW 99-662, NOV. 17, 1986. 33 USC 2231.*
>
> *(a) SUBMISSION TO SECRETARY*
>
> *1 In general. A non-Federal interest may on its own undertake a federally authorized feasibility study of a proposed water resources development project and submit the study to the Secretary.*
>
> *2 Guidelines. To assist non-Federal interests, the Secretary shall, as soon as practicable, issue guidelines for feasibility studies of water resources development projects to provide sufficient information for the formulation of studies.*
>
> *(b) REVIEW BY SECRETARY - The Secretary shall review each feasibility study received under subsection (a) (1) for the purpose of determining whether or not the study, and the process under which the study was developed, each comply with Federal laws and regulations applicable to feasibility studies of water resources development projects.*
> *(c) SUBMISSION TO CONGRESS =*
> *(1)REVIEW AND SUBMISSION OF STUDIES TO CONGRESS - Not later than 180 days after the date of receipt of a feasibility study of a project under subsection (a) (1), the Secretary shall submit to the Committee on Environment and Public Works of the Senate and the Committee on Transportation and Infrastructure of the*

House of representatives a report that describes

(A) the results of the Secretary's review of the study under subsection (b), including a determination of whether the project is feasible;

(B) any recommendations the Secretary may have concerning the plan or design of the project; and

(C) any conditions the Secretary may require for construction of the project.

(2) LIMITATION – The completion for the review by the Secretary of a feasibility study that has been submitted under subsection (a)(1)may not be delayed as a result of consideration being given to changes in policy or priority with respect to project consideration;

(d) CREDIT. If a project for which a feasibility study has been submitted under subsection (a) (1) is authorized by a Federal law enacted after the date of the submission to Congress under subsection (c), the Secretary shall credit toward the non-Federal share of the cost of construction of the project an amount equal to the portion of the cost of developing the study that would have been the responsibility of the United States if the study had been developed by the Secretary.

(e) REVIEW AND TECHNICAL ASSISTANCE. –

(1) REVIEW – The Secretary may accept and expend funds provided by non-federal interests to undertake reviews, inspections, certifications, and other activities that are the responsibility of the Secretary in carrying out this section.

(2) TECHNICAL ASSISTANCE - At the request of a non-Federal interest, the Secretary may provide to the non-Federal interest technical assistance relating to any aspect of a feasibility study if the non-Federal interest contracts with the Secretary to pay all costs of providing such technical assistance.

(3) LIMITATION – Funds provided by non-Federal interests under this subsection shall not be eligible for credit under subsection (d) or reimbursement.

(4) IMPARTIAL DECISIONMAKING – In carrying out this section, the Secretary shall ensure that the use of funds accepted from a non-Federal interest will not affect the impartial decisionmaking of the Secretary, either substantively or procedurally.

(5) SAVINGS PROVISION – The provision of technical assistance by the Secretary under paragraph (2) –

(A) shall not be considered to be an approval or endorsement of the feasibility study; and

(B) shall not affect the responsibilities of the Secretary under subsections (b) and (c).

This report has been developed based on the policy guidance provided in:

- ER 1165-2-209 (04 February 2016), which provides guidance for implementation of Section 203 of WRDA 1986, as amended by Section 1014(a) of WRRDA 2014;
- Memorandum for Commanding General U.S. Army Corps of Engineers (21 June 2018): Implementation Guidance for Section 1126 of WRDA 2016 – Study of Water Resources Development Projects by Non-Federal Interests (Revised); and
- Implementation Guidance for Section 1152 of the Water Resources Development of 2018, Studies of Water Resources Development Projects by Non-Federal Interests," dated 2 May 2019.

Review Assessment: Comment resolved with inclusion of above revised text in the report.

Action Taken: The revised text may be found in section 1.2 Study Authority of the Main Report.

2. Tentatively Selected Plan

Concern: Sections 6.1 and 10.1 of the report describe the recommended plan as "dredging" the federal navigation channel.

Basis of Concern: Dredging may occur for construction, operation, or maintenance of navigation projects. For clarity and to avoid confusion with operation and maintenance dredging activities, the tentatively selected plan should be described as "deepening" the federal navigation channel instead.

Significance of Concern: *Low.*

Action Needed to Resolve the Concern: The tentatively selected plan recommended generally should be referred to in sections 6.1 and 10.1 and throughout the report and its appendices as "deepening" the federal navigation channel, rather than simply "dredging" the federal navigation channel.

Sponsor Response:

Path to resolution: Revise text as recommended.

Response: Change made throughout as requested.

Review Assessment: Comment resolved with implementation of response.

Action Taken: Please see revised text throughout the Main Report including section 6 Formulation and Evaluation of Alternative Plans and section 9: Recommended Plan.

3. Recommendations

Concern: For the recommendations in section 14, the report describes only the first cost and annual incremental operations and maintenance cost to the federal government. No reference is made to the mitigation required for the project.

Basis of Concern: When a project is authorized by Congress, the recommendations contained in the feasibility report become the basis for proceeding with the project as a Federal undertaking. ER 1105-2-100, App'x G, para. G-9.i.(1). The wording of recommendations, incorporated by reference in the authorizing act, has the force of law for the project, and therefore requires special attention. The recommendations must contain a "clear reference to the plan being recommended for implementation, including appropriate mitigation." ER 1105-2-100, App'x G, para. G-9.i.(4)(a).

Significance of Concern: *Medium. While total project costs and mitigation are summarized elsewhere in the report, the recommendations section needs to clear reference these items as well.*

Action Needed to Resolve the Concern: Provide the total project cost at FY 2019 price levels in the recommendations section of the report. Indicate the expected federal and non-federal cost-share amounts. Summarize the mitigation for the project as well.

Sponsor Response:

Path to Resolution: Mitigation is currently being determined and will be included in report.

Response: The mitigation plan will be included in the description of the recommended plan, including federal and non-federal cost shares. The mitigation plan is currently being developed in coordination with the Wilmington District and will be included in the revised report.

Review Assessment: Comment is resolved pending review of the implemented response.

Action Taken: The Federal and non-Federal cost shares of the project are presented in section 9.4.1 Cost Sharing Table 9-4 Project Cost Shares (copied below), A preliminary mitigation, monitoring, and adaptive management plan is presented in section 8.25 Mitigation, Monitoring, and Adaptive Management Plan and presented in greater detail in Appendix N: Mitigation and Monitoring Plan. The preliminary plan will be finalized during development of the DEIS. The preliminary plan identifies a mitigation alternative that is appropriate to the level of environmental effects. Mitigation and monitoring plan costs are included in the economic analysis at FY2020 price levels. Table 9-4 includes $74 million for mitigation, $10 million for monitoring and $21 million for mitigation-related land acquisition plus a contingency of 21.4%.

Table 9-4
Project Cost Shares

Cost Item	Total Cost	75% Federal	25% Non-Federal
Dredging Cost	$547,882,000	$410,912,000	$136,971,000
Mitigation & Monitor	$84,000,000	$63,000,000	$21,000,000
Construction S&A	$10,800,000	$8,100,000	$2,700,000
PED	$21,100,000	$15,825,000	$5,275,000
Contingency (21.4%)	$142,049,000	$106,537,000	$35,512,000
Total Construction of GNF	**$805,831,000**	**$604,373,000**	**$201,458,000**
Lands & Damages	$28,262,000	$0	$28,262,000
Total project First Costs	**$834,093,000**	**$604,373,000**	**$229,720,000**
Berthing Area Dredging Costs	$1,760,000	$0	$1,760,000
Aids to Navigation	$10,531,000	$10,531,000	$0
10% GNF Non-Federal		-$52,321,000	$52,321,000
Total Cost	**$846,384,000**	**$562,583,000**	**$283,801,000**

4. Items of Local Cooperation

Concern: The non-federal responsibilities listed in the recommendations section of the report states the North Carolina State Ports Authority will "[a]ccomplish all removals determined necessary by the Federal Government other than those removals specifically assigned to the Federal Government."

Basis of Concern: It is not clear to what "removals" refers, particularly given that no real estate plan was provided.

Significance of Concern: *Medium.*

Action Needed to Resolve the Concern: Explain what "removals" refers to in the recommendations section of the report. As noted in a few paragraphs above this reference, the non-federal sponsor would be responsible to perform or ensure performance of all relocations determined necessary for the project.

Sponsor Response:

Path to resolution: We are currently clarifying if there are any removals or relocations. There were none identified when the draft was written. Is this standard language for this section of the report?

Response: The following information has been added to the main report:

6.1.3 Pipeline Relocation

There are four pipelines crossing the channel in the Fourth East Jetty Reach just south of Eagle Island that are owned by Exxon Mobile with the operation and maintenance of the pipelines contracted to Kinder Morgan. Two pipelines are active but currently have no commercial flow. These two pipelines are six-inch nominal diameter and are currently pressurized with nitrogen awaiting future business opportunities. Two pipelines are not active. These two pipelines are four-inch nominal diameter, filled with sea water and capped. One of the active six-inch lines is directionally drilled to a depth in excess of 68 feet MLLW and does not need to be relocated. The second active six-inch line is at a depth of ~49 feet MLLW and needs to be relocated. The two inactive four-inch lines are at a depth of ~47 feet MLLW and need to be removed. Table X provides the disposition of each pipeline.

Table 6-2
Pipeline Disposition

Size	Status	Depth (MLLW)	Action Needed
4-inch	Inactive	~47 feet	Remove
4-inch	Inactive	~47 feet	Remove
6-inch	Active	~49 feet	Relocate
6-inch	Active	>68 feet	No Action

Pursuant to Section 101(a) of the Water Resources Development Act of 1986 (WRDA 86), as amended, the non-Federal Sponsor is responsible for performing, or assuring the performance, of all relocations, including utility relocations, which are necessary for the navigation improvement project. All relocations, including utility relocations, are to be accomplished at no cost to the Federal Government. The estimated cost of the six-inch pipeline relocation is $2 million. This cost is included in the project cost as a 100% non-federal expense and the non-Federal Sponsor will receive equivalent credit toward its additional 10 percent cash payment required by Section 101(a)(4) of WRDA 86.

The two four-inch pipelines do not need to be relocated because they are no longer active. The non-Federal Sponsor has contacted the owner to reach a determination as to whether the owner has an interest in the existing line for which

compensation is owed by the non-Federal Sponsor. If the owner has a compensable interest, the non-Federal Sponsor, as part of its requirement to provide lands, easements, and rights-of-way required for the navigation improvement project, will be responsible for acquiring this interest, at no cost to the Federal Government. At this time, it appears that there is no compensable interest in these pipelines.

If there is a compensable interest, the non-Federal Sponsor will receive credit toward its additional 10 percent cash payment required by Section 101(a)(2) of WRDA 86 for the value of the interest acquired, and the Corps will revoke any existing Section 10 permit and remove the line as part of construction of the navigation improvement project, with the costs of the removal shared by the Corps and Sponsor as part of the costs of the general navigation features.

If no compensation is owed to the owner of the line, then the Corps will revoke any existing Section 10 permit and remove the line as part of construction of the navigation project, with the costs of the removal shared by the Corps and non-Federal Sponsor as part of the costs of the general navigation features. The estimated removal cost for the two four-inch pipelines is $300,000.

The non-Federal Sponsor will receive credit toward its additional 10 percent cash payment required by Section 101(a)(2) for the value of relocations provided under Section 101(a)(3) and for the costs of utility relocations borne by the Sponsor under Section 101(a)(4). Such credit will include any payment made by the Sponsor to the Corps associated with the Corps' exercise of the navigation servitude.

Review Assessment: Comment addressed, but further demonstration of understanding non-Federal responsibilities is needed in the report. Section 101(a)(4) of WRDA 1986 (33 U.S.C. § 2211(a)(4)) requires non-Federal sponsors to perform or assure the performance of all relocations of utilities necessary to carry out Federal navigation improvements. The law apportions payment responsibility between the owner of the utility and the non-Federal sponsor only in the case of utility relocations necessitated by projects with an authorized depth of greater than 45 feet ("deep-draft utility relocations"). For such deep-draft utility relocations, the non-Federal sponsor must bear at least 50 percent of the cost of relocation. Thus, except as to deep-draft utility relocations, whether the non-Federal sponsor owes compensation to the utility owner is determined by principles of just compensation under state law and the terms of any non-Federal permits, licenses, or rights-of-way instruments for the utility. Under section 101(a)(2) of WRDA 1986, the costs borne by the non-Federal sponsor for utility relocations are credited toward the non-Federal sponsor's additional payment of 10 percent of the cost of general navigation features. The amount of credit to be afforded for the total cost of each relocation shall not exceed the amount the Corps determines to be necessary to provide a functionally equivalent facility. The exercise of the navigation servitude to compel relocations of utilities is within the Government's discretion. The Corps will only exercise the navigation servitude to compel relocations for a project under limited circumstances set forth in Director of Civil Works (CECW-P) Policy Guidance Letter No. 44 (27 September 2017), which will not affect the non-Federal sponsor's responsibility for payment of relocation costs under section 101(a)(4) and administrative costs associated with the exercise of the navigation servitude. The report should recognize the non-Federal sponsor's obligation to perform or assure the performance of all relocations of utilities necessary to carry out Federal navigation improvements in accordance with 33 U.S.C. § 2211 and CECW-P Policy Guidance Letter No. 44 (27 September 2017).

Action Taken: The Main Report has been revised to include section 6.4.7 Pipeline Relocation (copied below). In addition, Appendix E: Real Estate Plan includes a discussion of pipeline relocations.

6.4.7 Pipeline Relocation

There are no utility relocations required for the project. As-built drawings for the Carolina Power and Light company and for the Brunswick County, NC display an 8" HDPE waterline and cable in a joint bore at -63 feet MLLW. The waterline and cable diverge outside of the channel. The existing overhead cable crossing has a vertical clearance of 210 feet, which does not interfere with projected future navigation.

There are four pipelines crossing the channel in the Fourth East Jetty Reach just south of Eagle Island that are owned by Exxon Mobile with the operation and maintenance of the pipelines contracted to Kinder Morgan. Two pipelines are active but currently have no commercial flow. These two pipelines are six-inch nominal diameter and are currently pressurized with nitrogen awaiting future business opportunities. Two pipelines are not active. These two pipelines are four-inch nominal diameter, filled with sea water and capped. One of the active six-inch lines is directionally drilled to a depth in excess of 68 feet MLLW and does not need to be relocated. The second active six-inch line is at a depth of ~49 feet MLLW and needs to be relocated. The two inactive four-inch lines are at a depth of ~47 feet MLLW and need to be removed. Table 6-8 provides the disposition of each pipeline.

Table 6-8
Pipeline Disposition

Size	Status	Depth (MLLW)	Action Needed
4-inch	Inactive	~47 feet	Remove
4-inch	Inactive	~47 feet	Remove
6-inch	Active	~49 feet	Relocate
6-inch	Active	>68 feet	No Action

Pursuant to Section 101(a) of the Water Resources Development Act of 1986 (WRDA 86), as amended, the non-Federal Sponsor is responsible for performing, or assuring the performance, of all relocations, including utility relocations, which are necessary for the navigation improvement project. All relocations, including utility relocations, are to be accomplished at no cost to the Federal Government. The estimated cost of one six-inch pipeline relocation is $2,000,000. This cost is included in the project cost as a 100% non-federal expense and the non-Federal Sponsor will receive equivalent credit toward its additional 10 percent cash payment required by Section 101(a)(4) of WRDA 86.

The two four-inch pipelines do not need to be relocated because they are no longer active. The non-Federal Sponsor has contacted the owner to reach a determination as to whether the owner has an interest in the existing line for which compensation is owed by the non-Federal Sponsor. If the owner has a compensable interest, the non-Federal Sponsor, as part of its requirement to provide lands, easements, and rights-of-way required for the navigation improvement project, will be responsible for acquiring this interest, at no cost to the Federal Government. At this time, it appears that there is no compensable interest in these pipelines.

If there is a compensable interest, the non-Federal Sponsor will receive credit toward its additional 10 percent cash payment required by Section 101(a)(2) of WRDA 86 for the value of the interest acquired, and the Corps will revoke any existing Section 10 permit and remove the line as part of construction of the navigation

improvement project, with the costs of the removal shared by the Corps and Sponsor as part of the costs of the general navigation features.

If no compensation is owed to the owner of the line, then the Corps will revoke any existing Section 10 permit and remove the line as part of construction of the navigation project, with the costs of the removal shared by the Corps and non-Federal Sponsor as part of the costs of the general navigation features. The estimated removal cost for the two four-inch pipelines is $300,000.

The non-Federal Sponsor will receive credit toward its additional 10 percent cash payment required by Section 101(a)(2) for the value of relocations provided under Section 101(a)(3) and for the costs of utility relocations borne by the Sponsor under Section 101(a)(4). Such credit will include any payment made by the Sponsor to the Corps associated with the Corps' exercise of the navigation servitude. At this time there is no indication that the exercise of navigation servitude will be required.

5. Real Estate Plan

Concern: There is no Real Estate Plan (REP).

Basis of Concern: Section 12-16(b) in Chapter 12 of ER 405-1-12 specifies that "A REP must be prepared in support of decision documents for all types of water resources projects whether full Federal or cost shared, specifically authorized or continuing authority. The level of detail required for each item described in subparagraph c below will vary depending on the scope and complexity of each project."

Significance of Concern: *High. The significance of this concern is high because it describes a fundamental problem with the project that could affect the recommendation, success, or justification of the project.*

Action Needed to Resolve the Concern: A REP consistent with the requirements of Section 12-16(c) in Chapter 12 of ER 405-1-12 should be added to the report. Per the guidance from Section 12-16(c), the Real Estate Plan must identify a number of requirements, such as "a description of the LER required for the construction, operation and maintenance of the project including those required for relocations, borrow material and dredged or excavated material disposal." The Corps recognizes that if it is doing the construction for the project, no land must be acquired for the dredging itself, but the Mitigation, Monitoring, and Adaptive Management Plan is missing a number of requirements relating to the lands needed for mitigation that would be in the REP.

Sponsor Response:

Path to resolution: A real Estate Plan will be developed based on the outcome of mitigation planning. We purposely did not include a mitigation plan because mitigation is the only aspect of the plan with any real estate effects.

Response: A Real Estate Plan (REP) is being developed that identifies and describes the lands, easements, and rights-of-way (LER) required for the construction, operation and maintenance of the proposed project, including those required for relocations and mitigation. The REP also identifies and describes the facility/utility relocations that are necessary to implement the project. Further, the REP describes the estimated LER value,

together with the estimated administrative and incidental costs attributable to providing project LER, and the acquisition process.

Review Assessment: Comment is unresolved until a Real Estate Plan in compliance with the requirements of paragraph 12-16 in Chapter 12 of ER 405-1-12 has been completed and reviewed.

Action Taken: A preliminary Real Estate Plan has been developed and is presented in Appendix E: Real Estate. The Real Estate Plan will be finalized during development of the DEIS at such time that the mitigation plan is finalized and final real estate acquisition requirements have been determined.

UNCLASSIFIED\\FOR OFFICIAL USE ONLY

Comment Report: All Comments
Project: Wilmington Harbor Navigation Improvement Project (WHNIP) Section 203 Study Review: Limited Agency Technical Review
Displaying 168 comments for the criteria specified in this report.

Id	Discipline	Section/Figure	Page Number	Line Number
8122210	Civil	Appdix A 9.2.8	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Assuming throughput will be unchanged is questionable when quantifying potential impacts to adjacent shorelines. The assumption conficts with section 2.2.1 of the economic appendix which states the intent of the improvement program is to increase throughput capacity to 1.1 million TEU's by 2025. Even if this assumption is valid for container ships, smaller vessels will be able to transit the new channel dredge dimensions at the same frequency at potentially an alignment that is closer to the shoreline which may result in increased erosion. These impacts should be evaluated in the analysis.

Response:

Additional modeling for a smaller vessel was performed and is discussed in a new Appendix A Section 9.2.8. Discussion concerning two new larger vessels replacing three current vessels was revised in Section 9.2.10 (previously Section 9.2.8) and new summary (9.2.11) and conclusion sections (9.2.12) were added.

See attached revised sections.

Reviewer: Response acceptable; proposed revision unacceptable

Explanation: The additional analyses is helpful to understand the potential impact of increased vessel traffic closer to these particular shorelines. Pushing the detailed analyses to PED is not acceptable. The environmental and economic analyses need to be fully informed of the vessel impacts to accurately describe and incorporate impacts and costs and to determine and mitigation requirements. Additionally, since the USACE did not develop the initial report pushing to PED will require duplication of effort to redevelop these models for further analyses in PED. This is cost prohibitive.

Response: Given the concern over previous erosion along these shorelines, additional detailed analyses will also be performed for these areas during development of the DEIS and / or PED phase of the project to collect field data, document the existing conditions and further quantify impacts. These analyses will then be incorporated into the design of mitigative measures for these two locations, if necessary. The mitigation and monitoring plan includes $10 million plus contingency for unspecified erosion mitigation.

8122242 Civil Appdix A 9.2.4.1 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Limiting draft to 38' without tide restrictions does not represent worst case scenario. Are there currently vessels that call on the port with tide restrictions that draft greater than 38'? If so, this case should be evaluated in the ship wake analysis. Similar, the future larger container ship should be assumed to call the port in a tide restriction condition to evaluate potential shoreline impacts.

Response:

For a feasibility level study no further drafts should need to be tested as the focus was on the differences between FWoP / Existing and FWP vessels and not to determine the worst case in the future. Additional draft conditions will be evaluated during PED to provide input to the design of mitigative efforts for the ship wakes. The scope for the PED study will be coordinated with USACE to ensure all parties concur with the vessel drafts to be tested. No revisions to the report were made.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: Since the USACE did not develop the initial report pushing to PED will require duplication of effort to redevelop these models for further analyses in PED which is cost prohibitive. Additionally, these impacts should be fully evaluated to accuratly develop project cost estimates that inform the project BCR.

Response: Given the concern over previous erosion along these shorelines, additional detailed analyses will also be performed for these areas during development of the DEIS and / or PED phase of the project to collect field data, document the existing conditions and further quantify impacts. These analyses will then be incorporated into the design of mitigative measures for these two locations, if necessary. The mitigation and monitoring plan includes $10 million plus contingency for unspecified erosion mitigation.

8122269 Civil Appdix A 9 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The included ship wake analysis and vessel traffic assumptions (which appear too low draft/frequency) appear to have sufficient wave height and shear stress increases to produce shoreline erosion within the limited analysis area included in the report. The scope of the analysis along the river deepening appears too limited and should be more inclusive of the project limits. There is no evaluation of the bird disposal islands and potential erosion to them, fate of the eroded sediment and from what I can find no inclusion of the maintenance cost associated with this erosion. Island and shoreline erosion should be more comprehensively evaluated and associated costs reflected in the cost analysis and economic evaluation.

Response:

For a feasibility level study, the areas of highest interest were evaluated. Discussion was added, though, to new Section 9.2.9 (and new summary (9.2.11) and conclusion sections (9.2.12) were added – please see attached document) regarding what could be expected at the Bird Islands based on model results at similarly located islands along the channel. Additional areas will be evaluated during PED. The scope for the PED study will be coordinated with USACE to ensure all parties concur with the areas evaluated.

See attached revised sections.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: Since the USACE did not develop the initial report pushing to PED will require duplication of effort to redevelop these models for further analyses in PED which is cost prohibitive. Additionally, these impacts should be fully evaluated to accuratly develop project cost estimates that inform the project BCR.

Response: Given the concern over previous erosion along these shorelines, additional detailed analyses will also be performed for these areas during development of the DEIS and / or PED phase of the project to collect field data, document the existing conditions and further quantify impacts. These analyses will then be incorporated into the design of mitigative measures for these two locations, if necessary. The mitigation and monitoring plan includes $10 million plus contingency for unspecified erosion mitigation.

8122271 Civil Appdix A 9.2.4.1 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The assumptions of vessel tracking is too limited. A sensitivity of vessel tracking should be included to assume worst case scenario tracks and the associated shoreline impacts rather than limiting the tracking to the modeled high traffic areas.

Response:

For this feasibility level study, the highest traffic density vessel track or a representative track based on the navigation simulations was evaluated since the purpose was to determine the differences between FWoP / Existing and FWP vessels and not to determine the worst case in the future. Additional tracks can be implemented in the PED study to provide input to the design of mitigative efforts for the ship wakes. The scope of PED study will be coordinated with the USACE. No revisions to the report were made.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: Since the USACE did not develop the initial report pushing to PED will require duplication of effort to redevelop these models for further analyses in PED which is cost prohibitive. Additionally, these impacts should be fully evaluated to accuratly develop project cost estimates that inform the project BCR.

Response: Given the concern over previous erosion along these shorelines, additional detailed analyses will also be performed for these areas during development of the DEIS and / or PED phase of the project to collect field data, document the existing conditions and further quantify impacts. These analyses will then be incorporated into the design of mitigative measures for these two locations, if necessary. The mitigation and monitoring plan includes $10 million plus contingency for unspecified erosion mitigation.

8122277 Civil Appdix A 9.2.5 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Relative comparisons of ship wake modeling within Xbeach is insufficient for this report. The model should be calibrated to existing shipping induced traffic water levels to ensure that potential impacts to shorelines along the river and bird/disposal islands are properly evaluated and captured in the cost/economic evaluations.

Response:

For the feasibility level of the study, a comparative approach was taken since the purpose was to determine the differences between FWoP / Existing and FWP vessels and not to determine the worst case in the future. During PED the ship wake modeling will be calibrated/validated based upon a scope coordinated with the USACE to provide input to the design of mitigative efforts for the ship wakes. No revisions to the report were made.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: Since the USACE did not develop the initial report pushing to PED will require duplication of effort to redevelop these models for further analyses in PED which is cost prohibitive. Additionally, these impacts should be fully evaluated to accurately develop project cost estimates that inform the project BCR. Accurately capturing shoreline impacts is also key in determining minimization and/or mitigation requirements.

Response: Given the concern over previous erosion along these shorelines, additional detailed analyses will also be performed for these areas during development of the DEIS and / or PED phase of the project to collect field data, document the existing conditions and further quantify impacts. These analyses will then be incorporated into the design of mitigative measures for these two locations, if necessary. The mitigation and monitoring plan includes $10 million plus contingency for unspecified erosion mitigation.

8122301 Civil Appdix A 8-16 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

An erosional hotspot has been a concern along Oak Island linked to the recent dredging activity from Jay Bird shoals where material was placed along Bald Head Island as part of the terminal groin construction. This spot is relatively close to the station "gencade33" where there is some modeled change in wave height with the proposed alignment. A closer look at the shoreline impacts associated with this project should be considered and potential costs associated with this should be included in the cost/economic evaluation.

Response:

Shoreline impacts on Oak Island from the proposed project are negligible as shown in Figures 8-41 and 8-42.

Revised text in Appendix A Section 8.3.8.2.

6.1.1.1

6.1.1.2 8.3.8.2 Oak Island/Caswell Beach Shoreline

The long-term shoreline change rates and annual net longshore sediment transport rates along Oak Island/Caswell Beach are presented in Figure 8-41 and Figure 8-42, respectively.

The model results indicate that the Project impacts on the Oak Island/Caswell Beach shoreline change rates (including existing "hot spots") would be negligible as compared to the baseline erosion rates; less than 0.1ft/yr difference over most of the island and a slight reduction of 0.2 ft/yr in erosion at the eastern end of Caswell Beach. The longshore sediment transport rate results also suggest minimal impacts due to the Project.

8122314 Civil Appdix A n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Recommend including information on the evaluation of the grid size used in the Delft models. Was a sensitivity of grid size alternatives or a grid convergence test conducted to ensure the appropriate grid was being used?

Response:

The model was developed with the highest feasible grid resolution, which was mainly dictated by the model accuracy. The horizontal grid is very fine to capture the subtle channel geometry with 5 m resolution across the channel. The vertical grid is also fine with 25 uniform layers and 1.28 m thickness for each layer so that the vertical distribution of velocity, salinity, and TSS can be accurately represented. Also, considering the large domain size and the 3D setup, the model resolution reached the practical limits for the runtimes.

Revised text in Appendix A Section 4.2.1.

4.2.1. Model Grid and Bathymetry

The model domain included the Cape Fear River estuary from upstream of the Cape Fear, Black, and Northeast Cape Fear Rivers to twenty miles offshore from the mouth of Cape Fear River near Southport, NC. The grid cell sizes were variable throughout the domain. In the offshore area the resolution was approximately 90 meters. For upstream Cape Fear, Black, and Northeast Cape Fear River areas, the resolution was approximately 30 meters. The resolution along the upstream river areas was selected and varied so that most of the meanders and oxbow sections were resolved as judiciously as possible. Along the channel the resolution was approximately 5 meters, which is sufficient to resolve the proposed changes in channel width and channel slopes. The vertical grid is also very fine with 25 uniform layers each having a 1.28m thickness. Considering the large 3-dimensional domain size, the model resolution reached the practical limits for runtimes while adequately capturing the processes modeled. The model domain and grid are shown in Figure 4 2. Figure 4 3 and Figure 4 4 show the model grid near Wilmington Harbor and the mouth of the Cape Fear River, respectively.

8122337 Civil Appdix A 4-29 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Applying slope to offshore boundary indicated some issue with model stability/functionality. Please expand on what slope was used, why and how this impacts model calibration.

Response:

During salinity initial calibration, simulated salinities at station ADM near the CFR mouth were consistently too fresh. As upstream stations were showing good matches, it was found that the freshwater plume offshore of the mouth was advected back into the estuary without adequate mixing. A constant alongshore current offshore of the mouth was added to the tidal boundary conditions to move the freshwater plume from the mouth and to allow ocean water with higher salinity to enter the estuary during flood tide. The imposed alongshore current mimics the effect of natural processes, which are not included in the model, such as currents due to wind and waves. These offshore processes were not included in the model as their effects are insignificant for estuarine hydrodynamics and salinities. The imposed current (intended to be approximately 0.5 m/s magnitude) was implemented by adding a small alongshore slope at the offshore boundaries. The low magnitude of the imposed slope and current had a negligible impact on the hydrodynamic calibration. The imposed slope had the intended effect of improving the salinity calibration at the most-downstream calibration point, without negatively impacting the calibration of points further upstream. The imposed slope did not create any model instabilities.

Revised text in Appendix A Section 4.3.2.1.

6.1.1.3 4.3.2.1 Offshore Boundary Conditions

The original HD model had seven open boundaries: four offshore—West, South, East, and North; and three upstream—NE Cape Fear River, Black River, and Cape Fear River. With the addition of salinity transport and

salinity boundary conditions, it was found that elimination of the North boundary (i.e. reformulating into a closed boundary) eliminated stability issues along that boundary. As the North boundary is far removed from the mouth of the Cape Fear River where the majority of tidal exchange occurs, this was considered an acceptable adjustment that would not impact the hydrodynamics within the estuary. The locations of the remaining tidal boundaries are shown in Figure 4-35. To enhance dispersion of the relatively-fresh plume of water exiting the river mouth with each ebb-tide, a constant, alongshore current offshore of the mouth was added to the tidal boundary conditions to move the freshwater plume from the mouth and to allow ocean water with higher salinity to enter the estuary during flood tide. The imposed alongshore current mimics the effect of natural processes, which are not included in the model, such as currents due to wind and waves. These offshore processes were not included in the model as their effects are insignificant for estuarine hydrodynamics and salinities. The imposed current (intended to be approximately 0.5 m/s magnitude) was implemented by adding a small alongshore slope at the offshore boundaries. The low magnitude of the imposed slope and current had a negligible impact on the hydrodynamic calibration. The imposed slope had the intended effect of improving the salinity calibration at the most-downstream calibration point, without negatively impacting the calibration of points further upstream. The imposed slope did not create any model instabilities.

8122352 Civil Appdix A 4 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The salinity report should include a comparison of existing conditions to with project conditions just after construction is completed in addition to the FwP vs. FwoP 2077 conditions with SLR. The report should address the immediate salinity impacts to the region.

Response:

One of the main purposes of the modeling efforts was to determine effect of the project on wetlands and fisheries (see Appendices F & I). Therefore, the potential SLR increases were included for the comparisons between FWoP and FwP conditions. However, salinity effects presented under the FwP with low SLR scenario are not expected to be sufficiently different than those experienced immediately after construction due to its very small magnitude (SLR = 0.34 ft) and could reasonably be used as a slightly conservative estimate.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: The reader should not be required to make these inferences and the report should include an explicit description of salinity impacts throughout the domain immediately after initial construction. These are necessary to fully evaluate potential environmental impacts to the region and mitigation requirements to offset the impacts.

Response: Concur. This analysis will be performed during development of the DEIS.

8122355 Civil Appdix A 4 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The expansion of the model domain to include tributaries along the Cape Fear River appears to be an afterthought. The salinity comparison is of limited value since there is no calibration or sampling (long duration water quality salinity measurements) within the creeks to determine existing conditions. Recommend re-evaluation of the salinity model within these areas to include proper salinity measurement campaign and model calibration.

Response:

Supplemental calibration efforts were performed for the more detailed model grid that included the tributaries to match the typical salinity levels for observed vegetation growths in the tributaries as the purpose of this effort was determine potential changes in the tidal wetland community in these areas.

Added Section 6.1.6 to Appendix A.

6.1.2

6.1.3 6.1.6 Model Calibration

The focus of this effort was to determine potential changes in the tidal wetland community composition and mitigation requirements in the tidal creeks, and thus additional calibration of salinity within the tidal creeks was performed based on matching existing vegetation patterns therein. Since wetland community composition change is influenced by average salinities over seasonal timescales, this calibration method has more relevance to the wetland community impacts than one based on short-term, synoptic salinity measurements. As discussed in Appendices F & I, surface salinity data were extracted from the year-long model simulation results and averaged for each grid cell to produce average annual surface salinity layers. Based on the grid cell average salinity values, salinity isopleths were developed to define the boundaries or thresholds between the polyhaline, mesohaline, oligohaline and tidal freshwater salinity zones in the tidal creek channels. Minor adjustments in the tidal creek widths and / or depths were then performed, if necessary, such that these isopleths had general agreement with the baseline wetland classifications. This approach thus allowed for a more accurate assessment of the potential with project changes in the tidal wetland community composition due to accurately matching the existing wetland conditions.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: The model should be calibrated based on salinity sampling within the creeks along the Cape Fear River. USACE is not aware of other salinity models successfully using the described approach. From our discussions with regional experts, there is significant concern with the accuracy of using vegitation mapping to

predict salinity values within the creeks along the Cape Fear River. Salinity changes are key to identifying environmental impacts and mitigation requirements.

Response: The additional technical analyses requested will be considered during development of the DEIS.

8122362 Civil Appdix A 8.4 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

It is unclear if modeled bathymetry includes channel slope or just deepening. Side slopes should be accurately updated.

Response:

Side slopes were accurately represented in the model bathymetry with a 5 meter horizontal and a 1.28 meter vertical grid resolution used across the channel.

Revised text in Appendix A Section 8.4.

6.2 8.4 Entrance Channel Morphology

The potential Project impacts on the entrance channel annual shoaling volumes under the Low RSLR scenario were investigated using the calibrated entrance channel morphology model.
The model setups were the same as the model calibration except for the initial model bathymetries which incorporated the FWOP and FWP channel conditions including accurately representing the proposed channel widening and deepening and the resulting side slopes. The shoaling volumes in the entrance channels were calculated after a 1-year simulation of sediment transport and morphology changes under annual average wave conditions. Tide and wave schematizations were the same as those used during model calibration.

8122368 Civil Appdix A 9.1.5 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Why is high SLR evaluated? The rest of the report evaluated low SLR, however intermediate may be more appropriate. The report should be consistent.

Response:

This is the “worst” case SLR scenario with respect to potential project impacts on groundwater resources and was used to bracket these impacts.

Revised text in Appendix A Section 9.1.5.

6.2.1 9.1.5 Simulations of Proposed Sea Level Rise and Channel Modifications

GMA used bathymetry data for the planned 47-foot deep channel improvement provided by Moffatt & Nichol to adjust the elevation of the top of layer one in the calibrated groundwater flow model. GMA identified areas where the proposed channel deepening would incise into a different aquifer or confining unit. GMA changed the model parameters in those model cells, as appropriate, to reflect the direct connection between the deepened channel with the newly exposed aquifer or confining layer materials. GMA then re-ran the calibrated model to evaluate the effects of the channel deepening. To evaluate the potential effects of sea-level rise, GMA also performed simulations of both the existing and the modified channel geometry under a

projected 2.56 foot rise in sea level. This corresponds to the Army Corps of Engineers' "high" estimate for projected sea-level rise for the year 2077 (50 years after construction is completed) and is the "worst" case SLR scenario with respect to potential project impacts on groundwater resources; thereby bracketing these potential impacts. GMA's groundwater simulations of the modified channel and sea-level rise effects indicate the following:

8123984 Hydraulics

Appendix A Section 5 Esturine Salinity and Water Quality Results

n/a

Appendix A, Page 5-1

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: The low flow river conditions used in the numeric models to evaluate water quality, estuarine salinity and tidal creek impacts of the WHNIP do not stress the system adequately. No statistics or frequency analysis of the model low flow conditions were provided. The study did not address climate change impacts on flow conditions.

Basis of Concern: The low flow conditions used in the WHNIP models were based on 2011 USGS flow records of the Cape Fear, Northeast Cape Fear, Black and Waccamaw Rivers to generate a representative one-year low flow hydrograph. The 2011 average annual flow for the rivers was a low flow year but put significantly more stress on the system. The low flow hydrographs provided in Tables 5-5, 5-6 and 5-7 may be underestimating salinity impacts in the upper reaches.

The model inflows used a varying one year hydrograph in 2-week blocks with a 42 day continuous low flow of 883 cfs (25 cms) on the Cape Fear, 106 cfs on the Black River and 141 cfs on the Northeast Cape Fear. In the fall of 2007 USGS recorded flows had a 122 day average flow of 802 cfs on the Cape Fear, 10 cfs on the Black River and 9 cfs on the Northeast Cape Fear. The UNCW Wilmington Harbor monitoring report noted the highest recorded salinity levels at the upstream stations during six months in 2007. The average flow at the Waccamaw gage from June to December in 2011 was 130 cfs while in 2007 it was 6.8 cfs.

Significance: High

Action Needed to Resolve: Recommend model simulations using 2007 low flow conditions. Results can be compared to the 2007 UNCW measured salinity dataset for verification. A frequency analysis of the low flow duration and return period should be included and impacts of climate change on drought conditions in the Cape Fear Basin should be addressed.

Response:

Concur that the flow is very low between July and October in 2007 and lower than 2011 during this time period. However, this study's goal was to evaluate wetland and vegetation response to salinity changes on a scale longer than 3-4 months. The 2007 extreme drought was not sufficiently long, while overall 2007 was a wetter year than 2011 (refer to Appendix F). The average annual flow was the main factor for selection of the representative dry year and the Year 2011 has the lowest average annual flow (refer to table 2-2 in the main report). In any case, the "typical" and "dry" year model runs were simulated using only three (high, medium, low) representative flow cases (not daily flows) for each "year." Thus, model results for Year 2007 would not

likely differ significantly from Year 2011 since the same three representative flow cases would be used; albeit in a slightly different sequence.

Additional discussion will be added to address potential climate change impacts to the project per Corps guidance.

No revisions were made to the Appendix A.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: The results in salinity changes for the tidal creeks was driven by the Waccamaw flows used in your model. The model use the 2011 flow of 130 cfs but gage records had a flow of only 6.8 cfs in 2007. This is a significant difference in flow that would have impacts on conclusions of salinity changes in the tidal creeks. Accurately evaluating salinity changes is critical to identifying environmental impacts and mitigation requirements.

Response: The salinity modeling performed for this study is sufficient for talking a "hard look" at the potential environmental effects, and it is comparable, or superior, to the modeling efforts performed on previous similar channel deepening projects. However, if additional analyses of the results are requested by the District, these will be considered during the development of the Draft EIS

8123986	Hydraulics	Appendix A 6.1.3.3 Tidal Creek Salinity	Appendix A, Page 6-4	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: Project salinity impacts within the tidal creeks might be underestimated or inadequately studied. The freshwater runoff into the modeled tidal creeks may be overestimated and may not accurately represent flows as experienced during recent droughts in southeast NC. The absence of flow and salinity data collected in the tidal creeks prevents a better estimate of freshwater inflows or calibration of tidal creek model.

Basis of Concern: The Tidal Creek Salinity Conclusion Section states salinity levels within the tidal creeks is highly sensitive to decreased freshwater flow inputs. Section 6.1.3.3 describes freshwater inflows as being redistributed from the full estuarine model within each tidal creek subbasin.
Inflows from the full model were estimated using a ratio of watershed areas with flows recorded at the Waccamaw River gage. The Waccamaw gage watershed is 680 sq mi and includes large pocosins. Relating the large Waccamaw watershed to the Lilliput 16 sq mi watershed may not be accurate. No freshwater inflow hydrographs were provided and there was also no statistical analysis for the low flow provided.

The Waccamaw 2011 USGS gage data was used to represent a low flow condition year in the project evaluation but may not have stressed the system enough compared to recent low flow years. The average flow from June to December flow at Waccamaw and in 2011 was 130 cfs and in 2007 it was 6.8 cfs while from September to December 2007 the average flow was 1.9 cfs.

Significance: High

Action Needed to Resolve: Prepare a better estimate of freshwater inflows into the tidal creeks based on a field data collection to calibrate the model. Provide a sensitively analysis of freshwater inflows to increase salinity along with statistics. Recommend running the full estuarine and tidal creek model low flow conditions based on 2007.

Response:

Supplemental calibration efforts were performed for the more detailed model grid that included the tributaries to match the typical salinity levels for observed vegetation growths in the tributaries as the purpose of this effort was determine potential changes in the tidal wetland community in these areas.

Added Section 6.1.6 to Appendix A.

6.2.2 6.1.6 Model Calibration

The focus of this effort was to determine potential changes in the tidal wetland community composition and mitigation requirements in the tidal creeks, and thus additional calibration of salinity within the tidal creeks was performed based on matching existing vegetation patterns therein. Since wetland community composition change is influenced by average salinities over seasonal timescales, this calibration method has more relevance to the wetland community impacts than one based on short-term, synoptic salinity measurements. As discussed in Appendices F & I, surface salinity data were extracted from the year-long

model simulation results and averaged for each grid cell to produce average annual surface salinity layers. Based on the grid cell average salinity values, salinity isopleths were developed to define the boundaries or thresholds between the polyhaline, mesohaline, oligohaline and tidal freshwater salinity zones in the tidal creek channels. Minor adjustments in the tidal creek widths and / or depths were then performed, if necessary, such that these isopleths had general agreement with the baseline wetland classifications. This approach thus allowed for a more accurate assessment of the potential with project changes in the tidal wetland community composition due to accurately matching the existing wetland conditions.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: There was no reference to past salinity studies or projects where this approach was proven to be defendable.

Response: The salinity modeling performed for this study is sufficient for talking a "hard look" at the potential environmental effects, and it is comparable, or superior, to the modeling efforts performed on previous similar channel deepening projects. However, if additional analyses of the results are requested by the District, these will be considered during the development of the Draft EIS

8123989 Hydraulics

Section 4.5.4 Water Quality Calibration and Validation Results

n/a

Appendix A, Page 4-116

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: The water quality model calibration was for a relatively short period, from Aug 7 to Sep 15 2017. From the calibration graphs provided in Appendix C-1 many of the calculated curves overlap only one or two measured data points. Total Kjeldahl Nitrogen and phosphate PO4 did not appear to calibrate well. The calculated dissolved oxygen did not replicate changes with the tide cycle at most reference locations. The model validation suffers from the same lack of measure data points. The lack of rigorous model calibration and validation may not have produced a model capable of evaluating the WHNIP under varying riverine flows, boundary loadings, point source loadings, climate conditions and oxygen demands.

Basis of Concern: The calibration graphs provided in Appendix C-1 show measured data for water quality parameters were available from July to mid-October 2017. The calibration was only from Aug 7 to Sep 15. Numerous calibration graphs have calculated results for the model time window available for only one measured data point. Extending the calibration run into October may have coincided with four additional measured points (example Chl a and PO4 plots). Is there an impact to the calibration statistics with a longer model run with more measured data points?

The majority of the model validation graphs in Appendix C-2 do not have a measured water quality data point that coincides with the computed model time window. The trends in the calculated results also do not accurately extend out to measured data beyond the modeled time window (see graphs on pages 938, 930, 938, 945, 949, 957 in file "WHNIP Sec 203 Appendix A Engineering Sub Appendices 06-28-19.pdf")

Significance: High.

Action Needed to Resolve: Recommend a USACE subject matter expert review the adequacy of the water quality field data collection effort and a thorough review the DEWAQ model development and calibration.

Response:

In addition to the calibration period, the water quality model was further tested for a full year under typical flow year condition as discussed in Appendix Section 4.5.4.3 and the results were presented in Appendix C-3. Moreover, model sensitivity results were presented for a dry year flow condition as discussed in Appendix Section 4.5.5; results were presented in Appendix C-4. Seasonal variations of water quality parameters over an annual time frame were captured well based on these tests combined with the calibration. Taken all together, calibration, validation, and sensitivity show that the model performs acceptably and is an appropriate tool to analyze potential impacts of the proposed project (see Appendix Section 4.5.6, Conclusion). It should be noted that former USACE ERDC employee, Dr. Mark Dortch, oversaw all water quality modeling efforts and all modeling efforts were independently reviewed by Dr. Ioannis Georgiou (formerly University of New Orleans). His comments were reviewed and addressed for his concurrence.

Appendix S "Quality Control Report" was expanded to document the independent review by Dr. Georgiou and his comments.

8124165 Civil n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Recommend including a section in the report that discusses climate change and the potential impacts to the project. Climate change should be included in the project analysis throughout the document, in particular salinity, water quality, and ship wake analysis where assumptions are made regarding future discharge rates and water levels. The most recent Corps' guidance is Engineering and Construction Bulletin No. 2018-14. http://www.wbdg.org/FFC/ARMYCOE/COEECB/ecb_2018_14.pdf

Response: A qualitative analysis of climate-impacted hydrology and any potential resulting impacts on the proposed project was prepared and added as Section 1.6 of the Engineering Appendix and a summary has been added to the Main Report section 10.7.1 Risk and Uncertainty Climate Change (provided below). Climate Change was added to the risk register in the Cost Appendix but was determined to be low risk.

10.7.1 Climate Change

The USACE's Engineering and Construction Bulletin (ECB) 2018-14, issued in September 2018, requires a qualitative climate hydrology analysis that discusses the relationships between climate, streamflows, and the USACE project, to ensure that changes in climate with the potential to significantly affect the project with respect to hydrology are identified, and the potential impacts are assessed with respect to the project over its life cycle. The USACE recommends that projects be evaluated for potential vulnerabilities to planning, engineering and operational activities affected by climate change. Navigation and associated dredging projects like the TSP may be impacted.

ECB 2018-14 was developed by the USACE as an update to ECB 2016-25, Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects. The ECB provides guidance for incorporating climate change into the USACE planning process for long term projects. The analysis was performed for this project based on literature review and two USACE tools in accordance with this guidance. The full analysis is presented in the Engineering Appendix Section 1.6: Climate Change Impacts. The conclusions of the analysis are presented below.

The project itself is not expected to have a significant effect on climate change per se. Furthermore, potential climate change impacts do not impact the decision regarding the selection of the TSP. However, the project will be affected by the results of climate change. Increases in extreme precipitation events and resulting increases in streamflow have the potential to move more nutrients and sediment into the navigation channel. This combined with increases in air temperatures has the potential to impact water quality and dissolved oxygen (DO) levels through increases in oxygen demanding materials and nuisance algal blooms. Furthermore, increases in sediment transport may increase the need for channel maintenance in the future.

Review of the model results presented in Appendix A, though, indicates that the project impacts on water quality (DO) are most pronounced during the winter months when DO is at its highest levels (and temperature is lowest). Therefore, the potential impacts from increased temperatures and nutrients will likewise have the largest relative changes during the winter months when these impacts will not further adversely affect fishery resources under the with-project conditions as compared to without-project conditions.

With respect to the increase of salinity intrusion into the estuary due to the project (as well as future RSLR), increases in streamflow will actually be a mitigating factor reducing the potential impacts of the project on wetland vegetation composition and fishery resources.

Increases in streamflow and suspended sediment will likely increase potential maintenance dredging activities. If any changes in predicted future dredging volumes are observed, these will ultimately have to be incorporated into future dredge material management practices. However, given the project itself is expected to only increase these volumes by about 10%, climate change impacts should also be relatively minor and adaptive responses can be undertaken.

8126953	Hydraulics	Section 9.2 Vessel Wakes	Appendix A, Page 9-7	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: Estimates of ship wave impacts along the riverbank might not be accurate. No field data was collected of vessel generated wave energy along the Cape Fear River. There was no calibration of the vessel wave model used to evaluate impacts of vessel waves on the shoreline.

Basis for Concern: Measured ship wakes would allow calibration and validation of model results and justify any conclusions. Erosion of the shoreline from vessel generated waves has been on ongoing problem along the lower Cape Fear River.

Significance: High

Action Needed to Resolve: Conduct a field data collection effort using a suite of pressure sensors at locations of known shoreline erosion hot-spots.

Response:

For the feasibility level of the study, a comparative approach was taken since the purpose was to determine the differences between FWoP / Existing and FWP vessels and not to determine the worst case in the future. During PED the ship wake modeling will be calibrated/validated based upon a scope coordinated with the USACE to provide input to the design of mitigative efforts for the ship wakes. No revisions to the report were made.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: See response to Comment #8122269

Response: Given the concern over previous erosion along these shorelines, additional detailed analyses will also be performed for these areas during development of the DEIS and / or PED phase of the project to collect field data, document the existing conditions and further quantify impacts. These analyses will then be incorporated into the design of mitigative measures for these two locations, if necessary. The mitigation and monitoring plan includes $10 million plus contingency for unspecified erosion mitigation.

8127461 Economics 2.4.2 36

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The report states that "Bulk commodities include fuel and chemicals (liquid bulk), wood chips and potash (dry bulk), and lumber (break bulk). Future without-project commodity tonnages are projected to be consistent with recent historical tonnages. The transport of bulk commodities is not constrained by without-project channel dimensions and will not benefit from the proposed project. Therefore, they have no effect on plan formulation or plan selection."

Please expand on this, as it is unclear as to how the determination that there will be no change in the bulk carrier fleet

was produced.

Suggest a table with projections to clarify.

Response: The determination that there will be no change in the bulk carrier fleet is based on three observations on recent historical data: (1) approximately 80% of bulk vessel calls are at drafts of less than 36 feet (2018 data) i.e., the existing fleet is not constrained, (2) there is no historic growth trend in tonnage observed in recent years, with the exception of wood pellets which are carried on vessels with design drafts in the 36 to 40-foot range (wood pellet fleet is not constrained under without-project conditions) and, (3) most of the bulk cargo transits are partial loads for which Wilmington channel depth does not constrain vessel loading. Tables showing more detailed historical bulk commodity tonnage and bulk carrier fleet operations are being added to the Economics Appendix.

8127479 Environmental 8.11.2.4 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Overflow from the dump scow is briefly mentioned under section 6.4.1 Pre-treatment Methods but is not addressed in other sections of the document.

Concern: The report needs to address impacts from overflow of scows (during loading) in different reaches of the CFR and acknowledge that overflow is not acceptable by the EPA (under Section 103) during transport to the ODMDS.

Recommendation: Address overflow of scows under section 8.11.2.4 and throughout the document as needed. Otherwise, the document should clearly state that overflow of scows during loading will not occur.

Response: Additional analysis of scow and barge overflow loading and a statement specifying adherence to EPA ocean dumping criteria during transport have been added to Section 8.11.2.4. Revised text from Section 8.11.2.4 is provided below.

8.11.2.4 Sediment Suspension and Redeposition
Although cutterhead dredges are generally associated with relatively low resuspension rates the use of hydraulic barge overflow loading for offshore transport purposes would result in relatively high sediment suspension rates. Bucket dredge and scow operations would also employ overflow loading to achieve economic loads, although the use of bucket dredges specifically for pretreated rock removal may reduce resuspension rates. Pursuant to EPA ocean dumping criteria under the Marine Protection, Research, and Sanctuaries Act (MPRSA); water and dredged material would not be permitted to overflow or spill out of scows, barges, or hoppers during transport to the ODMDS.

Reviewer: Response acceptable; proposed revision unacceptable
Explanation: Comment was not fully addressed. States that overflow will be employed but doesn't address impacts associated with high sediment suspension.

Response: Dredging will be monitored and “dredged material would not be permitted to overflow” as stated in section 8.11.3 Sediment Suspension and Redeposition.

8127481 Environmental 6.1.4, 8.25.1 145

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

It is clearly stated that advanced maintenance is not proposed for the project but then it is suggested in the avoidance and minimization measures (8.25.1).

If advanced maintenance is not proposed then it's recommended that it be removed from A&M measures (8.25.1).

Response: Concur. Advanced maintenance removed from A&M measures.

8127485 Environmental n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Channel width increases are not explained or justified in the main report.

Recommend a better explanation of how various proposed widths were determined, and how those widths compare to existing and alternative widths.

Response: Ship simulation modeling was performed to evaluate performance of the design vessel under existing channel conditions and alternative channel improvements. Please note that channel widths were determined by the physical requirements of the design vessel for safe navigation of the channel and were not determined through economic analysis. The purpose of channel widening is to provide safe navigation and not to provide economic benefits. Channel widening for the purpose of improving vessel meeting opportunities was evaluated as a planning measure and was not forwarded for more detailed analysis. Table 6-1 Existing and Proposed Channel Widths by Range presents existing and proposed widths. Section 5.3.2 Structural Measures includes the following:

Channel widening to reduce navigation restrictions: Desktop ship simulation analyses were performed to evaluate where and to what extent widening would be necessary for safe navigation of the design vessel (Engineering Sub-appendices B-1 through B-5). Full bridge simulation modeling will be performed during Preconstruction Engineering and Design (PED) to define the details of channel widening. The widening resulting from the desktop simulation is considered a “maximum” widening, which will be refined during PED. The decision to use “maximum” widening during

the feasibility phase results in conservative cost and impact estimates, which would likely be reduced after the full bridge simulation analysis to be performed in PED.

8127488 Environmental n/a n/a n/a Comment C

The recommended plan suggests thin layer placement of dredged material at the lower end of the CFR (Battery, Shellbed and Striking Islands) and shoreline placement onto Battery Island. These are not prior-approved placement areas for dredged material.

Recommendation: Ensure that costs for permitting and construction have been considered for these placement suggestions.

Response: Costs for permitting and construction are included in the mitigation cost estimate. Total mitigation costs are currently $150 million, but the mitigation plan is currently under development and these costs may change.

8127493 Economics n/a n/a n/a Comment C

General Comment- Additional explanation is required to guide the reader from the FWO Project conditions to the recommended plan. The primary concern is that the reader is unaware of the screening which has taken place up to selection of a recommended or locally preferred plan.

Increased description of the modeling results are required for explanation of the screening.

Response: Screening has been revised in response to a number of comments. Screening has been revised to include a preliminary screening of management measures (see revised preliminary screening table), a secondary incremental screening of alternative plans based on the Systems of Accounts (NED, RED, Environmental, OSE), and a final screening based on a detailed incremental economic analysis.

Response: The following table has replaced the preliminary screening table

Reviewer: Response acceptable; proposed revision unacceptable

Explanation: This is not the correct way to do screening. This is supposed to use economics environmental and technical screening criteria at this stage. Acceptable is in regards to laws and regulations, not acceptable to the end user.

Response: Section 6.2 Management Measures has been revised based on this comment.

6.2.2.1.1.1.1 Table 5-1

6.2.2.1.1.1.2 Preliminary Screening

Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Channel Deepening	Incomplete, may be combined with channel widening and berth deepening to fully realize planning objectives	Effective when combined with berth deepening	Efficient	Acceptable	Meets the primary planning objective and the NEPA purpose and need	Yes	
Stepped Channel	Incomplete	Ineffective	A stepped channel does not realize the planning objectives	Acceptable	Containerships use the full channel depth inbound and outbound, so deepening only for one direction would not address restrictions in the other direction	No	Only reduces restrictions in one direction. Both directions need reduced restrictions.

Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Turning Basin	Incomplete	Ineffective	Increasing the turning basin dimensions to more than the currently permitted basin does not realize the planning objectives	Acceptable	The turning basin as currently permitted supports the primary planning objective and NEPA purpose and need	No	Increasing the turning basin dimensions to more than the currently permitted basin is unnecessary to realize the primary planning objective and the NEPA purpose and need
Anchorage basin	Incomplete	Ineffective	Increasing the anchorage basin dimensions does not realize the planning objectives	Acceptable	The turning basin is located within the anchorage basin. Increasing the anchorage function is not needed	No	Increasing the anchorage basin dimensions does not contribute to realizing the primary planning objective and the NEPA purpose and need
Channel widening to reduce navigation restrictions	Incomplete but may be combined with channel and berth deepening to	Effective	Efficient	Acceptable	Channel widening is required for the design vessel to regularly use the channel	Yes	

Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
	achieve planning objectives						
Channel widening to accommodate vessel meeting	Incomplete but may be combined with channel and berth deepening to achieve planning objectives	Effective	Inefficient	Acceptable	Meeting of the design vessel and another post-panamax vessel is projected to occur infrequently	No	The benefits of building a meeting area for two post-panamax vessels would be less than the cost of construction and maintain the meeting area

Non-Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Reduce vessel speed	Incomplete	Ineffective	Inefficient	Acceptable	Vessel speed often cannot be reduced due to the need to maintain maneuverability and to reduce crabbing in the channel	No	Reducing vessel speed does not contribute to realizing the primary planning objective and the NEPA purpose and need
Additional tug assistance	Incomplete	Ineffective	Inefficient	Acceptable	Additional tugs are included in		Additional tug assistance does not

Non-Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
					the without and with-project conditions as required for the design vessel		contribute to realizing the primary planning objective and the NEPA purpose and need
Relocate aids to navigation	Incomplete but can be a component of channel widening.	Effective in some channel reaches	Relocating aids to navigation can be a very efficient way to widen the channel	Acceptable, but must be approved by USCG	There are channel reaches in the Entrance Channel and at Bald Head where deeper water is adjacent to the existing channel	Yes	
Tidal advantage	Incomplete	Effective	Efficient	Acceptable	Use of tidal advantage is an existing practice that is projected to be used in the without and with-project condition	Yes	

Non-Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Lightering	Incomplete	Ineffective	Inefficient	Unacceptable	Lightering containerships at sea is potentially dangerous and not practiced. Lightering other types of vessels is unnecessary because they are not restricted by existing channel conditions	No	Lightering does not contribute to realizing the primary planning objective and the NEPA purpose and need

Local service facility Improvements	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out

Local service facility Improvements	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Container Terminal Improvements	Incomplete. Must be combined with channel improvements and berth deepening	Ineffective	Inefficient	Acceptable	Terminal improvements have been completed, which are sufficient for the design vessel and planned improvements are sufficient for projected commodity flow	No	Terminal improvements beyond recently completed improvements and planned future improvements do not contribute to realizing the primary planning objective and the NEPA purpose and need
Relocate cargo terminals	Incomplete. Must be combined with channel improvements and berth deepening	Effective	Inefficient	Unacceptable	Development of a new container terminal at Southport was investigated prior to this study and it was determined to be prohibitively expensive and environmentally damaging	No	The construction cost and environmental degradation associated with a new terminal make the measure infeasible

Local service facility Improvements	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Berth Deepening	Incomplete but must be combined with channel deepening to achieve planning objectives	Effective	Efficient	Acceptable	Berth deepening is necessary for the realization of channel deepening benefits	Yes	
Bulk Terminal Improvements	Incomplete	Ineffective	Inefficient	Acceptable	Bulk vessels are not restricted under the without-project condition	No	Bulk terminal improvements do not contribute to realizing the primary objective or the NEPA purpose and need
Breakbulk/General Cargo Improvements	Incomplete	Ineffective	Inefficient	Acceptable	Breakbulk and general cargo vessels are not restricted under the without-project conditions		Breakbulk and general cargo terminal improvements do not contribute to realizing the primary objective or the NEPA purpose and need

8127509 Environmental throughout document various

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

ENVIRONMENTAL WINDOWS proposed:

"The current proposed construction schedule assumes that all dredging will be performed during the dredging work windows that occur annually from June 15 through February 15. CU blasting will be limited to October 1 through February 15" (pg 157).

"inlet and estuarine dredging operations under the TSP would adhere to the standard and anadromous fish windows, thereby avoiding peak larval ingress periods." (pg 190)

"Project construction activities would adhere to the Standard (1 April – 30 September) and Anadromous (1 February – 30 June) fish moratoria established by the NCDMF, thereby limiting the exposure of estuarine-dependent and anadromous species to potential sediment suspension effects." (pg 191)

"All dredging will be performed within the voluntary environmental windows established by the USACE (USACE 2017)." (pg 252)
Concern: It is not clearly stated in the main report what environmental window(s) applies to which portion(s) of the project. The majority of windows allow for work to occur during the months of December - February. Was this considered in the proposed construction schedule Table 6-6?
Recommend: Provide a table of windows and their purposes. The table should explain what time of year dredging and placement is to occur and in what locations. The specific type of dredge (mechanical, pipeline or hopper) to be used should also be included.

Response: Table 6.7 clarifying the proposed environmental work windows has been added to Section 6.7. All document references to “environmental windows” and “work windows” have been standardized to “environmental work windows.” Specific environmental work window dates have been added where applicable.

Example of revised standardized text from Section 8.11.1:

It is expected that the Wilmington District would continue to conduct maintenance dredging within the established fisheries environmental work window (1 August – 31 January), thus minimizing the potential for larval entrainment and other effects on anadromous and estuarine-dependent fish and invertebrate species.

Table 6-7 WHNIP Environmental Work Windows

Construction Activity	Channel Reaches	Environmental Work Window	Reason for Window
Hopper dredging with ODMDS disposal	Baldhead Shoal 2 Baldhead Shoal 3 Entrance channel extension reach	1 Dec – 15 April	Minimization of sea turtle entrainment risk
Cutterhead dredging with ODMDS disposal	Baldhead Shoal 3 Battery Island Lower Swash Snows marsh Horseshoe Shoal	Year round	NA
Cutterhead dredging with ODMDS disposal	Reaves point Lower Midnight Upper Midnight Lower Lilliput Upper Lilliput Keg Island Lower Big Island Upper Big Island Lower Brunswick Upper Brunswick Fourth East Jetty Between Reach Anchorage Basin	1 Aug – 31 Jan	Avoidance of anadromous fish spawning period
Cutterhead dredging with beach placement	Baldhead Shoal 1 Smith Island Baldhead-Caswell Southport	16 Nov - 30 April	Avoidance of sea turtle nesting season
CU blasting with drill barge and ODMDS disposal	Keg Island Lower Big Island Upper Big Island Lower Brunswick	1 Aug – 31 Jan	Avoidance of anadromous fish spawning period

Bucket dredging with ODMDS disposal	Keg Island Lower Big Island Upper Big Island Lower Brunswick	Year round	NA

8127513 Environmental 8.2 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Shoreline Erosion (Section 8.2) only takes BHI and Oak Is into account and does not consider effects on shorelines along the lower Cape Fear River.

The text indicates that larger ships will have an increased bed sheer stress x3, however it is predicted that fewer ships will call on port in the future. This prediction does not appear to be supported by data.

Concern: Deepening and widening of the channel will have a direct effect on the stability of the CFR shoreline. PPX3 vessels will eventually frequent the port as regularly as current vessels, thus creating more larger and frequent ship wakes.

Recommendation: The Main Report must take into consideration that shorelines along the CFR already experiencing erosion from ship wakes will experience greater wave energy under the proposed project which likely will affect mitigation requirements.

Reference comment 8126953 addressing vessel wakes and need for field data collection on erosion hotspots. Revisions will need to be made to the impact analysis based on this new data.

Response:

For a feasibility level study, the areas of highest interest were evaluated. Additional areas will be evaluated during PED. The scope for the PED study will be coordinated with USACE to ensure all parties concur with the areas evaluated.

Also, see responses to Comments 8122210 and 8122269. Text in Section 8.2 of the main report was revised.

Reviewer: Response acceptable; proposed revision unacceptable

Explanation: Same reasons as 8122210 and 8122269

Response: Given the concern over previous erosion along these shorelines, additional detailed analyses will also be performed for these areas during development of the DEIS and / or PED phase of the project to collect field data, document the existing conditions and further quantify impacts. These analyses will then be incorporated into the design of mitigative measures for these two locations, if necessary. The mitigation and monitoring plan includes $10 million plus contingency for unspecified erosion mitigation.

8127514 Environmental 8.10 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Soft Bottom Benthic Communities (Section 8.10) – This section gives no relevance to effects of dredging in proposed deepened or newly dredged areas. It assumes effects are temporary and that opportunistic species will return quickly; it does not assume a permanent change in habitats.

Recommendation: More documentation and emphasis on habitat loss is needed throughout the main report where

slopes are interfacing with shallow bottom habitat and where new dredging is proposed to occur.

Response: The soft bottom impact analysis sections (8.10.1 and 8.10.2) have been thoroughly revised to provide clarification of new vs existing channel dredging impacts and additional analysis of long-term effects based on a Wilmington Harbor benthic characterization and recovery study that was conducted for the 96 Harbor Act Project (Ray 1997). Changes to the impact analyses in Sections 8.10.1 and 8.10.2 have been incorporated into follow-on fisheries, EFH, and protected species impact sections as applicable. A portion of the revised soft bottom impact section is provided below.

8.10 Soft Bottom

Section 8.10.2 Effects of the TSP

Construction of the proposed Wilmington Harbor navigation channel improvements, inclusive of the channel slopes, would directly impact ~3,151 acres of soft bottom habitat over a three-year period; including ~2,226 acres of disturbed (periodically dredged) habitat within the existing channel and ~925 acres of relatively undisturbed (new dredging) habitat in the proposed channel widening and extension areas (Table 8-9). The new dredging acreages in Table 8-9 include areas between the existing channel top-of-slope and proposed channel top-of-slope, along with the channel bottom and side slopes of the offshore entrance channel extension reach. Based on projected post-construction maintenance intervals, soft bottom communities in both the existing channel and new dredging areas would experience periodic maintenance dredging disturbance every one to four years for the duration of the 50-year project. In relation to the No Action alternative, long-term maintenance of the new dredging areas under the TSP would increase the area of recurring soft bottom disturbance by ~925 acres; including 567 acres of estuarine soft bottom and 368 acres of marine softbottom.

Channel construction and subsequent maintenance events would remove benthic infaunal invertebrate communities along with the extracted sediments. The reestablishment of relatively stable benthic invertebrate communities would occur at rates similar to those described for maintenance dredging under the No Action alternative. However, the extent to which the recovered communities resemble those of pre-construction conditions in terms of taxa richness, abundance, biomass, and community structure would vary according to the extent of long-term habitat modification. Channel deepening would permanently alter the physical soft bottom environment through the conversion of relatively shallow bottom to deep bottom. At greater depths, decreased sunlight penetration and DO concentrations would be expected to have negative effects on benthic microalgal primary productivity and secondary benthic invertebrate productivity. Additionally, soft bottom habitats in the new dredging areas would be exposed to new or intensified periodic disturbances from maintenance dredging and ship prop wash.

The long-term effects of channel deepening and maintenance dredging on benthic communities in the CFR were previously investigated through a benthic characterization and recovery study that was undertaken by the USACE Waterways Experiment Station (WES) for the 96 Harbor Act Project (Ray 1997). The channel bottom, side slopes, and adjacent undisturbed flats were sampled along 14 transects, which were distributed throughout the inner and outer harbor in reaches representing 1, 2, and 3-year post-dredging conditions.

8127517 Environmental 2.10.4, 8.10.4 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The report needs to identify/classify where soft, hard, shell, SAV bottoms exist within the project area before claiming negligible effects.

Stating that "SAV beds are apparently absent" based on comms with one NCDMF employee and ground-truthing efforts outside of the impact areas does not constitute their absence from the project area.

Recommendation: Provide more/better analysis of potential shell, SAV and hard bottom habitats within the project area.

Response: Affected Environment sections that describe the distribution of soft bottom (2.10.1), hardbottom (2.10.2), shell bottom (2.10.3), and SAV (2.10.4) have been revised or expanded to clarify the distribution of the habitats within the study area. An additional figure (Fig 2-5) depicting NCDMF mapped shell bottom habitats has been added to Section 2.10.3. Revisions to the affected environment sections have been incorporated into the corresponding impact analysis sections as applicable. Applicable revised or added text from the affected environment sections is provided below.

2.10.1 Soft Bottom

Estuarine soft bottom consisting of unvegetated, unconsolidated sediments comprises all of the subtidal benthic habitat in the existing inner harbor channel reaches and proposed channel widening areas, as well as the vast majority of the subtidal benthic habitat in the overall Cape Fear River estuary. The estuary is estimated to contain ~37,800 acres of softbottom habitat in waters less than six feet deep and ~188,549 acres in waters greater than six feet (NCDEQ 2016).

Marine unconsolidated soft bottom comprises essentially all of the subtidal benthic habitat in the existing ocean entrance channel and proposed offshore extension reach, as well as the vast majority of the nearshore ocean subtidal benthic habitat within the overall study area.

2.10.2 Hardbottom

Comprehensive remote sensing hardbottom surveys of the existing navigation channel and proposed channel expansion areas were conducted in 2017 and 2018 (Appendix H: Hardbottom Resources). Analysis of the survey data did not identify any natural hardbottom habitats within the existing or proposed channel areas; however, several identified deposits of dredged rubble material along the west side of the existing channel in the old ODMDS (Figure 2-3) have relief up to 1.5 meters and support

typical hardbottom benthic assemblages (Appendix H: Hardbottom Resources). Additional loosely scattered rocks along the margins of the old ODMDS channel reach have varying degrees of sessile invertebrate coverage. Based on towed video surveys, these naturalized hardbottom features have been colonized by marine algae, tunicates (*Urochordata* spp.), echinoderms (*Arbacia punctulata*, *Luidia clathrate*) octocorals (*Leptogorgia vergulata*, *L. hebes*, *Phyllangia americana*, *Astrangia* sp.) and other sessile and motile invertebrates that are common to natural nearshore hardbottom habitats. Several fish species that are typical of nearshore hardbottoms were also observed; including black sea bass (*Centropristis striata*), sheepshead (*Archosargus probatocephalus)*, belted sand fish (*Serranus subligarius*), and pinfish (*Lagodon rhomboides*). These naturalized hardbottom habitats in the old ODMDS were the only hardbottom features identified within the existing and proposed channel areas. Prior remote sensing surveys conducted by the USACE did not identify any hardbottom habitats within the new ODMDS or a 500-meter surrounding buffer zone (USACE TBD). Figure 2-3 depicts additional study area hardbottom survey data that were compiled by the USACE during the new ODMDS site selection process. Although study area survey coverage is not comprehensive, the distribution of identified hardbottoms is restricted to areas approximately two to three miles west of the existing ocean entrance channel and proposed offshore extension reach.

2.10.3 Shell Bottom

NCDMF benthic habitat maps depict two areas of shell bottom habitat between Snows Cut and Federal Point; including one area along the western margin of the existing Upper Midnight channel reach, and a second area ~2,500 ft east of the Reaves Point channel reach (Figure 2-5). NCDMF shell bottom habitat mapping has not been completed for the remainder of the lower estuary below Federal Point; however, analyses of remote sensing survey data did not identify any structural shell bottom habitats within the existing or proposed channel areas.

2.10.4 SAV

NCDMF benthic habitat maps show small scattered patches of SAV throughout the lower Cape Fear River estuary; however, NCDMF has determined that the mapped occurrences are aerial imagery-based misidentifications of marine macroalgae (Personal communication, Ann Deaton, NCDMF Habitat Protection and Enhancement Section, 19 Feb 2019). NCDMF has concluded that SAV are absent from the lower estuary. The only confirmed SAV beds in the Cape Fear River estuary, consisting of slender naiad (*Najas gracillima*), are located in the Brunswick River near the US HWY 74/76 Bridge. Slender naiad is a species of tidal freshwater to oligohaline habitats (Brush and Hilgartner 2000). Identified beds in the Brunswick River occupy shallow subtidal flats along the shoreline of Eagle Island.

8127521 Environmental 8.2.2 n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: Erosion effects on Battery Island Audubon Sanctuary (92 acres of privately owned managed lands).

Battery Island Turn: Proposing channel realignment; from existing 500 feet to up to 1300 feet in width. A total of 191 dredging acres (111 new) and 4,000-ft radius curve. The Oct 2018 EA completed by the Wilmington District proposes widening to 750 feet with a 3,900-ft radius curve.

"Potential effects on the Battery Island shoreline and the need for mitigation would be evaluated further during the PED phase of project development." (pg 199, 212)

SLR and erosion effects on Battery Island seem significant (Section 8.2.2) and more should be proposed to protect this island that "provides nesting habitat for the largest assemblage of colonial tree-nesting wading birds in the state" (pg 43).
Recommendation: More alternatives need to be suggested for the Battery Island Turn. Additionally, the report should have a more detailed analysis of erosion effects (from dredging and ship wakes) on the island with each alternative, and mitigation/monitoring should be proposed for unavoidable impacts.

Response:

The modeling configuration was determined from the outcome of the navigation simulations. Additional alternatives can be evaluated in PED. The scope for the PED study will be coordinated with USACE to ensure all parties concur with the areas and alternatives evaluated.

Also, see responses to Comments 8122210 and 8122269. Text in Section 8.2 of the main report was revised.

Reviewer: Response acceptable; proposed revision unacceptable

Explanation: Same reasons as 8122210 and 8122269

Response: Given the concern over previous erosion along these shorelines, additional detailed analyses will also be performed for these areas during development of the DEIS and / or PED phase of the project to collect field data, document the existing conditions and further quantify impacts. These analyses will then be incorporated into the design of mitigative measures for these two locations, if necessary. The mitigation and monitoring plan includes $10 million plus contingency for unspecified erosion mitigation.

8127604 Cost Engineering COST ENGR APPENDIX n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

[Critical/Flagged.**]**

The cost appendix tables, narrative, etc. identifies all elements necessary to be considered reasonable of cost engineering requirements for a feasibility report pricing. However, no detail backup of labor, equipment, etc has been provided for review to determine what the unit price per cubic yard for dredging would be, what mob-demob costs are, what blasting cost/cy would be, etc. Therefore, this detail would be needed to review and determine the

reasonableness of overall pricing presented in the report.

Response:

USACE typically has requested that detailed cost information not be included in official documentation to avoid contractors from duplicating Engineer's Estimate. Detailed cost estimates can be sent to USACE for review if desired. No revisions to the report were made.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: "1. Appendix for public/published costs and MCACES should include only summary costs by code of accounts for each year of definable feature, investigations, design, dredging, etc. (and assumption of what year costs will begin). Appendix detail costs should not be published publicly.

2. TPCS would be developed from these code of accounts and backup costs. No TPCS has been provided that reviewer is aware of for fully funded project costs.

3. Dredge cost labor of dredge estimates is based on DEC 2017. It's not clear what economic costs were developed but should be compatible or updated. Local area factors for cost of money, dredge months available, and fuel pricing of $3.14/gallon for 2017 need to be updated/confirmed. It seems likely that 6,000 CY scows would be used vs 5,000 CY scows shown. Basis or historical production comments should be provided under separate cover or noted in excel unit price costs for rock and non-rock.

4. SPREADSHEET PROVIDED excel "VOLUMES with Distributed Areas and Dredge Areas.." will need discussion and explanation of author in order to understand relationship to DREDGING UNIT PRICING AND COSTS FOR BLASTING PER CUBIC YARD.

5. Appendix identifies blasting cost per day as $76,000/day which seems low based on historic pricing. No details were provided of what makes up this cost for labor, equipment, materials, etc. Production has not been provided per reach of rock in form of sf/day average coverage, blasts/day, relationship to pay cubic yardage vs. blast CY, and how this incorporates into excel spreadsheet of costs for PED Design, Construction Mgt S&A, ATON, and Mitigation,.

6. Additional blasting costs for pre inventory of buildings within blast zone and inventory of any damage to structures after blasting, environmental monitoring costs before, during, and after blast is not clear if costs are included. General blasting costs/CY in narrative of appendix do not match excel sheet costs/CY in "VOLUMES with Distributed Areas and Dredge Areas."

7. Appendix indicates blasted rock would be removed by bucket/barge/scow; however, excel dredge estimates provided only included pipeline to scow with disposal to ODMDS. Needs clarification.

8. If process for 203 requires a QC and ATR, the review and comments/responses should be provided under separate cover to document that process.

9. It is understood the mob and demobs have been distributed per overall mob demob; however, mob-demob should be separated by contract year along with dredging tasks to be performed. Calculations for mob and

demob need to be provided or referenced. It is unlikely a four year contract will be the method of acquisition; however, Contracting Division will decide or have input for acquisition strategy.

10. Contingency has been established through Crystal Ball as approximately 20% which seems low for this estimate as this point in time. With no true history of a deepening at this location in the last decade 30% would seem more realistic, please relook at the risk register items. "

Response: Please see the revised Appendix D: Cost Appendix.

8127606	Cost Engineering	COST SCHEDULE RISK ANALYSIS - CSRA	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Discussions with Coastal Engr, it is not clear if a risk was entered in the risk register to cover climate change and how that may impact sedimentation rates within the channel.

Response:

Climate change has been added to the risk register but was determined to be low risk.

No revision to the report was made.

8127627 Civil n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern that the shoaling analysis was limited to the anchorage basin and the entrance channel reaches of Bald Head Shoal 1, 2, and Smith Island Channel. The remainder of the project area should be included in the shoaling analysis to determine any impacts related to the proposed deepening and/or widening of these reaches. This analysis should be updated and coordinated with the DMMP to ensure sufficient capacity is available within all disposal areas and is reflective of any changes to the shoaling pattern in the modified channel.

Response:

Shoaling rates for the Anchorage Basin and the entrance channel reaches of Bald Head Shoal 1, 2, and Smith Island Channel were modeled to determine the shoaling rate changes between FwoP and FwP since the middle section of the navigation channel experiences significantly less deposition than these two locations. The shoaling rate change for the remainder of the project area, though, was included for estimating any increases in the future maintenance dredging quantities using the same calculated shoaling rate changes calculated for the Anchorage Basin and the entrance channel reaches of Bald Head Shoal 1, 2, and Smith Island Channel as a conservative estimate.

No report revisions were made.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: Comment was not fully addressed. Was an analysis of capacity of the disposal area completed to account for shoaling increases or changes?

Response: Yes, the capacity of the disposal areas was assessed. Please see section 3.6 Sufficiency Analysis in Appendix R: Dredged Material Management.

8127703 Hydrology Appendix A Section 6.1.2 Tidal C r

k Bathymetry | Appendix A, Page 6-2 | n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Review Concern: The tidal creek impacts might not be accurate. The model bathymetry for the tidal creeks was based on NOAA charts and by a trial and error process of changing the model bathymetry until the salinity model results matched the salinity level that the observed vegetation grows in (either fresh, brackish or saltwater).

Basis for Concern: Changes in salinity in the tidal creeks and adjacent wetlands would be greatly influenced by the depth and flow area of the tidal creek channels. NOAA chart 11537 had very limited detail only of Town Creek, no others. The bathymetry estimates are not accurate enough to evaluate changes in salinity of 0.5 ppt, the freshwater wetland boundary.

Significance of Concern: High.

Action Needed to Resolve: Refine the model tidal creek bathymetry with new survey data. Possible use of readily available LiDAR may reduce the amount of surveys needed of the creeks.

Response:

LIDAR data and local knowledge of creek depths were also utilized in the defining the bathymetry. Additionally, grid resolution limits the degree that all tidal creek tributaries can be incorporated into the model. Model was calibrated to match existing vegetation patterns to accurately assess the potential project impacts on vegetation and fisheries (See appendices F & I).

Section 6.1.2 in Appendix A was revised.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: There was no reference to past salinity studies or projects where this approach was proven to be defendable in determining salinity impacts with the required accuracy. A defendable approach for determining salinity impacts is critical to accurately assessing environmental impacts and developing a mitigation plan.

Response: The salinity modeling performed for this study is sufficient for talking a “hard look” at the potential environmental effects, and it is comparable, or superior, to the modeling efforts performed on previous similar channel deepening projects. However, if additional analyses of the results are requested by the District, these will be considered during the development of the Draft EIS

8127709 Civil n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern that the estuary behind Bald Head Island appears to not be included in the salinity, water quality and shoaling analyses within the report. These portions of the report should be updated with appropriate sampling and calibration to measure potential changes within the estuary that may result from deepening the harbor and/or creation of bird islands as discussed in section 1.5 of the DMMP appendix. Both of these actions will likely impact flow within the estuary.

Response:

The estuary behind Bald Head Island was included in the model. Modeling results indicate that there will be negligible impacts to this area. Average current velocities near the sloughs differ by less than 0.1 ft/sec and thus no additional sediment or erosion should occur.

No revisions to the report were made.

Reviewer: Response acceptable; proposed revision unacceptable

Explanation: Where in the report are these areas discussed?

Response: Please see section 5: Estuarine Numerical Modeling Results to see that the area in question was included in the modeling and results.

8127922 Geotechnical n/a

Main Report
-ES-13 Project Costs

n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: No costs for utility relocations. The report states none needed.
Basis of Concern: Previous harbor deepening projects had concerns about the height of the high energy power line crossing and gas line relocations.
Significance of Concern: Medium: These elements could add significant cost increase if necessary. Action Needed to Resolve Concern: Fully investigate if utility relocations are a concern.

Response: The high energy power lines are currently being raised (scheduled completion December 2019) and are included as a part of the without-project condition. The following text concerning utility relocations has been added to the Main Report. The relocations will also be addressed in the Real Estate Appendix.

6.2.3 6.1.3 Pipeline Relocation

There are four pipelines crossing the channel in the Fourth East Jetty Reach just south of Eagle Island that are owned by Exxon Mobile with the operation and maintenance of the pipelines contracted to Kinder Morgan. Two pipelines are active but currently have no commercial flow. These two pipelines are six-inch nominal diameter and are currently pressurized with nitrogen awaiting future business opportunities. Two pipelines are not active. These two pipelines are four-inch nominal diameter, filled with sea water and capped. One of the active six-inch lines is directionally drilled to a depth in excess of 68 feet MLLW and does not need to be relocated. The second active six-inch line is at a depth of ~49 feet MLLW and needs to be relocated. The two inactive four-inch lines are at a depth of ~47 feet MLLW and need to be removed. Table X provides the disposition of each pipeline.

6.2.3.1.1.1.1 Table 6-2

Pipeline Disposition

Size	Status	Depth (MLLW)	Action Needed
4-inch	Inactive	~47 feet	Remove
4-inch	Inactive	~47 feet	Remove
6-inch	Active	~49 feet	Relocate
6-inch	Active	>68 feet	No Action

Pursuant to Section 101(a) of the Water Resources Development Act of 1986 (WRDA 86), as amended, the non-Federal Sponsor is responsible for performing, or assuring the performance, of all relocations, including utility relocations, which are necessary for the navigation improvement project. All relocations, including utility relocations, are to be accomplished at no cost to the Federal Government. The estimated cost of the six-inch pipeline relocation is $2 million. This cost is included in the project cost as a 100% non-federal expense and the non-Federal Sponsor will receive equivalent credit toward its additional 10 percent cash payment required by Section 101(a)(4) of WRDA 86.

The two four-inch pipelines do not need to be relocated because they are no longer active. The non-Federal Sponsor has contacted the owner to reach a determination as to whether the owner has an interest in the existing line for which compensation is owed by the non-Federal Sponsor. If the owner has a compensable interest, the non-Federal Sponsor, as part of its requirement to provide lands, easements, and rights-of-way required for the navigation improvement project, will be responsible for acquiring this interest, at no cost to the Federal Government. At this time, it appears that there is no compensable interest in these pipelines.

If there is a compensable interest, the non-Federal Sponsor will receive credit toward its additional 10 percent cash payment required by Section 101(a)(2) of WRDA 86 for the value of the interest acquired, and the Corps will revoke any existing Section 10 permit and remove the line as part of construction of the navigation improvement project, with the costs of the removal shared by the Corps and Sponsor as part of the costs of the general navigation features.

If no compensation is owed to the owner of the line, then the Corps will revoke any existing Section 10 permit and remove the line as part of construction of the navigation project, with the costs of the removal shared by the Corps and non-Federal Sponsor as part of the costs of the general navigation features. The estimated removal cost for the two four-inch pipelines is $300,000.

The non-Federal Sponsor will receive credit toward its additional 10 percent cash payment required by Section 101(a)(2) for the value of relocations provided under Section 101(a)(3) and for the costs of utility relocations borne by the Sponsor under Section 101(a)(4). Such credit will include any payment made by the Sponsor to the Corps associated with the Corps' exercise of the navigation servitude.

8127926 Geotechnical n/a Appendix D, Table 5.1 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: Costs of mobilization is done by reaches.
Basis of Concern: Mobilization usually done by contract items. Significance of Concern:
Medium: could be incorrectly estimating the cost.
Action Needed to Resolve Concern: State why it is done by reach and verify that the cost is correct.

Response:

The costs of mobilization were estimated per contract. The mobilization costs were then equally distributed among the reaches within the seven expected contracts.

Section 4.7 added to Appendix D.

6.3 4.7 Mobilization and Demobilization

Mobilization and demobilization costs were estimated using factors including the distance the equipment must travel to reach the project, the setup time and breakdown time required for equipment, and the travel distance for the dredge plant to transit back to the home base of the dredge. These estimates were then checked with dredging bid tabs for projects on the east coast for comparison purposes. The dredge mobilization and demobilization costs were then distributed per the anticipated split in contracts, as described section 5.6 below

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8128093 Geotechnical n/a Report, Overall

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: The report does not indicate that the NC Ports Authority has coordinated with NCDOT regarding the proposed navigation improvement project.
Basis of Concern: NCDOT is developing plans for constructing a new bypass to re-route traffic traveling back-and-forth from Brunswick County. Although NCDOT has developed multiple proposals, some of their plans include new bridge construction, which will cross the Cape Fear River and may even impact Eagle Island.
Significance of Concern: Medium. NCDOT's new road and bridge might interfere with the proposed harbor deepening and widening project. Additionally, the height(s) of NCDOT's planned bridge(s) might not accommodate the larger USEC-Asia vessels.
Action Needed to Resolve Concern: NC Ports Authority should coordinate efforts with NCDOT regarding potential conflicts between harbor widening and new road and bridge construction.

Response: Construction of this bridge is not in the without-project condition because there has been no confirmation of the location or specific design elements. New air-draft restrictions (after the raising of the power lines are completed in December 2019) will be approximately 210 feet of vertical clearance above MHW. The NCSPA will continue to coordinate with NCDOT during the evolution of the bridge project.

8128099 Geotechnical n/a Report, Overall

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: The Wilmington Harbor area lacks the extensive rail infrastructure that already exists in Norfolk, VA and Savannah, GA.
Basis of Concern: The report assumes that upgrading the Wilmington harbor alone would be enough to encourage increased USEC-Asia traffic. However, rail infrastructure is an influencing factor with respect to commercial port calls.
Significance of Concern: Medium: Assuming the port is upgraded in accordance with the proposal received, USEC-Asia vessels might still avoid Wilmington in lieu of Norfolk and Savannah, which have greater railroad infrastructure for moving freight. As a result, does the NC Ports Authority plan to work with CSX to expand railroad infrastructure, along with harbor improvements?
Alternatively, what guarantee does the NC Ports Authority have that upgrading the Wilmington Harbor alone will increase USEC-Asia port calls?
Action Needed to Revolve Concern: Coordinate efforts with CSX to consider development of a rail infrastructure improvement plan that could be implemented along with the proposed harbor improvement plan.

Response: The reviewer's statement "rail infrastructure is an influencing factor with respect to commercial port calls" is accurate for many ports but is less accurate concerning Wilmington. Most of the containerized cargo using the Port of Wilmington is short haul cargo, which is not efficiently carried by rail. The rail cargo handled at Norfolk and Savannah is long-haul cargo. Nonetheless, the NCSPA is currently developing a rail plan, although success to date has been limited.

8128756 Specifications Main Report Sect. 5.3.3 133 - Main Report n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

(Document Reference: Relocating Cargo Terminals)

PDF page 167, Sec 5.3.3 of Main Report - Concern: Project alternatives have not been fully vetted or justified, primarily relocating cargo terminals. Basis of Concern: Potential for relocating terminal to a site closer to the ocean is briefly mentioned, but the measure is disregarded without a lack justifiable evidence. The expense of constructing a new terminal at Southport is not provided nor explained. This option could result in an overall reduced project improvement cost, due to a shorter length of channel to deepen. Also the lack of institutional support is not explained, so not sure if that is internal support by the Ports Authority leadership or some other institution. Needs further explanation.

Response: An alternative port at Southport was assessed in detail ten years ago. The local community was not in favor of the project. The cost of the project was well over a billion dollars – without the terminal, which does not exist. Although the main channel is shorter than the channel to Wilmington, a long access channel would need to be dredged through valuable wetlands and shallow water habitat. The environmental effects of dredging were projected to have a substantial negative impact to surrounding wetlands and primary nursing area habitat. This information will be added to the report.

8128894 Specifications Main Report Sect. 3.6.2 120 - Main Report

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

(Document Reference: Landside Transportation Costs)

PDF Page 154, Sec 3.6.2 of Main Report - Concern: Rail service transportation comparisons are not provided. Basis of Concern: Report only compares truck transportation costs for Wilmington, Charleston, and Savannah. Should be more detailed comparison in cost analysis regarding rail services from Wilmington and alternate ports, since those are typically the least cost transportation method.

Response:

Rail is not considered as a least cost alternative because it is not a least cost alternative for the short haul distances between Wilmington's hinterland and the alternative ports. Rail service from Wilmington's hinterland to either Savannah or Charleston is inefficient and more expensive than truck service because there is limited cargo in any single area within the hinterland that would be used to make up trains, which means that cargo would need to be trucked to the rail yard (double handling) and the cargo would have to wait for a sufficient volume of cargo to arrive to build the train (time delay). The port of Wilmington currently has rail service that is under-utilized, even though it is subsidized with government funds, due to the transportation inefficiencies mentioned above. Rail is an efficient alternative for cargo travelling the equivalent of multi-day truck distances, in which the inefficiencies of double handling and waiting for sufficient cargo to accumulate at the rail yard is more than offset by travelling 24 hours-a-day on a double-stacked train carrying 400 TEUs.

Reviewer: Response unacceptable; proposed revision unacceptable
Explanation: Response seemed ok, but they didn't confirm this would be included in the report.

Response: Please see Section 2.9.2 Without-project Condition Landside Transportation Costs in Appendix C: Economics.

8129023 Office of Counsel n/a Page ES-1 to ES-2

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Page ES-1 to ES-2, states: "Pursuant to Section 203 of WRDA 1986, this study is intended to determine the feasibility and extent of federal and non-federal participation in improving the federal Wilmington Harbor navigation channel, consistent with the federal objective of maximizing contributions to National Economic Development (NED), and consistent with protecting the nation's environment." This is not entirely accurate. I would suggest that this be amended, as the purpose is not related to the issue of non-federal participation ... the purpose of the feasibility report is to establish why there is a need for the project, and whether there is a federal interest sufficient for Federal participation and Congressional authorization.

Response: Text has been revised to state: "Pursuant to Section 203 of WRDA 1986, this study is intended to determine the feasibility of the project and whether there is a Federal interest sufficient for Federal participation and Congressional authorization of improvements to the federal Wilmington Harbor navigation channel, consistent with the federal objective of maximizing contributions to National Economic Development (NED), and consistent with protecting the nation's environment."

8129030 Office of Counsel Preliminary Plan Formulation Page ES-7 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Page ES-7, Preliminary Plan Formulation, states". . .Under the No Action Alternative, vessels on USEC- Asia services would not include the Port of Wilmington as a port-of-call due to the high cost (to the carrier) of light-loading at Wilmington." This seems like a drastic assumption that would be extremely restrictive in the analysis, unless it is supported with facts, especially since such vessels are currently calling.

Response:

The assumption that the two Asia services would not call at the Port of Wilmington under without-project conditions is substantiated by the enormity of the inefficiency of having vessels light-loaded on 82% of calls and be light-loaded by as much as seven feet. The vessel loading cumulative distribution functions developed for the design vessel used in the Charleston Post-45 Study, which is the same design vessel used for this study, were used to compare weighted average waterborne transportation cost per TEU per 1,000 nautical miles and also to compare the weighted average number of TEUs on board per vessel call. The draft restrictions imposed by the without-project condition channel depth at Wilmington increases the waterborne cost by 40% per TEU per 1,000 miles. The weighted average number of TEUs on board at Wilmington under without-project conditions is 2,605 TEUs fewer than the weighted average number of TEUs for the same vessel at Charleston or Savannah. Over the course of a single year, the two services would leave a combined 271,000 TEUs at the docks due to draft restrictions at Wilmington, which also affects the departure draft at the prior port and the arrival draft at the next port. It would take an additional 38 trips per year (under without-project draft restrictions), just to get this cargo to its destinations. It is economically infeasible for the design vessel to regularly call at Wilmington under without-project conditions.

The Economics Appendix displays the calculations used to support Assumption 4the discussion presented above. The risk and uncertainty associated with this assumption is addressed in a sensitivity analysis in which the design vessel calls at Wilmington in the without-project condition.

8129032 Office of Counsel Section 1.2, Page 5 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Page 5, Section 1.2, Implementation Guidance for Section 1152 of WRDA 2018, dated 2 May 2019 is not listed. This part of the report was probably written before that was issued.

Response: Text has been revised to state:

This report has been developed based on the policy guidance provided in:

- ER 1165-2-209 (04 February 2016), which provides guidance for implementation of Section 203 of WRDA 1986, as amended by Section 1014(a) of WRRDA 2014;
- Memorandum for Commanding General U.S. Army Corps of Engineers (21 June 2018): Implementation Guidance for Section 1126 of WRDA 2016 – Study of Water Resources Development Projects by Non-Federal Interests (Revised); and
- Implementation Guidance for Section 1152 of the Water Resources Development of 2018, Studies of Water Resources Development Projects by Non-Federal Interests," dated 2 May 2019.

8129033 Office of Counsel Section 1.3 Page 5 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Page 5, Section 1.3, Study Purpose and Need, Number 3 is one of several references to ". . . and more efficient cargo vessels . . ." I would delete such language, as the ships are larger - but the efficiency is related to the loading of the vessels, and is inherently related to the size of the vessel rather than a separate aspect. This is supported on Page 110, where it states ". . . these larger vessels cannot operate to their full efficiency at Wilmington, due to existing channel constraints." If the need is to accommodate the larger vessels, it will allow the vessels to be utilized accordingly (and more efficiently).

Response: Change made as requested.

8129034 Office of Counsel Section 3 and 3.1 Page 112 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Page 112, Section 3 and 3.1, respectively state: "The major difference between existing conditions and without-project conditions is the completion of many navigation and marine transport improvements which are occurring at other USEC ports and at the Port of Wilmington." and "The major differences between existing conditions and without-project conditions at the Wilmington Harbor Federal navigation project are NCSPA improvements to the turning basin at the Lower Anchorage and the raising of the dikes for increased dredged material placement capacity at the Eagle island CDF." This is not accurate. Existing conditions include projects conducted by the NCSPA - why would that stop if there is no "federal" project to make improvements? Raising the Eagle Island dike and widening the turning basin are being done regardless of whether this federal project is ever authorized, and therefore should not be excluded from the without project conditions.

Response: Concur that "Raising the Eagle Island dike and widening the turning basin are being done regardless of whether this federal project is ever authorized" These items are included in the without-project condition as the reviewer recommends.

Section 3.1.1. goes on to state ". . . The design vessel, although it may be capable of periodically transiting the without-project condition Federal navigation channel under perfect wind, current, and tide conditions with additional tug assistance, cannot use the without-project condition Federal navigation channel as standard operating procedures with the Port of Wilmington as a regular port- of-call." Is this inconsistent with the prior description of the vessel's currently calling on the port?

Response: There is no inconsistency here. The vessels currently calling at the port on a regular basis are smaller than the design vessel. There was one vessel call by a vessel that is nearly the size of the design vessel, but this was a special case with the vessel less than half-loaded with perfect weather conditions. This vessel does not call at Wilmington on a regular basis.

8129038 Office of Counsel Section 5.5 Page 135 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Page 135, Section 5.5, states "Asia cargo (imports and exports) on the ZCP and EC2 USEC-Asia services with origins and destinations in the Port of Wilmington hinterland would use alternative ports under the No Action Alternative." What makes this case, as these vessels currently call on the port. What gives them the ability to say it is all or nothing, especially in light of the documented calls? This is highly restrictive, and needs to be supportable.

Response: The statement "these vessels currently call on the port" is not fully accurate. In the future without-project condition, the vessels will be the size of the design vessel, not the size of the current vessels.

Boston, Jacksonville, and Savannah, which are the USEC prior and next ports in the port rotations for the two services (Table 2-42) are all under construction (see the FY19 USACE Construction Work Plan). These ports are still operating at their pre-construction channel depths (Boston 40 feet, Savannah 42 feet, and Jacksonville 40 feet – Table 3-1). Wilmington's 42-foot channel depth is comparable with the existing drafts at these other ports and currently operates with draft restrictions that are very similar to these other ports. When construction is completed at these other ports their channel depths will be substantially deeper than Wilmington's 42 feet (Boston 48 feet, Savannah 47 feet, and Jacksonville 47 feet – Table 3-1), which will upset the historical and existing balance of channel depths for the USEC ports on these two services. The thrust of the economic argument is that it will be economically infeasible for these two services to continue to incur the existing draft restrictions at Wilmington and thereby **NOT** take advantage of the port-construction deeper depths at Boston, Savannah, and Jacksonville. The economic justifications for the deepening projects at Boston, Savannah, and Charleston are based on carriers taking advantage of the deeper depths.

The assumption that the vessels on these two services will shift to the size of the design vessel is substantiated by historical trends in the size of vessels transiting the Panama Canal (Section 2.28.2 Existing Containership Fleet and Tables 2-38 through 2-40) which indicates that prior to the expansion of the Panama Canal, 99% of containerships on the major Asia-USEC routes were Panamax vessels and after the expansion in 2015, vessels on these services are trending towards the neo-Panamax vessels (PPX3Max).

The shift towards PPX3 Max vessels on the two Asia services in question is also supported by the historical trend in carriers reducing the transportation cost per TEU by shifting to larger more efficient vessels. Tables 2-35 and 2-36 show the decrease in transportation cost per TEU and show how the fleet is adding predominantly larger and more efficient vessels.

The shift to PPX3Max vessels on the two services is further substantiated by statements by the carriers indicating that economic forces are driving them to use PPX3Max vessels on these two services when

the USEC ports are able to handle them in an efficient manner and on a regular schedule (See Attachment to the Economics Appendix).

The risk and uncertainty associated with Assumption 3 is addressed in a sensitivity analysis in which, one of the services remains a PPX3 vessel and the second service shifts to the PPX3Max vessel.

The assumption that these vessels will not call at Wilmington under without-project conditions is substantiated by the enormity of the inefficiency of having vessels light-loaded on 82% of calls and light-loaded by as much as seven feet. The vessel loading cumulative distribution functions developed for the design vessel used in the Charleston Post-45 Study, which is the same design vessel used for this study, were used to compare weighted average waterborne transportation cost per TEU per 1,000 nautical miles and also to compare the weighted average number of TEUs on board per vessel call. The draft restrictions imposed by the without-project condition channel depth at Wilmington increases the waterborne cost by 40% per TEU per 1,000 miles. The weighted average number of TEUs on board at Wilmington under without-project conditions is 2,605 TEUs fewer than the weighted average number of TEUs for the same vessel at Charleston or Savannah. Over the course of a single year, the two services would leave a combined 271,000 TEUs at the docks due to draft restrictions at Wilmington, which also affects the departure draft at the prior port and the arrival draft at the next port. It would take an additional 38 trips per year (under without-project draft restrictions), just to get this cargo to its destinations. It is economically infeasible for the design vessel to regularly call at Wilmington under without-project conditions.

The Economics Appendix displays the calculations used to support the above assumption. The risk and uncertainty associated with this assumption is addressed in a sensitivity analysis in which the design vessel calls at Wilmington in the without-project condition.

8129040 Office of Counsel Section 6.2.2 Page 149 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Page 149, Section 6.2.2., states that rock will likely require blasting. However, it does not appear that tests have determined the extent to which blasting will be required. This is vital for mitigation and a consideration of environmental impacts.

Response:

Initial estimates (see Appendix B Update Report Figure 10) were based on prior investigations and geophysical surveys. Additional testing will be performed during PED. Cost risk was accounted for.

No report revisions were made.

Reviewer: Response acceptable; proposed revision unacceptable

Explanation: There should be some estimate as to the extent of the blasting required - even if based upon prior investigations and geophysical surveys.

Response: Please see revisions to section 6.4.3 Dredging Methods (and sub-sections) in the Main Report where the extent of blasting is discussed.

8129042 Office of Counsel Section 8.2.2 Page 164 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Page 164, Section 8.2.2., there are significant historical sites on the Cape Fear bank (is that encompassed in "Orton Point"?) nothing specifically addresses them , although it is acknowledged that 106 consultation is deferred.

Response: NRHP-listed historic sites along the CFR have been added to the Affected Environment Cultural Resources Section (2.22). Analysis of potential erosional and flooding effects on NRHP-listed historic sites has been added to the Cultural Resource impact analysis section (8.22.2). Applicable added text from these sections is provided below

8129043

Off

ice of Counsel

2.22 Cultural and Historic Resources

A number of historic sites that are listed in the National Register of Historic Places (NRHP) occur along the banks of the CFR; including the Wilmington Historic District, Brunswick Town/Fort Anderson State Historic Site, Orton Plantation, Fort Fisher State Historic Site, Southport Historic District, Fort Caswell Historic District, and the Bald Head Island Lighthouse. Additionally, the NRHP-listed USS North Carolina is berthed in the CFR opposite downtown Wilmington.

8.22.2 Effects of the TSP

A number of NRHP-listed historic sites are located along the banks of the CFR; including the USS North Carolina, Wilmington Historic District, Brunswick Town/Fort Anderson State Historic Site, Orton Plantation, Fort Fisher State Historic Site, Southport Historic District, Fort Caswell Historic District, and the Bald Head Island Lighthouse. Shoreline erosion has been an issue of concern in the vicinity of Southport Historic District, Orton Plantation, and Brunswick Town/Fort Anderson. Accordingly, modeling analyses were used to evaluate the potential effects of channel deepening and ship wakes on these areas. The model results indicate that the TSP would have negligible effects on the Southport shoreline. Along the shoreline of Orton Plantation and Brunswick Town/Fort Anderson, ship wave water levels and bed shear stress are generally projected to decrease; however, increases in bed shear stress are projected to occur at isolated locations along the shoreline. Increases in bed shear indicate the potential for increased erosion; however, the model results do not address the extent of any additional erosion that might occur. The potentially affected shoreline areas would be evaluated further during the Pre-Construction Engineering and Design (PED) phase of project development. Tidal nuisance flooding has been an ongoing issue of concern for the downtown Wilmington waterfront and Battleship Park. Under the TSP, the DELFT 3D hydrodynamic modeling results show a maximum relative MHW increase of 1.4 inches in the vicinity of downtown Wilmington and the Anchorage Basin, with progressively smaller increases through the up-estuary and down-estuary reaches above and below. MHW increases of 1.4 inches or less would not have any

significant effect on the frequency of nuisance flooding events, and thus would not be expected to adversely affect historic sites along the CFR.

Reviewer: Response unacceptable; proposed revision unacceptable
Explanation: See response to Comment #8122269 Response: Given the concern over previous erosion along these shorelines, additional detailed analyses will also be performed for these areas during development of the DEIS and / or PED phase of the project to collect field data, document the existing conditions and further quantify impacts. These analyses will then be incorporated into the design of mitigative measures for these two locations, if necessary. The mitigation and monitoring plan includes $10 million plus contingency for unspecified erosion mitigation.

Page 231, Section 8.25.1.6. the discussion of advanced maintenance seems to imply routine applicability. However, ER 1130-2-520, Para 8.2.a.(7) has some specific requirements for advanced maintenance to be utilized. This should be clarified to provide a reasonable expectation of the applicability of this. (I believe earlier in the report, it was stated that it wasn't used. Therefore, I would not sell it a big part of this.)

Response: Concur that USACE guidance lays out specific requirements for advanced maintenance. Advanced maintenance is not used by the District for the existing project. References to use of advanced maintenance in the future have been removed from the document.

8129044 Office of Counsel Section 8.25.6 Page 250 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Page 250, Section 8.25.6. concerns me because they are committing USACE to several things that potentially are long-term and expensive obligations, without authority.

Response Authority would be granted by Congress in a future WRDA, assuming that the ASA recommends the project to Congress. The wording in question is typical for a Feasibility Report. The wording can be changed if the District has specific language it prefers.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: I don't have suitable language. In order to support such recommendations, some justification should be provided.

Response: Please see revised language in section 8.25.8 Future Environmental Considerations in the Main Report.

8129046 Office of Counsel Table 9-1 Page 254 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

See Page 254, Table 9-1. The proposed costs for mitigation are grossly underestimated, and makes it difficult to assess the true costs of this project. The Table indicates Mitigation and Monitoring costs at $30,000,000.00. However, the costs of the two fish passages at lock and dams 2 and 3 alone are projected to cost almost twice that amount (see page 248).

Response: Mitigation costs will be more fully developed with USACE coordination. The current working estimate for mitigation has increased to $150 million. Potential mitigation plan components include:

- Shoreline protection at Orton Point, Brunswick Plantation, and Southport
- Fish passages at Lock and Dam 2 & 3
- Purchase and protection of environmentally sensitive property in the watershed
- Restoration of Alligator Creek
- Restoration of Bird islands, and
- Restoration of wetlands at various locations along the river.

8129047 Office of Counsel n/a Page 279 Para. h. n/a Comment Classifi

n/a

Page 279, Para. h., is this duplicative of para. f.? Relocations would only be applicable in the event of a widening, I would assume. What is to be removed? Is this talking about removal of sunken vessels?

Response: This is standard language, which may be removed by District Office of Counsel. Paragraph f refers to relocations, which are different from removals identified in paragraph h.

8129057 Project Management n/a Overall n/a Comment Classifi

Concern: The report provides the review comments of only two individuals, one discipline in planning and the other in cost estimating. There is no indication of review completed by any other reviewers nor any other Quality Control/Quality Assurance process was followed.
Basis of Concern: EC 1165-2-217 Review Policy for Civil Works and ER Planning Guidance Notebook outlines the requirements for review of all Civil Works projects including initial planning. The EC requires a Review Plan (RP) which is a component of the Project Management Plan (PMP) or Program Management Plan (PgMP).
ER 1105-2-100 also requires quality control / quality assurance (4.4).
Significance of Concern: Medium. Calls into question what level of quality control was completed when developing the feasibility study and estimates on economic benefits and costs.
Action Needed to Resolve Concern: Develop PMP and RP along with completing and documenting all QC and QA activities.

Response: We will provide PMP and RP and QA/QC documentation with the revised report. Please note that review and QA/QC is ongoing as a part of revising the document based on these and other comments.

8129059 Cost Engineering Appendix D, Cost, Section 6.6.1 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Item T-2:
Concern: Appendix D, Cost, Section 6.6.1, Item T-2 indicates that stabilization measures are needed but assigns a cost of $0. Additionally, the report lacks any discussion or evaluation on where slope stability could be a concern and what measures could be implemented to stabilize the slope. There is especially the concern in the Anchorage Basin, Between Channel, and Fourth East Jetty reaches were the channel is deepened and along with being widened (Between Channel and Fourth East Jetty) and the daylight of the dredged slope encroaches closer to Eagle Island.
Basis of Concern: The Feasibility Study needs to capture everything that would be needed for the project to be implemented.
Significance of Concern: Medium. Additional cost to construction and to PED will affect the NED plan. Implementation of stabilization measures could impact additional areas of environmental concern. Action Needed to Resolve Concern: Determine areas in which stabilization measures are likely, especially adjacent to Eagle Island.

Evaluate the mean and methods that could be used to stabilize the slopes; and estimate costs. Include this evaluation in the report along with incorporating additional costs into construction costs.

Response:

A preliminary analysis of the side slope in the Fourth East Jetty Reach indicated that widening the channel 50 ft towards the west (Eagle Island) and dredging to Elevation -50 ft-MLLW would result in the same factor of safety for stability as the existing slope. Additional analyses will, though, be performed in PED and the cost risk is accounted for.

Revised text in Appendix D, Section 6.6.1

T-2 Side Slope Stability

The side slope stability risk assumes that in some areas, the deepening of the channel will approach the side slopes, requiring stabilization measures to be required at the shore to keep the shore stable and avoid impacts to private or government property. This was modeled as a triangular distribution with a high value of $2 million to account for the possibility of stabilization measures such as riprap or a bulkhead required in select areas. The low and expected cost remains at $0, as no side slope stability measures are expected to be required given the analysis completed to date.

8129212 Civil n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Main Report, Section 4, page 15 of 337: Report states there are no utility relocations. There are known active submarine utility lines crossing Smith Island Channel and Fourth East Jetty Channel that may be impacted by the proposed channel improvements. There are also inactive submarine utility lines at the intersection of Baldhead Shoal Channel Reach 1 and Smith Island Channel that may be encountered. Potential impacts to utilities should be thoroughly evaluated in the report.

Response: The utilities at Forth East Jetty Reach have been identified. The inactive utility lines at Baldhead Shoal Channel have not been located. The following text concerning utility relocations has been added to the Main Report. The relocations will also be addressed in the Real Estate Appendix.

6.3.1 6.1.3 Pipeline Relocation

There are four pipelines crossing the channel in the Fourth East Jetty Reach just south of Eagle Island that are owned by Exxon Mobile with the operation and maintenance of the pipelines contracted to Kinder Morgan. Two pipelines are active but currently have no commercial flow. These two pipelines are six-inch nominal diameter and are currently pressurized with nitrogen awaiting future business opportunities. Two pipelines are not active.

These two pipelines are four-inch nominal diameter, filled with sea water and capped. One of the active six-inch lines is directionally drilled to a depth in excess of 68 feet MLLW and does not need to be relocated. The second active six-inch line is at a depth of ~49 feet MLLW and needs to be relocated. The two inactive four-inch lines are at a depth of ~47 feet MLLW and need to be removed. Table X provides the disposition of each pipeline.

Table 6-2
Pipeline Disposition

Size	Status	Depth (MLLW)	Action Needed
4-inch	Inactive	~47 feet	Remove
4-inch	Inactive	~47 feet	Remove
6-inch	Active	~49 feet	Relocate
6-inch	Active	>68 feet	No Action

Pursuant to Section 101(a) of the Water Resources Development Act of 1986 (WRDA 86), as amended, the non-Federal Sponsor is responsible for performing, or assuring the performance, of all relocations, including utility relocations, which are necessary for the navigation improvement project. All relocations, including utility relocations, are to be accomplished at no cost to the Federal Government. The estimated cost of the six-inch pipeline relocation is $2 million. This cost is included in the project cost as a 100% non-federal expense and the non-Federal Sponsor will receive equivalent credit toward its additional 10 percent cash payment required by Section 101(a)(4) of WRDA 86.

The two four-inch pipelines do not need to be relocated because they are no longer active. The non-Federal Sponsor has contacted the owner to reach a determination as to whether the owner has an interest in the existing line for which compensation is owed by the non-Federal Sponsor. If the owner has a compensable interest, the non-Federal Sponsor, as part of its requirement to provide lands, easements, and rights-of-way required for the navigation improvement project, will be responsible for acquiring this interest, at no cost to the Federal Government. At this time, it appears that there is no compensable interest in these pipelines.

If there is a compensable interest, the non-Federal Sponsor will receive credit toward its additional 10 percent cash payment required by Section 101(a)(2) of WRDA 86 for the value of the interest acquired, and the Corps will revoke any existing Section 10 permit and remove the line as part of construction of the navigation improvement project, with the costs of the removal shared by the Corps and Sponsor as part of the costs of the general navigation features.

If no compensation is owed to the owner of the line, then the Corps will revoke any existing Section 10 permit and remove the line as part of construction of the navigation project, with the costs of the removal shared by the Corps and non-Federal Sponsor as part of the costs of the general navigation features. The estimated removal cost for the two four-inch pipelines is $300,000.

The non-Federal Sponsor will receive credit toward its additional 10 percent cash payment required by Section 101(a)(2) for the value of relocations provided under Section 101(a)(3) and for the costs of utility relocations borne by the Sponsor under Section 101(a)(4). Such credit will include any payment made by the Sponsor to the Corps associated with the Corps' exercise of the navigation servitude.

8129218 Civil n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Drawings, Sheet C301, page 25 of 144: The typical dredge sections for non-rock and rock show various over depths that are not in agreement with paragraph 6.1.4 on page 179 of 337 and paragraph 6.3 of page 183 of 337 of the Main Report. The Main Report states that project dredging volume estimates include the required dredge depth, an additional one foot of overdepth where rock is present, and 2 feet of allowable overdepth. Typical dredge section for non-rock should be revised to show design dredge elevation and 2' allowable overdepth. Typical dredge section for rock should be revised to show design dredge elevation, 1' required overdepth and 2' allowable overdepth. It would be helpful if the table included a column for required dredging depth and another column for dredging depth including required plus allowable overdepth.

Response:

The cross-sections on Drawing Sheet C301 have been revised. The table will be revised in PED once more accurate rock locations are known.

No report revisions were made.

8129342	Hydraulics	Section 4.3.5 Salinity Calibration and Validation Results	Appendix A, Page 4-39	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Review Concern: There is concern about defending the validation of the WHNIP 3D hydrodynamic estuarine salinity model. The salinity parameter of the estuary model was validated with continuous measured data from only two water quality stations deployed along the river. The south station included bottom and surface measurements but the north upstream station collected only surface data. The validation period was short at only 5 days of continuous data. The upstream station was at Eagle Island and no measured data was used in the model validation from the upper estuary.
Basis for Concern: The short model validation period did not show how the model performed in simulating salinity transitions between spring and neap tides or during low flows. The Savannah and Mobile Harbor models were calibrated and verified over a period of months to years and were able to captured varying river discharge and tide cycles. The model calibration period was also relatively short at 16 days and showed difficulty in simulating the transition between spring to neap tides, salinity was off 5 ppt (Station KM) between measured and modeled. The WHNIP water quality model (DELWAQ) was validated with a typical flow yearlong simulation (Appendix A page 4-143) but inflows were period averaged and salinity movement in the upper estuary was not under stress conditions.
Significance of Concern: High
Action Needed to Resolve: Suggest a second year long validation of only the hydrodynamic model with salinity using recorded flows and tides for 2007. Water level and salinity measurements collected along the estuary by UNC-Wilmington as used was in the DELWAQ model can be used in the validation. 2007 represents both high flows and record low flows in the system.

Response:

The model simulates the neap/spring transition in salinities well (see ADM results - see Figure 4-39). The differences noted at KM and throughout upper estuary are due to sub-tidal, freshwater discharge trends that are not simulated as well (due to a number of issues discussed). The calibration period included a pronounced freshet due to rainfall that was not well captured by the available upstream discharge gages. However, the model is already well calibrated for tidal processes (see de-trended results), including the variation over a tidal cycle and over the spring-neap transition. While short, the validation period represents the critical period for project impacts well (where inflow is low and tidal fluctuations are the dominant driver of salinity processes).

No report revisions were made.

8129596	Economics	2.6.1	n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern. Section 2.6.1 is referenced but the question go to the overall future without project scenario referenced in multiple sections of the economic appendix. The analysis assumes that all Far East traffic will transfer from Wilmington to a nearby Port without a channel deepening.
Concern is that this assumption means the carriers make all of the decisions and have total control over where this

cargo is handled. Under this scenario the carriers are adding an additional 100 to 180 million per year, presumably all to the end of line customer. Would the end of line customer not find another carrier willing to transport these goods on smaller vessels to Wilmington at a substantially lower cost?
Response: If containerized cargo were transported like bulk cargo, the reviewer would be correct. Bulk cargo is typically transported from a single port of origin to a single destination port, often traveling empty in one direction. For example, the wood pellets exported from Wilmington depart fully loaded, arrive and offload their entire cargo at a European port, and return to Wilmington empty. In this case the carrier can select the vessel size that is most profitable for the one-way loaded trip between two ports.

Transporting containerized cargo follows a different model. For the two Asia services that call at Wilmington, the ZCP services calls at 11 different ports and the EC2 service calls at 10 different ports. This is typical for all major liner services. The carrier seeks to maximize profits for the entire route. The rationale for Asia services to drop Wilmington as a port-of-call is the enormity of the inefficiency of having vessels light-loaded on 82% of calls and light-loaded by as much as seven feet. The vessel loading cumulative distribution functions developed for the design vessel used in the Charleston Post-45 Study, which is the same design vessel used for this study, were used to compare weighted average waterborne transportation cost per TEU per 1,000 nautical miles and also to compare the weighted average number of TEUs on board per vessel call. The draft restrictions imposed by the without-project condition channel depth at Wilmington increases the waterborne cost by 40% per TEU per 1,000 miles. The weighted average number of TEUs on board at Wilmington under without-project conditions is 2,605 TEUs fewer than the weighted average number of TEUs for the same vessel at Charleston or Savannah. Over the course of a single year, the two services would leave a combined 271,000 TEUs at the docks due to draft restrictions at Wilmington, which also affects the departure draft at the prior port and the arrival draft at the next port. It would take an additional 38 trips per year (under without-project draft restrictions), just to get this cargo to its destinations. It is economically infeasible for the design vessel to regularly call at Wilmington under without-project conditions.

Similarly, using smaller vessels as recommended by the reviewer would also substantially increase costs to the carrier. If the existing fleet were to call at Wilmington under without-project conditions (PPX3 vessel loaded to 40 feet) the carriers transportation costs would be 37% higher than a PPX3Max vessel loaded to 45 feet. The PPX3 vessel under without-project draft restrictions would have 3,633 fewer containers on board the vessel, which is a 34% fewer containers than the PPX3Max vessel would carry at a 45-foot draft. The costs to the carriers calling at Wilmington under without-project conditions are increased due to the increase in unit costs and by the need for additional voyages to carry the boxes left on the dock due to draft restrictions.

The calculations supporting the discussion provided above is included in the revised economics appendix. The risk and uncertainty associated with this assumption is addressed in a sensitivity analysis in which the design vessel calls at Wilmington in the without-project condition.

Reviewer: Response unacceptable; proposed revision unacceptable
Explanation: Commenter must provide an explanation to this backcheck comment.
Response: Please see the Attachment to the Economics Appendix containing letters from six carriers on the two services in question that support the projected future without-project condition.

Basis of Concern: Next Least Costly Alternative - ER 1105-2-100, Appendix E Page E-6 Paragraph E-3.a.(4)(a)(2)(c)

Significance of Concern: High, impacts the overall benefits of the proposed deepening

Action Needed to Resolve the Concern: Analysis must demonstrate that finding another carrier that will still call on the East Coast on smaller vessel is not possible.
Response: This comment is directly addressed in the previous comment # 8129596.

8130124	Environmental Engineering	2.19	77	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Main Report: 2.19, HTRW: Please elaborate what is being done concerning the found contamination. was done about them?

Response: Information regarding the current status of site has been added to Section 2.19 and is provided below.

2.19 HTRW

In 1999, Southern Wood Piedmont consented to voluntary remediation of the contamination, and responsibility for oversight and approval of remedial actions was deferred to the State under the Superfund State Deferral Memorandum of Agreement between the USEPA Region IV and the State of North Carolina. Oversight is provided by the NC Division of Waste Management under the Inactive Hazardous Sites Program. Remedial investigations have been ongoing since the late 1990s, but the site does not have an approved remedial action plan and no remedial actions have been undertaken.

8130125	Geotechnical	6.6.1	143 & 144

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

6.1.1: Lower Anchorage basin has 4.2 mcy rock and 22.7 mcy sand and silt. 6.1.2: Dredge mat'l primarily fine to medium sands. Is this reasonable?

Response: Text clarified.

Revised text in Section 6.1.2 Main Report

6.3.2 6.1.2 Dredged Material Placement

Construction dredging material will be placed within the New Wilmington ODMDS. Dredged sediment is expected to primarily include fine- to medium-grained sand with silts from the upper channel reaches and the anchorage basin. Dredged rock is expected to be limestone, siltstone and sandstone (sedimentary rock).

8130126	Cost Engineering	6.7	153

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)** n/a

6.7: 3 years for construction seems questionable.

Response:

This encompasses four dredging windows and the cost risk is accounted for.

No revisions to the report were made.

8130130 Environmental 9.1.1 252

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

9.1.1: No indication that dredging will be done within Environmental window. Is this being assumed? Need to clarify.

Response: Table 6.7 clarifying the proposed environmental work windows has been added to Section 6.7. Section 9.1.1 has been revised to specify adherence to environmental work windows in Table 6-7. The applicable revised text from Section 9.1.1 is provided below.

9.1.1 Construction Assumptions

Prior to all dredging, sediment sampling will be performed to ensure that materials are suitable for their proposed placement locations and the appropriate permits will be obtained. All dredging will be performed within currently established USACE environmental work windows (see Section 6, Table 6-7) (USACE 2017).

Table 6-7 WHNIP Environmental Work Windows

Construction Activity	Channel Reaches	Environmental Work Window	Reason for Window
Hopper dredging with ODMDS disposal	Baldhead Shoal 2 Baldhead Shoal 3 Entrance channel extension reach	1 Dec – 15 April	Minimization of sea turtle entrainment risk
Cutterhead dredging with ODMDS disposal	Baldhead Shoal 3 Battery Island Lower Swash Snows marsh Horseshoe Shoal	Year round	NA

Cutterhead dredging with ODMDS disposal	Reaves point Lower Midnight Upper Midnight Lower Lilliput Upper Lilliput Keg Island Lower Big Island Upper Big Island Lower Brunswick Upper Brunswick Fourth East Jetty Between Reach Anchorage Basin	1 Aug – 31 Jan	Avoidance of anadromous fish spawning period
Cutterhead dredging with beach placement	Baldhead Shoal 1 Smith Island Baldhead-Caswell Southport	16 Nov - 30 April	Avoidance of sea turtle nesting season
CU blasting with drill barge and ODMDS disposal	Keg Island Lower Big Island Upper Big Island Lower Brunswick	1 Aug – 31 Jan	Avoidance of anadromous fish spawning period
Bucket dredging with ODMDS disposal	Keg Island Lower Big Island Upper Big Island Lower Brunswick	Year round	NA

8130132 Environmental Table 9-1 254

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Table 9-1 shows 20% contingency, other places indicate 23.7%. Need to clarify and be consistent.

Response:

Contingency will be updated / corrected. The appropriate contingency resulting from the SCRA is 23.7%

Reviewer: Response acceptable; proposed revision unacceptable

Explanation: No revisions were provided.

Response: Please see the revised Table 9-4 that correctly displays contingency at 21.4%

8130134 Design Team Leader Appendix A, Figure 1-3 A 1-6

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Figure 1-3 is represented in NAVD88 datum while the Main Report uses other datum. Need to be consistent.

Response:

Water levels / elevations are referenced to NAVD88 as is typical while dredging depths / channel depths are referenced to MLLW. Figures and Tables (including those in appendices) were checked to ensure applicable datum is included.

8130136 Geotechnical Appendix A, 1.3 & 2.8 A 1-3 & 2-27

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Figure 1-3 is represented in NAVD88 datum while the Main Report uses other datum. Need to be consistent.

Response:

Water levels / elevations are referenced to NAVD88 as is typical while dredging depths / channel depths are referenced to MLLW. Figures and Tables (including those in appendices) were checked to ensure applicable datum is included.

8130138 Hydraulics Appendix A, 5.4.3 A 5-24

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

1.3 & 2.8: There are no stability analyses completed or indication of slope stability concerns with the proposed deepening and widening.

Response:

The proposed channels use the same side slopes as existing. A preliminary analysis of the side slope in the Fourth East Jetty Reach indicated that widening the channel 50 ft towards the west (Eagle Island) and dredging to Elevation -50 ft-MLLW would result in the same factor of safety for stability as the existing slope. Additional analyses will, though, be performed in PED and the cost risk is accounted for.

Revised text in Appendix A Section 2.8

6.4 2.8 Geotechnical

A survey of the navigation channel was performed from April 25 to June 19, 2017. This survey collected low frequency and high frequency sub-bottom profiler data to image the shallow subsurface. The reports included in the Geotechnical Appendix evaluated the results of the survey and integrated the geophysical survey data with the existing geotechnical data to characterize the subsurface conditions along the Cape Fear River.

It is noted that the proposed channels will use the same side slopes as existing. Additionally, a preliminary analysis of the side slope in the Fourth East Jetty Reach indicated that widening the channel 50 ft towards the west (Eagle Island) and dredging to Elevation -50 ft-MLLW would result in the same factor of safety for stability as the existing slope.

8130141 Hydraulics Appendix A, 5.4.3 Appendix A 5-24

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

5.4.3: Shoaling rate in Anchorage Basin also depends on widening. Section only attributes it to deepening. Please clarify.

Response:

The anchorage basin is currently being widened as part of the turning basin expansion, so deepening is the only difference between FWP and FWOP.

Revised text in Appendix A, Section 5.4.3

5.4.3. Annual Shoaling Rate in Anchorage Basin

Additional analyses were later performed for the turning basin expansion project which determined a minimal increase (<1%) in sedimentation within the new turning basin limits. Thus, the changes presented here are representative for the channel deepening as the widening will already be completed and is assumed part of the FWoP conditions.

8130143 Geotechnical n/a Appendix B

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Figures: The existing navigation channel and proposed deepening should be included on the profiles.

Response:

Profiles were updated as requested. See Revised Geotechnical Appendix.
Reviewer: Response acceptable; proposed revision unacceptable
Explanation: No revisions were provided.

Response: Please see the revised Geotechincal Appendix (Appendix B)

8130147 Cost Engineering Appendix D 4.1 Appendix D 4-1

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

4.1: Is it a good assumption that sand dredged from the channel can be placed on the beaches?

Response: Yes but additional analyses will be performed in PED to confirm.

No revisions to the report were made.

8130149 Cost Engineering Appendix D 4.7.2 Appendix D 4-5

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

4.7.2: How was it determined that the construction oversight of 4 construction management position and $150,000 per reach for surveys was this enough? Please indicate.

Response:

USACE Construction management and survey costs were estimated from previous project experience and discussion with contractors.

No revisions to the report were made.

Reviewer: Response acceptable; proposed revision unacceptable

Explanation: No revisions were made to report. Report should be revised to include how assumptions were made.

Response: Please see the Summary of Assumptions in Appendix F of the Cost Appendix.

8130150 Cost Engineering Appendix D t-2 Appendix D 6-6

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

T-2: indicates that stabilization measures are needed but assigns a cost of $0

Response:

Risk T-2 accounts for stabilization measures needed. Based on the current analysis, no stabilization measures are required, so an expected value of $0 was included in the risk analysis. The low value considered was also $0, with the high value assigned as $2 million. The Monte Carlo Simulation then utilizes the distribution created by these values.

Revised text in Appendix D, Section 6.6.1

T-2 Side Slope Stability

The side slope stability risk assumes that in some areas, the deepening of the channel will approach the side slopes, requiring stabilization measures to be required at the shore to keep the shore stable and avoid impacts to private or government property. This was modeled as a triangular distribution with a high value of $2 million to account for the possibility of stabilization measures such as riprap or a bulkhead required in select areas. The low and expected cost remains at $0, as no side slope stability measures are expected to be required given the analysis completed to date.

8130152 Cost Engineering n/a Appendix D

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Annual maintenance costs should be considered for without project and again with project.

Response:

They are accounted for. See Section 5.4.

8130204 Economics Section 6.1.2 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: Multiple costs occurring at the port are not considered financial costs necessary to accrue the benefits calculated in the analysis. Only the cost of deepening the berth. Costs necessary for the benefits should be included as a project cost and therefore in BC ratio. There are multiple reference to work the port is completing today to

accommodate vessels that the analysis assumes will not call in the future without project scenario. While they are being implemented today, the analysis assume these costs/improvements are only necessary to achieve benefits in the future with project scenario. There is reference to the dock being approved to handle a 1,200 LOA vessels, cranes being purchased to handle larger vessels more efficiently, channel and turning basin improvements for larger vessels, etc... In this analysis, for the future without project scenario, these costs are not necessary since larger vessels will bypass Wilmington for other harbors.

Basis of Concern: Effect on net benefits

Significance of Concern: This comments has an impact on the overall project cost and net benefits claimed in the analysis.

Action needed to resolve: Include all associated costs necessary to achieve projected benefits in the NED costs section and BC ratio.
Response: The costs of terminal improvements are sunk costs incurred regardless of the findings of this feasibility study. These without-project condition terminal improvements enhance current terminal operations and efficiency regardless of improvements to the federal channel. The NCSPA is currently realizing the benefits of larger and faster cranes, improved mooring facilities, and yard configuration. Planned future improvements will further increase the efficiency of cargo flow at the terminal under without-project conditions. The costs of these improvements are not associated costs of the project.

8130217 Economics Section 2.1.2 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: It is not clear that the placement areas currently associated with Wilmington Harbor are capable of handling the additional material that will be placed there as of a result of the proposed channel improvement. How does this additional material impact the future overall cost of maintaining this harbor.

Basis of Concern: Cumulative impacts on placement areas should be taken into account to determine the overall cost of the project.

Significance of Concern: Medium. This additional material could increase the future costs of harbor maintenance.

Action Needed to resolve the concern: Confirm the placement area can handle the additional material without impacting the current cost of the O&M or include the additional cost as a project cost if is does.

Response: Section 7.1.2 describes the projected effects of additional O&M material due to the deepening project on the District's O&M plan. Placement of additional maintenance material from the channel improvement project would increase the 5-year placement cycle volume by 9.4% (Table 7-2). There is no construction material projected for placement at Eagle Island. The cost of dredging additional O&M material is included in project costs.

8131047 Geotechnical n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

(Document Reference: ES & Main Report)

At the beginning of these sections place a map of the project area that clearly defines the reaches by name. The figure 1,1 in Appendix A would be good.

Response: Change made as requested.

8131083 Geotechnical n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

(Document Reference: Main Report, para. 6.2.2)

Last sentence of first paragraph: State if the difference in rock mapping is due to lack of data or something else. If further investigation is warranted verify that is accounted for in the costs.

Response:

This is due to limited data in this area. Further investigations will be performed in PED and the cost risk is accounted for.

Revised text in Section 6.2.2 in the Main Report

6.4.1 6.2.2 Underlying Channel Rock

Geotechnical analyses were performed to map the top of rock and confirm mapping of top of rock performed previously by others. “Rock” implies that the materials have undergone lithification (deposits have been subjected to pressure, heat, and/or cementation and lithified as a rock) and exhibit physical properties (e.g. strength) of rock. “Formation” refers to materials that have been assigned to a geologic formation and been given a formation name (e.g. Castle Hayne). Formation materials may exhibit properties similar to rock or soil (e.g. dense to very dense sand or hard clay). The geotechnical analysis interpreted seismic horizons (or reflectors) and interpreted their association with formations. In the inner harbor, the interpreted seismic horizons generally correlate well with rock intervals described on exploration logs and top of rock mapping presented by others. However, in the offshore channel reaches there appear to be differences between top of rock mapping by others and the seismic horizons presented in this study due to limited data in this area.

8131088 Geotechnical n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

(Document Reference: Main Report,Table 6.5)

According to Table 6.3, the Fourth East Jetty is likely to encounter hard rock (over 4,000 psi). This should be stated here as well as the different dredging operations needed.

Response:

Based on our review of historical geotechnical data in the Fourth East Jetty Reach, materials encountered above elevation (El.) -52 ft (MLLW) are predominantly described as non-lithified materials with occasional thin layers of limestone. Two unconfined compressive strength test results were identified that have values of 4,835 and 4,924 psi. Historical borings north of Fourth East Jetty in the Turning Basin and Between Channel reaches encountered materials described as limestone that were more than 2 feet thick; however, the unconfined compressive strength test results are approximately 1,000 psi or less. Based this historical data, we infer that the cutterheads described in the report will be capable of excavating this material.

Section 6.2.2 of the main report has been revised as well as Table 6-3 and Table 6-5 (now Table 6-6) and Table 6-4 added.

6.2.2 Underlying Channel Rock

Geotechnical analyses were performed to map the top of rock and confirm mapping of top of rock performed previously by others. “Rock” implies that the materials have undergone lithification (deposits have been subjected to pressure, heat, and/or cementation and lithified as a rock) and exhibit physical properties (e.g. strength) of rock. “Formation” refers to materials that have been assigned to a geologic formation and been given a formation name (e.g. Castle Hayne). Formation materials may exhibit properties similar to rock or soil (e.g. dense to very dense sand or hard clay). The geotechnical analysis interpreted seismic horizons (or reflectors) and interpreted their association with formations. In the inner harbor, the interpreted seismic horizons generally correlate well with rock intervals described on exploration logs and top of rock mapping presented by others. However, in the offshore channel reaches there appear to be differences between top of rock mapping by others and the seismic horizons presented in this study due to limited data in this area.

As show in Table 6-4, in general, from the Turning Basin through Upper Lilliput any type of deepening from the current channel bottom is likely to encounter rock. In addition, based on the average UCS data and presumed rock thickness, deepening in the Lower Brunswick, Upper and Lower Big Island and Keg Island reaches may require blasting to remove the encountered rock. From Lower Lilliput through Horseshoe Shoal, deepening of the channel is not likely to encounter rock. From Snows Marsh to approximately the end of Battery Island, it is likely to encounter rock if any deepening were to occur, although due to a lack of strength data it is uncertain if blasting will be required to excavate the material. Southport, Baldhead-Caswell, Smith Island and Baldhead Reaches 1 & 2 are not likely to encounter rock. Deepening in Baldhead Reach 3 is interpreted to likely encounter Castle Hayne Unit B materials.

Table 6-3

Summary of Subsurface Conditions

Channel Reach	Beneficial Use Widening	Beneficial Use Deepening	Deepening Interval (ft)	Rock Encountered	Estimated Top of Rock Elevation (ft-MLLW)
Anchorage Basin	D	D	0 to 5	Likely (Peedee)	-41 to -52[a]
		D	5 to 10	Likely (Peedee)	
Between Channel	D	D	0 to 5	Likely (Peedee)	-41 to -54[a]
		D	5 to 10	Likely (Peedee)	
Fourth East Jetty	D	D	0 to 5	Likely (Peedee)	-47 to -54[a]
		D	5 to 10	Likely (Peedee)	
Upper Brunswick	C, D	C, D	0 to 5	Likely (Peedee)	-47 to -57[a]
		C, D	5 to 10	Likely (Peedee)	
Lower Brunswick	C, D	C, D	0 to 5	Likely (Peedee)	-47 to -57[a]
		C, D	5 to 10	Likely (Peedee)	
Upper Big Island	C, D	C, D	0 to 5	Likely (Castle Hayne B/A)	-45 to -50[a]
		C, D	5 to 10	Likely (Castle Hayne B/A)	
Lower Big Island	C, D	C, D	0 to 5	Likely (Castle Hayne B/A)	-47 to -52[a]
		C, D	5 to 10	Likely (Castle Hayne B/A)	
Keg Island	A, B, C, D	B, C, D	0 to 5	Likely (Peedee) (Castle Hayne A)	-47 to -67[a]
		C, D	5 to 10	Likely (Peedee) (Castle Hayne A)	
Upper Lilliput	A, B, C, D	B, C, D	0 to 5	Likely (Peedee) (Castle Hayne A)	-47 to -57[a]
		B, C, D	5 to 10	Likely (Peedee) (Castle Hayne A)	
Lower Lilliput	A, B, C, D	A, B, C, D	0 to 5	Likely (Peedee) (Castle Hayne A)	-47 to -62[a]
		A, B, C, D	5 to 10	Likely (Peedee) (Castle Hayne A)	
Upper Midnight	C, D	C, D	0 to 5	Not Likely	-56 to -65
		C, D	5 to 10	Not Likely	
Lower Midnight	B, C, D	B, C, D	0 to 5	Not Likely	-56 to -65
		B, C, D	5 to 10	Not Likely	
Reaves Point	B, C, D	B, C, D	0 to 5	Not Likely	-57 to -62
		B, C, D	5 to 10	Not Likely	
Horseshoe Shoal	A, B, C, D	A, B, C, D	0 to 5	Not Likely	-58 to -66
		A, B, C, D	5 to 10	Not Likely	
Snows Marsh	C, D	C, D	0 to 5	Likely (Peedee) (Castle Hayne A)	-47 to -59[a]

		C, D	5 to 10	Likely (Peedee) (Castle Hayne A)	
Lower Swash	B, C, D	B, C, D	0 to 5	Likely (Castle Hayne B)	-47 to -52[a]
		C, D	5 to 10	Likely (Castle Hayne B)	
Battery Island	A, B, C, D	C, D	0 to 5	Likely (Castle Hayne B)	-47 to -52[a]
		C, D	5 to 10	Likely (Castle Hayne B)	
Southport	A, B, C, D	A, B, C, D	0 to 5	Likely (Castle Hayne B)	-47 to -72[a]
		A, B, C, D	5 to 10	Likely (Castle Hayne B)	
Baldhead-Caswell	A, B, C, D	A, B, C, D	0 to 5	Not Likely	-70 to -75
		A, B, C, D	5 to 10	Not Likely	
Smith Island	A, B, C, D	B, C, D	0 to 5	Not Likely	-70 to -80
		B, C, D	5 to 10	Not Likely	
Baldhead Shoal Reach 1	A, B, C, D	B, C, D	0 to 5	Not Likely	-65 to -72
		B, C, D	5 to 10	Not Likely	
Baldhead Shoal Reach 2	A, B, C, D	B, C, D	0 to 5	Not Likely	-62 to -75
		B, C, D	5 to 10	Not Likely	
Baldhead Shoal Reach 3	C, D	C, D	0 to 5	Likely (Castle Hayne)	-46 to -58
		C, D	5 to 10	Likely (Castle Hayne)	

[a] Channel widening or excavation of the cut slope may encounter rock shallower than indicated by this range

Table 6-4
Rock Summary

Channel Reach	Rock Quality Designation (RQD)			Rock Layer Thickness (ft)			UCS (psi)		
	Ave.	Min.	Max.	Ave.	Min.	Max.	Ave.	Min.	Max.
Anchorage Basin	26	0	100	4.2	0.1	20	624	257	2,286
Between Channel	50	7	98	2.8	0.2	6	1,025	776	1,269
Fourth East Jetty	7	0	34	0.5	0.1	2.5	4,880[a]	4,835[a]	4,924[a]
Upper Brunswick	11	0	24	0.4	0.1	0.9	n/a	n/a	n/a
Lower Brunswick	13	0	34	0.6	0.2	1.2	1,666	319	4,346
Upper Big Island	43	0	99	3.3	0.1	9.7	4,258	461	12,273
Lower Big Island	69	10	99	2	0.4	14.4	4,077	252	7,462
Keg Island	26	0	46	1.9	0.2	12.2	4,956	1,384	10,167
Upper Lilliput	26	26	26	2.5	0.4	9.4	1,939	1,682	2,177
Lower Lilliput									
Upper Midnight	--	--	--	3.45	1.3	5.6	--	--	--
Lower Midnight									
Reeves Point									
Horseshoe Shoal									
Snows Marsh	15	0	63	4.6	1.3	10	2,636	2,636	2,636
Lower Swash	36	0	76	5	4	6	1,473	1,473	1,473
Battery Island	54	54	54	9	4	14.1	--	--	--
Southport	--	--	--	--	--	--	--	--	--
Baldhead-Caswell									
Smith Island									
Baldhead Shoal									
Reaches 1 and 2									

Baldhead Shoal Reach 3	41	0	100	4.3	0.2	8.5	1,239	969	1,473

[a] Only two test results are reported for this reach

Table 6-6

Summary of Dredging Equipment and Dredged Material Type

Range Name	Dredge Equipment	Dredged Material Type
Entrance	Hopper	Sand / Silt
Bald Head Shoal Reach 3	Hopper and Cutterhead	Sand / Silt / Soft Rock
Bald Head Shoal Reach 2	Hopper	Sand / Silt
Bald Head Shoal Reach 1	Cutterhead with Beach Disposal	Sand
Smith Island	Cutterhead with Beach Disposal	Sand
Bald Head - Caswell	Cutterhead with Beach Disposal	Sand
Southport	Cutterhead with Beach Disposal	Sand
Battery Island	Cutterhead with Spider Barge	Sand / Silt / Soft Rock
Lower Swash	Cutterhead with Spider Barge	Sand / Silt / Soft Rock
Snows Marsh	Cutterhead with Spider Barge	Sand / Silt / Soft Rock
Horseshoe Shoal	Cutterhead with Spider Barge	Sand
Reaves Point	Cutterhead with Spider Barge	Sand
Lower Midnight	Cutterhead with Spider Barge	Sand
Upper Midnight	Cutterhead with Spider Barge	Sand
Lower Lilliput	Cutterhead with Spider Barge	Sand / Silt / Soft Rock
Upper Lilliput	Cutterhead with Spider Barge	Sand / Silt / Soft Rock
Keg Island	Blasting Rig with Mechanical Dredge for Rock, Cutterhead with Spider Barge	Sand / Silt / Hard Rock
Lower Big Island	Blasting Rig with Mechanical Dredge for Rock, Cutterhead with Spider Barge	Sand / Silt / Hard Rock
Upper Big Island	Blasting Rig with Mechanical Dredge for Rock, Cutterhead with Spider Barge	Sand / Silt / Hard Rock
Lower Brunswick	Blasting Rig with Mechanical Dredge for Rock, Cutterhead with Spider Barge	Sand / Silt / Hard Rock
Upper Brunswick	Cutterhead with Spider Barge	Sand / Silt / Soft Rock*
Fourth East Jetty	Cutterhead with Spider Barge	Sand / Silt / Soft Rock*
Between Channel	Cutterhead with Spider Barge	Sand / Silt / Soft Rock*
Anchorage Basin	Cutterhead with Spider Barge	Sand / Silt / Soft Rock*

- These reaches may contain thin layers of hard rock which can be dredged with a cutterhead.

8131234 Geotechnical n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

(Document Reference: Appendix A, Para. 1.1)

Add verbiage that clearly states where the deepening ends at the Anchorage Basin and whether any dredging occurs from the end of the turning basin to the Cape Fear Memorial Bridge.

Response:

Revised text in Appendix A, Section 1.1

1.1 Existing Project

The channel is maintained by the United States Army Corps of Engineers (USACE) Wilmington District. Table 1-1 shows the authorized and currently maintained dimensions of the channel resulting from the Wilmington Harbor 96 Project improvements that began in the year 2000. Three main sections can be distinguished in this table: entrance channel (Baldhead Shoal to Battery Island), Wilmington Harbor (Lower Swash to Anchorage Basin), and northern reach (Cape Fear Memorial Bridge to just north of Hilton Railroad Bridge). Existing water depths along the northern reaches, however, are lower than the project dimensions, as these were not dredged due to lack of users (USACE, 2014). The reaches above the existing turning basin which is located in the lower section of the anchorage basin reach are not included in this proposed project.

8131237 Civil n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Drawings, Sheets X114, X115 & X119, pages 139,140 & 144 of 144: Vertical slopes are shown on right side of cross sections 2183+00 through 2209+00 and cross sections 2257+00 through 2270
+00. Recommend typical dredge section be added to drawings to address vertical slopes.

Response:

The vertical slopes represent the vertical steel cutoff wall located at the face of Berths 3-9 and the new cutoff wall being installed at the turning basin. No revisions to the drawings were made.

8131248 Geotechnical n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

(Document Reference: Appendix A, General)

In previous deepening contracts in the State Ports/Eagle Island area there was vibration monitoring due to the cutterhead work. This included before and after inspections and reports of structures that may be affected by the

work as well as the Eagle Island CDF. I think this should be included here and costs for the monitoring included in the cost estimate. This may also have to be done in other places along the river.

Response:

This is true only in areas where rock was present and drilling and blasting or cutterhead were used as the method to break up the rock. Cost will be accounted for.

8131254 Geotechnical n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

(Document Reference: Appendix A, General)

There is no discussion of the effects of the work on the Eagle Island CDF slope stability of the riverbank and the overall stability of the dikes. This is needed and may affect the cost estimate.

Response:

A preliminary analysis of the side slope in the Fourth East Jetty Reach indicated that widening the channel 50 ft towards the west (Eagle Island) and dredging to Elevation -50 ft-MLLW would result in the same factor of safety for stability as the existing slope. Additional analyses will, though, be performed in PED and the cost risk is accounted for.

Revised text in Appendix A Section 2.8

2.8 Geotechnical

A survey of the navigation channel was performed from April 25 to June 19, 2017. This survey collected low frequency and high frequency sub-bottom profiler data to image the shallow subsurface. The reports included in the Geotechnical Appendix evaluated the results of the survey and integrated the geophysical survey data with the existing geotechnical data to characterize the subsurface conditions along the Cape Fear River.

It is noted that the proposed channels will use the same side slopes as existing. Additionally, a preliminary analysis of the side slope in the Fourth East Jetty Reach indicated that widening the channel 50 ft towards the west (Eagle Island) and dredging to Elevation -50 ft-MLLW would result in the same factor of safety for stability as the existing slope.

8131262 Geotechnical n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

(Document Reference: Appendix D, General)

Previous deepening of the river took well over 5 years to complete. The 3 year time frame appears to be very optimistic. Variables such as dredge windows and dredge equipment availability are important factors. The longer dredging period obviously has cost implications that may not be factored into the risk summary.

Response: This encompasses four dredging windows and the cost risk is accounted for.

No revisions to the report were made.

8131264 Geotechnical n/a n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

(Document Reference: Appendix D, Para. 5.6)

For better correlation between this page and the Project Schedule in sub-Appendix B, include the contract number with the year.

Response: This information is included in the schedule in the mobilization line item.

No revisions to the report were made.

8131625 Geotechnical Executive Summary n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

According to an "Ocean Insights" article from September 2018, the USEC-Asia network typically involves port calls in New York, Norfolk, and Savannah - in that order. Thus, it seems that information from the article conflicts with text in the second paragraph beneath "Alternative Plan Evaluation..." The executive summary states (p. 10), "Savannah is the most likely alternative port...because Savannah comes before Charleston in the port rotation..." Please confirm the accuracy of this statement or make appropriate corrections. Based on port rotation it may be more appropriate to compare Wilmington to Norfolk, instead of comparing Wilmington to Savannah.

Response: The reviewer is directed to table 2-42 which is the actual schedule and order of port calls used by the carriers. Please note that Norfolk is not in the port rotations for these services. The analysis assumes that these two services, which are the only two services from Asia to Wilmington would maintain the existing port rotation under without-project conditions (less Wilmington) and under with-project conditions (with Wilmington).

8131628 Geotechnical Section 2.1 12

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The third paragraph under section 2.1 states, "...sands are a major component of suspended sediment..." However, sands are generally constitute bed load material and are only part of suspended resulting from storm-induced water velocities and resultant shear stress along the stream bed. Although true that sands are lost to the flood plain during such events, sandy material is generally deposited with the naturally-occurring stream levees, where the subaerial plain meets the stream channel.

Response: The intent here was simply to demonstrate that although substantial quantities of sand are transported by Piedmont tributaries of the CFR, the sand is being lost before it reaches the lower CFR estuary. “Suspended sediment load” has been revised to “sediment load.” “Floodplain storage” and “recent overbank deposits on floodplains” are the terms used by Benedetti et al. (2006) to describe sand losses during transport.

2.1 Geology, Soils, and Sediments

According to Benedetti et al. (2006), the combined annual suspended sediment yield of the Black River and Northeast Cape Fear River subbasins probably does not exceed 22,500 cy. Although sands are a major component of sediment loads in the Piedmont tributaries of the upper Cape Fear River basin, the majority of the sand fraction is lost to floodplain storage and deposition behind dams during fluvial transport across the Coastal Plain.

8131632 Geotechnical Sections 2.1, 6.2 13, 14, 149

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please confirm that appropriateness of "Turritellid" as actually being a formal Formation name. The term "turritellid" seems to be an adjective, which refers to gastropod fossils (genus Turitella) within limestone. Additionally, the "Turritellid Limestone" is not a formally-recognized formation name, according to the USGS and the Association of State Geologists lexicon database (https://ngmdb.usgs.gov/Geolex/search), while the Castle Hayne and Peedee are. Finally, some literature indicates that the "Turritellid Limestone" may actually be part of the Castle Hayne or Peedee Formation.

Response:

Reference to Turrilettid has been deleted from both sections. See Response to Comment 8131088 for revised text.

8131634 Geotechnical Table 2.1 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

A lot of information has already been compiled regarding the top of rock in the Cape Fear River. As a result, please delete all phrases of "At or near surface" and list the top of rock, or the depth ranges for the top of rock for each channel reach, where known. You may consult USACE boring logs, as well as your own Geotechnical Appendix for this information.

Response: Concur. Please see the response to comment #8131088. Table 6-3, as identified in comment #8131088 will be referenced and the phases referred to have been replaced with more accurate descriptions. Revised Table 2-1

Table 2-1
Geology and Sediment Characteristics of the
Wilmington Harbor Navigation Channel

Channel Reach	Length (ft)	Uppermost Formation	Top of Rock (Ft MLLW)	Surficial Sediments
N. Project Limit - Hilton RR Brg	6,718	Peedee		Thin layer of loose sediment over silty/gravelly sand
Hilton RR Brg - Isabel Holmes Brg	2559	Peedee		Thin layer of loose sediment over silty/gravelly sand
Isabel Holmes Brg - Memorial Brg	9,573	Peedee		Thin layer of silty/gravelly sand
Anchorage Basin	11.651	Peedee	-41 to -52	Thin layer of silty/gravelly sand in channel center, thick clay/silt layer on channel flanks
Between	2,827	Peedee	-41 to -54	Thin layer of silt in channel center, thick clay/silt layer on channel flanks
Fourth East Jetty	8,852	Peedee	-47 to -54	Interbedded layers of fine material and sand on channel flanks
Upper Brunswick	4,079	Peedee	-47 to -57	Clay layer over sand on channel flanks
Lower Brunswick	8,161	Peedee	-47 to -55	Thin silt layer over sand on channel flanks
Upper Big Island	3,533	Castle Hayne	-45 to -50	Layer of fine material over sand on channel flanks
Lower Big Island	3,616	Castle Hayne	-47 to -52	Silty/gravelly sand on channel flanks
Keg Island	7,726	Peedee		Silty sand
Upper Lilliput	10,217	Peedee		Thin layer of fine material over silty sand
Lower Lilliput	10,825	Peedee		Thin layer of fine material over silty sand
Upper Midnight	13,736	Peedee		Layer of fine material over sand
Lower Midnight	8,241	Peedee		Layer of fine material over sand
Reaves Point	6,531	Peedee		Sand w/occasional interbedded fine-grained material
Horseshoe Shoal	6,102	Peedee		Sand
Snows Marsh	15,775	Peedee	-47 to -59	Thin layer of silty fine sand
Lower Swash	9,789	Castle Hayne		Sand w/occasional interbedded fine-grained material
Battery Island	2,589	Castle Hayne	-47 to -52	Sand to clayey sand on channel flanks
Southport	5,363			No data
Baldhead-Caswell	1,921			No data
Smith Island	5,100			No data
Baldhead Shoal Reach 1	4,500	Turritellid Limestone		Interbedded deposits of fine-grained material and sand

Baldhead Shoal Reach 2	4,342	Turritellid Limestone	No data
Baldhead Shoal Reach 3	26,658	Castle Hayne	No data
Total (Feet)	**200,984**		
Total (Miles)	**38.1**		

Source: Fugro 2017

8131635 Geotechnical Section 2.3 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

This section indicates that readings from one monitoring well shows a regional loss of groundwater head. However, multiple monitoring wells, with appropriate spatial distribution are needed to confirm this statement. Please add verbiage some tentative verbiage to explain that while one monitoring well seems to show this trend, other wells are needed for confirmation.

Response:

This section discusses Baseline Conditions. New monitoring wells were installed as discussed in Appendix A; sub-Appendices E-1 and E-2.

No revisions to the report were made.

8131637 Geotechnical Table 2-2 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please present these data on a graph. Seeing graphical data trends will be more meaningful than the current table.

Response: Graph has been added.

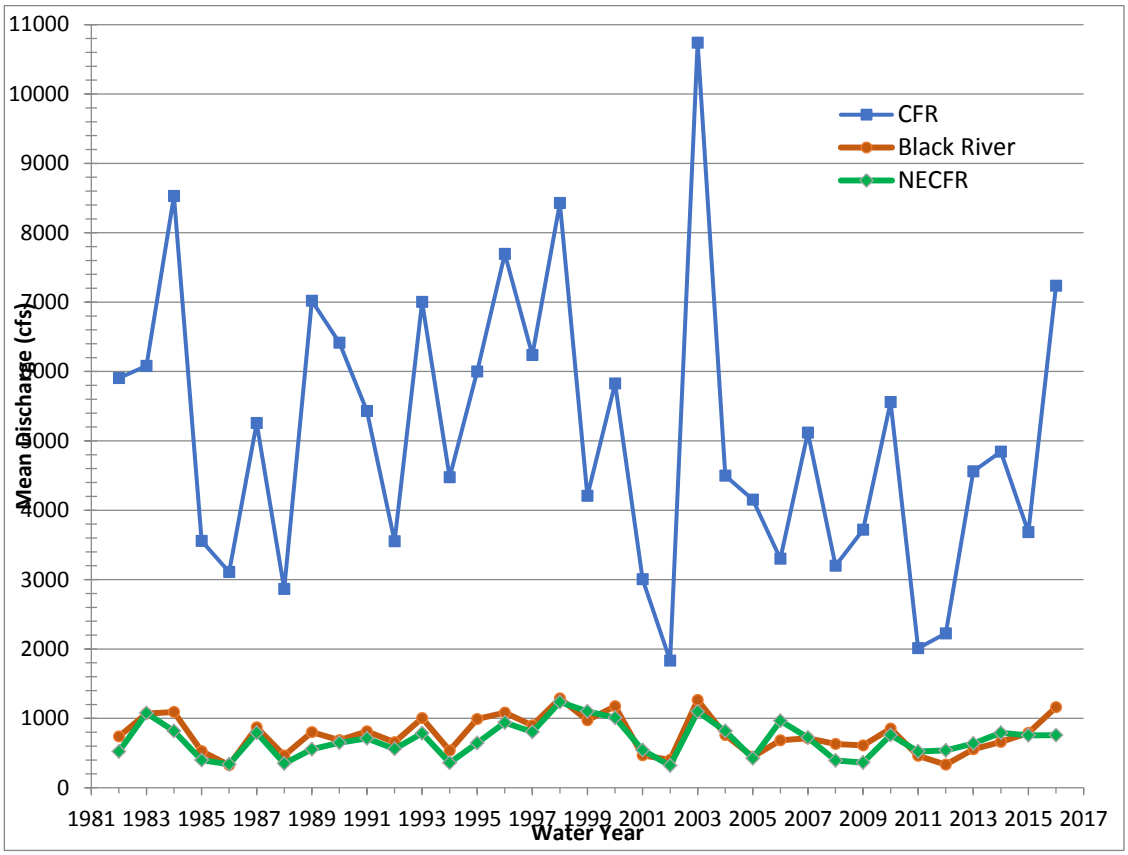


Figure 2-2. Mean Annual Discharge at USGS Gage Stations on the Cape Fear River, Northeast Cape Fear River, and Black River.

8131639 Geotechnical 6.1.1 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The second paragraph in this section mentions the extension of the seaward portion of the channel to extend 48,000 ft. offshore. First, please consider changing 48,000 ft. into units of nautical or statute miles. Second, please note that vibracoring will be needed in this specific reach, due to a lack of coring data.

Response:

Text will be revised and it is noted that additional geotechnical investigations will be conducted during PED.

Revised Section 6.1.1 of Main Report

6.1.1 Dredging the Federal Navigation Channel

Dredging the Federal navigation channel from its currently authorized and maintained depth of -42 ft MLLW in the river and -44 ft MLLW beginning at the Battery Island Reach and extending offshore to new depths of -47 ft MLLW in the river and -49 ft MLLW beginning at the Battery Island Reach and extending offshore.

The 47-ft MLLW depth evaluated for this study applies to the Federal navigation channel at the Lower Swash range and all ranges up to and including the Lower Anchorage. From the Battery Island Range to the pilot station, the depth will be increased to -49 ft MLLW to allow for adequate under keel clearance in areas affected by ocean

waves. The improved channel will extend 48,000 feet (~9.1 miles) out to sea from the junction with Baldhead Reach 3 to reach water that is consistently deeper than the maintained channel depth of -49 ft MLLW. The range offshore of the current pilot boarding station (Sta 490+00) will have a heading of approximately 30° (inbound), which, is approximately 16° shifted from Bald Head Shoal Reach 3 (14°). The purpose of this heading change is to reach deeper water in the most direct path and reduce dredging costs. The Cape Fear River Pilots have been consulted and approve of this realignment.

8131640 Geotechnical 6.1.2 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The text mentions that siltstone and sandstone is expected to be encountered during dredging operations. However, historical USACE coring data show that limestone is also prevalent. This carbonate material will likely be harder to excavate than unconsolidated sediments and should be considered.

Response: Text revised

Revised text in Section 6.1.2 Main Report

6.1.2 Dredged Material Placement

Construction dredging material will be placed within the New Wilmington ODMDS. Dredged sediment is expected to primarily include fine- to medium-grained sand with silts from the upper channel reaches and the anchorage basin. Dredged rock is expected to be limestone, siltstone and sandstone (sedimentary rock).

8131643 Geotechnical Table 6-3 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please add two columns to this table. One column would show the proposed depth for each channel reach, while the other would show the expected top of rock for each channel reach.

Response:

Section 6.2.2 of the main report has been revised as well as Table 6-3 and Table 6-5 (now Table 6-6) and Table 6-4 added. See Comment 8131088 response for revisions.

8131644 Geotechnical Section 7 155

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please add a figure to this section showing the new ODMDS location, as well as the current ODMDS bathymetry.

Response: The ODMDS is called the “New” Wilmington ODMDS. It has been in service for about 10 years. A new ODMDS is not required for this project. The existing ODMDS has sufficient capacity as detailed in Appendix R: Dredged Material Management.

8131647 Geotechnical Section 7.2.1. 158

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The first sentence in the third paragraph states, "Safety zones will be established and enforced by contractor-provided patrol boats." However, while contractor boat crews might have the ability to advise mariners to stay clear of construction work, these personnel lack the capability to compel safety zone compliance. Thus, does the NC Ports Authority have a plan in place to request and receive USCG law enforcement support, should the need arise?

Response:

Past projects have had both safety/security boats, similar to what we have recommended. USCG will be aware of the project and will maintain jurisdiction for compliance to safety zones.

No revision to the report was made.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: The text still states that the contractor will "enforce" the safety zone, which the contractor cannot legally do. Please revise text to state that the contractor will have a COMMS plan in place to contact local or federal law enforcement (i.e. USCG, etc.) to provide safety zone enforcement when necessary.

Response: Text in section 7.2.1 of the Main Report has been revised as follows: Safety zones will be established and the contractor will have a COMMS plan in place to contact local or federal law enforcement (i.e. USCG, etc.) to provide safety zone enforcement when necessary.

8131653 Geotechnical Section 9.1.1 252

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The text mentions that "...sediment sampling will be performed to ensure that materials are suitable for their proposed placement locations..." This step is critical. As a result, sampling should be specifically planned in the proposed offshore entrance channel extension where data area lacking. Additional sampling may also be needed in the more inland reaches too.

Response:

Concur. Additional geotechnical investigations will be conducted in PED.

No revisions to the text were made.

8131656 Geotechnical Section 10 260

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

A figure showing the Cape Fear River and the channel reaches should be included in this section. Although Figure 1-1 is provided, it would be helpful to repeat a similar figure within Section 10. This figure should also show the currently authorized depth of each reach, as well as the proposed authorized depth of each reach.

Response: The figure has been provided as requested.

8131659 Geotechnical Section 10.1.2 261

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The text mentions that siltstone and sandstone is expected to be encountered during dredging operations. However, historical USACE coring data show that limestone is also prevalent. This carbonate material will likely be harder to excavate than unconsolidated sediments and should be considered.

Response: Text clarified.

Revised text in Section 10.1.2 Main Report

10.1.2 Dredged Material Placement

Construction dredging material will be placed within the New Wilmington ODMDS. Dredged sediment is expected to primarily include fine- to medium-grained sand with silts from the upper channel reaches and the anchorage basin. Dredged rock is expected to be limestone, siltstone and sandstone (sedimentary rock).

8131661 Geotechnical Appendix B n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please define the term "hard rock." As used in the context of the report, the term likely represents a compressive strength limit. Otherwise, the term "hard rock" has specific, yet different meanings for different technical disciplines.

Response:

Rock strength classifications are based on ISRM (1979) (Section 3.2 pg. 9 of report). Reference to rock strength on Figure 10 will be updated to align with ISRM (1979). See Revised Geotechnical Appendix.

8131662 Geotechnical Appendix B n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The compressive strength presented in this document is based on laboratory analysis of rock samples. However, results from small lab samples generally yield higher compressive strength results compared to the respective large-scale (i.e. outcrop or formation sized) rocks. This phenomenon should be expressed within the report text, or even added as a text box to related data plots, so the reader will understand that in-field rock strength will likely be less. This point is also important since report Section 6 mentions the possibility of using a high-capacity hydraulic hammer to break rock, as opposed to blasting.

Response:

Text was revised. See Revised Geotechnical Appendix.

8131664 Geotechnical Appendix B n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please clarify what entity performed this study. It seems that Moffatt Nichol and Fugro were involved, but the text is unclear as to the contractors' specific contributions.

Response:

Fugro performed and prepared all work in Appendix B. No Revisions to the Report were made.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: Although not a "show-stopper" for this project, Fugro should be mentioned. Entities should received credit for their work. Additionally, providing the company's name allows for easier research and verification of data. WE TYPICALLY DO NOT INCLUDE CONTRACTOR NAMES IN EISs AS IT GIVES THEM "FREE

ADVERTIZING. THE APPENDICES USUALLY HAVE THEIR NAMES SO THEY ARE IDENTIFIED, JUST NOT USUALLY IN THE MAIN TEXT.

Response: The contractor's name has been removed from the Main Report except when a specific document is cited from the list of references.

8131666 Geotechnical Appendix B n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Assuming this proposed project moves forward, please note that additional geotechnical sampling will be needed to fill existing data gaps. For instance, additional boring data is needed to better assess material in the entrance channel extension.

Response:

Additional geotechnical investigations will be conducted in PED. No revisions to the report were made.

8131672 Geotechnical Appendix B (1st half) Section 1.1

n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The second paragraph in this section mentions previous studies. It would help to have a list of the previous study titles to which this paragraph is referring.

Response:

Text was revised. See Revised Geotechnical Appendix.

8131677 Geotechnical Figures 4-1 through 4-20 Appendix B (1st half) n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

These figures seem to be missing historical boring data, despite attempts by the author to capture it. For instance, Figure 4-13 only shows one data point from the Reaves Point Reach, but 18 borings have been completed in that area. Supplemental USACE boring data can be made available on request.

Response:

Any additional available data will be incorporated as part of PED effort. No revisions to the report were made.

8131681 Geotechnical Figures 4-1 through 4-20 Appendix B (1st half) n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Each figure should have callout text or a text box to show which of the boring data points are being represented on the plot. Additionally, it is unclear if the plotted dots represent individual samples taken from cores or if the dots represent a statistical composite (i.e. weighted mean) of samples from one or more cores.

Response:

Test results are from discrete laboratory tests. See revised geotechnical appendix.

8131686	Geotechnical	Figures 5-1 through 5-11	Appendix B (1st half)	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Does each grain gradation curve represent one sample from a given core? If not, does each curve represent a statistical summary of multiple gradation curves for all samples from a given core?Please clarify.

Response:

Each curve represents a discrete test. Text was clarified. See revised geotechnical appendix.

8131687	Geotechnical	Figures 5-1 through 5-11	Appendix B (1st half)	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please annotate either via callout text of text box the samples that are represented as gradation curves. Also, the number of gradation curves on each graph apparently do not correspond with data points on Figures 4-1 through 4-20.

Response:

In some cases, only the fines content was available in reports and the grain size curves were not available. Text was clarified. See revised geotechnical appendix.

8131690	Geotechnical	Figure 6	Appendix B (1st half)	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Eleven graphs are all labeled as "Figure 6." These graphs should be re-labeled as "6-1..... 6-11." Additionally, the graphs constituting what should be Figures 6-2 through 6-11 ought to have annotations or text to identify which core samples are being represented.

Response:

Text was revised. See revised geotechnical appendix.

8131694	Geotechnical	Seismic Profile Images	Appendix B (1st

and 2nd halves)

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please add one or more maps showing the locations of the seismic profiles.

n/a

Response:

Map was added. See revised geotechnical appendix.

8131697 Geotechnical Figures 4b through 4f Appendix B (2nd half)

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

n/a

These figures seem to be missing historical boring data, despite the updates incorporated since February 2019. Supplemental USACE boring data can be made available on request.

Response:

Any additional available data will be incorporated as part of PED effort. No revisions to the report were made.

8131702	Geotechnical	Figures 4b through 4f	Appendix B (2nd half)	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Each figure should have callout text or a text box to show which of the boring data points are being represented on the plot. Additionally, it is unclear if the plotted dots represent individual samples taken from cores or if the dots represent a statistical composite (i.e. weighted mean) of samples from one or more cores.

Response:

Each point represents a discrete test result. Text was clarified. See revised geotechnical appendix.

8131707	Geotechnical	Figures 5b through 5q	Appendix B (2nd half)	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Does each grain gradation curve represent one sample from a given core? If not, does each curve represent a statistical summary of multiple gradation curves for all samples from a given core?
Please clarify.

Response:

Each grain size curve represents a discrete test result. Text was clarified. See revised geotechnical appendix.

8131711	Geotechnical	Figures 6a through 6n	Appendix B (2nd half)	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please provide a text box or callout text to show which core samples were used for these data plots. n/a

Response:

Text was revised. See revised geotechnical appendix.

8131714 Geotechnical Table 3.1 Appendix B (2nd half)

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please add a column listing the top of rock (with vertical datum) for each channel reach, if known.

Response:

Table was revised. See revised geotechnical appendix.

8131718 Geotechnical Chart 2 through Chart 8 Appendix B (2nd half) n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

These diagrams look great. However, please provide the vertical datum for the profile elevations. Although the vertical datum for bathymetry is MLLW, the reader cannot infer that that same datum is used for fence diagram elevations.

Response:

All data are referenced to MLLW. Figures were revised. See revised geotechnical appendix.

8131720 Geotechnical Figures 3-1 through 3-58 Appendix B (2nd half)

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

n/a

Please provide denote the vertical datum to which the interpreted top of rock elevation is referenced. Additionally, please consider using a color ramp with more variation, as some printers might have trouble resolving the different shades of brown that are currently being used.

Response:

Revisions were made. See revised geotechnical appendix.

8131726	Geotechnical	Figure 7 and all fence diagrams	Appendix B (2nd half)	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please consider using a legend which matches the USACE-Wilmington's gINT database file for USCS classifications for the unlithified "soil types" shown. Doing so will allow for standardization which will match reports and cross-sections from prior research and future field studies.

n/a

Response:

Text was revised. See revised geotechnical appendix.

8131731 Geotechnical n/a Appendix C - overall

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

This appendix addresses railroad infrastructure within the Port of Wilmington. However, seeing as how Wilmington will be economically competing with Norfolk and Savannah for USEC-Asia maritime traffic, adding a discussion about the currently existing rail infrastructure in those port cities would be helpful.

Response: The cargo that Wilmington competes for is the primary hinterland cargo that is carried by truck. Rail requires longer distances than the distance to Wilmington's primary hinterland to be competitive with trucking due to double handling and the time it tacks to accumulate a trainload of cargo. The rail cargo going through Norfolk and Savannah typically travels farther distances than cargo coming from Wilmington's hinterland.

8131766 Geotechnical n/a Appendix C - Overall

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

n/a

This appendix addresses railroad infrastructure within the Port of Wilmington. However, seeing as how Wilmington will be economically competing with Norfolk and Savannah for USEC-Asia maritime traffic, adding a discussion about the currently existing rail infrastructure in those port cities would be helpful.

Response: Repeat of previous comment # 8131731

8131771 Geotechnical Figures 2 and 3 Appendix H

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

These maps have a legend item called, "Contact Target Location." If this target refers to a hardbottom location, please state so in the legend. Otherwise, please clarify.

Response: The Contact Target Location features are potential hardbottoms identified through side-scan sonar surveys. Subsequent in-water investigations identified these features as naturalized hardbottom rubble mounds and scattered rock with varying coverage of sessile invertebrates. The Figures are being revised to clarify the nature of these targets.

8131775 Geotechnical Photographs 2 through 5 Appendix H

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

These maps have a legend item called, "Contact Target Location." If this target refers to a hardbottom location, please state so in the legend. Otherwise, please clarify.

Response: The Contact Target Location features are potential hardbottoms identified through side-scan sonar surveys. Subsequent in-water investigations identified these features as naturalized hardbottom rubble mounds and scattered rock with varying coverage of sessile invertebrates. The photos are being revised to clarify the nature of these targets.

8131779 Geotechnical Section 3 Appendix R

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The dredged material management plan does not address the possibility of developing Cell #4 on Eagle Island as a disposal option. This option should be evaluated, as it might result in disposal cost-savings.

Response: Eagle Island expansion northward to cell 4 was evaluated and rejected as an alternative because it is not large enough to receive dredged material by pipeline and still meet water quality standards and because of mitigation and constructions costs. Please see section 3.2.6.1 Eagle Island Expansion from the DMMP AFB Pre-conference Materials developed by the District in 2007.

8131780 Geotechnical Section 3 Appendix R

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please note that additional geotechnical sampling and analysis will likely be required to assess dredged material for bird island and beach nourishment. Data are especially lacking in the proposed entrance channel.

Response: Concur. Additional data will be collected during PED.

8131783 Geotechnical Table 3-1 Appendix R

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please add two columns to this table. One column would show the proposed depth for each channel reach, while the other would show the expected top of rock for each channel reach.

Response:

Table 3-1 (Main report table 6-3) and Table 3-2 (Main Report Table) 6-4 added. See Comment 8131088 response for revisions.

8131784 Geotechnical Section 3.3 Appendix R

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please confirm that appropriateness of "Turritellid" as actually being a formal Formation name. The term "turritellid" seems to be an adjective, which refers to gastropod fossils (genus Turitella) within limestone. Additionally, the "Turritellid Formation" is not a formally-recognized formation name, according to the USGS and the Association of State Geologists lexicon database (https://ngmdb.usgs.gov/Geolex/search), while the Castle Hayne and Peedee are. Finally, some literature indicates that the "Turritellid Limestone" may actually be part of the Castle Hayne Formation or the upper Peedee Formation.

Response:

Repeat of comment 8131632. Reference to Turrilettid has been deleted from both sections. The Turritelline-dominated limestone unit does not appear to have a formally-recognized name; however, it was described by Harris and Laws (1994) as the Bald Head Shoals Formation. Harris (2000) also described it as the Bald Head Shoals Formation in the geological investigation report for the 96 Act Wilmington Harbor project. Section 2.1 and Table 2-1 have been revised accordingly. Applicable revised text from Section 2.1 is provided below.

2.1 Geology, Soils, and Sediments

The ~7-mile Bald Head Shoal ocean entrance channel is underlain by the Castle Hayne Formation (Reach 3) and a Turritelline-dominated limestone unit that was described by Harris and Laws (1994)

and Harris (2000) as the Bald Head Shoals Formation (Reaches 1 and 2).

8131785 Geotechnical G001 Drawings n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please enlarge the map shown on the first sheet. Additionally, please overlay the project areas, with text labels onto the map. Doing so will allow for a better contextual understanding of the maps on the following pages.

Response:

Drawing Sheet G001 was revised.

8131788 Geotechnical C101 through X119 Drawings

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please include a small, inset map showing the general location of the maps and cross-sections with respect to the overall project.

Response:

Inset map was added to Drawing Sheets C101-C131 as well as a note referencing relevant cross-section sheets.

8131791 Geotechnical C101 through C111 Drawings

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please add a legend to each map to define each of the lines (i.e. contour lines, edge of channel, top of slope, etc.)

Response:

A legend was added to Drawing Sheets C101-C111.

8131792 Geotechnical C111 Drawings

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please enlarge the size of the image showing "Anchorage Basin 1 (Turning Basin)." Doing so will also mean that a new scale bar needs to be included to match the re-sized image.

Response:

Preference is for both images to be at the same scale to avoid confusion when reviewing them. No revisions to Drawing Sheet 111 were made.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: Although not a "show-stopper" enlarging the image per the request would assist with reader comprehension.

8131795 Geotechnical C111 Drawings

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The upper image (Fourth East Jetty Reach) seems to indicate that the harbor widening will impact Eagle Island. What mitigation strategies are being considered to either (1) avoid Eagle Island impacts or (2) mitigate Eagle Island impacts?

Response:

A preliminary analysis of the side slope in the Fourth East Jetty Reach indicated that widening the channel 50 ft towards the west (Eagle Island) and dredging to Elevation -50 ft-MLLW would result in the same factor of safety for stability as the existing slope. Additional analyses will, though, be performed in PED and the cost risk is accounted for.

Revised text in Appendix A Section 2.8

6.5 2.8 Geotechnical

A survey of the navigation channel was performed from April 25 to June 19, 2017. This survey collected low frequency and high frequency sub-bottom profiler data to image the shallow subsurface. The reports included in the Geotechnical Appendix evaluated the results of the survey and integrated the geophysical survey data with the existing geotechnical data to characterize the subsurface conditions along the Cape Fear River.

It is noted that the proposed channels will use the same side slopes as existing. Additionally, a preliminary analysis of the side slope in the Fourth East Jetty Reach indicated that widening the channel 50 ft towards the west (Eagle Island) and dredging to Elevation -50 ft-MLLW would result in the same factor of safety for stability as the existing slope.

8132066	Environmental	Section 3 Without-Project Condition	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Discussion of the existing conditions and without-project (FWOP)conditions in Section 3 and 3.1 is very confusing. Text indicates there are differences between existing conditions and the FWOP conditions; however, the differences are difficult to discern. The FWOP is the basis for comparison of impacts and thus is very important. Although follow-on sections may better explain these differences, Section 3 and 3.1 need to be revised to be much more clear.

Response: Text has been revised to removed mention of existing conditions in the sections focused on without-project conditions.

8132081 Environmental Section 6.6 and other sections n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Several Sections in the report, as well as some appendices reference the Wilmington District's DMMP for Wilmington Harbor. There is no completed DMMP for Wilmington Harbor so text needs to be revised to reference current operations and maintenance.

Response: Change made as requested

8132106 Environmental Section 8 - various sections n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

In many cases, the discussion of impacts does not clearly distinguish between temporary versus long-term impacts and does not clearly lay out the construction duration or long-term maintenance timeframes. Text either at the beginning of Section 8 or in applicable locations throughout Section 8 should explicitly explain the anticipated duration of construction as well as the frequency and duration of maintenance activities so readers get a clear sense of the extent of impacts.

Response: Information describing the timing, duration, and frequency of construction and maintenance activities has been added at the beginning of Section 8. Where applicable, the follow-on impact analysis sections have also been revised to clarify the timing, duration, and frequency of projected impacts. Applicable revised text from Section 8 is provided below.

8.0 Environmental Consequences

The timeframe of the effects analysis encompasses the projected three-year project construction period and the subsequent 50-year project life through 2077. The timing, location, and duration of various construction activities over the course of the three-year construction period would vary according to the construction sequence and annual environmental work windows that were previously described in Section 6.7. Post-construction maintenance of the federal navigation channel for the duration of the 50-year project would involve the continuation of current dredging and disposal practices and maintenance intervals for the existing channel reaches, with the addition of periodic maintenance dredging of the nine-mile offshore entrance channel extension reach.

Example of impact analysis revision from follow-on soft bottom impact section (8.10.1.2):

Construction of the proposed Wilmington Harbor navigation channel improvements, inclusive of the channel slopes, would directly impact ~3,151 acres of soft bottom habitat over a three-year period; including ~2,226 acres of disturbed (periodically dredged) habitat within the existing channel and ~925 acres of relatively undisturbed (new dredging) habitat in the proposed channel widening and extension areas (Table 8-9). The new dredging acreages in Table 8-9 include areas between the existing channel top-of-slope and proposed channel top-of-slope, along with the channel bottom and side slopes of the offshore entrance channel extension reach. Based on projected post-construction maintenance intervals, soft bottom communities in both the existing channel and new dredging areas would experience periodic maintenance dredging disturbance every one to four years for the duration of the 50-year project. In relation to the No Action alternative, long-term maintenance of the new dredging areas under the TSP would increase the area of recurring soft bottom disturbance by ~925 acres; including 567 acres of estuarine soft bottom and 368 acres of marine softbottom.

8132119 Environmental Section 8 - various sections n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

It's unclear if the impact analyses provided throughout Section 8 considered the slope (full extent)of project impacts. Section 8 should be revised to clearly explain what impacts were considered. full channel with side slopes? If the impact analyses do not include side slopes then those impacts need to be added for all applicable resources.

Response: Impact analyses and bottom impact calculations did include the slopes. Impacts to bottom areas between the existing top-of-slope and proposed top-of-slope were classified as new dredging impacts in Table 8-9. Section 8.10.1.2 and Table 8-9 have been revised to clarify the inclusion of existing and proposed channel slopes, as well as the difference between new dredging and existing channel dredging. Applicable revised text from Section 8.10.1.2 is provided below.

8.10.1.2 Effects of the TSP

Construction of the proposed Wilmington Harbor navigation channel improvements, inclusive of the channel slopes, would directly impact ~3,151 acres of soft bottom habitat over a three-year period; including ~2,226 acres of disturbed (periodically dredged) habitat within the existing channel and ~925 acres of relatively undisturbed (new dredging) habitat in the proposed channel widening and extension areas (Table 8-9). The new dredging acreages in Table 8-9 include areas between the existing channel top-of-slope and proposed channel top-of-slope, along with the channel bottom and side slopes of the offshore entrance channel extension reach.

8132129 Environmental Section 8.25.5.2 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Table 8-16, Costs for Alligator Creek Restoration, does not include Real Estate (RE)Costs. The RE cost will be significant and should be included.

Response: Real estate costs have been included into the total mitigation cost. Total mitigation costs have increased from $30 to $150 million, but the mitigation plan is currently under development and these costs may change.

8132149 Environmental Section 10.5 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Section 10.5 includes a summary of beach erosion impacts; however, it's not clear if the erosion rate takes into account the periodic placement of sand on Bald Head Island and Oak Island. Text should be added to clarify this point.

Response:

Text will be revised to indicate these rates are net, and independent, of any future nourishment

Revised Section 10.5, Main Report

- Beach erosion - Wave transformation and shoreline change modeling results indicate that channel deepening would have minor to negligible effects on the shorelines of Bald Head Island and Oak Island. On Bald Head Island, channel deepening is projected to have minor adverse effects on the central South Beach shoreline and minor beneficial effects on the western South Beach shoreline. Erosion rates, net of any beach nourishment activities, along the central South Beach shoreline are projected to increase by 0.6 ft/yr or less, while erosion rates along the western South Beach shoreline are projected to decrease by ~1.3 ft/yr. Erosion rate increases, net of any beach nourishment activities, of 0.1 ft/yr or less are projected along most of Oak Island, with an increase of ~0.2 ft/yr projected along the east end of Caswell Beach;

8132162 Environmental Section 11.14 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Section 11.14, Executive Order 11988 (Floodplain Management) does not follow the 8-step decision making process to address E) 11988. Text should be added to address each of the 8 steps.

Response: Table 11.1 has been added to Section 11.14 to address the 8-step process.

Table 11.1. WHNIP 8-Step Floodplain Planning Process

Step	Project Analysis
Step 1: Determine whether the Proposed Action is located in a wetland and/or the 100-year floodplain, or whether it has the potential to affect or be affected by a floodplain or wetland.	The project is located in the 100-year floodplain (FIRM Zones AE and VE). The project is not located in wetlands.
Step 2: Notify public at earliest possible time of the intent to carry out an action in a floodplain or wetland, and involve the affected and interested public in the decision-making process.	The USACE published a Notice of Intent (NOI) informing the public of the proposed project and the intent to develop a Draft Environmental Impact Statement (DEIS). An initial public scoping meeting was held on 26 September 2019.
Step 3: Identify and evaluate practicable alternatives to locating the Proposed Action in a floodplain or wetland.	The Wilmington Harbor navigation channel is a functionally dependent water resource project. There are no alternatives to locating the project in a floodplain.
Step 4: Identify the full range of potential direct or indirect impacts associated with the occupancy or modification of floodplains and wetlands, and the potential direct and indirect support of floodplain and wetland development that could result from the Proposed Action.	The project would be confined to the subtidal river channel. Navigation channel deepening would not obstruct the floodway or affect its capacity to discharge floodwater. Modeling results indicate that the project would produce small increases in MHW (≤1.3 inches), but no significant effects on 100-yr flood elevation are expected. Small increases in salinity (≤0.3 ppt) in the upper estuary would cause minor changes in tidal freshwater wetland community composition. The project would not induce development in floodplains or wetlands.
Step 5: Minimize the potential adverse impacts from work within floodplains and wetlands (identified under Step 4), restore and preserve the natural and beneficial values served by wetlands.	The project would not have any adverse impacts on floodplains. A mitigation plan is currently being developed that will address the effects of salinity increases on tidal freshwater wetlands. Wetland impacts will be fully mitigated through the NEPA process.
Step 6: Re-evaluate the Proposed Action to determine: 1) if it is still practicable in light of its exposure to flood hazards; 2) the extent to which it will aggravate the hazards to others; and 3) its potential to disrupt floodplain and wetland values.	The proposed action would not be subject to flood hazards and would not aggravate flood hazards or disrupt floodplain or wetland values.
Step 7: If the agency decides to take an action in a floodplain or wetland, prepare and provide the public with a finding and explanation of any final decision that the floodplain or wetland is the only practicable alternative. The explanation should include any relevant factors considered in the decision-making process.	The public will be involved in decision making through the NEPA process.
Step 8: Review the implementation and post-implementation phases of the Proposed Action to ensure that the requirements of the EOs are fully implemented. Oversight responsibility shall be integrated into existing processes.	Full compliance with EO requirements will be achieved through the NEPA process.

8132178 Environmental Section 8 & Appendix I (EFH) n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The impact analyses in Section 8 should clearly address maintenance of the proposed deepened project; particularly, important is that the EFH assessment clearly address long-term maintenance impacts on EFH. Revise applicable Sections of the main text and Appendix I as needed to describe the impacts of long-term maintenance.

Response: Information describing the timing, duration, and frequency of construction and maintenance activities has been added at the beginning of Section 8. Where applicable, the impact analysis sections have been revised to clarify the timing, duration, and frequency of projected impacts. The soft bottom impact analysis sections (8.10.1 and 8.10.2) have been thoroughly revised to include additional analysis of long-term maintenance dredging effects based on a Wilmington Harbor benthic characterization and recovery study that was conducted for the 96 Harbor Act Project (Ray 1997). Changes to the impact analyses in Sections 8.10.1 and 8.10.2 have been incorporated into follow-on fisheries and EFH impact analysis sections. A portion of the revised soft bottom impact section is provided below.

8.10 Soft Bottom

Section 8.10.2 Effects of the TSP

Construction of the proposed Wilmington Harbor navigation channel improvements, inclusive of the channel slopes, would directly impact ~3,151 acres of soft bottom habitat over a three-year period; including ~2,226 acres of disturbed (periodically dredged) habitat within the existing channel and ~925 acres of relatively undisturbed (new dredging) habitat in the proposed channel widening and extension areas (Table 8-9). The new dredging acreages in Table 8-9 include areas between the existing channel top-of-slope and proposed channel top-of-slope, along with the channel bottom and side slopes of the offshore entrance channel extension reach. Based on projected post-construction maintenance intervals, soft bottom communities in both the existing channel and new dredging areas would experience periodic maintenance dredging disturbance every one to four years for the duration of the 50-year project. In relation to the No Action alternative, long-term maintenance of the new dredging areas under the TSP would increase the area of recurring soft bottom disturbance by ~925 acres; including 567 acres of estuarine soft bottom and 368 acres of marine softbottom.

Channel construction and subsequent maintenance events would remove benthic infaunal invertebrate communities along with the extracted sediments. The reestablishment of relatively stable benthic invertebrate communities would occur at rates similar to those described for maintenance dredging under the No Action alternative. However, the extent to which the recovered communities resemble those of pre-construction conditions in terms of taxa richness, abundance, biomass, and community structure would vary according to the extent of long-term habitat modification. Channel deepening would permanently alter the physical soft bottom environment through the conversion of relatively shallow bottom to deep bottom. At greater depths, decreased sunlight penetration and DO concentrations would be expected to have negative effects on benthic microalgal primary productivity and secondary benthic invertebrate productivity. Additionally, soft bottom habitats in the new dredging areas would be exposed to new or intensified periodic disturbances from maintenance dredging and ship prop wash.

The long-term effects of channel deepening and maintenance dredging on benthic communities in the CFR were previously investigated through a benthic characterization and recovery study that was undertaken by

the USACE Waterways Experiment Station (WES) for the 96 Harbor Act Project (Ray 1997). The channel bottom, side slopes, and adjacent undisturbed flats were sampled along 14 transects, which were distributed throughout the inner and outer harbor in reaches representing 1, 2, and 3-year post-dredging conditions.

8132289	Planning - Plan Formulation	Section 4.3.1	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The Planning Objectives, as written in Section 4.3.1, are not Federal objectives. Revise the objectives to comply with ER 1105-2-100, which is to contribute to national economic development, is to be consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

Objectives have been revised as presented below and used in a revised plan formulation and evaluation.

4.3.1 Planning Objectives

In addition to the Federal objective, project-specific planning objectives have been identified, and these objectives guided the plan formulation process in this study. Objectives must be clearly defined and provide information on:

- the effect desired (quantified, if possible);
- what will be changed by accomplishing the objective;
- the location where the expected result will occur, and
- the timing of the effect (when would the effect occur) and the duration of the effect.

Based on the problems posed by channel dimensions and the opportunities available through channel improvements (as detailed in Sections 4.1 and 4.2), the following planning objectives have been established to assist in the development of management measures and evaluation of alternative plans:

Objective 1: Reduce origin to destination transportation costs at the Port of Wilmington and contribute to NED from 2027 to 2076.

Objective 2: Reduce navigation restrictions to the Port of Wilmington for the projected future fleet from 2027 to 2076.

Objective 3: Develop an alternative for navigation improvements that is environmentally acceptable and sustainable from 2027 to 2076.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: These are still not Federal planning objectives. Up front provide Federal objective, then add greater detail on those provided in regards to effect quantified. Such as: "Reduce travel time by x hours per vessel, with attendant savings of y $"

Response: Please see the revised planning objectives in section 5.3.1 Planning Objectives in the Main Report.

8132318	Planning - Plan Formulation	Section 5	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Since the objectives are incorrectly stated, they cannot be used to screen alternatives, which appears arbitrary for depths of -43 to -46. The local, regional and state goals should not be used as screening criteria; therefore the alternatives screening is not suitable for this type of analysis. The solution is to analyze every depth beyond existing depth to the same level of detail.

Response: Text has been revised to focus on the four primary criteria.

5.2 Plan Formulation and Screening Criteria

Management measures were identified and evaluated in the development of alternative plans that address the problems of navigation restrictions and increased transportation costs in the without-project condition. Management measures were evaluated with respect to their ability to meet the planning objectives based on the four general criteria for plan formulation that are identified in the Principles and Guidelines (1983):

- Completeness: does the alternative provide and account for all necessary investments or actions to ensure the realization of the planning objectives;
- Effectiveness: does the alternative contribute to achieving the planning objectives;
- Efficiency: is the alternative the most cost-effective means of addressing the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment; and
- Acceptability: is the alternative plan acceptable in terms of applicable laws, regulations, and policies.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: Response does not provide evidence that depths -43 to -46 were evaluated at same level of detail as proposed TSP of -47. Need to provide a screening matrix for depths -43 to -48 showing NED, RED, EQ and OSE outcomes for each.

Response: Please see the revised sections 6.3 Array of Alternatives, section 6.4 Final Array of Alternatives, and section 6.5 Comparison of Final Array of Alternatives.

8132336	Planning - Plan Formulation	Section 5.3.1	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Many non-structural alternatives were pre-screened based on incorrect objectives and should be reanalyzed based on the basis of contribution to National Economic Development (NED).

Table 5-1

Preliminary Screening

Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Channel Deepening	Incomplete, may be combined with channel widening and berth deepening to fully realize planning objectives	Effective when combined with berth deepening	Efficient	Acceptable	Meets the primary planning objective and the NEPA purpose and need	Yes	
Stepped Channel	Incomplete	Ineffective	A stepped channel does not realize the planning objectives	Acceptable	Containerships use the full channel depth inbound and outbound, so deepening only for one direction would not address restrictions in the other direction	No	Only reduces restrictions in one direction. Both directions need reduced restrictions.

Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Turning Basin	Incomplete	Ineffective	Increasing the turning basin dimensions to more than the currently permitted basin does not realize the planning objectives	Acceptable	The turning basin as currently permitted supports the primary planning objective and NEPA purpose and need	No	Increasing the turning basin dimensions to more than the currently permitted basin is unnecessary to realize the primary planning objective and the NEPA purpose and need
Anchorage basin	Incomplete	Ineffective	Increasing the anchorage basin dimensions does not realize the planning objectives	Acceptable	The turning basin is located within the anchorage basin. Increasing the anchorage function is not needed	No	Increasing the anchorage basin dimensions does not contribute to realizing the primary planning objective and the NEPA purpose and need
Channel widening to reduce navigation restrictions	Incomplete but may be combined with channel and berth deepening to	Effective	Efficient	Acceptable	Channel widening is required for the design vessel to regularly use the channel	Yes	

Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
	achieve planning objectives						
Channel widening to accommodate vessel meeting	Incomplete but may be combined with channel and berth deepening to achieve planning objectives	Effective	Inefficient	Acceptable	Meeting of the design vessel and another post-panamax vessel is projected to occur infrequently	No	The benefits of building a meeting area for two post-panamax vessels would be less than the cost of construction and maintain the meeting area

Non-Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Reduce vessel speed	Incomplete	Ineffective	Inefficient	Acceptable	Vessel speed often cannot be reduced due to the need to maintain maneuverability and to reduce crabbing in the channel	No	Reducing vessel speed does not contribute to realizing the primary planning objective and the NEPA purpose and need
Additional tug assistance	Incomplete	Ineffective	Inefficient	Acceptable	Additional tugs are included in		Additional tug assistance does not

Non-Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
					the without and with-project conditions as required for the design vessel		contribute to realizing the primary planning objective and the NEPA purpose and need
Relocate aids to navigation	Incomplete but can be a component of channel widening.	Effective in some channel reaches	Relocating aids to navigation can be a very efficient way to widen the channel	Acceptable, but must be approved by USCG	There are channel reaches in the Entrance Channel and at Bald Head where deeper water is adjacent to the existing channel	Yes	
Tidal advantage	Incomplete	Effective	Efficient	Acceptable	Use of tidal advantage is an existing practice that is projected to be used in the without and with-project condition	Yes	

Non-Structural Measures	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Lightering	Incomplete	Ineffective	Inefficient	Unacceptable	Lightering containerships at sea is potentially dangerous and not practiced. Lightering other types of vessels is unnecessary because they are not restricted by existing channel conditions	No	Lightering does not contribute to realizing the primary planning objective and the NEPA purpose and need

Local service facility Improvements	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out

Local service facility Improvements	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Container Terminal Improvements	Incomplete. Must be combined with channel improvements and berth deepening	Ineffective	Inefficient	Acceptable	Terminal improvements have been completed, which are sufficient for the design vessel and planned improvements are sufficient for projected commodity flow	No	Terminal improvements beyond recently completed improvements and planned future improvements do not contribute to realizing the primary planning objective and the NEPA purpose and need
Relocate cargo terminals	Incomplete. Must be combined with channel improvements and berth deepening	Effective	Inefficient	Unacceptable	Development of a new container terminal at Southport was investigated prior to this study and it was determined to be prohibitively expensive and environmentally damaging	No	The construction cost and environmental degradation associated with a new terminal make the measure infeasible

Local service facility Improvements	Completeness	Effectiveness	Efficiency	Acceptability	Other	Retain	Reason for Screening Out
Berth Deepening	Incomplete but must be combined with channel deepening to achieve planning objectives	Effective	Efficient	Acceptable	Berth deepening is necessary for the realization of channel deepening benefits	Yes	
Bulk Terminal Improvements	Incomplete	Ineffective	Inefficient	Acceptable	Bulk vessels are not restricted under the without-project condition	No	Bulk terminal improvements do not contribute to realizing the primary objective or the NEPA purpose and need
Breakbulk/General Cargo Improvements	Incomplete	Ineffective	Inefficient	Acceptable	Breakbulk and general cargo vessels are not restricted under the without-project conditions		Breakbulk and general cargo terminal improvements do not contribute to realizing the primary objective or the NEPA purpose and need

8132344 Environmental Section 5 and Section 8 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The alternatives analysis lacks the detail needed to fully comply with NEPA. A much more detailed analysis of impacts for depths from -43 to -48 is suggested. At a minimum, detailed analysis of the most reasonable alternatives, besides the TSP and no action, should be included in the report.

Response: An Environmental Quality table that compares the impacts of incremental depth alternatives will be included in the preliminary alternatives analysis section of the revised Feasibility Study/Environmental Report back-check submittal document. An example from the preliminary draft Environmental Quality table is provided below. Note that that the table as presented is not complete, additional resources are being included, and "TBD" values are currently being assessed.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: The EQ table is an improvement; however it does not adequately capture alternatives besides changes in depth. What about options to widening, extending the outer bar channel, etc.? All alternatives considered need to be described in narrative form and those alternatives not preliminarily screened should be included in the EQ table. This is the right approach; however, need to see final (not just interpolated) analyses to determine adequacy of plan selection process. Also, this needs to include NED, RED, and OSE, not just EQ, as the (entire) System of Accounts.

Resolution Note: Widening and outer bar channel extensions are not alternatives, however both are components of the deepening alternatives evaluated. Each depth alternative is widened to the same extent, so as to allow passage of the design vessel. Each depth alternative also has a outer bar channel extension component. The deeper the alternative, the farther out the channel extension. Both the widening and extension components of each depth alternative are included in the evaluations at each depth.

Response: Please see revised section 6.5 Comparison of the Final Array of Alternatives in the Main Report.

Resource	Alternatives					
	No Action	-44 ft	-45 ft	-46 ft	-47 ft	-48 ft
Groundwater	Modeling results indicate negligible RSLR effects on groundwater flow and discharge patterns, and no increase in potential for salinity intrusion via downward surface water migration.	Interpolated modeling results indicate no measurable effects on groundwater flow and discharge patterns, and no increase in potential for salinity intrusion via downward surface water migration.	Interpolated modeling results indicate no measurable effects on groundwater flow and discharge patterns, and no increase in potential for salinity intrusion via downward surface water migration.	Interpolated modeling results indicate no measurable effects on groundwater flow and discharge patterns, and no increase in potential for salinity intrusion via downward surface water migration.	Modeling results indicate no measurable effects on groundwater flow and discharge patterns, and no increase in potential for salinity intrusion via downward surface water migration.	Interpolated modeling results indicate no measurable effects on groundwater flow and discharge patterns, and no increase in potential for salinity intrusion via downward surface water migration.
Water Levels and Tides	Modeling results indicate a maximum MHW increase of 4.1 inches in the lower estuary at Battery Island due to RSLR. Projected increases are progressively smaller through the estuary above.	Interpolated modeling results indicate a maximum relative MHW increase of 0.3 inch in the Anchorage Basin. Projected increases are progressively smaller through the up-estuary and down-estuary reaches above and below.	Interpolated modeling results indicate a maximum relative MHW increase of 0.7 inch in the Anchorage Basin. Projected increases are progressively smaller through the up-estuary and down-estuary reaches above and below.	Interpolated modeling results indicate a maximum relative MHW increase of 1.0 inch in the Anchorage Basin. Projected increases are progressively smaller through the up-estuary and down-estuary reaches above and below.	Modeling results indicate a maximum relative MHW increase of 1.3 inches in the Anchorage Basin. Projected increases are progressively smaller through the up-estuary and down-estuary reaches above and below.	Interpolated modeling results indicate a maximum relative MHW increase of 1.6 inches in the Anchorage Basin. Projected increases are progressively smaller through the up-estuary and down-estuary reaches above and below.

Currents	Modeling results indicate negligible RSLR effects on current speeds. Maximum projected changes are +/- 0.2 ft/s.	Interpolated modeling results indicate that channel deepening would have minor relative effects on current speeds. Projected maximum relative increases and decreases are +0.2 ft/s and -0.1 ft/s.	Interpolated modeling results indicate that channel deepening would have minor relative effects on current speeds. Projected maximum relative increases and decreases are +0.3 ft/s and -0.2 ft/s.	Interpolated modeling results indicate that channel deepening would have minor relative effects on current speeds. Projected maximum relative increases and decreases are +0.5 ft/s and -0.3 ft/s.	Modeling results indicate that channel deepening would have minor relative effects on current speeds. Projected maximum relative increases and decreases are +0.6 ft/s and -0.4 ft/s.	Interpolated modeling results indicate that channel deepening would have minor relative effects on current speeds. Projected maximum relative increases and decreases are +0.8 ft/s and -0.5 ft/s.
Salinity	Modeling results indicate that RSLR will cause maximum bottom and surface layer salinity increases of 0.7 and 0.5 ppt, respectively.	Interpolated modeling results indicate maximum bottom and surface layer relative salinity increases of 1.0 and 0.3 ppt, respectively.	Interpolated modeling results indicate maximum bottom and surface layer relative salinity increases of 2.1 and 0.6 ppt, respectively.	Interpolated modeling results indicate maximum bottom and surface layer relative salinity increases of 3.1 and 0.9 ppt, respectively.	Modeling results indicate that channel deepening would cause maximum bottom and surface layer salinity increases of 4.1 and 1.2 ppt, respectively.	Interpolated modeling results indicate maximum bottom and surface layer relative salinity increases of 5.1 and 1.5 ppt, respectively.
Wetlands *Interpolated salinity isopleth shifts were used to delineate affected tidal floodplain wetland areas for the incremental depth alternatives. Wetland impact acreages for the -44 to -46 and -48 alternatives are being calculated via GIS and will be included in the table.*	Model-projected upstream shifts in the 0.5 ppt salinity isopleth due to RSLR would affect ~278 acres of tidal freshwater wetlands. Projected surface salinity increases of ≤0.2 ppt would have negligible to minor effects on the composition of freshwater tidal wetlands in the isopleth shift zones.	Channel construction and maintenance would not have any direct impacts on wetlands. Interpolated upstream shifts in the 0.5 ppt salinity isopleth would affect ~TBD acres of tidal freshwater wetlands. Projected surface salinity increases of ≤0.3 ppt would have negligible to minor effects on the composition of freshwater tidal wetlands in the isopleth shift zones.	Channel construction and maintenance would not have any direct impacts on wetlands. Interpolated upstream shifts in the 0.5 ppt salinity isopleth would affect ~TBD acres of tidal freshwater wetlands. Projected surface salinity increases of ≤0.3 ppt would have negligible to minor effects on the composition of freshwater tidal wetlands in the isopleth shift zones.	Channel construction and maintenance would not have any direct impacts on wetlands. Interpolated upstream shifts in the 0.5 ppt salinity isopleth would affect ~TBD acres of tidal freshwater wetlands. Projected surface salinity increases of ≤0.3 ppt would have negligible to minor effects on the composition of freshwater tidal wetlands in the isopleth shift zones.	Channel construction and maintenance would not have any direct impacts on wetlands. Model-projected upstream shifts in the 0.5 ppt salinity isopleth would affect ~340 acres of tidal freshwater wetlands. Projected surface salinity increases of ≤0.3 ppt would have negligible to minor effects on the composition of freshwater tidal wetlands in the isopleth shift zones.	Channel construction and maintenance would not have any direct impacts on wetlands. Interpolated upstream shifts in the 0.5 ppt salinity isopleth would affect ~TBD acres of tidal freshwater wetlands. Projected surface salinity increases of ≤0.3 ppt would have negligible to minor effects on the composition of freshwater tidal wetlands in the isopleth shift zones.

Hardbottom	Continuing maintenance of the currently authorized channel would not affect hardbottom communities.	Widening of the Baldhead Shoal entrance channel would have minor direct impacts on naturalized hardbottom rubble mounds in the old ODMDS.	Widening of the Baldhead Shoal entrance channel would have minor direct impacts on naturalized hardbottom rubble mounds in the old ODMDS.	Widening of the Baldhead Shoal entrance channel would have minor direct impacts on naturalized hardbottom rubble mounds in the old ODMDS.	Widening of the Baldhead Shoal entrance channel would have minor direct impacts on naturalized hardbottom rubble mounds in the old ODMDS.	Widening of the Baldhead Shoal entrance channel would have minor direct impacts on naturalized hardbottom rubble mounds in the old ODMDS.
SAV	Continuing maintenance of the currently authorized channel would not affect SAV.	The -44 ft alternative would not affect SAV.	The -45 ft alternative would not affect SAV.	The -46 ft alternative would not affect SAV.	The -47 ft alternative would not affect SAV.	The -48 ft alternative would not affect SAV.
Shell Bottom	Continuing maintenance of the currently authorized channel would not have any direct mechanical impacts on shell bottom. Sediment resuspension and redeposition during maintenance dredging would have short-term, localized effects on shell bottom communities.	No direct mechanical impacts on shell bottom. Short-term and localized sediment resuspension and redeposition effects during construction and maintenance dredging. Relative increase in dredging intensity and magnitude of resuspension effects during construction.	No direct mechanical impacts on shell bottom. Sediment resuspension and redeposition during construction and maintenance dredging would have short-term, localized effects on shell bottom communities. The relative increase in resuspension effects during construction would be slightly greater than the -44 ft alternative.	No direct mechanical impacts on shell bottom. Sediment resuspension and redeposition during construction and maintenance dredging would have short-term, localized effects on shell bottom communities. The relative increase in resuspension effects during construction would be slightly greater than the -45 ft alternative.	No direct mechanical impacts on shell bottom. Sediment resuspension and redeposition during construction and maintenance dredging would have short-term, localized effects on shell bottom communities. The relative increase in resuspension effects during construction would be slightly greater than the -46 ft alternative.	No direct mechanical impacts on shell bottom. Sediment resuspension and redeposition during construction and maintenance dredging would have short-term, localized effects on shell bottom communities. The relative increase in resuspension effects during construction would be slightly greater than the -47 ft alternative.

8132348	Planning - Plan Formulation	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Lack of mitigation costs in the project cost estimate calls into question plan selection and economic justification. Mitigation costs need to be included to accurately determine project feasibility.

Mitigation costs have increased as the mitigation plan is further developed. Mitigation costs have increased from $30 million to $150 million, but the mitigation plan is currently under development and these costs may change. Note that the project remains economically justified, albeit with fewer net benefits, with the increase in mitigation costs.

Reviewer: Response acceptable; proposed revision unacceptable
Explanation: This is a start; need to see details on mitigation plan before we can determine correct plan selection.

Response: Please see the summary of the preliminary mitigation, monitoring, and adaptive management plan in section 8.25 of the Main Report and Appendix N: Mitigation and Monitoring Plan. Please note that the mitigation plan will be finalized during development of the DEIS.

8132360	Planning - Plan Formulation	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**			n/a	n/a
The report does not include adequate information regarding benefits for depths of -43 to -46. The fleet transition is not likely to be all to super PPX3s, which calls into question the NED plan. Substantiate and/or reconsider assumptions made for calculating benefits for -43 to -46. Response: Incremental analysis from -44 to -48 feet has been included. Reviewer: Response acceptable; proposed revision unacceptable Explanation: Need to see incremental analysis. Response: Please see revised section 6.5 Comparison of the Final Array of Alternatives in the Main Report.				
8132371	Environmental	Section 8, multiple sections and some appendices		

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Reference comment #8123986,which indicates that project salinity impacts within tidal creeks might be underestimated or inadequately studied. Besides having implications for impacts to tidal freshwater marsh and swamp forest, salinity impacts to other resources (benthos, fisheries, etc.) may be affected. Revise all resource impact sections as needed to reflect any changes to the salinity analysis and conclusions.

Response: There are no changes to the tidal creek salinity analyses or conclusions (see response to comment #8123986). The modeling approach used provides an appropriate assessment of the potential with project changes in the tidal wetland community composition due to accurately matching the existing wetland conditions.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: As state above, USACE is not aware of other salinity models successfully using the described approach. From our discussions with regional experts, there is significant concern with the accuracy of using vegetation mapping to predict salinity values within the creeks along the Cape Fear River. Salinity changes are key to identifying environmental impacts and mitigation requirements.

Response: The salinity modeling performed for this study is sufficient for talking a "hard look" at the potential environmental effects, and it is comparable, or superior, to the modeling efforts performed on previous similar channel deepening projects. However, if additional analyses of the results are requested by the District, these will be considered during the development of the Draft EIS

8132377 Environmental Section 8 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The report does not include a table that compares the impacts of all reasonable alternatives. For comparison purposes, a summary table needs to be added to the document. Besides no action and the TSP, the environmental impact sections and the summary table should describe the impacts of all reasonable alternatives (depths).

Response: An Environmental Quality table that compares the impacts of incremental depth alternatives will be included in the preliminary alternatives analysis section of the revised Feasibility Study/Environmental Report back-check submittal document. See response to Comment 8132344 for an example of the preliminary draft Environmental Quality table.

Reviewer: Response acceptable; proposed revision unacceptable

Explanation: The EQ table is an improvement, but is incomplete so it's unclear if the revision is acceptable.

Response: Please see revised section 6.5 Comparison of Final Array of Alternatives in the Main Report.

8132382 Environmental Section 8 n/a

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The 203 report does not address direct or indirect impacts to local or regional infrastructure, such as roads, railroads, the Wilmington Waterfront, businesses along the river, the USS NC berthing area, etc. Add discussion of impacts to infrastructure and facilities along the river, as applicable.

Response: Analysis of potential shoreline erosion effects on waterfront infrastructure is deferred to PED. This has been clarified in the Shoreline Erosion impact analysis section (8.2.2). Text addressing the potential effects of projected MHW increases on waterfront infrastructure has been added to the Water Levels and Tides impact analysis section (8.4.1.2). Applicable revised text from these sections is provided below.

8.2.2 Effects of the TSP
PED-phase erosion modeling analyses would also be expanded to include additional shoreline reaches and potential effects on waterfront infrastructure, as necessary based on input from agencies and stakeholders.

8.4.1.2 Effects of the TSP
The small projected MHW increases of 1.4 inches or less under the TSP would not significantly affect the frequency of tidal nuisance flooding events or the potential for related adverse effects on waterfront infrastructure along the CFR.

Reviewer: Response unacceptable; proposed revision unacceptable
Explanation: Understanding and documenting the impacts to adjacent shorelines is critical to adeqately address NEPA and inform the public regarding impacts. During scoping, several concerns regarding potential impacts to significant shoreline resources were identified and will need to be addressed in the EIS. Delaying analysis of potential shoreline erosion effects to PED may result in the need for additional NEPA documentation at a later date and additional mitigation. Also, not accurately estimating the mitigation costs could affect the project's feasibility.

Response: Given the concern over previous erosion along these shorelines, additional detailed analyses will also be performed for these areas during development of the DEIS and / or PED phase of the project to collect field data, document the existing conditions and further quantify impacts. These analyses will then be incorporated into the design of mitigative measures for these two locations, if necessary. The mitigation and monitoring plan includes $10 million plus contingency for unspecified erosion mitigation.

8132844 Geotechnical Main Report, Section 2.25.3.2 94

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The statement, "The dikes for all three cells are proposed to be raised to 50 feet above mean sea level, which will extend the useful life of Eagle Island CDF to 2032 (USACE 2017)" is partially correct. Currently cell 2 can be raised to 50 ft NAVD 88, but at a smaller footprint than was cited in referenced 2017 document. Additonally, stability analyses are being re-evaluated in cells 1 and 3.
In light of these current re-evaluations the projected life will likely change. In light of these current re-evaluations the projected life will likely change.

Response: The text has been revised as follows:
"The dikes for cell 2 are proposed to be raised to 50 feet above mean sea level (NAVD 88) and stability analyses are currently being performed for cells 1 and 3 to determine the appropriate improvement to dike height. The useful life of Eagle Island CDF was projected to be extended to 2032 (USACE 2017), however more recent analyses indicate that the footprint for cell 2 may be smaller than identified in the 2017 report and the results of the stability analyses may affect the useful life estimate." We will use the updated information if it is available prior to the final report.

8132858 Geotechnical Main Report, Section 6.1.2, Second Sentence 144 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Please include limestone in list of sedimentary rock types to be dredged.

Response: Text clarified.

Revised text in Section 6.1.2 Main Report

6.5.1 6.1.2 Dredged Material Placement

Construction dredging material will be placed within the New Wilmington ODMDS. Dredged sediment is expected to primarily include fine- to medium-grained sand with silts from the upper channel reaches and the anchorage basin. Dredged rock is expected to be limestone, siltstone and sandstone (sedimentary rock).

8132910 Geotechnical Main Report, Section 6.2.2, Table 6-3, and cost appendix 148-149 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

[Critical/Flagged.]

Where rock is likely, but strengths are unknown and extents are not fully determined, how are the projected dredging costs reflected? Is there a level of conservatism applied to costs in order to capture these unknowns? For instance, in upper Brunswick Reach, Table 6-3 shows that the Pee Dee formation is likely to be encountered, and it lies between 2 reaches where UC Strengths in the Pee Dee indicate blasting will likely be needed, do costs reflect blasting will be likely in Upper Brunswick?

Response:

Based on our review of historical geotechnical data in the Fourth East Jetty and Upper Brunswick Reaches, materials encountered above elevation (El.) -52 ft (MLLW) are predominantly described as non-lithified materials with occasional thin layers of limestone. Two unconfined compressive strength test results were identified that have values of 4,835 and 4,924 psi. Historical borings north of Fourth East Jetty in the Turning Basin and Between Channel reaches encountered materials described as limestone that were more than 2 feet thick; however, the unconfined compressive strength test results are approximately 1,000 psi or less. Based on this historical data, we infer that the cutterheads expected to be utilized for this project will be capable of excavating this material.

In addition, the risk analysis assumes that up to 50% of soft rock throughout the project that is currently removed using cutterhead dredging would require blasting. That is the single largest risk to the project, representing over 80% of the variability in the total project cost in the Monte Carlo Simulation. (See Figure 6-3 in the Cost Appendix).

Section 6.2.2 of the main report has been revised as well as Table 6-3 and Table 6-5 (now Table 6-6) and Table 6-4 added. See Comment 8131088 response for revisions.

8133072	Geotechnical	Main Report, Table 6-3 and Table 6-5	148 & 152	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

In table 6-3, Fourth East Jetty reach shows UCS of 4880 psi, some of the highest strengths recorded in the project, and are above the 4300 psi threshold where blasting is likely required, and yet in Table 6-4, the same reach shows that soft rock is present and blasting will not be required. Please address this discrepancy. It is also highly recommended that it is confirmed that the likely nature of dredging/rock removal is reflected in the dredging costs for this reach.

Response:

Based on our review of historical geotechnical data in the Fourth East Jetty Reach, materials encountered above elevation (El.) -52 ft (MLLW) are predominantly described as non-lithified materials with occasional thin

layers of limestone. Two unconfined compressive strength test results were identified that have values of 4,835 and 4,924 psi. Historical borings north of Fourth East Jetty in the Turning Basin and Between Channel reaches encountered materials described as limestone that were more than 2 feet thick; however, the unconfined compressive strength test results are approximately 1,000 psi or less. Based on this historical data, we infer that the cutterheads expected to be utilized for this project will be capable of excavating this material. Rock strength, layer thickness, and rock quality designation (RQD) were criteria considered when assessing the excavation method.

The risk analysis also assumes that up to 50% of all rock dredging with the cutterhead could be completed with a blasting rig. This additional risk compensates for the isolated pockets of hard rock in the Upper Brunswick and Fourth Each Jetty reaches. In fact, the quantity of hard rock represents the single largest risk to the total project cost according to the cost analysis completed.

Section 6.2.2 of the main report has been revised as well as Table 6-3 and Table 6-5 (now Table 6-6) and Table 6-4 added. See Comment 8131088 response for revisions.

8133084	Geotechnical	Main Report, Table 6-6	154	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

If Fourth East Jetty has UCS >4300 psi, why is it not included in drill barges and mechanical dredge equipment type category? Please address.

Response:

Based on our review of historical geotechnical data in the Fourth East Jetty Reach, materials encountered above elevation (El.) -52 ft (MLLW) are predominantly described as non-lithified materials with occasional thin layers of limestone. Two unconfined compressive strength test results were identified that have values of 4,835 and 4,924 psi. Historical borings north of Fourth East Jetty in the Turning Basin and Between Channel reaches encountered materials described as limestone that were more than 2 feet thick; however, the unconfined compressive strength test results are approximately 1,000 psi or less. Based on this historical data, we infer that the cutterheads expected to be utilized for this project will be capable of excavating this material. Rock strength, layer thickness, and rock quality designation (RQD) were criteria considered when assessing the excavation method.

The risk analysis also assumes that up to 50% of all rock dredging with the cutterhead could be completed with a blasting rig. This additional risk compensates for the isolated pockets of hard rock in the Upper Brunswick and Fourth Each Jetty reaches. In fact, the quantity of hard rock represents the single largest risk to the total project cost according to the cost analysis completed.

Section 6.2.2 of the main report has been revised as well as Table 6-3 and Table 6-5 (now Table 6-6) and Table 6-4 added. See Comment 8131088 response for revisions.

8133112	Geotechnical	Main Report, Section 7.1.2, first full sentence on p.157, and DMMP Append	157	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

[Critical/Flagged.]

It may be economically infeasible to build dikes 62 ft MSL for cells 1, 2, and 3 thereby terminating the life of Eagle Island, but was the option of building a Cell 4 (combining old cells 4 and 5 and adding additional Federal and State land to make a much larger 300+ acre cell) evaluated from a benefit to cost perspective? Adding a fourth larger cell, even with required mitigation, should be evaluated in the economics of this project.

Response: Please note that this same response was used for comment #8131779. Eagle Island expansion northward to cell 4 was evaluated an rejected as an alternative because it is not large enough to receive dredged material by pipeline and still meet water quality standards and because of mitigation and constructions costs. Please see section 3.2.6.1 Eagle

Island Expansion from the DMMP AFB Pre-conference Materials developed by the District in 2007.

Reviewer: Response unacceptable; proposed revision unacceptable
Explanation: Please change/delete your reference to 2007 Pre-conference materials document that you cite which are preliminary in nature and outdated. While there is not a requirement to conduct a DMMP within a Feasibility document, this would be an opportune time to include proposed capacity increases (ie build out of Eagle Island cell 4 & 5) and include those costs in the cost estimate here under construction than hoping for O&M costs to fund increased disposal capacity.

Response: Please not that references to the 2007 Pre-conference materials have been removed from the Main Report with the exception of the excerpt presented in section 2.1.2 because it is the best written source of maintenance practices.

8133313	General	Main Report	p. ES-2	last full sentence

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

In the last two full sentences. "The Chief's Report is dated 09 September 1996. The project up to the Cape Fear Memorial Bridge was completed in 2003." there seems to be a discrepancy. Actually the last deepening of new work material related to 96 Act was dredged in 2013 in Anchorage Basin within 800ft of Cape Fear Memorial Bridge. Please rectify.

Response: text has been revised as requested: "The Chief's Report is dated 09 September 1996. The project up to within 800 feet of the Cape Fear Memorial Bridge was completed in 2013. The remaining authorized improvements from the Cape Fear Memorial Bridge to the upper project limit were deferred due to a marginal cost to benefit ratio."

8133373	Cost Engineering	First two bullets at top of page	Coast Appendix D, p.4-2	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

[Critical/Flagged.]

Upper Brunswick and Fourth East Jetty reaches are designated as being dredged by cutterhead and rather than by drilling/blasting/mechanical means. However, strength data in Main Report & Geotech Appendix show that Fourth East Jetty has rock strengths in excess of blasting threshold of 4300 psi. Additionally, Upper Brunswick has no strength data, but is straddled by reaches on either side, which are expected to penetrate the same Pee Dee Formation, with strengths in excess of 4300 psi. Suggest that either: (1) a better defense be given to not using blasting/mechanical means in these reaches; or (2) change costs and rock removal means to be more reflective of drilling/blasting/mechanical methodology.

Response:

Rock in the Fourth East Jetty reach was primarily lower in strengths, with the higher strengths isolated in thin layers. From discussions with contractors, thin layers of hard rock can generally be dredged with a cutterhead. The risk analysis also assumes that up to 50% of all rock dredging with the cutterhead could be completed with a blasting rig. This additional risk compensates for the isolated pockets of hard rock in the Upper Brunswick and Fourth Each Jetty reaches. In fact, the quantity of hard rock represents the single largest risk to the total project cost according to the cost analysis completed.

Section 6.2.2 of the main report has been revised as well as Table 6-3 and Table 6-5 (now Table 6-6) and Table 6-4 added. See Comment 8131088 response for revisions.

8133397 Cost Engineering Section 4.1 Coast Appendix D, p.4-1

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

n/a

Sentence, "Areas with 95% sand can be placed on beaches for beneficial use in lieu of the ocean disposal site." does not agree with assumptions in other parts of report that 90% sand can be placed on beaches. Less than 10% fines passing the #200 sieve (weighted composite), or 90% sand, is one of the criteria used by the Corps to determine viability of beach placement. Please rectify statement and make sure costs in appendix are reflective of using at least 90% sand for beneficial use beach placement.

Response:

Appendix D, Section 4.1 was revised.

Hopper dredges operate more efficiently in open waters, but do not dredge rock well. Cutterhead dredges can dredge rock up to 4,300 PSI, but struggle to operate efficiently in rough waters. Areas with 90% sand can be placed on beaches for beneficial use in lieu of the ocean disposal site.

8133479	Cost Engineering	PED Estimate for Geotechnical Investigations	Coast Appendix D, Sub Appendix F, last page	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Do costs reflect performance of splitting tensile strength testing for reaches with rock? It has been found over the years that splitting tensile strength is very useful information for determination of the dredge performance, means, and costs. There are limited data available for project. As far as the reviewer knows, splitting tensile was only performed on rock in Anchorage and Turning Basin prior to last of the 96 Act New Work deepening in 2013.

Response:

Costs were not estimated based on splitting tensile strength, as limited data was available. Generally, areas in excess of 4300 psi were considered to require blasting unless the rock later was thin (1 ft thick or less). Testing and associated costs will be included in PED.

No revisions to the report were made.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: I don't believe that the comment was fully understood. I am not asking if splitting tensile strength data are available. I am asking if the cost for collecting this data are included in PED costs.

Response: Yes, they are in the PED estimate. There is $12 million for Geotech analysis currently in the PED budget. Please see Appendix F of the Cost Appendix.

8133487	Cost Engineering	PED Estimate for Geotechnical Investigations	Coast Appendix D, Sub Appendix F, last page	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Do costs reflect additional drilling and testing in Upper Brunswick where strength data are lacking?

Response:

Based on our review of historical exploration logs in Upper Brunswick Reach, the materials encountered above El. -52 feet are described as predominantly non-lithified deposits with occasional thin layers of limestone. We do not anticipate blasting will be required to remove materials in this reach. Further testing in PED should determine the extent of rock and if blasting is required. The risk analysis does address the potential for additional rock blasting volume throughout the project in areas where cutterhead dredging is utilized for rock.

Section 6.2.2 of the main report has been revised as well as Table 6-3 and Table 6-5 (now Table 6-6) and Table 6-4 added. See Comment 8131088 response for revisions.

8133553	General	Introduction, 4th Para, First sentence	DMM Appendix R, page 1	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

[Critical/Flagged.]

The sentence, "A DMMP for the Wilmington Harbor Navigation Channel Project was developed and evaluated by the USACE Wilmington District (SAW) (USACE 2007)." is misleading. This DMMP was never finalized (more of a rough draft, than draft), nor vetted through the full NEPA process. To put much stock in the document as a whole at this stage may be problematic. However, it is the opinion of this reviewer that a more useful and up-to-date DMMP is within reach if the 2007 DRAFT findings and this 203 effort are combined. This, of course, would have to be vetted through programmatic channels within USACE and NCSPA before such an undertaking is allowed.

Response: Concur. This may be an item of cooperation for PED

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: Please change/delete your reference to 2007 Pre-conference materials document that you cite which are preliminary in nature and outdated. While there is not a requirement to conduct a DMMP within a Feasibility document, this would be an opportune time to include proposed capacity increases (ie build out of Eagle Island cell 4 & 5) and include those costs in the cost estimate here under construction than hoping for O&M costs to fund increased disposal capacity.

Response: Please not that references to the 2007 Pre-conference materials have been removed from the Main Report with the exception of the excerpt presented in section 2.1.2 because it is the best written source of maintenance practices.

8133622	General	Section 4 Conclusion	DMM Appendix R,	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

[Critical/Flagged.]

In the sentence, "The Planning Guidance Notebook indicates that if a Preliminary Assessment identifies a disposal capacity shortage over the next 10 years, then a DMMP needs to be developed. A DMMP is required to identify 20 years of dredged material disposal capacity. The existing DMMP identified 50 more than years of dredged material disposal capacity. This Preliminary Assessment verifies the 50-year dredged material disposal capacity, including new construction and maintenance material generated by the TSP. A new or updated DMMP is not required at this time." may be true from an overall capacity of dredged material placement in the ODMDS standpoint, bud doesn't seem to reflect the potential viability (from both an engineering and economic standpoint) of building a Cell 4 north of cells 1 through 3 for O&M dredged material placement. Until it is determined that a cell 4 is not viable, then the need for a DMMP is still a possibility.

Response: Eagle Island expansion northward to cell 4 was evaluated and rejected as an alternative because it is not large enough to receive dredged material by pipeline and still meet water quality standards and because of mitigation and constructions costs. Please see section 3.2.6.1 Eagle Island Expansion from the DMMP AFB

Pre-conference Materials developed by the District in 2007. Please note that this is the same response to comment #8131779.

Reviewer: Response unacceptable; proposed revision unacceptable

Explanation: Please change/delete your reference to 2007 Pre-conference materials document that you cite which are preliminary in nature and outdated. While there is not a requirement to conduct a DMMP within a Feasibility document, this would be an opportune time to include proposed capacity increases (ie build out of Eagle Island cell 4 & 5) and include those costs in the cost estimate here under construction than hoping for O&M costs to fund increased disposal capacity.

Response: Please not that references to the 2007 Pre-conference materials have been removed from the Main Report with the exception of the excerpt presented in section 2.1.2 because it is the best written source of maintenance practices.

8133869 Navigation n/a n/a Comment Classification:

Unclassified\\For Official Use Only (U\\FOUO)

n/a

Some improvements that must be completed during PED level simulations include: incorporating accurate bathymetric data with appropriate side slopes, updating the hydrodynamics with the proposed final channel designs, validating bank effects, validating ship-to-ship interaction, completing a more rigorous testing matrix, incorporating fully piloted vessels for passing (no tracked vessels or vessels run from the instructor station), completing a more overlap of different pilots testing area (n should be equal to or greater than 3 if possible), testing of the exact design vessel. It is important to understand that the project provided preliminary solutions that will need to be refined and confirmed during PED.

Response:

Concur. Scope for PED study will be coordinated with USACE.

8133875 Navigation Appendix A 3-10

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

There does not appear to be any testing of the proposed design in the area between Upper Lilliput and Upper Brunswick.

Response:

Concur - Design channel width was established through testing of other representative portions of the channel. PED scope will include rigorous testing of the full channel length.

8133880 Navigation Appendix A 3.2.2.1 3-10

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Design should be updated to include exact design vessel in PED.

Response:

Concur. Scope for PED study will be coordinated with USACE to ensure that all parties concur with the representation of the design vessel in the simulator.

8133884 Navigation Appendix A 3.2.2. 3-13 n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

How are the forces represented? Please clarify the ship-to-ship interaction forces assumptions and implementation.

Response: A description of the ship-to-ship interaction forces will be added to the report

Section 3.2.2.3 of the main report was revised.

3.2.2.3 Passing Vessels

The channel was designed to support two-way traffic (passing) at specific locations along the channel. To verify the width of these passing areas, auto-piloted vessels were included in the model to simulate vessels passing in the opposite direction.

The design basis is a 12,400 TEU design vessel passing a similarly-sized vessel. The TRANSAS ship model shown in Table 3 5 for use as the design vessel was also be used as the passing vessel. The simulator includes representation of ship-to-ship interaction forces acting on the piloted vessel, but these forces were not validated or calibrated for the feasibility-level simulations. In TRANSAS the ship-to-ship interaction forces are calculated based on the pressure field induced by the passing vessel. The pressure distribution about the moving ship is approximated by three circular zones, bow, aft, and midship. If there is an intersection between the passing ships' zones, then a force is applied from the passing ship to the own ship along the line between the intersecting zones' center. For feasibility-level simulations these forces were used "as is" in the model and deemed acceptable by the pilots for preliminary channel width evaluations. Validation or calibration will be done for full bridge simulations.

The use of an auto-piloted vessel to simulate two-way traffic with a piloted ship was acceptable for feasibility level simulations. Two piloted ships will be used for the final design simulation program.

8133887 Navigation Appendix A 3.2.3.1 3-15

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

With these two statements in the paragraph without any other clarification. It implies 3-3.5 hour transits were performed with the water levels held constant. This would not be standard practice. It is clear later in the text that much shorter transits were simulated making this paragraph contradictory.

Response:

Only one full length channel simulation was performed (Simulation #5). So, it is true that most simulations involved much shorter durations where a constant water level is more realistic. However, the decision to use a constant water level of MLLW was irrespective of the simulation duration; the stated purpose being to minimize under keel clearance. Use of different or variable water levels can be coordinated and included in the PED simulations as appropriate.

Section 3.2.3.1 of the main report was revised.

3.2.3.1 Tide and Current Fields

A full channel transit – inbound or outbound – typically takes 3 to 3.5 hours. Throughout this duration, the tidal currents vary during the transit. Time and space varying tidal currents were included in the simulator to account for these effects. However, the tide level was held constant at MLLW for all simulations representing a conservative under keel clearance. This is a common approach for feasibility level channel design studies. Extenuating circumstances, such as the need to “ride the tide”, were not present in this effort.

8133890 Navigation Appendix A 3.3.3.2 3-26

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

There is no mention here of bathymetric data being utilized for the channel. During PED, this must be included with accurate side slopes.

Response:

Concur. Scope for PED study will be coordinated with USACE.

8133896 Navigation Table 3-12 3-29

n/a Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

In general, this testing matrix looks good for Feasibility. During PED, a more rigorous testing matrix will be required, with more overlap of different pilots. It should be noted that there does not appear to be any proposed design testing of the area between Upper Lilliput and Upper Brunswick.

Response:

Concur. Scope for PED study will be coordinated with USACE.

8133902 Navigation Table 3-14 3-42 n/a Comment

The testing for the one-way channel width was really only completed with one pilot (simulation 5, 29, and 30 were all existing conditions). During PED, a greater sample size should be used.

Response:

Concur. Scope for PED study will be coordinated with USACE.

8133911 Navigation Appendix A 3.4.3 3-45 n/a Comment

The assumption that ship to ship interaction forces in the simulation are less than real world should be addressed in PED. Both vessels should be piloted with actual pilots, not using a track.

Response:

Concur. Scope for PED study will be coordinated with USACE.

8133920 Navigation Appendix A 3.4.3 3-46 n/a Comment

The channel width modeled is likely true, but final passing design should be confirmed in PED simulations with proper bathymetry (including channel side slopes), bank effect, ship-to-ship interaction, and piloted vessels (not on a track).

Response:

Concur. Scope for PED study will be coordinated with USACE.

ATTACHMENT 1

Memorandum from Moffatt & Nichol on Tidal Datum Changes
January 17, 2020

moffatt & nichol

4700 Falls of Neuse Road, Suite 300
Raleigh, NC 27609

(919) 781-4626 ❖ Fax: (919) 781-4869
www.moffattnichol.com

Memorandum

To:	OASACW
From:	Moffatt & Nichol
Date:	January 17, 2020
Subject:	Tidal Datum Changes
Project:	Wilmington Harbor Navigation Improvement Project Section 203 Study
CC:	

1.0 INTRODUCTION

The review assessment for our "Policy Review Assessment – July 2019, Comment D.2" response stated that "Anecdotal, physical data, and peer-reviewed studies support the comment on tidal range instability." However, historically, the river channel has been modified numerous times, and quite substantially, which has led to the observed changes in tidal datums (MHW, MLW) and mean tidal range. These referenced studies do recognize this important point, and previous modeling efforts have shown that the prior deepening and widening of the river channel has increased the tidal range over time. It is this increase in tidal range due to previous channel modifications that has then been manifested in the apparently higher historical rate of increase of MHW over MSL (which encompasses these periods of channel modifications) referenced anecdotally and in prior studies.

Going forward in time, though, it is expected that MHW should generally increase at the same rate as MSL increases absent any alterations to the river channel. To support this assumption, analyses of the water levels at Wilmington over the past four decades were performed. These analyses consisted of investigating two distinct time periods:

1. From April 2004 to December 2019 which represents the time since the most recent channel deepening / widening project; and

2. From January 1983 to July 2000 which represents the time between the most recent two channel deepening / widening projects.

It is noted that the most recent project was performed in phases between August 2000 and March 2004, so this time interval was not included in the two analysis periods. The prior deepening / widening project was completed in October 1982.

2.0 TIDAL ANALYSES

The present tidal analysis was performed using hourly observations at the NOAA CO-OPS Station 8658120 Wilmington, NC. Continuous data was available from 1936 until the present. The analysis of tidal constituents and tidal datums was performed based on monthly and annual (January to December) intervals. The tidal datums values (MHW and MLW) were referenced to the local MSL. MSL values was computed as the arithmetic mean of observations over each interval. Mean tidal range was computed as the difference between MHW and MLW.

As shown in Table 1 and Figures 1, 3, 7 and 11 the rate of increase during the aforementioned time periods for MHW and MLW is similar to the rate of increase of MSL. Specifically, it was observed that MHW is increasing at a slower rate (by 15–20%) than MSL during the periods when no major alterations were made to the river channel.

Table 1: Tidal Datum Rate of Change

Tidal Datum	1983-2000 (ft/yr)	2004-2019 (ft/yr)
MHW	0.006	0.033
MSL	0.008	0.039
MLW	0.008	0.043
Mean Range	-0.002	-0.010

Table 2 shows a notable change in the mean tide range as a result of the channel improvements that occurred between 2000 and 2004. This is especially clear in Figure 10 (based on monthly data) and the figure below (based on yearly data). Both figures show a significant but gradual increase in the tidal range which occurred between 2000 and 2004 due to the most recent channel deepening / widening project.

Table 2: Tidal Datum Absolute Changes

Tidal Datum	1983-2000 (ft-MSL)	2004-2019 (ft-MSL)	Change (ft)	Change Relative to MSL (ft)
MHW	1.958	2.251	+0.293	+0.081
MSL	-0.017	0.195	+0.212	0.000
MLW	-2.242	-2.177	+0.065	-0.147
Mean Range	4.200	4.429	+0.228	n/a

Additionally, with respect to the modeling performed for the proposed project, a comparison can be made between the changes that occurred previously and the model predictions for the current project. One can expect similar in magnitude changes given the similar scopes of each project. In fact, Table 2 shows an increase in MHW of 0.081 ft compared to the model prediction of 0.12 ft; a decrease in MLW of 0.147 ft compared to

the model prediction of -0.18 ft, and an increase in the tidal range of 0.228 ft compared to the model prediction of 0.31 ft. This provides a validation that the model is predicting similar tendencies and changes in magnitudes that are comparable to those measured previously for a similar magnitude of modifications to the river channel.

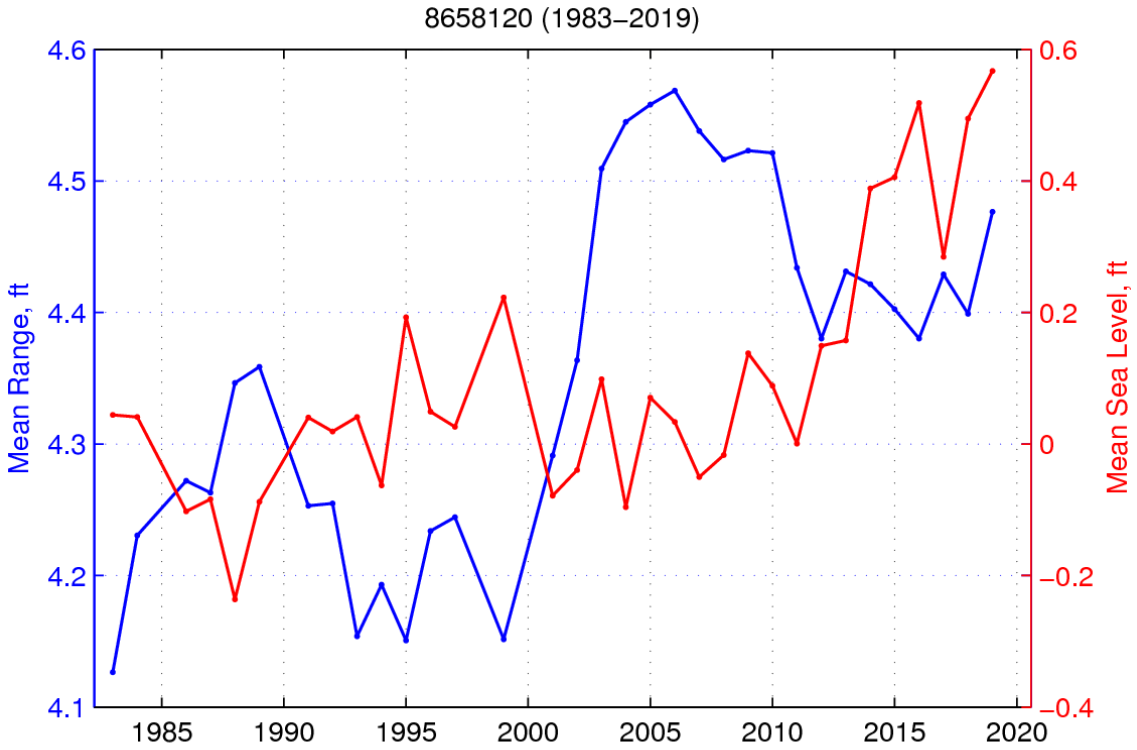


Figure Variability of mean tidal range based on annual data

3.0 CONCLUSIONS

As a result of these analyses, it can be concluded that based on historical measurements:

- Changes in MHW and MLW relative to MSL were primarily due to river channel modifications; and
- The rate of change of MHW during the periods which were absent of modifications to the river channel is similar to the rate of change of MSL.

Thus, the use of the Sea Lever Rise scenarios dictated by USACE guidance ER 1100-2-8162, Incorporating Sea Level Changes in Civil Works Programs, are appropriate for this project.

Figure 1

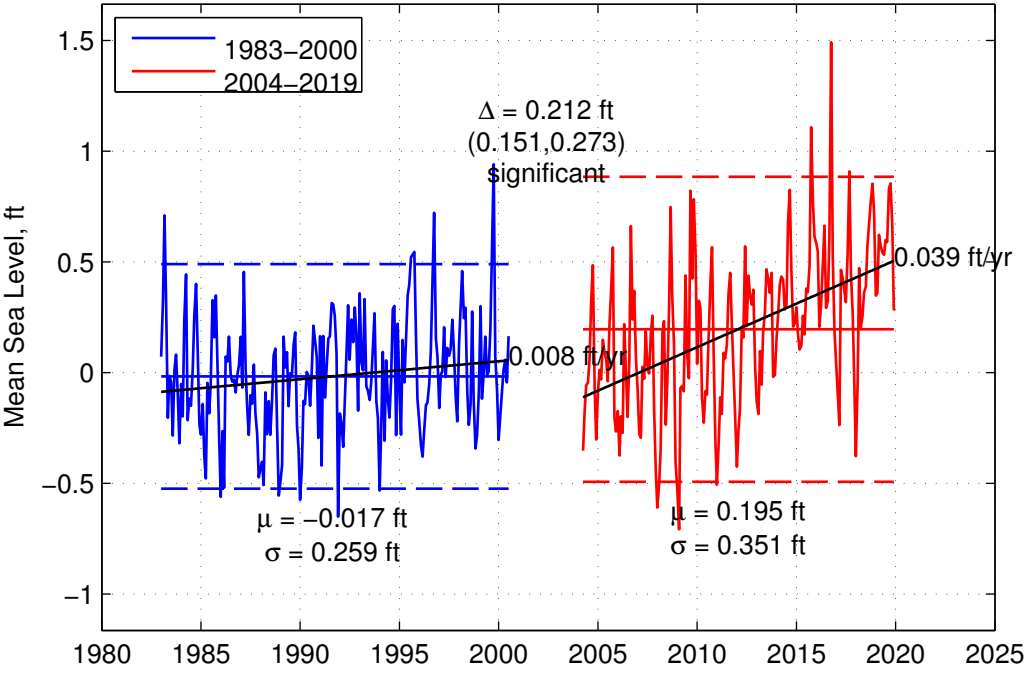

1983–2000
2004–2019
Δ = 0.212 ft
(0.151,0.273)
significant
0.008 ft/yr
0.039 ft/yr
μ = −0.017 ft
σ = 0.259 ft
μ = 0.195 ft
σ = 0.351 ft
Mean Sea Level, ft
1.5
1
0.5
0
−0.5
−1
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025

Figure 2 (1983–2019)

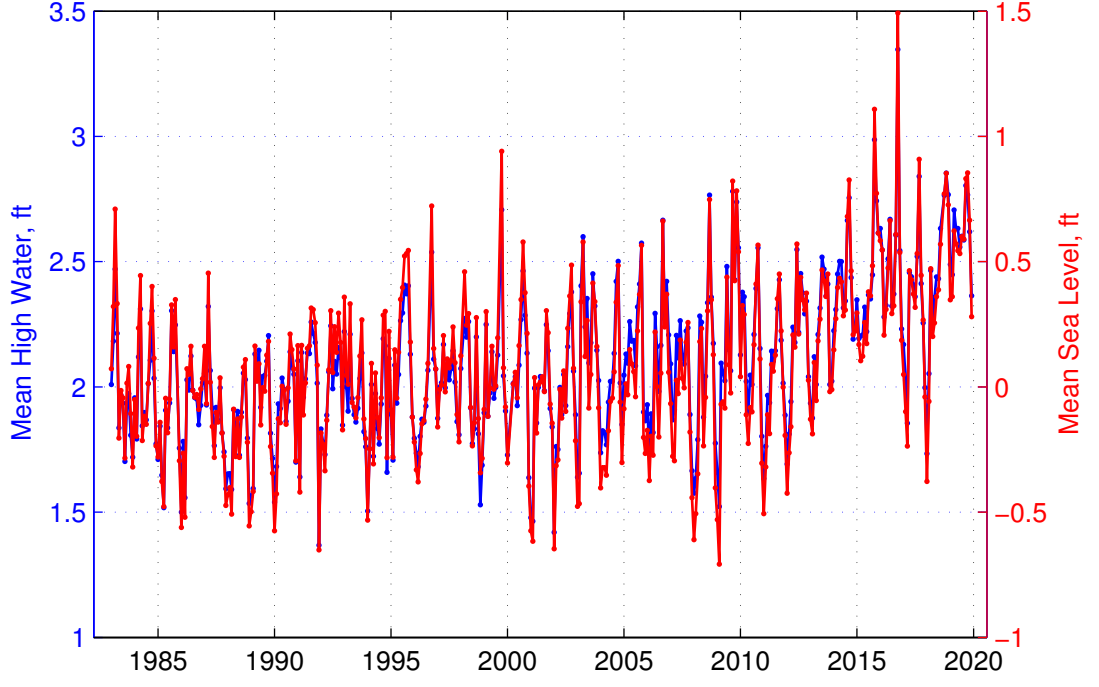


Figure 3

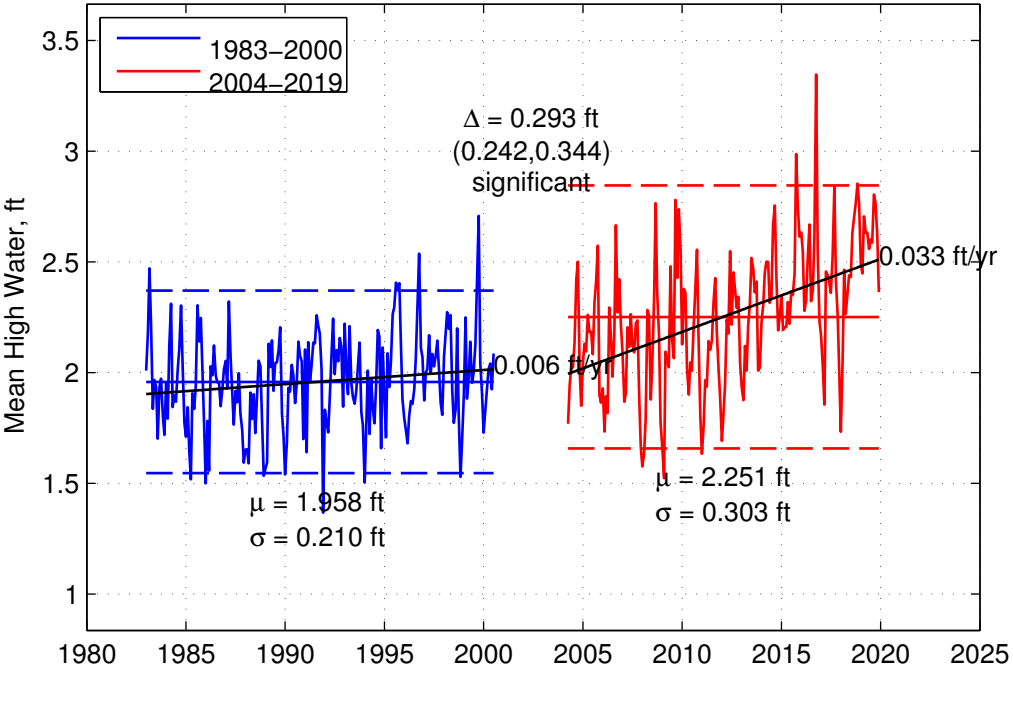

1983–2000
2004–2019
Δ = 0.293 ft
(0.242,0.344)
significant
0.006 ft/yr
0.033 ft/yr
μ = 1.958 ft
σ = 0.210 ft
μ = 2.251 ft
σ = 0.303 ft
Mean High Water, ft
3.5
3
2.5
2
1.5
1
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025

Figure 4 (1983–2000)

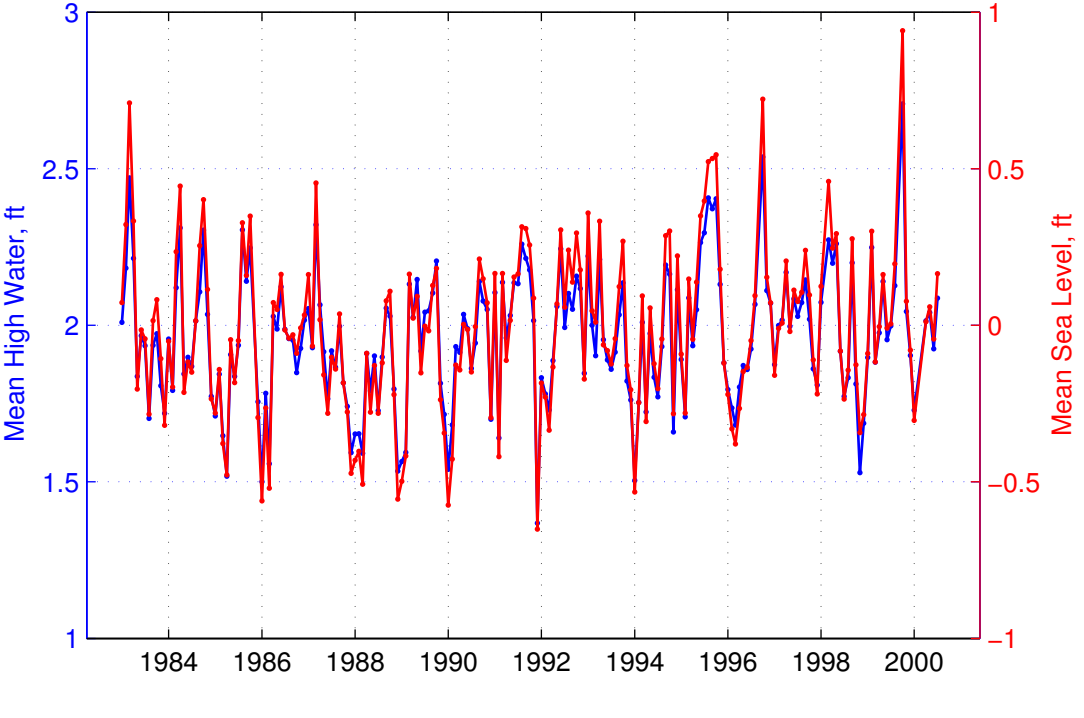
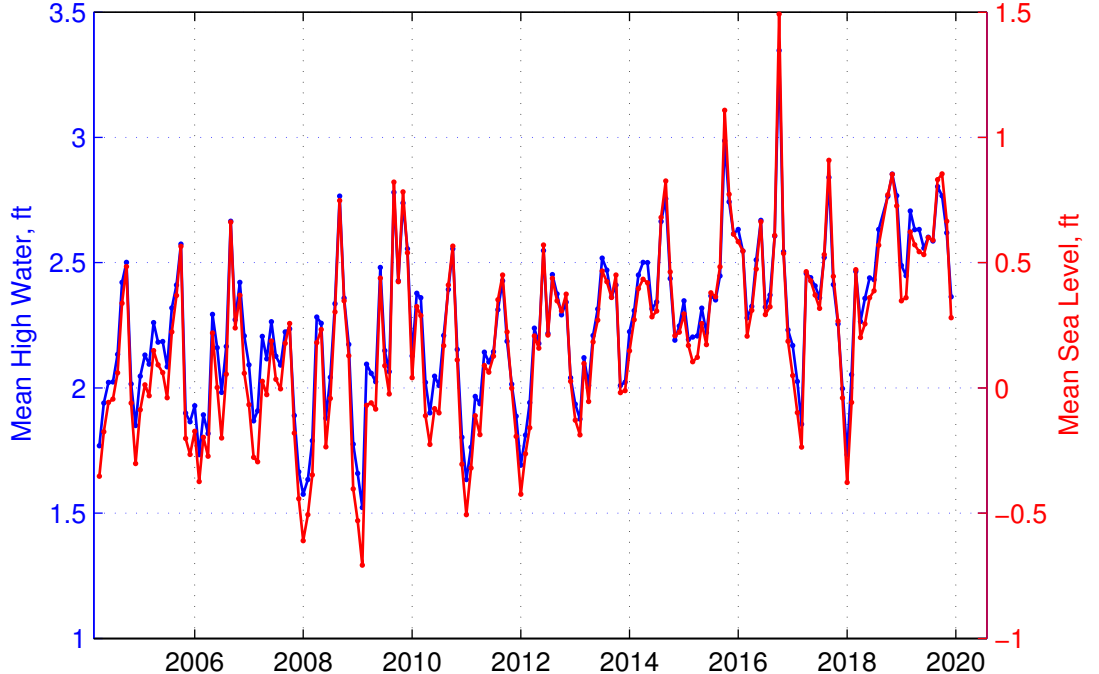


Figure 5 (2004–2019)



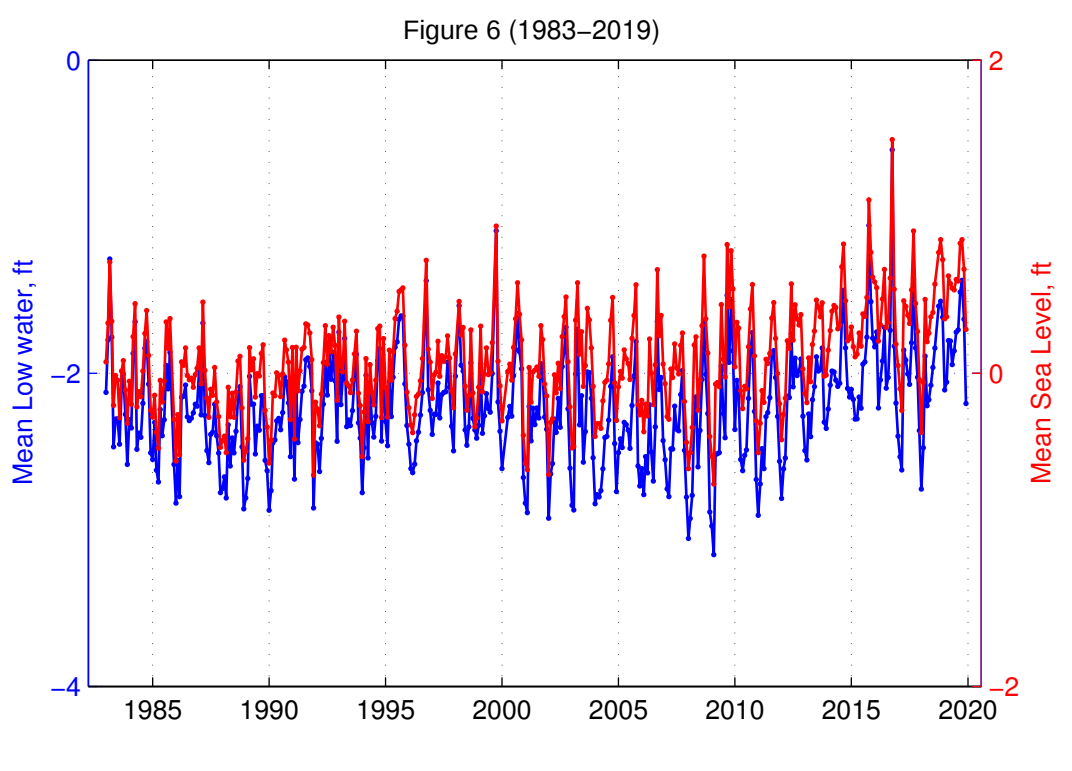
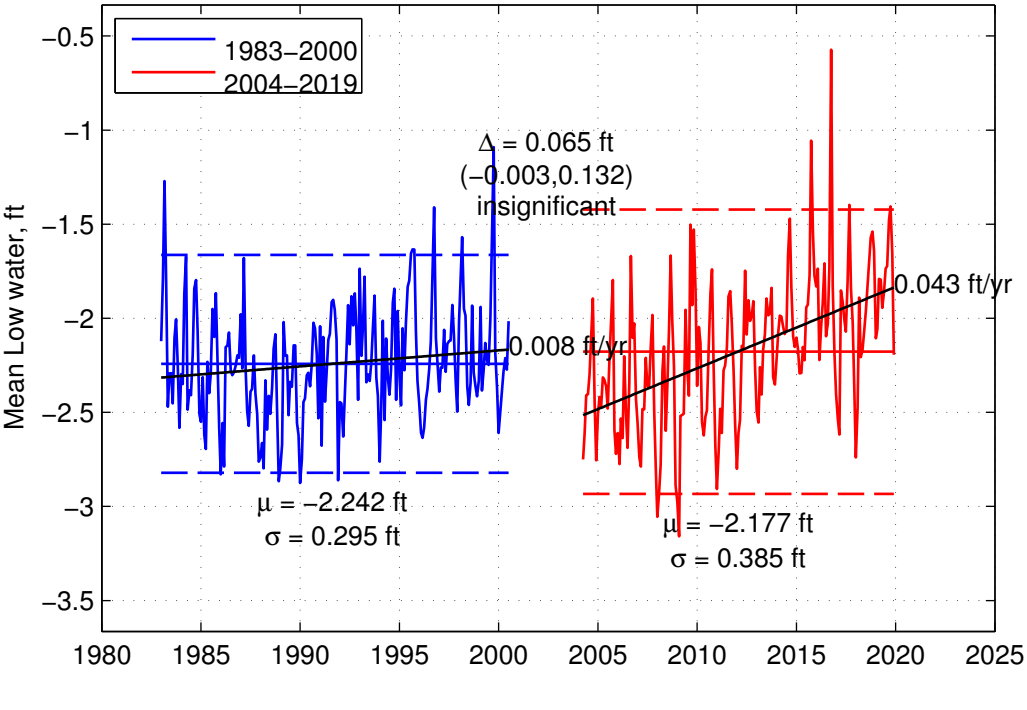


Figure 6 (1983–2019)
Mean Low water, ft
Mean Sea Level, ft
0
−2
−4
2
0
−2
1985
1990
1995
2000
2005
2010
2015
2020

Figure 7


1983–2000
2004–2019
Δ = 0.065 ft
(–0.003,0.132)
insignificant
0.008 ft/yr
0.043 ft/yr
μ = –2.242 ft
σ = 0.295 ft
μ = –2.177 ft
σ = 0.385 ft
Mean Low water, ft
–0.5
–1
–1.5
–2
–2.5
–3
–3.5
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025

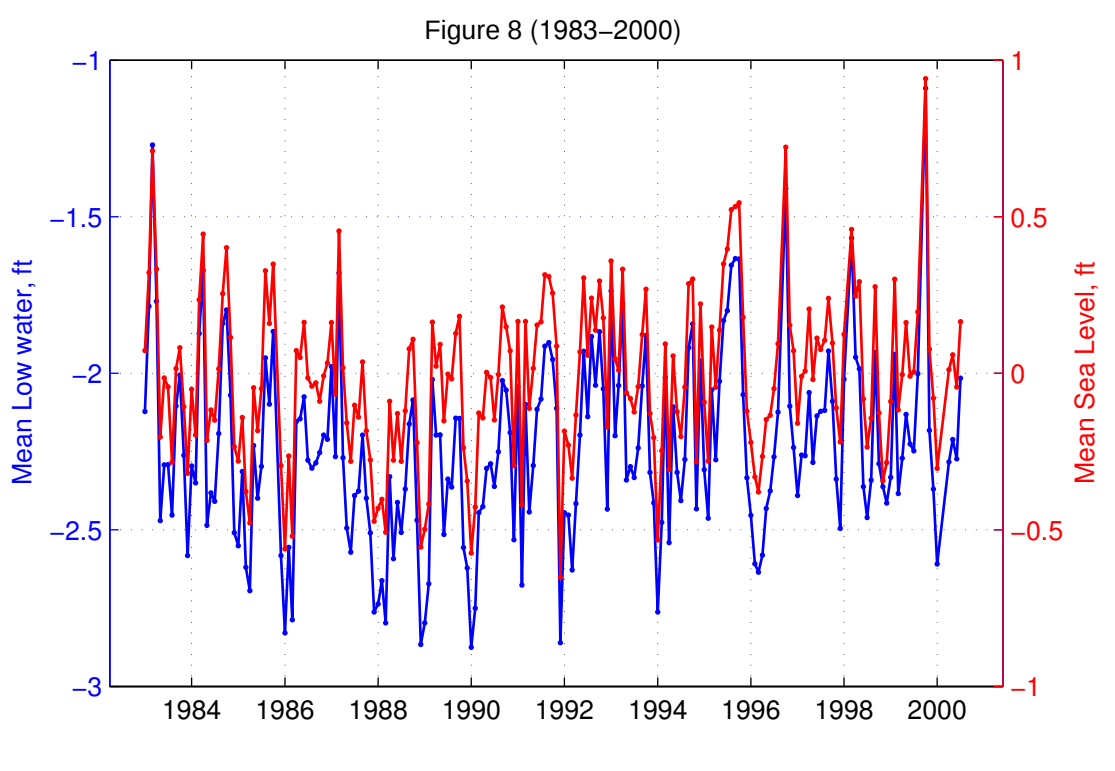


Figure 8 (1983–2000)
Mean Low water, ft
Mean Sea Level, ft
−1
−1.5
−2
−2.5
−3
1
0.5
0
−0.5
−1
1984
1986
1988
1990
1992
1994
1996
1998
2000

Figure 9 (2004–2019)

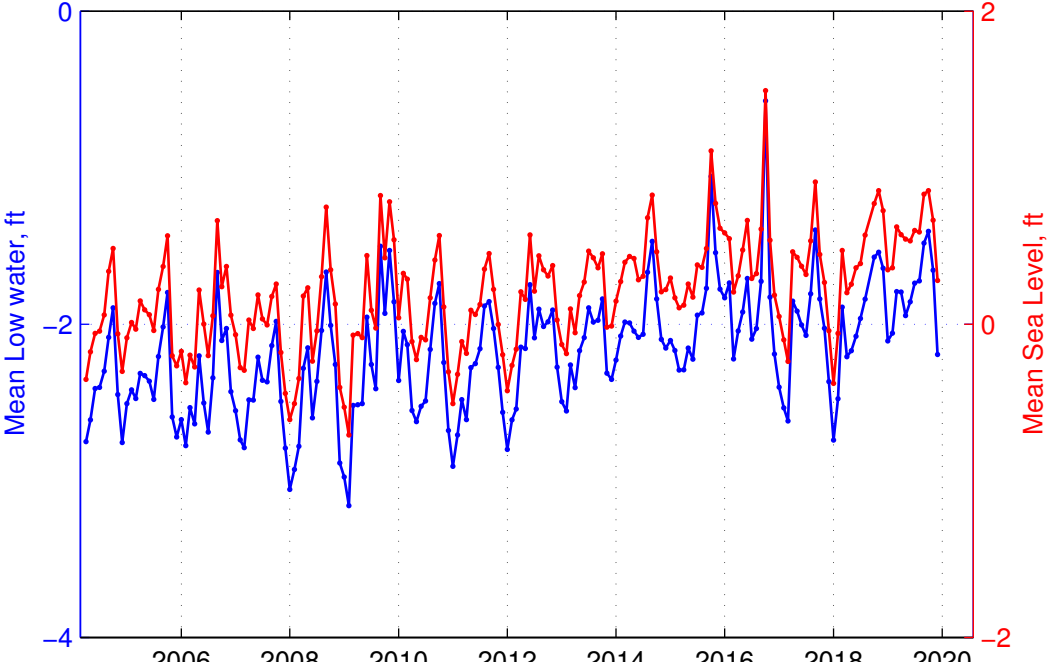


Figure 10 (1983–2019)

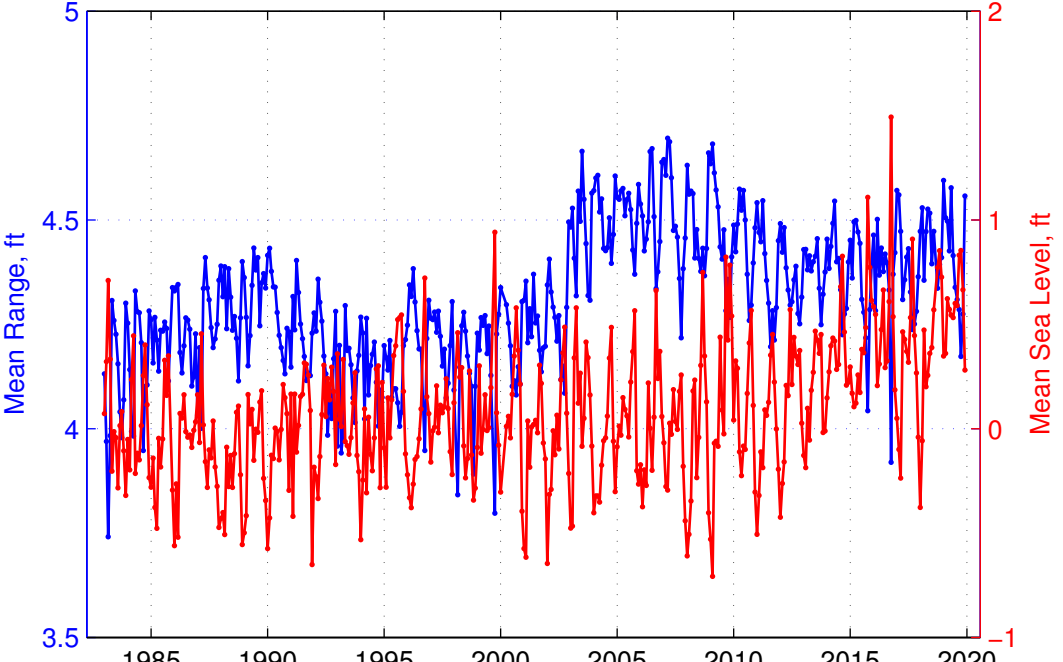
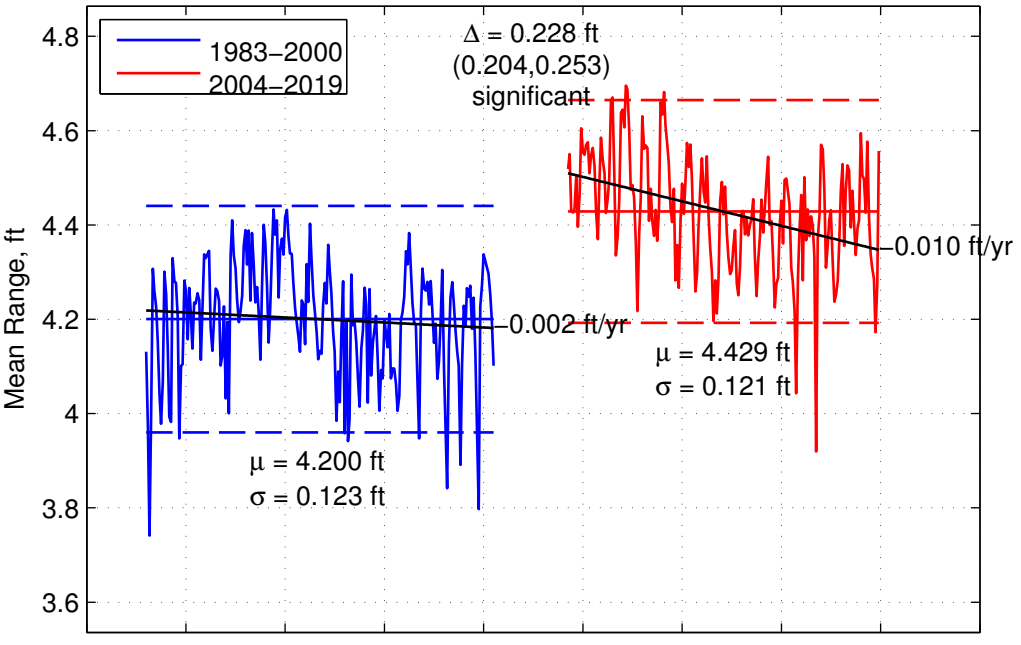


Figure 11


1983–2000
2004–2019
Δ = 0.228 ft
(0.204,0.253)
significant
0.010 ft/yr
0.002 ft/yr
μ = 4.429 ft
σ = 0.121 ft
μ = 4.200 ft
σ = 0.123 ft
Mean Range, ft
4.8
4.6
4.4
4.2
4
3.8
3.6
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025

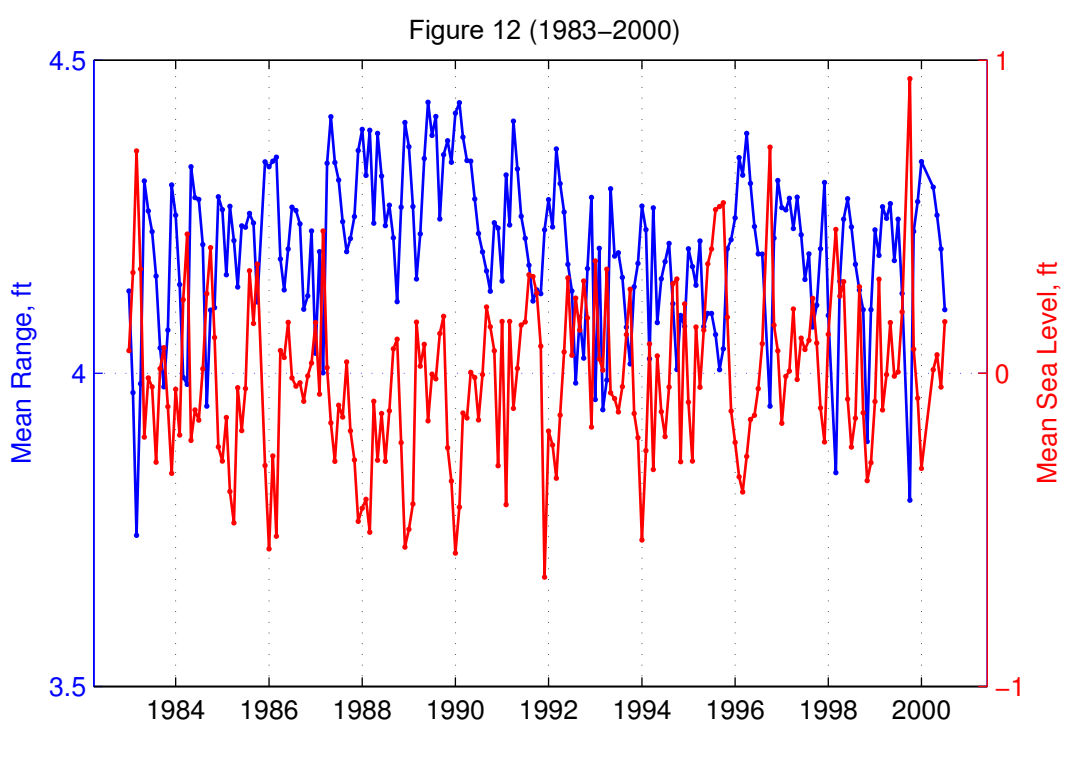


Figure 12 (1983–2000)
Mean Range, ft
Mean Sea Level, ft
4.5
4
3.5
1
0
−1
1984
1986
1988
1990
1992
1994
1996
1998
2000

Figure 13 (2004–2019)