

EXECUTIVE SUMMARY

"Additional Assessments of the Craney Island Eastward Expansion in the Elizabeth River and Hampton Roads - Hydrodynamic Model Results"

1. For the additional assessments of the CIEE using the VIMS 3D Hydrodynamic Eutrophication Model (HEM-3D), 4 model scenario runs were conducted:
 - a. Scenario 1 was for the model testing of the cumulative impact of the CIEE expansion and the deepening of the Maersk Terminal using *single variable runs* (using a single variable, tidal range, for model input).
 - b. Scenario 2 was model testing of these combined alterations further combined with ship berthing at both the CIEE and the Maersk Terminal facilities.
 - c. Scenario 3 tested a dye release in the Southern Branch using the simulated dye release feature of the model to compare the flushing capability both within the Southern Branch and for the entire Elizabeth River.
 - d. Scenario 4 was model testing of this cumulative impact (CIEE land expansion, Maersk Terminal dredging, and ship berthing at both facilities) using a *historical run* (using multiple variables in real time for model input).

2. The approach was to use a global analysis methodology to compare quantitatively the impacts of dredging and ship berthing over the far-field, including the areas of Hampton Roads and the Elizabeth River. This was done by determining percentages of total area associated with class intervals of change from the Base Case as differences in water surface elevation, surface and bottom salinity, surface and bottom current magnitude, surface and bottom residual current magnitude, and sedimentation potential.

3. From single variable runs, it is shown that both the APM terminal dredging and the berthing of ships had minimal impact on either surface elevation or sedimentation potential. The berthing of ships at CIEE, if considered permanent, has a local effect on the salinity distribution, and the velocity distribution, as shown in Table 1.

Table 1. 95th Percentile Values for Impacts of APM Terminal Dredging and Ship Berthing shown against CIEE alone.

Global Change – 95 th Percentile				
(5% of area contains change greater than value listed)				
Single Variable - Cumulative Impact of Dredging and Ship Berthing				
Difference (from Base Case):	Eastward Expansion Only	Eastward + APM Dredging	Eastward + APM dredging + triangular ships	Eastward + APM dredging + square ships
Surface Elevation	0.14 cm	0.13 cm	0.13 cm	0.14 cm
Surface Current	2.4 cm/s	2.4 cm/s	2.5 cm/s	2.6 cm/s
Bottom Current	1.6 cm/s	1.7 cm/s	2.1 cm/s	2.5 cm/s
Surface Salinity	0.00 ppt	0.10 ppt	0.15 ppt	0.19 ppt
Bottom Salinity	0.00 ppt	0.06 ppt	0.10 ppt	0.15 ppt
Sedimentation Potential	0.08 %	0.08 %	0.09 %	0.10 %

4. A second table, Table 2, is created in order to compare the cumulative impacts resulting from both the APM dredging and ship berthing to the previously evaluated land expansion options. Impacts occurred on velocity and salinity distributions, but their magnitudes were less than those of the previously studied land expansion options (In this table, the cumulative impact of the Eastward Expansion, APM dredging, and ship berthing, is shown in the second column and its values are shown in **bold**).

Table 2. 95th Percentile Values for Cumulative Impacts Shown against Previously Evaluated Land Expansion Options.

Global Change – 95 th Percentile (5% of area contains change greater than value listed)					
Single Variable - Comparison to Prior Land Expansion Options					
Difference (from Base Case):	Eastward Expansion Only	Eastward + Dredging + Square Ships	Westward Expansion Only	Northward Expansion Only	North+eastward Expansion Only
Surface Elevation	0.14 cm	0.14 cm	0.34 cm	1.00 cm	1.04 cm
Surface Current	2.4 cm/s	2.6 cm/s	5.3 cm/s	12.3 cm/s	11.7 cm/s
Bottom Current	1.6 cm/s	2.5 cm/s	3.3 cm/s	7.8 cm/s	6.6 cm/s
Surface Salinity	0.00 ppt	0.19 ppt	0.12 ppt	0.71 ppt	0.23 ppt
Bottom Salinity	0.00 ppt	0.15 ppt	0.35 ppt	1.00 ppt	0.23 ppt
Sedimentation Potential	0.08 %	0.10 %	2.8 %	8.9 %	6.3 %

5. Flushing analysis revealed that neither the flushing of the Southern Branch nor that of the entire Elizabeth showed any detectable adverse response from the combined effects of the APM terminal dredging and ship berthing (see Figures III.3 and III.4).
6. In order to assess the impacts of dredging and ship berthing during extreme conditions, the historical run was conducted testing the cumulative impact of the CIEE land expansion, the dredging of the Maersk Terminal area, and the berthing of ships. In the historical run simulation scenario, the impacts of dredging and ship berthing are tested against extreme conditions comprised of high and low discharge and high wind during a six-month simulation for which the input variables (i.e., discharges, wind, boundary conditions) are taken from historical records. Its impact was compared with those of two expansion options: Option 7 (eastward expansion) and Option 7/5a (combined eastward and westward expansion). The results for this are shown in Table 3. As in the single variable runs, little change was noted in historical run of this cumulative test case while comparing with Option 7. Comparing the results to those of Option 7/5a, the changes were slightly greater in salinity, but less for all other parameters compared.

Table 3. 95th Percentile Values for Cumulative Impacts Shown against Previously Evaluated Land Expansion Options for Periods of Extreme Events as Modeled by the Historical Run Scenario.

Global Change – 95th Percentile (5% of area contains change greater than value listed)			
Historical – High Discharge Event			
Difference (from Base Case):	Eastward Expansion Only	Eastward + Dredging + Square Ships	Eastward-Westward Expansion Only
Surface Elevation	0.20 cm	0.20 cm	0.33 cm
Surface Current	5.5 cm/s	5.9 cm/s	6.7 cm/s
Bottom Current	2.7 cm/s	3.6 cm/s	3.7 cm/s
Surface Salinity	0.00 ppt	0.08 ppt	0.02 ppt
Bottom Salinity	0.00 ppt	0.09 ppt	0.07 ppt
Sedimentation Potential	1.0 %	1.1 %	1.9 %
Historical – Low Discharge Event			
Difference (from Base Case):	Eastward Expansion Only	Eastward + Dredging + Square Ships	Eastward-Westward Expansion Only
Surface Elevation	0.14 cm	0.14 cm	0.33 cm
Surface Current	2.7 cm/s	3.0 cm/s	4.3 cm/s
Bottom Current	1.9 cm/s	2.7 cm/s	2.9 cm/s
Surface Salinity	0.00 ppt	0.12 ppt	0.04 ppt
Bottom Salinity	0.01 ppt	0.16 ppt	0.09 ppt
Sedimentation Potential	0.9 %	1.0 %	2.8 %
Historical – High Wind Event			
Difference (from Base Case):	Eastward Expansion Only	Eastward + Dredging + Square Ships	Eastward-Westward Expansion Only
Surface Elevation	0.21 cm	0.21 cm	0.46 cm
Surface Current	2.2 cm/s	2.8 cm/s	5.0 cm/s
Bottom Current	1.5 cm/s	2.4 cm/s	3.0 cm/s
Surface Salinity	0.00 ppt	0.09 ppt	0.00 ppt
Bottom Salinity	0.00 ppt	0.11 ppt	0.02 ppt
Sedimentation Potential	0.8 %	0.9 %	1.7 %

