

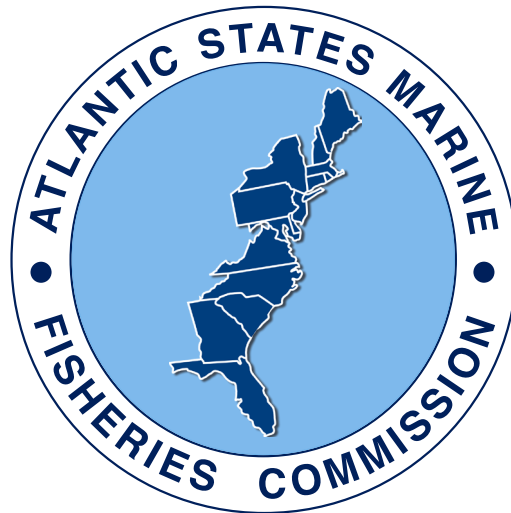


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# Harbor Deepening: Potential Habitat and Natural Resources Issues

*Working towards healthy, self-sustaining populations for all Atlantic coast fish species  
or successful restoration well in progress by the year 2015*



# Harbor Deepening: Potential Habitat and Natural Resources Issues

prepared by the  
**ASMFC Habitat Committee**

**Approved by the ISFMP Policy Board  
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# Harbor Deepening: Potential Habitat and Natural Resources Issues

## Introduction

In 2014, an upgrade of the locks in the Panama Canal will be completed, allowing for passage of “Post-Panamax” class vessels with maximum dimensions of 1,200 ft long, 160 ft wide, and a draft of 49.9 ft. The present expansion of the locks, as well as future expansion, which ultimately will service ships with a draft approaching 60 ft, have major implications for economic drivers affecting ports and harbors. Berthing facilities to handle the substantially larger vessels require channels and turning basins that provide safe navigation conditions. Not surprisingly, multiple ports along the Atlantic coast have initiated navigation infrastructure improvements to accommodate the larger, deeper draft vessels. Channels serving the Ports of Norfolk and Baltimore have already been deepened to 50 ft, and the Port of New York/New Jersey is in the final stages of deepening to 50 ft. Other ports, such as Philadelphia and Miami, are entering construction phases, while others, including Fort Lauderdale, Savannah and Charleston, are aggressively pursuing deepening projects. Each project differs in details. Clearly these projects can have tremendous economic consequences for local, regional, and national economies. Likewise, however, they also represent large-scale modifications of existing and historical fish habitat. In most cases, they also represent a progression in a series of incremental improvements to navigation infrastructure that has occurred in tandem with other alterations to coastal, estuarine, and tidal riverine bathymetric features.

Although the port projects are generally classified as “channel deepening” projects, it is important to understand that deepening may also involve widening. Depending on the types of geological formations through which the navigational channels run (e.g., limestone versus sand, silts and clays), side slopes of the constructed channels must allow for sufficient angle of repose. Geological rock formations can incorporate steeper side slopes than the gentler side slopes required by softer formations. Thus, the authorized width of the channel basin does not always represent the full footprint of modified substrate. To varying extents, every deepening project entails a net loss of shallow-water habitat and a net gain of deep-water habitat. Inherent in every deepening project are tradeoffs in terms of costs and benefits. With respect to habitat, the shift from shallow- to deep-water habitat may affect fishery resources in numerous ways.

This document describes potential impacts to inform decision-making on future projects. Each project can



*Deep draft container ship. Photo credit: Doug Clarke*



*Example of a “bucket” or “clamshell” dredge loading a barge using an open bucket. Photo Credit: Doug Clarke*

proceed only through adherence to the National Environmental Policy Act (NEPA) process, which ideally includes transparent consideration of fish habitat as an important attribute in the evaluation of project-specific merits. Awareness of the many inherent tradeoffs affecting fish habitat in deepening projects can minimize conflicts and provide insights into short- and long-term impacts and means to mitigate them.

While the issues associated with harbor deepening projects can be geographically specific, there are a number of alterations associated with these projects that should be considered when evaluating the potential effects on habitats and associated biological resources. These can include alterations in the water quality and physical characteristics of the harbor and associated drainage systems, as well as both direct and indirect effects on critical biological resources. The following sections identify some of the potential changes that should be considered.

## Water Quality Effects

- Evaluate the extent of salinity intrusion into freshwater areas and redistribution of vertical and horizontal salinity zones. Assessments should determine the extent of altered salinity regimes, both spatially and temporally.
- Determine if altered or exacerbated occurrences of bottom hypoxic conditions could occur that may prevent benthic habitat access or use by fishery resources.
- Consider the potential exposure of nutrient-rich sediments to the water column.
- Predictive models need to be robust with adequate resolution to predict changes in circulation and water quality appropriate for specific areas of concern.
  - Hydrodynamic and water quality models should have 3-D capabilities such that horizontal salinity gradients can be integrated over depth to drive the baroclinic portion of the convective mode of estuarine circulation. Modifications to depths and salinity gradients on the buoyancy-driven and non-tidal circulation should be examined.
  - Vertical resolution should be sufficient to accurately predict water quality conditions in the bottom meter of the water column.
  - Horizontal resolution should be sufficient to accurately predict changes in peripheral water bodies and habitats (e.g., wetlands, tidal rivers and tributaries within the project’s area of influence).



*The dredger Queen of the Netherlands leaves a trail of silt as channel deepening commenced in Port Phillip Bay, February 8, 2008. Photo Credit: ABC News, James Fisher, [http://www.abc.net.au/reslib/200802/r222333\\_876404.jpg](http://www.abc.net.au/reslib/200802/r222333_876404.jpg)*

- Model applications should address both normal and drought conditions based on the historical record as well as severe weather occurrences.
- Potential effects of sea level rise under scenarios that reflect low, moderate, and high rates of change should be considered.
- Calibration and validation of the model(s) should be evaluated using data from stations as close as practicable to sensitive resources.

## Physical Effects

- Evaluate tradeoffs in habitat types and attributes associated with widening aspects of deepening projects, i.e., aerial extent of shallow habitat lost versus deep habitat gained, and the implications for various life history stages of species of concern.
- Determine the potential for increased shoreline erosion associated with passage of large deep-draft vessels.
- Consider the impacts of suspension and redistribution of contaminants.
- Evaluate water circulation patterns and effects on flushing and residence time, especially to tidal creeks and coves.
- Consider consequences of potential relocation of turbidity maximum zone(s).
- Evaluate potential effects of turbidity plumes associated with construction and impacts of increased sedimentation, both within and outside the channel. Sediment transport models should be used where appropriate.
- Consider potential for salinity intrusion into freshwater aquifer and resultant effects.
- Evaluate how the altered channel configuration may affect hurricane storm surge on lands surrounding the harbor.
- Altered channel configuration can affect rates of sedimentation in a given channel reach, and modify sediment transport pathways within harbor settings. Consequent changes to the sediment budget may increase or decrease the need for, and frequency of, future channel maintenance dredging.



*Winter flounder in submerged aquatic vegetation.  
Photo Credit: Carl LoBue, The Nature Conservancy*

## Biological Effects

- Consider the effects of water quality changes on the distribution of vegetated wetland species, resident and migratory species distributions, and abundances of invertebrate assemblages.
- Ensure that Habitat Suitability Index (HSI) models are appropriate for the area. Are HIS models available for key species and sufficiently refined to predict project impacts?
- Evaluate effects on spawning and migration of anadromous and diadromous species.
- Evaluate the effects on spawning and habitat relationships of non-migratory species.
- Determine suitability of dredging windows to minimize impacts related to critical species, including use of differing windows for various sections of the project if warranted (e.g., bottleneck areas, lower estuarine areas versus upper reaches if relevant).
- Evaluate effects on threatened and endangered species and protected marine mammals, including noise and ship-strike issues associated with construction activities and passage of deep-draft vessels.
- Evaluate effects on sensitive shoreline habitats (e.g., intertidal shellfish habitats, vegetated shorelines, bird nesting areas) or any Essential Fish Habitat (EFH), including effects on the accessibility of those habitats by the species that use them.
- Determine the extent and effects of dredging on sensitive bottom habitats, such as hard bottom/reef habitats and submerged aquatic vegetation.



*Bubble curtain in use to minimize intrusion of contaminated water. Photo Credit: [http://www.atlascopco.com/microsites/Images/ac0050862\\_456.jpg](http://www.atlascopco.com/microsites/Images/ac0050862_456.jpg)*

- Evaluate effects of dredged material disposal activities on adjacent habitats and biota (e.g., effluents from upland disposal, habitats adjacent to ocean disposal areas).
- Evaluate effects on existing habitats altered due to any need to expand approved disposal areas.
- Identify potential for beneficial uses of dredged material to enhance or protect existing habitats.
- Determine if specialized excavation techniques will be used, such as blasting or use of hydro-hammers; underwater sound represents one obvious source of concern. Mitigation measures, such as the use of bubble curtains might be appropriate. Where

habitats or species of concern may be exposed to suspended sediment plumes, dredging management practices and controls such as closed buckets for mechanical dredges and silt curtains should be considered.

- It is important to consider that modifications in infrastructure required for the deepening project (e.g., bridge alterations, private spur channels, existing port facilities, removal or relocation of utilities and pipelines) may entail practices (e.g., pile driving, trenching) that impact the natural resources identified in the above bullets.

## Mitigation

Discussion of habitat compensatory mitigation for harbor deepening projects typically focuses upon impacts caused by the proposed incremental deepening, rather than impacts from historical construction, because the historical construction usually occurred before passage of modern environmental laws. Mitigation that replaces direct loss of habitats, such as salt marsh, mangroves, mud flats, seagrass, corals, and live/hardbottom, follows the same process used for typical dredge-and-fill projects; however, the larger scale affords opportunities to include landscape ecology considerations, such as the spatial distribution of habitats. Mitigation designs that take into account the spatial distribution of habitats within a harbor should be more effective across a broader range of fish life stages, especially stages where habitat is more likely to be limiting. Also due to the larger scale, mitigation for harbor deepening projects can include unusual elements rarely seen in other project types. For example, deepening of Savannah Harbor will include rerouting distributaries and building freshwater reservoirs to reduce salinity intrusion and injecting dissolved oxygen into the harbor in perpetuity to offset impacts from altered flushing patterns. For the deepening of both Savannah Harbor and Wilmington Harbor, loss of nursery habitat for sturgeon, permanently by dredging and temporarily by blasting, respectively, will be mitigated by restoring sturgeon access to spawning areas upriver from the estuaries.

The mitigation for harbor deepening projects also may take an adaptive management approach. Long-term (e.g., 10 years) evaluations of deepening impacts and mitigation benefits allows a more precise assessment of



*Turbidity curtain for dredging. Photo Credit: [http://www.layfieldenvironmental.com/Content\\_Files/Images/Product/Lomond\\_Turbidity\\_Curtain\\_9\\_N\\_Side\\_-\\_Orange.jpg](http://www.layfieldenvironmental.com/Content_Files/Images/Product/Lomond_Turbidity_Curtain_9_N_Side_-_Orange.jpg)*



*Bucket dredge using a closed bucket.  
Photo Credit: Doug Clarke*

whether project effects are consistent with those envisioned within the Environmental Impact Statement. The best examples of an integrated monitoring and adaptive management program include pre-approved additional mitigation that would be triggered when monitoring shows impacts are greater than anticipated or mitigation is not performing as well as expected. Savannah Harbor is an example of such a program.

While not described as mitigation, harbor deepening projects often include a component on beneficial use of dredged material to address federal policy requirements. These components may include building marsh islands or oyster reefs in shallow water areas and building offshore berms to provide storm protection and serve as artificial reefs. These beneficial use projects also are often part of an integrated monitoring and adaptive management program. While outside the scope of this report, it should be noted that mitigation for harbor deepening often includes socioeconomic components to address land-based activities, such as constructing roadways to accommodate additional truck traffic that result from a harbor deepening project.

## Conclusions

Harbor and channel deepening projects are invariably complex, posing a plethora of challenges during their planning and construction phases. Protection of fishery resources and habitat should be established as a primary goal early in the planning process and continued throughout the life of the project.

*Note: Economic and other issues not specific to habitats and associated natural resources are not considered in this document.*





Hopper Dredge. Photo Credit: Doug Clarke

## ADDITIONAL INFORMATION

### Sources of information and documents related to ongoing or planned deepening projects:

Charleston Harbor Deepening: <http://www.sac.usace.army.mil/Missions/CivilWorks/CharlestonHarborPost45.aspx>

Savannah Harbor Deepening: <http://www.sas.usace.army.mil/shexpan/Home.html>

Savannah Harbor Deepening Project: <http://sav-harbor.com/>

New York/New Jersey Harbor Deepening: <http://www.nan.usace.army.mil/Missions/Navigation.aspx>

– Environmental Assessment: <http://www.nan.usace.army.mil/Portals/37/docs/harbor/Harprogrep/ea.pdf>

– Silt Curtain Pilot Study <http://www.nan.usace.army.mil/Missions/Navigation/NewYorkNewJerseyHarbor/HarborProgramReports.aspx>

Delaware River Main Channel Deepening: <http://www.nap.usace.army.mil/Missions/CivilWorks/DelawareRiverMainChannelDeepening.aspx>

– Environmental Assessment: <http://www.nap.usace.army.mil/Portals/39/docs/Civil/Deepening/DRMCD%20-%20Final%20Environmental%20Assessment%20-%20September%202011.pdf>

Miami Harbor Deepening: <http://www.saj.usace.army.mil/Missions/CivilWorks/Navigation/NavigationProjects/MiamiHaborDeepeningStudy.aspx>

Port Everglades Deepening: [http://www.saj.usace.army.mil/Portals/44/docs/Planning/PeerReviewReports/Port%20Everglades%20IEPR\\_Final%20Report\\_final.pdf](http://www.saj.usace.army.mil/Portals/44/docs/Planning/PeerReviewReports/Port%20Everglades%20IEPR_Final%20Report_final.pdf)

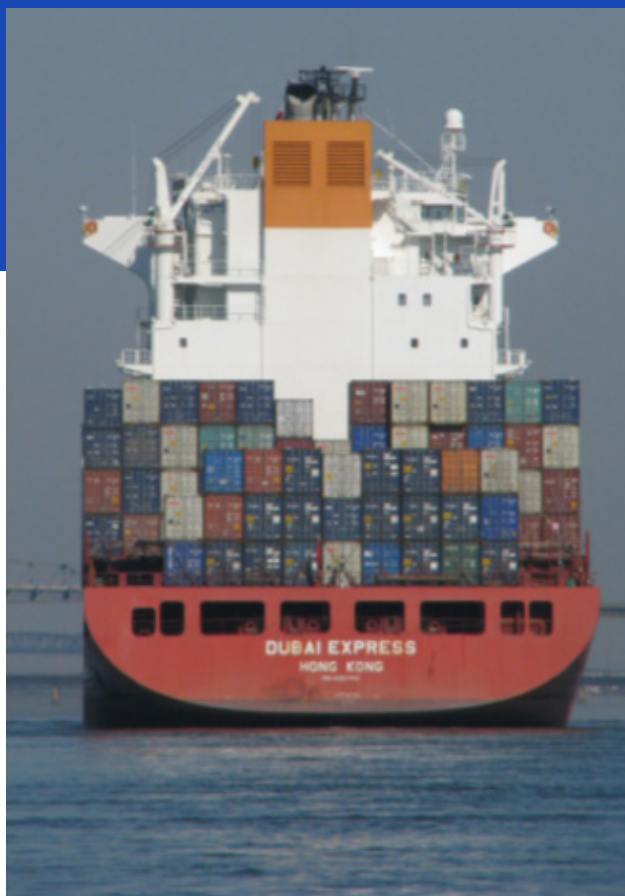
Jacksonville Harbor Channel Deepening: <http://www.saj.usace.army.mil/Missions/CivilWorks/Navigation/NavigationProjects/JacksonvilleHarborChannelDeepeningStudy.aspx>

### Other Relevant Sources:

EPA: Identifying, Planning, and Financing Beneficial Use Projects Using Dredged Material Beneficial Use Planning Manual: [http://water.epa.gov/type/oceb/oceandumping/dredgedmaterial/upload/2009\\_02\\_27\\_oceans\\_ndt\\_publications\\_2007\\_beneficial\\_use\\_manual.pdf](http://water.epa.gov/type/oceb/oceandumping/dredgedmaterial/upload/2009_02_27_oceans_ndt_publications_2007_beneficial_use_manual.pdf)

Massachusetts Department Marine Fisheries: Cape Cod and Islands Resource Recommendations for Municipal Dredging: [http://www.mass.gov/dfwele/dmf/programsandprojects/fish\\_hab\\_publications.htm](http://www.mass.gov/dfwele/dmf/programsandprojects/fish_hab_publications.htm)

Massachusetts Department of Marine Fisheries: Recommended Time of Year Restrictions (TOYs) for Coastal Alteration Projects to Protect Marine Fisheries Resources in Massachusetts: [http://www.mass.gov/dfwele/dmf/publications/tr\\_47.pdf](http://www.mass.gov/dfwele/dmf/publications/tr_47.pdf)



Deep draft container ship. Photo Credit: Doug Clarke

NOAA technical Memorandum, NMFS-NE-209: Impacts to Marine Fisheries Habitat from Nonfishing Activities in the Northeastern United States: <http://www.fpir.noaa.gov/Library/HCD/NOAA%20Technical%20Memo%20NMFS-NE-209.pdf>

NOAA Technical Memorandum, NMFS-F/SPO-70: National Gravel Extraction Guidance. A review of the effects of in- and near-stream gravel extraction on anadromous fishes and their habitats, with recommendations for avoidance, minimization, and mitigation: <http://spo.nwr.noaa.gov/tm/tm70.pdf>

NY Department of Environmental Conservation: Marsh Loss and Beneficial Use of Dredged Material: <http://www.dec.ny.gov/lands/5489.html>

USACE dredging literature database: <http://el.erdc.usace.army.mil/e2d2/>

USACE dredging technology transfer site: <http://el.erdc.usace.army.mil/dots>

USACE Waterways Experiment Station: <http://www.wes.army.mil/Welcome.html>

USACE Coastal & Hydraulics Laboratory, Effect of Dredging: <http://chl.erdc.usace.army.mil/dredging>

USACE The Environmental Effects of Underwater Explosions with Methods to Mitigate Impacts: <http://www.denix.osd.mil/nr/upload/underwaterexplosions.pdf>

## Literature References:

Thomas M. Keevin. Review of Natural Resource Agency Recommendations for Mitigating the Impacts of Underwater Blasting. Environmental Planning Branch, U.S. Army Corps of Engineers, St. Louis District, 1222 Spruce Street, St. Louis, MO 63103-2833A

Barry S. Drucker, William Waske, and Mark R. Byrnes, 2004. The U.S. Minerals Management Service Outer Continental Shelf Sand and Gravel Program: Environmental Studies to Assess the Potential Effects of Offshore Dredging Operations in Federal Waters *Journal of Coastal Research*. Winter 2004, Vol. 20 Issue 1, p1