

# Integrated City of Norfolk

## Coastal Storm Risk Management Feasibility Study Report/Environmental Impact Statement



### Draft Feasibility Report

October 2017



US Army Corps  
of Engineers ®  
Norfolk District



## EXECUTIVE SUMMARY

This Draft Integrated Feasibility Report and Environmental Impact Statement is for the Norfolk Coastal Storm Risk Management Study.

Norfolk, Virginia is an international city and the urban core of the Hampton Roads region. Its location at the mouth of the Chesapeake Bay, one of the richest tidal estuaries in the world, places it at the gateway to the Nation's capital. Established in August 1682, Norfolk has a long and proud history as a national maritime trading, shipbuilding and military center. Today, a city of approximately 250,000, Norfolk is the commercial center of Hampton Roads, a region of 1.7M residents, producing over \$93B worth of product annually.

The city is a global security hub home to the largest naval base in the world, Naval Station Norfolk (NSN), and the only NATO command on U.S. soil. Many of the 65,000 active duty and civilian base personnel employed at NSN commute to work from off the base, making the housing and road infrastructure in the city of Norfolk critical to mission readiness for the US Navy. The city of Norfolk is home to the Port of Virginia's Norfolk International Terminals (NIT), one of Virginia's most significant economic assets with an impact of \$60 billion in economic activity annually and port-related industries generating 374,000 jobs. The city is also home to multiple universities and key medical services supporting the region including Old Dominion University, Norfolk State University, Eastern Virginia Medical School, Sentara Norfolk General Hospital, and The Children's Hospital of the King's Daughters.

The City of Norfolk is increasingly at risk from flooding and damage from coastal storms. The city is a highly urbanized, relatively flat, community with nearly all areas below elevation 15 feet (North American Vertical Datum of 1988). The low elevations and tidal connections to the Elizabeth River and Chesapeake Bay place a significant percentage of the city at risk of flooding from high tides, northeasters, hurricanes and other storms. Exacerbating the flooding is the phenomenon of relative sea level rise (RSLR), which is the combination of water level rise and land subsidence. Norfolk is documented as having one of the highest rates of RSLR among Atlantic coastal communities.

This U.S. Army Corps of Engineers (USACE) study is a response to identified flood risks and will develop and evaluate coastal storm risk management measures for the city of Norfolk. These measures will be formulated to reduce risk to residents, industries, and businesses which are critical to the nation's economy. The long-term strategy for resilience in Norfolk is a layered solution that includes elements executed by the non-Federal sponsor, other Federal agencies, the Commonwealth of Virginia or one of its agencies, and/or non-governmental organizations in addition to the recommendations for implementation by the USACE study. The study seeks to not only reduce coastal storm risk, but also to build on resilience by implementing strategic approaches that address identified stresses and potential shocks such as nuisance flooding risk, major storms, and the impact on residents and economic activity.

The following Tentatively Selected Plan (TSP), Alternative 4d, includes a combination of structural, nonstructural, and Natural and Nature-based features (NNBFs) to reduce flood risk across large segments of the city. The study follows policies and guidelines for consideration of economic,

environmental, cultural, and social impacts. The TSP presented herein is formulated and designed for a coastal storm flood elevation calculated by the USACE as the 2% (50 yr.) annual chance exceedance (ACE) event. Further optimization of the TSP will include revisions to the plan after it is analyzed for multiple flood elevations. The revisions and optimization of the TSP will take place prior to release of the final report and may result in changes to the project costs and benefits.

To assist with better understanding of the components of the plan it has been broken down into four construction areas. The following paragraphs gives a brief description of the measures by these areas.

*Pretty Lake Barrier System Plus Nonstructural*

This system of measures would provide flood risk reduction for the Pretty Lake area that includes residential neighborhoods, emergency evacuation routes for northern Norfolk, and routes that provide access to Little Creek Amphibious Base. In particular, Route 60 (Shore Drive), used by military personnel, has average annual daily traffic volume of 26,000. A system of floodwalls and a storm surge barrier are recommended for keeping storm surge from entering Pretty Lake at Shore Drive. The commercial and residential areas to the east of Shore Drive, such as East Beach, that are outside of the structural system are proposed for nonstructural flood management measures. The NNBFs would be living shorelines in combination with subtidal reefs.

*Lafayette River Watershed Storm Surge Barrier Plus Nonstructural*

A storm surge barrier extending from Norfolk International Terminal (NIT) to the Lamberts Point golf course is proposed for providing flood risk management to the Lafayette River watershed. The Lafayette watershed represents approximately 26% of the study land area. The barrier would protect portions of Hampton Boulevard, which is used by military personnel to access Naval Station Norfolk. Nonstructural flood management measures are proposed for primarily industrial areas west of the storm surge barrier. The NNBFs would be living shorelines in combination with subtidal reefs.

*Ghent, Downtown, Harbor Park Barrier System Plus Nonstructural*

This system would provide flood risk reduction in the economic core of the city. The structural measure would form an alignment extending from West Ghent to the Harbor Park area. Floodwalls would tie into both sides of the existing downtown floodwall. A storm surge barrier is proposed at the entrance of The Hague. Nonstructural measures are proposed for those structures that remain between the proposed floodwalls and the Elizabeth River. This combination of measures protects the downtown area which has high economic value for the city as well as important infrastructure such as the region's only Tier 1 trauma hospital, the region's children's hospital, emergency services, the region's only medical school, critical transportation corridors used for evacuation, city hall, city institutional network, cultural assets, and adjacent historic districts as well as public housing. The NNBFs would be two separate greenways and living shorelines in combination with subtidal reefs.

*Broad Creek, Berkley, and Campostella*

A storm surge barrier and associated floodwalls are proposed for preventing floodwaters from the Elizabeth River from entering the Broad Creek watershed. The barrier system will be aligned parallel with the southern side of I-264 and the light rail tracks. Nonstructural measures are proposed for the Elizabeth Park neighborhood and areas south of the floodwalls. Nonstructural measures are proposed south of the Elizabeth River in the Berkley and Campostella neighborhoods. The NNBFs would be living shorelines in combination with subtidal reefs.

Figure 1 below shows the areas of the city impacted by the TSP color coded in order to provide a high level overview of the geographic extent of the measures that make up the TSP. Solid colored areas are those parts of the city that are behind the proposed structural measure. The colored, hatched areas are those parts of the city that are recommended to receive nonstructural flood risk management measures. Areas of the city that are not hatched or colored were not recommended for flood risk management. The hatched naval base area is not part of the study.

Project First Cost and Total Project Cost are estimated to be \$1.60 billion and \$1.81 billion respectively. These costs are draft estimates based on preliminary engineering and are subject to change as the level of detail on the project increases. Project First Cost is the constant dollar cost of the TSP at current price levels and is the cost used in the authorizing document for a project. Total Project Cost is the constant dollar fully funded with escalation to the estimated midpoint of construction. Total Project Cost is the cost estimate used in Project Partnership Agreements for implementation of design and construction of a project. Total Project Cost is the cost estimate provided to non-Federal sponsor for their use in financial planning as it provides information regarding the overall non-Federal cost sharing obligation. The Project First Cost and Total Project Cost are shown below in Table 1 and Table 2 respectively.

**Table 1. First Cost Apportionment Table (FY2017 Price Level)**

	<b>Federal (65%)</b>	<b>Non-Federal (35%)</b>	<b>Total</b>
<b>Initial Project Cost</b>	\$ 1,043,184,350	\$ 561,714,650	\$ 1,604,899,000
Real Estate Credit*		\$ 50,881,927	
Cash Contribution		\$ 510,832,723	

\*Real Estate Credit includes contingency and includes LER only

**Table 2. Total Project Cost Apportionment Table (FY2017 Price Level)**

	<b>Federal (65%)</b>	<b>Non-Federal (35%)</b>	<b>Total</b>
<b>Initial Project Cost</b>	\$ 1,177,242,950	\$ 633,900,050	\$ 1,811,143,000
Real Estate Credit*		\$ 54,187,980	
Cash Contribution		\$ 579,712,070	

\*Real Estate Credit includes contingency and includes LER only

Integrated City of Norfolk Coastal Storm Risk Management Feasibility Study Report/Environmental Impact Statement

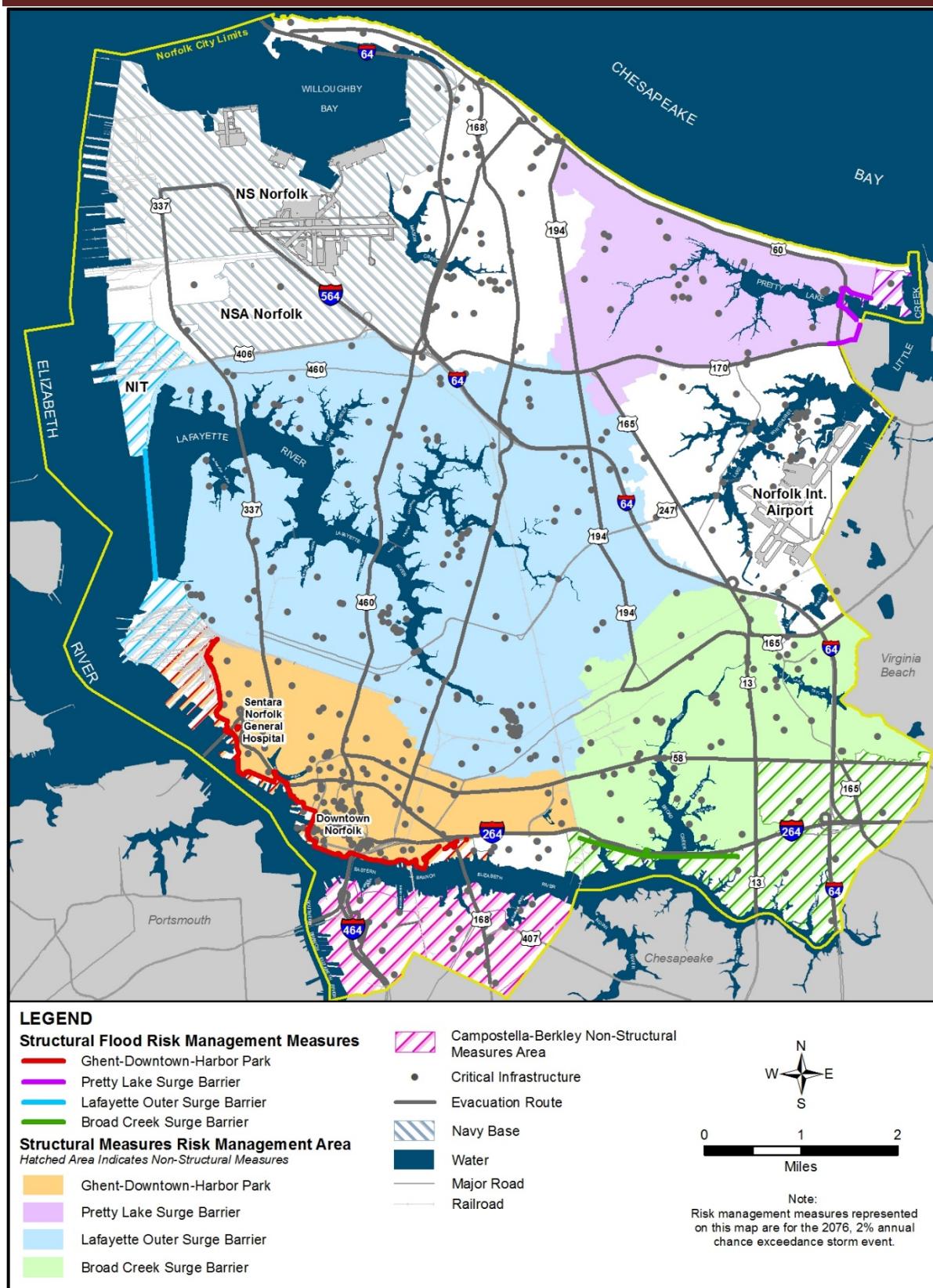


Figure 1. Map Supporting the Description of the TSP

## **Environmental Impacts and Mitigation**

A public scoping meeting and a follow up public meeting were held. Cooperating agencies were invited to participate in the development of this EIS; and consulting parties were invited to participate in the development of a Programmatic Agreement to address historic resources. Interagency coordination was initiated and will continue between the release of this draft and the final EIS.

The project will have both temporary and permanent adverse impacts on essential fish habitat, federally listed threatened and endangered species, marine mammals, navigation, recreation, wetlands, cultural resources, and visual resources.

Minor to moderate, temporary and permanent adverse effects to fish and other aquatic organisms may occur as a result of construction of the storm surge barriers and gate openings. During construction, noise and temporary minimal sedimentation due to disturbance of the bottom is expected, which could disrupt foraging, reproduction, and passage. Once completed, the storm surge barrier gates will remain open except during major storm events requiring closure. The gates will allow passage of aquatic organisms; however, passage and availability of prey species may be more restricted than currently. Closures would temporarily cut off passage of all aquatic organisms. Adverse effects on Essential Fish Habitat (EFH) and marine mammals are being addressed through coordination with the National Marine Fisheries Service, pursuant to the Magnuson-Stevens Act, and the Marine Mammal Protection Act (MMPA), respectively. Similarly, the project may adversely affect Atlantic sturgeon, fin and sei whales, and Kemps Ridley, loggerhead, and green sea turtle species. Adverse effects on threatened and endangered species are being addressed through coordination with the U.S. Fish and Wildlife Service (USFWS), pursuant to the Section 7 Endangered Species Act formal consultation process.

There will be minor to moderate impacts on navigation; particularly at the Lafayette River storm surge barrier. The storm surge barrier at the mouth of the Lafayette River will have ten openings. The USACE-maintained federal navigation channel near the center of the Lafayette River will remain in operation; sector gate will be constructed at that location. There are no navigational channels in Pretty Lake, The Hague, or Broad Creek; however, those areas are used for navigational purposes. Overall, impacts to navigation due to the storm surge barriers will be minor to moderate; however, the proposed navigational openings would be sufficient for navigable use and access.

With respect to floodplains, structural flood risk management projects, such as the storm surge barrier systems recommended in the TSP, are typically large scale projects that protect a large number of structures, which is a beneficial and significant impact. The USACE required Floodplain Management Plan should address the City's outreach and education plan for communicating residual flood risks to its citizens, which is a beneficial and significant component of the flood protection system, and the City's ability to be resilient and sustainable from a storm event. Impacts to the environment and floodplain areas, including wetlands, upland areas, natural drainage features, utilities, existing structures, etc. will generally be within the footprint of the line of

protection. The associated impacts are not considered adverse and will be temporary and negligible/minor in severity. The project will adhere to Executive Order 11988.

The footprint of the storm surge barriers and the floodwalls will permanently impact less than 2 acres of emergent intertidal wetlands, and less than 2 acres of scrub/shrub intertidal wetlands. In addition, approximately 22 acres of subaqueous bottom and mudflat will be directly impacted by structures. All wetland, oyster, and mudflat impacts will be mitigated. All required permits will be obtained for these impacts.

Hydrodynamic and water quality modelling was conducted to determine effects on flushing, salinity, dissolved oxygen, and nutrients. It was found that minor but permanent changes to water quality would occur. Significant changes to the salinity of upper reach waters of Pretty Lake are expected during a storm-event driven closure; however, water quality will return to normal within a month post-storm. Minor, permanent changes to bathymetry would occur, except where surge barriers are placed, where impacts are significant. Plankton mortality due to changes in salinity in upper reach waters of Pretty Lake are expected, but only during closure due to storm event. Permanent and adverse effects on benthics will occur for construction of surge barriers, which will be compensated for using mitigation.

Cultural resources impacts will include visual impacts to some historic districts and properties that are eligible for listing in the National Register of Historic Places. There is also potential to affect sunken historical vessel sites. Further study will be needed, and these potential impacts are being addressed through a Programmatic Agreement (PA) with the Virginia Department of Historic Resources (VDHR) and consulting parties, pursuant to Section 106 of the National Historic Preservation Act.

There will be both temporary and permanent visual adverse effects. Construction equipment will be visible at almost all locations, during construction. The floodwalls and storm surge barriers will be permanent and visible on land and/or water at their locations.

The project will have temporary, minor to moderate, adverse to beneficial effects on land use, socioeconomics, recreation, transportation, safety, and utilities. Construction may result in temporary noise, temporary diversion or restriction of traffic in locations where structures are installed; potentially restricted use during construction of the recreational facilities such as the Elizabeth River Trail, Harbor Park, and Town Point Park. There may also be permanent impacts on the Lamberts Point Golf Course at the location of the storm surge barrier. However, overall, the permanent effects on land use, recreation, transportation, safety, noise, and utilities are expected to be minimally adverse to mostly beneficial, because these resources would be enhanced through protection from flooding. Noise impacts would be temporary and minor, during construction.

Impacts to hazardous materials and wastes would be negligible to temporary and minor during construction. Care would be taken at the storm surge barrier connection to upland at Lamberts Point Golf Course, formerly a landfill. Overall, there would be minor benefits post-construction due to increased protection against coastal erosion.

There will be minimal to negligible temporary or permanent impacts on wildlife and terrestrial vegetation. Some mechanized land clearing will be necessary for installation of structures and construction access. Wildlife in the area is accustomed to an urban/suburban environment and would likely avoid the areas during construction. There will be minor to negligible impacts on geology and soils. All erosion and sediment control regulations will be followed and all disturbed areas will be stabilized.

This project would have negligible temporary effects on air quality during construction due to emissions, and negligible permanent effects are anticipated.

There will be negligible adverse impacts on submerged aquatic vegetation (SAV); there are no SAV beds near the project footprints of any of the structures.

Greenways provide innovative water management solutions that increase water storage capacity, increase infiltration capacity with natural elements, and provide native plantings that enhance wildlife habitat. Greenways contain water storage features that can be used to store water and can be incorporated with native vegetation plantings to provide for increased infiltration capacity. Examples of greenway features include community gardens, dry swales, retention ponds, bio-swales, porous pavement, riparian buffers, vegetated roofs, etc. Natural and nature based features provide beneficial impacts in many ways, such as reducing flood impacts, valuable habitat, recreational areas, urban landscape diversity, etc. These types of features can be long lasting or temporary as necessary. While these measures will not significantly reduce flood risks during major storms, they may make a difference for small and localized flood events, and they may provide some mitigation value.