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CHIEF OF ENGINEERS  
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WASHINGTON, DC 20310-2600

DAEN

FEB 05 2019

SUBJECT: Norfolk Coastal Storm Risk Management Study, Virginia

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on coastal storm risk management (CSRM) recommendations for the city of Norfolk, Virginia. It is accompanied by the report of the district and division engineers. The city of Norfolk was previously evaluated for coastal storm flood risk within the January 2015 North Atlantic Coast Comprehensive Study (NACCS), and was identified as a high-risk area of the North Atlantic Coast that warranted additional analysis by the Corps. This study is an interim response to a resolution of the Senate Committee on Environment and Public Works dated 25 July 2012. The resolution requested that the Secretary of the Army review the report of the Chief of Engineers on beach erosion and hurricane protection for Norfolk, VA, dated 17 April 1984, and other pertinent reports, to include existing coastal storm risk management studies and engineering reports to determine whether any modifications of the recommendations contained therein are advisable in the interest of flood damage reduction in the vicinity of Norfolk, VA. Preconstruction engineering and design activities for the Norfolk CSRM project are authorized under the authority granted in "America's Water Infrastructure Act of 2018." Section 1203(a)(29) of the Water Resources Development Act of 2018, Public Law 115-270, identifies the Norfolk CSRM project for expedited transition to preconstruction engineering and design once a justified project is identified in a completed report.

2. The reporting officers recommend authorizing a plan that will significantly reduce the coastal storm risk and associated damage to structures in the city of Norfolk. The Recommended Plan is the National Economic Development (NED) Plan which includes the following principal features:

*Pretty Lake Storm Surge Barrier:* This structural feature would be a 114 linear foot storm surge barrier with a pump and power station. The feature would tie into 5,642 linear feet of floodwall.

*Lafayette River Storm Surge Barrier:* This structural feature would be a 6,634 linear foot storm surge barrier with a power station. The feature would tie into 1,535 linear feet of constructed earthen levee. Three tide gates would be constructed and operated.

*The Hague / Downtown Storm Surge Barrier:* This structural feature would be a 600 linear foot storm surge barrier with a pump and power station. The surge barrier would tie into 27,236 linear feet of constructed floodwall and 2,582 linear feet of earthen levee. Three pump stations would also be constructed and operated for interior drainage.

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*Broad Creek Storm Surge Barrier:* This feature would be a 1,291 linear foot storm surge barrier with four operational tide gates and a power station. The surge barrier would tie into approximately 8,787 linear feet of flood wall. One pump station would also be constructed and operated for interior drainage

*Nonstructural features:* Nonstructural features would be constructed in neighborhoods outside of a structural system alignment to include the following:

- Basement fills – 176 properties
- Basement fills plus elevation – 89 properties
- Basement fills plus dry floodproofing – 1 property
- Elevation – 624 properties
- Dry floodproofing – 54 properties
- Acquisition – 76 properties

*Natural and nature-based features (NNBF):* These CSRMs would include approximately 0.3 acres of oyster reef and approximately 8.9 acres of living shoreline to increase resiliency.

The Recommended Plan requires the non-federal sponsor to prepare a Floodplain Management Plan, as required for all Corps flood risk management projects by Section 402 of WRDA 1986, as amended. The Recommended Plan would have some adverse impacts to the environment and mitigation is required. Approximately 2.5 acres of wetlands, 2 acres of mudflats, and 20 acres of open water will be impacted. All impacts will be mitigated by the construction of living shoreline oyster reef and wetland in the study area. The Recommended Plan would implement the environmental compensatory mitigation plan and associated monitoring and adaptive management plan.

3. The city of Norfolk, Virginia is the non-federal cost sharing sponsor for all features of the project. Project costs are based on October 2018 price levels. The estimated project first cost of construction is \$1,361,810,000 which includes the cost of constructing structural, nonstructural, and NNBF measures along with the value of lands, easements, rights-of-way, relocations, and disposal areas (LERRDs). Total LERRD is estimated to be \$125,990,000. Cost sharing is applied in accordance with the provision of Section 103(c)(5) of WRDA 1986, as amended (33 U.S.C. 2213(c)(5)), as follows:

a. The cost share of construction is split 65% federal and 35% non-federal. The estimated federal and non-federal shares of the project first cost are \$885,180,000 and \$476,630,000 respectively. The non-federal sponsor will receive credit for the costs of LERRD toward the non-federal share.

b. The additional annual cost of operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) for the Recommended Plan is estimated to be \$1,780,000. The non-federal sponsor will be responsible for 100 percent of the cost of project OMRR&R.

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4. Based on a 2.875 – percent discount rate and a 50-year period of analysis, the equivalent average annual benefits and costs are estimated at \$177,700,000 and \$55,650,000 respectively. The project is estimated to provide annual net benefits of \$122,050,000 and a benefit-to-cost ratio (BCR) of 3.2. All project costs are allocated to the authorized purpose of coastal storm risk management.
5. The city of Norfolk, the U.S. Navy, and other key institutions have institutionalized a collaborative adaptive systems strategy that will incorporate the Recommended Plan and benefit Department of Defense facilities, the community, and other employers in the region. The city is a global security hub, home to the largest naval base in the world, Naval Station Norfolk (NSN), and the only North Atlantic Treaty Organization 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 Norfolk critical to mission readiness for the U.S. Navy. The Recommended Plan will directly contribute to national security by reducing the risk of flooding to this residential and transportation infrastructure. The study also incorporates a strategic approach that will reduce impacts on economic impacts in the city. 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.
6. The goals and objectives included in the Campaign Plan of the Corps have been fully integrated into the Norfolk CSRSM study process. The Recommended Plan was developed in coordination and consultation with various federal, state and local agencies using a systematic and regional approach to formulating solutions and evaluating the benefits and impacts that would result. Coordination with the public occurred throughout the study process via public meetings and comment periods.
7. Risk and uncertainty were addressed during the study by completing a cost risk analysis and including sensitivity analyses as appropriate to evaluate potential impacts of assumptions in the economics, hydraulic modeling, and sea level change. The project is not intended to, nor will it, reduce all risk to loss of life during major storm events. Residual risks to the city of Norfolk have been communicated and these risks can be reduced by residents and visitors following local evacuation plans that are already in place. The future impact of sea level change is likely the largest risk factor and source of uncertainty for the project. As the study area is extremely sensitive to sea level rise due to the low-lying topography of Norfolk, a sensitivity analysis on sea level change was completed using the three Corps sea level change curves. The Recommended Plan is formulated to the intermediate sea level change curve, which projects approximately 1.4 feet of sea level rise during the 50 year analysis period of 2026 – 2075. A sea level change more closely aligning with the high rate would require significant adaptation and

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investment to maintain the same level of risk management. As such, adaptable measures such as T-walls have been designed into the Recommended Plan due to their ability to be modified for increased height in the future.

8. Washington level review indicates that the plan recommended by the reporting officers is technically sound, environmentally and socially acceptable, cost effective, and economically justified. The plan complies with all essential elements of the U.S. Water Resources Council's *Economic and Environmental Principles and Guidelines for Water and Land Related Resources Implementation Studies* and complies with other administrative and legislative policies and guidelines. The views of interested parties, including federal, state, and local agencies, were considered.

9. I concur in the findings, conclusions, and recommendation of the reporting officers. Accordingly, I recommend that CSRSM improvements for Norfolk, Virginia, be authorized in accordance with the reporting officers' Recommended Plan at an estimated cost of \$1,361,810,000 with such modifications as in the discretion of the Chief of Engineers may be advisable. My recommendation is subject to cost sharing, financing, and other applicable requirements of federal and state laws and policies, including Section 103 of WRDA 1986, as amended (33 U.S.C. 2213). The non-federal sponsor would provide the non-federal cost share and all lands, easements, and rights of way, including those necessary for the borrowing of material and the disposal of dredged or excavated material, and would perform or assure the performance of all relocations, including utility relocations. This recommendation is subject to the non-federal sponsor agreeing to comply with all applicable federal laws and policies include that the non-federal sponsor must agree with the following requirements prior to project implementation.

a. Provide 35 percent of project costs assigned to coastal and storm damage reduction, as further defined below:

(1) Provide, during design, 35 percent of design costs allocated to coastal and storm damage reduction in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

(2) Provide all lands, easements, rights-of-way, including suitable borrow areas, and perform or assure performance of all relocations, including utility relocations, as determined by the Federal Government to be necessary for the initial construction, periodic nourishment or operation and maintenance of the project, all in compliance with applicable provisions of the Uniform Relocation and Assistance and Real Property Acquisition Policies Act of 1970, as amended (42 U.S.C. 4601-4655) and the regulations contained in 49 C.F.R. Part 24;

(3) Provide, during construction, any additional amounts necessary to make its total contribution equal to 35percent of project costs assigned to coastal and storm damage reduction;

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b. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the outputs produced by the project, hinder operation and maintenance of the project, or interfere with the project's proper function;

c. Inform affected interests, at least yearly, of the extent of protection afforded by the project; participate in and comply with applicable federal floodplain management and flood insurance programs; comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12); and publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the flood risk management features;

d. Operate, maintain, repair, replace, and rehabilitate the completed project, or function portion of the project, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable federal and state laws and regulations and any specific directions prescribed by the Federal Government;

e. For so long as the project remains authorized, ensure continued conditions of public ownership and use of the project features;

f. Hold and save the United States free from all damages arising from the initial construction, operation, maintenance, repair, replacement, and rehabilitation of the project, except for damages due to the fault or negligence of the United States or its contractors;

g. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation and maintenance of the project;

h. Assume, as between the Federal Government and the non-federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way required for the initial construction, periodic nourishment, or operation and maintenance of the project;

i. Agree, as between the Federal Government and the non-federal sponsor, that the non-federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and, to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA;

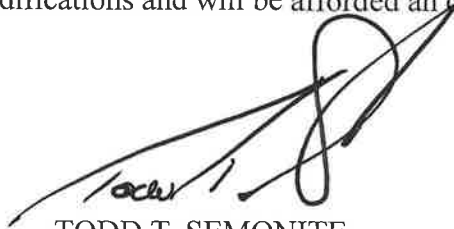
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j. Seek legislation in the Virginia General Assembly to authorize the use of submerged lands owned by the Commonwealth for the project.

10. The recommendation contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the perspective of higher review levels within the Executive Branch. Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for authorization and implementation funding. However, prior to transmittal to Congress, the city of Norfolk (the non-federal sponsor), interested federal agencies, and other parties will be advised of any significant modifications and will be afforded an opportunity to comment further.

*Fully Reviewed  
THIS PROJECT -  
CRITICAL TO PROTECT  
THE LIVES, PROPERTY AND  
LIVELIHOOD OF NORFOLK!*



TODD T. SEMONITE  
Lieutenant General, USA  
Chief of Engineers