



DEPARTMENT OF THE ARMY
CHIEF OF ENGINEERS
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WASHINGTON, DC 20310-2600

28 MAY 2024

DAEN

SUBJECT: *St. Tammany Parish, Louisiana Coastal Storm and Flood Risk Management*

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on coastal storm and flood risk management in St. Tammany Parish, Louisiana. It is accompanied by the report of the New Orleans District Commander. This study is an interim response to section 1201(14) of the Water Resources Development Act of 2016 authorizing a feasibility study for flood damage reduction and ecosystem restoration. Preconstruction engineering and design (PED) activities will continue under the study authority cited above.
2. The reporting officers recommend authorizing structural and nonstructural features each as separable elements to reduce the risk of damages from coastal storms, riverine, and rainfall flooding to residential and commercial structures, public infrastructure, and critical facilities.
 - a. The structural features of the Recommended Plan consist of a levee and floodwall system (with related features) for coastal storm risk management. The structural features are inseparable from one another and must be implemented together to form the comprehensive structural risk management system.
 - b. The nonstructural features of the Recommended Plan are separable from the structural features and can be implemented independently. The nonstructural features (i.e., the residential structure elevations and the nonresidential dry floodproofing) are also separable elements that can be implemented independently of one another, as well as independently of the structural measures.
3. Based on October 2023 price levels, the estimated total project first cost for the entire Recommended Plan (structural and nonstructural features) is \$5,894,229,000. The total project first cost includes the value of lands, easements, rights-of-way, relocations, and dredged material placement area improvements (LERRD). Total LERRD costs are estimated to be \$273,695,000. Cost sharing is applied in accordance with the provisions of Section 103 of the Water Resources Development Act (WRDA) of 1986 (33 U.S.C. § 2213).
4. The structural system for coastal storm risk management will reduce the risk of flooding to lives, property, and infrastructure. The Recommended Plan for structural features is the National Economic Development (NED) Plan and the plan that reasonably maximizes net NED benefits consistent with protecting the Nation's environment.

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a. Structural Features: A fifteen (15) mile long earthen levee and a three and a half (3.5) mile long floodwall system totaling eighteen and a half (18.5) miles in length, together with eight (8) pump stations, thirteen (13) sluice gates/lift gates, eighteen (18) vehicular gates, one (1) pedestrian floodgate, one (1) railroad gate, six (6) road ramps, and the raising of the I-10 road surface.

i. The structural features of the Recommended Plan would have adverse effects to the environment, requiring mitigation. The following are the habitat losses that would result with the implementation of the Recommended Plan:

1. Loss of 48 Average Annual Habitat Units (AAHUs) of fresh and intermediate marsh wetland habitat in the Mississippi Alluvial Plain, Deltaic Coastal Marshes and Barrier Islands ecoregion within Louisiana.

2. Loss of 67 AAHUs (9.7 red-cockaded woodpecker AAHU; 57 pine warbler AAHU) of Pine Savanna habitat in the Lake Pontchartrain Watershed.

3. Loss of 9 AAHUs (7 red-cockaded woodpecker AAHU; 2 pine warbler AAHU) of Pine Savanna habitat on refuge land within Big Branch Marsh National Wildlife Refuge (BBMNWR) or on other USFWS Lands within the Lake Pontchartrain Watershed.

ii. The Recommended Plan includes a compensatory mitigation plan inclusive of associated monitoring and adaptive management. The environmental impacts will be mitigated by a combination of pine savanna mitigation bank credit purchases; the construction of fresh and intermediate marsh; and the construction of pine savanna on Big Branch Marsh National Wildlife Refuge. The total costs of mitigation for the Recommended Plan is \$39,973,512, which is included in the estimated total project first cost.

b. The State of Louisiana, acting by and through, the Coastal Protection and Restoration Authority Board of Louisiana is the non-federal cost sharing sponsor for all features of the project. As a shared responsibility, the Recommended Plan is inclusive of the non-federal sponsor's additional floodplain management responsibilities and emergency response actions in conjunction with state and Federal Emergency Management Agency (FEMA) related programs to mitigate the Plan's residual risk, including potential life loss and damages to critical infrastructure. Based on October 2023 price levels (FY24), the estimated total project first cost for the structural levee and floodwall system is \$2,881,740,000. This total project first cost includes the lands, easements, rights-of-way, relocations, and disposal areas (LERRD) costs of \$85,792,000 and the additional facility relocation cost of approximately \$20,600,000 (or \$31,200,000 with contingency) for elevating Interstate 10, which was listed in construction rather than LERRD. LERRDs includes the acquisition of approximately 110 acres of suitable and desirable property in a location authorized for the Big Branch March National Wildlife Refuge and exchange that property for project property needed within the Wildlife Refuge via an agreement executed at the appropriate Agency level for the U.S. Fish and Wildlife Service.

i. The federal share of the project first cost for initial construction of the structural features is estimated at \$1,817,366,200 and the non-federal share, which includes the cost of LERRD, is

estimated at \$1,064,373,800, which equates to 65 percent federal and 35 percent non-federal. The non-federal sponsor is responsible for Facility/Utility Relocations, including the elevation of a segment of Interstate 10, the costs for which are accounted for in the non-federal share of the project cost.

c. The additional annual cost of operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) for the Recommended Plan is estimated to be \$7,753,000. OMRR&R activities include routine maintenance, periodic inspection, monitoring, machinery and gate replacements, and minor and major repairs. The non-federal sponsor will be responsible for 100 percent of the cost of project OMRR&R..

d. Based on a 2.5 percent discount rate and a 50-year period of analysis, the equivalent average annual benefits for the structural levee and floodwall system are estimated at \$159,036,000 and equivalent average annual costs are estimated at \$115,196,000, with equivalent average annual net benefits of \$43,840 and a benefit-to-cost ratio (BCR) of 1.4 to 1.

The structural features of the Recommended Plan reasonably maximize the National Economic Development benefits and also provides Regional Economic Development, Other Social Effects, and Environmental Quality benefits such as increased reliability and economic productivity and the preservation of community cohesion. Forty-six percent (46%) of the NED benefits provided by the structural portion of the Recommended Plan will accrue to disadvantaged communities.

5. The reporting officers recommend authorizing a nonstructural plan that will reduce the risk of flooding to lives, property, and infrastructure. The Recommended Plan for nonstructural features is the NED Plan and the plan that reasonably maximizes net NED benefits consistent with protecting the Nation's environment. The nonstructural plan includes both elevations and dry floodproofing of structures.

a. The nonstructural (NS) plan addresses structures impacted by FRM and CSRSM flooding. The riverine portion of the NS plan includes 3,762 structures, and the coastal portion of the NS plan includes 2,648 structures. There is a difference in performance and adaptive capacity and sensitivity to sea level change based on if the structure is impacted by FRM or CSRSM flooding. An analysis was conducted on the structures impacted by coastal flooding. The NS plan's projected benefits and project performance would remain through the 50-year period of analysis and is not potentially impacted by sea level rise until 70-150 years in the future based on the actual level of sea level rise encountered.

i. Elevation of 5,583 preliminarily eligible residential structures to a height no greater than thirteen (13) feet above grade. Elevation includes the entire structure or the habitable area of a structure to allow floodwaters to flow and recede underneath;

ii. Dry floodproofing of 827 non-residential structures to make walls, doors, and other openings impermeable to water penetration up to three (3) feet above grade;

iii. The elevation of residential structures and the dry floodproofing of non-residential structures will be implemented on a voluntary participation basis. Authorization of the

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nonstructural plan would not provide continuous authority to floodproof and elevate homes. Property owners will have a reasonable amount of time to elect to participate. It is anticipated that the nonstructural plan will be implemented over a period of 12 years assuming five separate contractors completing 500 structures a year.

b. Regarding NS resiliency in relation to climate change, approximately 96% of structures targeted for elevation in the nonstructural plan would not exceed the thirteen (13) feet maximum elevation height when taking into account the stage elevations from the high sea-level change scenario.

c. The nonstructural features of the Recommended Plan do not have adverse effects to the environment, and do not require compensatory mitigation.

d. Based on October 2023 price levels (FY24), the estimated total project first cost for the nonstructural features is \$3,012,488,000. The total nonstructural project first cost includes the value of lands, easements, rights-of-way, relocations, and disposal areas (LERRD). Total LERRD (including Facility/Utility Relocations) costs are estimated to be \$187,903,000.

e. The federal share of the project first cost for initial construction of the non-structural features is estimated at \$1,835,980,250 and the non-federal share, which includes the cost of LERRD, is estimated at \$1,176,507,750, which equates to 65 percent federal and 35 percent non-federal.

f. For the nonstructural features, the non-federal cost sharing sponsor will be required to obtain subordinations and releases for all rights required for project implementation, including the temporary work area easements. In addition, non-standard estates in the form of a perpetual land use restriction and perpetual access easement, will be submitted in accordance with USACE regulations with a request for approval.

g. There are no OMRR&R obligations for the completed nonstructural work other than the performance of monitoring and periodic inspections.

h. Based on a 2.5 percent discount rate and a 50-year period of analysis, the equivalent average annual benefits for the nonstructural are estimated at \$213,455,000 and equivalent average annual costs are estimated at \$111,964,000, with equivalent average annual net benefits of \$101,491,000 and a benefit-to-cost ratio (BCR) of 1.9 to 1.

The nonstructural features of the Recommended Plan reasonably maximize the National Economic Development benefits and also provides Regional Economic Development, Other Social Effects, and Environmental Quality benefits, such as increased reliability and economic productivity, and preservation of community cohesion. The nonstructural component of the Recommended Plan is the least Environmental Quality impacts of any alternative considered. Four percent (4%) of the benefits provided by the nonstructural plan accrue to disadvantaged communities.

6. The study report fully describes flood risk and coastal storm risk to structures and life safety associated with coastal storms and other flood events. The Recommended Plan would reduce, but not eliminate future damages and residual risk would remain. The Recommended Plan reduces equivalent annual damages by approximately seventy percent (70%) for the structures included in the study area relative to the without project conditions.

7. The residual risk, along with the potential consequences, has been communicated to the non-federal sponsor and will become a requirement of any communication and evacuation plan. The Recommended Plan is not intended to, nor will it, reduce the risk to loss of life during major storm events. The only certain method to prevent loss of life is by residents and visitors following existing local evacuation plans and leaving the study area prior to major storm events.

8. The study evaluated potential impacts of sea level change in formulating and engineering the Recommended Plan. To address this uncertainty, project performance was assessed at the intermediate rate of sea level rise as it offered the best balance between equally likely scenarios (i.e., the historic rate of sea level rise continuing indefinitely and the high rate including accelerated rates of change caused by warming temperatures and accelerated ice melt). In recognition of the uncertainty presented by sea level rise, adaptation capacity has been incorporated into the final feasibility-level design to maximize the overall usefulness of the system over the life of the project by including redundancy and robustness in the design, so they are adaptable to future conditions including the high rate of sea level rise. Local conditions will be monitored to determine if the intermediate scenario of sea level change is reasonably representative of observed conditions. If observed conditions significantly exceeding the intermediate projection are identified during design or construction, reevaluation of the NED Plan will be required. The non-federal cost sharing sponsor will continue monitoring for sea level changes as part of its OMRR&R responsibility.

9. All compliance with required applicable environmental laws and regulations has been completed.

10. In accordance with USACE policy on the review of decision documents, all technical, engineering, and scientific work underwent an open, dynamic, and rigorous review process. The comprehensive review process included District Quality Control Review, Agency Technical Review, Independent External Peer Review, Mississippi Valley Division (MVD) Policy and Legal Compliance review, and Headquarters Policy and Legal Compliance review to confirm the planning analyses, alternative design and safety, and the quality of decisions. Washington-level review indicates that the plan recommended by the reporting officers complies with all essential elements of the U.S. Water Resources Council's Economic and Environmental Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies, as well as other administrative and legislative policies and guidelines. The views of interested parties, including federal, state, and local agencies, were considered and all comments from public reviews have been addressed and incorporated into the final report documents where appropriate. All comments from these reviews have been addressed and incorporated into the final documents.

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11. Additional modeling and design refinements will be performed in Preconstruction Engineering and Design PED, to include:

- a. performance of additional hydraulic and hydrologic modeling, performance of field surveys (centerline profile, topographic, bathymetric, etc.), and the acquisition of additional geotechnical data (borings); and,
- b. detailed review of the adequacy of interior drainage conveyances to handle landside runoff from the levee and floodwall system; and,
- c. full safety risk assessment to support Risk Informed Design and NFIP Accreditation.

12. USACE decision documents recognize cost risk and uncertainty surrounding implementation. All cost estimates will carry degree of uncertainty. The estimated total for the combined structural and nonstructural features of the Recommended Plan is \$5,894,229,000 and meets the minimum requirements for a Class 3 cost estimate. The cost contingencies reflect an eighty percent (80%) confidence level in estimated total project first cost and are intended to cover cost and schedule increase due to the identified project risks and their probability of occurrence. An eighty percent (80%) percent confidence level carries some degree of uncertainty. Even a 100 percent confidence level carries some degree of uncertainty. Changes to assumptions or the basis of design can result in additional risks not currently identified. Contingencies were developed utilizing the cost schedule risk analysis (CSRA), and the computed contingency for the overall project is 46%, with a 51% computed contingency for the structural portion and a 43% computed contingency for the nonstructural portion. When considering the fully funded costs, the structural portion (West and South Slidell Levee and Floodwall System) represents roughly 51% of the total fully funded project cost and the nonstructural portion that represents roughly 49% of the total fully funded project cost.

a. Given that there is limited underlying field data and that the hydraulics has been advanced to a high percentage of completion, the cost estimate for the structural component of the Recommended Plan meets the minimum requirements for a Class 3 cost estimate. The contingency derived from the CSRA is outside the upper limit of the typical range of 20%-50%, but major elements of scope have been captured, with uncertainty remaining around scale and magnitude of foundations for project elements. The total project first cost is within a similar order of magnitude of other recently approved USACE coastal storm and flood risk management projects. Therefore, while there is uncertainty that will need to be addressed through field investigations and additional design during the Preconstruction Engineering and Design phase, the project cost estimates meet the USACE minimum standard for Class 3.

b. For the Recommended Plan project first costs, the currently known major uncertainty drivers are the following:

i. Limited geotechnical data and borings may result in further refinements of design elements, changes in the structure number, configuration, and size/capacity and levee footprints/cross-sections and pile foundation depths. In addition, there is risk of increase in the cost and duration utility/facility relocations.

ii. Further refinements of hydraulics and hydrology modeling in the future may result in quantity and construction feature changes.

iii. Inflation estimates may be lower than actual inflation.

iv. There may be a variation in major material costs and bid assumptions.

v. Any changes to assumptions on productivity, construction sequencing due to funding allocations and future market conditions can affect overall project cost.

vi. Limited survey data may result in quantity changes for levee construction materials.

vii. Further investigations into the pricing for residential structure elevation and dry floodproofing could result in significant cost increases.

c. Notwithstanding the foregoing uncertainties that will need to be addressed, the project cost estimates meet the minimum standard for a Class 3 level of technical information and design. As the project moves into the next phases, USACE will focus risk management and mitigation on the primary cost and other significant risk drivers to the extent within USACE control. However, there still exists the potential for other unanticipated and uncontrollable changes in environmental or economic conditions that could further increase the total project first cost beyond the current estimate and/or necessitate changes in the project's design.

i. ***Structural (West and South Slidell Levee)*** The structural portion consists of an approximately 18.5-mile levee and floodwall system surrounding the City of Slidell. Designs underpinning this cost estimate are based upon limited existing field data; no additional field investigations were taken for this study. Design computations informed by engineering judgment, lessons-learned from recent similar projects, and the hydraulic elevations/stages resulting from the modeling performed. Key assumptions for the structural portion are described below.

1. Topography/bathymetry used for hydraulic modeling and geotechnical analysis is limited to existing LiDAR datasets. The data utilized is a mosaic terrain dataset (NGOM), prepared for the Gulf Coast that is supplemented by bathymetry to cover areas under water and other data subsets to provide more definition where needed. All terrain data is pre-2018. Aerial imagery is from Louisiana NAIP (2021). The bathymetry utilized for AdCIRC modeling represented the most current bathymetric grid.

2. No subsurface investigations were performed for this study. Existing data, which was limited and largely concentrated on the eastern half of the proposed alignment, was used. The limited existing data required extrapolation and resulted in soil strength assumptions with high degrees of uncertainty. The available data was largely concentrated at the eastern end of the alignment, consisted of 3-inch borings (not the 5-inch typically utilized by the New Orleans District for detailed design), and did not necessarily provide coverage directly on the project alignment, instead being "near" the project alignment in the region between the railroad tracks at

the western end and the Kings Point East Levee at the eastern end. Essentially, the western end of the project from the railroad to the western terminus (approximately 9 miles) utilized a single boring near the railroad tracks near the center of the overall 18.5 mile project alignment. The middle third of the project had nearby existing data and some on the alignment (approximately 5 miles), and the eastern end of the project to its eastern terminus had limited to no existing borings (approximately 4 miles). The PDT applied best judgment based on the knowledge of the geomorphology of the area and developed what is expected to be conservative assumptions for soil parameters.

3. No additional alignment survey, topographic survey, bathymetric survey, or detailed utility surveys were performed therefore the PDT relied only on the available existing data described above.

4. From the hydraulic design perspective, AdCIRC modeling using the latest grid and 2D HEC-RAS modeling were performed to support pump station, drainage structure, and navigation structure sizing. However, no detailed review of adequacy of interior drainage conveyances to handle land side runoff from the levee system were performed.

5. The PDT utilized conservative design approaches based on recent experiences on the West Shore Lake Pontchartrain (WSLP) project, to include wider levee sections, deeper pile tips for structures, etc. Design calculations were performed to size major elements utilizing the limited field data available and the hydraulic model results. Given that this is the study phase, a minimum number of typical sections were developed for each feature type (e.g., a limited number of typical floodwall sections based on relative height were used) to support cost estimate development. Given the lack of geotechnical data, there are residual uncertainties that pose risks for cost growth and schedule growth for the West and South Slidell Levee component during PED and Construction. While the hydraulic analysis is well advanced, there still remains a residual risk of configuration and size/capacity changes associated with hydraulic design refinements during PED. There is certainly residual risk of levee footprints/cross-sections increasing in size and pile foundation depths increasing during PED. There is risk of utility/facility relocations, including the coordination needed for relocation of Interstate 10, creating schedule and cost growth during PED.

6. Given that there is some underlying field data, and that the hydraulics has been advanced to a high percentage of completion, the design maturity for the West and South Slidell Levee reflects the minimum required to support a Class 3 designation. The contingency for the West and South Slidell Levee derived from the CSRA does fall just outside the upper limit of the typical range defined in ER 1110-2-1302 (20%-50%), but major elements of scope have been captured, with uncertainty remaining around scale and magnitude of foundations for project elements. In comparison to an analog project (WSLP, which also primarily consisted of an 18.5-mile levee system constructed in similar conditions) the overall fully funded cost for the West and South Slidell Levee is within a similar order of magnitude.

ii. **Nonstructural** The Nonstructural measure of the Recommended Plan consists of the elevation of residences and dry floodproofing businesses. Although no specific design computations were performed, the home sizes were pulled from a structural inventory and quotes

were obtained from local shoring contractors and local governments executing grant programs. Similarly, the dry floodproofing cost was obtained through vendor quotes. The estimate also utilizes the best available information and judgment by the cost estimating community across the enterprise with respect to Preliminary Engineering and Design percentage and Supervision and Administration percentage, given that there is not a strong history of execution of such a program by USACE. It should be noted, however, that there was a wide range of pricing for home raising presented by local contractors, which could result in some potential cost growth. Another unknown that could impact the ultimate cost is the frequency and magnitude of appropriations to execute the program. Incremental funding or a prolonged overall execution timeline could also result in cost growth. Based upon the methodology used, the Nonstructural estimate fits within the definition of a Class 3 estimate. The CSRA-derived contingency is 43%, which fits within the range of typical contingencies for a Class 3.

13. In full consideration of the risks as documented in the preceding paragraphs in this report, I concur in the findings, conclusions, and recommendation of the reporting officers. Accordingly, I recommend that coastal storm and flood risk management improvements for St. Tammany Parish, Louisiana be authorized in accordance with the reporting officers' Recommended Plan for structural and nonstructural features at an estimated cost of **\$5,894,229,000** for initial construction, with such modifications as in the discretion of the Chief of Engineers may be advisable.

14. The federal implementation of the Recommended Plan includes, but is not limited to, the following items of local cooperation to be undertaken by the non-federal sponsor in accordance with applicable federal laws, regulations, and policies:

- a. Provide 35 percent of construction costs for structural features, as further specified below:
 - i. Provide, during design, 35 percent of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;
 - ii. 2. Provide all lands, easements, rights-of-way, and placement areas and perform all relocations determined by the federal government to be required for the project;
 - iii. Provide, during construction, any additional contribution necessary to make its total contribution equal to at least 35 percent of construction costs;
- b. Provide 35 percent of construction costs for the nonstructural features, as further specified below:
 - i. Provide, during design, 35 percent of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;
 - ii. Provide all lands, easements, rights-of-way, and placement areas and perform all relocations determined by the federal government to be required for the project;
 - iii. Provide, during construction, any additional contribution necessary to make its total

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contribution equal to at least 35 percent of construction costs;

c. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) that might reduce the level of coastal storm risk reduction the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;

d. Inform affected interests, at least yearly, of the extent of risk reduction afforded by the project; participate in and comply with applicable federal floodplain management and flood insurance programs; prepare a floodplain management plan for the project to be implemented not later than one year after completion of construction of the project; 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 the project;

e. Operate, maintain, repair, rehabilitate, and replace the project or functional portion thereof at no cost to the federal government, in a manner compatible with the project's authorized purposes and in accordance with applicable federal laws and regulations and any specific directions prescribed by the federal government;

f. Give the federal government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-federal sponsor owns or controls for access to the project to inspect the project, and, if necessary, to undertake work necessary to the proper functioning of the project for its authorized purpose;

g. Hold and save the federal government free from all damages arising from design, construction, operation, maintenance, repair, rehabilitation, and replacement of the project, except for damages due to the fault or negligence of the federal government or its contractors;

h. Perform, or ensure performance of, any investigations for hazardous, toxic, and radioactive wastes (HTRW) that are determined necessary to identify the existence and extent of any HTRW regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601-9675, and any other applicable law, that may exist in, on, or under real property interests that the federal government determines to be necessary for construction, operation and maintenance of the project;

i. Agree, as between the federal government and the non-federal sponsor, to be solely responsible for the performance and costs of cleanup and response of any HTRW regulated under applicable law that are located in, on, or under real property interests required for construction, operation, and maintenance of the project, including the costs of any studies and investigations necessary to determine an appropriate response to the contamination, without reimbursement or credit by the federal government;

j. Agree, as between the federal government and the non-federal sponsor, that the non-federal sponsor shall be considered the owner and operator of the project for the purpose of CERCLA liability or other applicable law, and to the maximum extent practicable shall carry out

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its responsibilities in a manner that will not cause HTRW liability to arise under applicable law; and

k. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended, (42 U.S.C. 4630 and 4655) and the Uniform Regulations contained in 49 C.F.R Part 24, in acquiring real property interests necessary for construction, operation, and maintenance of the project including those necessary for relocations, and placement area improvements; and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

15. 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 Congress as a proposal for authorization and implementation funding. However, prior to transmittal to Congress, 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.



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