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U.S. ARMY CORPS OF ENGINEERS, NORTH ATLANTIC DIVISION
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CENAD-PD-X (1105-2-10c)

17 October 2023

MEMORANDUM FOR RECORD

SUBJECT: Recommendation for Planning Model Certification of Beach-*fx* v 2.0 with SBEACH Forcing for Use in Estimating Economic Consequences of Coastal Storm Events

1. References:

- a. Engineer Circular (EC) 1105-2-412, Assuring Quality of Planning Models, 31 March 2011
- b. Planning Bulletin (PB) 2013-02, Assuring Quality of Planning Models (EC 1105- 2-412), 31 March 2013
- c. Memorandum, CECW-P, Modification of the Model Certification Process and Delegation of Model Approval for Use, 4 Dec 2017
- d. Memorandum, CECW-P, Delegation of Model Certification, 11 May 2018
- e. Engineering Report (ER) 1105-2-100, Planning Guidance Notebook, 22 April 2000
- f. ER 1105-2-101, Risk Assessment for Flood Risk Management Studies, 15 July 2019
- g. Model Certification Review Plan, Beach-*fx* 2.0, 25 August 2022
- h. Planning Model Certification Report: Beach-*fx* Version 2.0 with SBEACH, October 2023

2. The National Planning Center of Expertise for Coastal Storm Risk Management (PCX-CSR) endorses Planning Model Certification of Beach-*fx* Version 2.0 with SBEACH for estimating economic damages related to coastal storm events. This endorsement is based on a successfully completed model review process in accordance with references 1.a, 1.b, and 1.c.

3. Beach-*fx* software is developed and maintained by the U.S. Army Engineer Research and Development Center Coastal and Hydraulics Laboratory (ERDC-CHL) and the Architecture and Engineering (A/E) firm CDM Smith. Beach-*fx* has been used extensively

SUBJECT: Recommendation for Planning Model Certification of Beach-*fx* v 2.0 with SBEACH Forcing for Use in Estimating Economic Consequences of Coastal Storm Events

to provide risk-based projections of economic consequences from coastal storm events and is relied upon to accurately evaluate proposed coastal storm risk management (CSRM) measures for USACE planning studies. It has been tested rigorously since a useable beta version first became available in Fiscal Year 2006. The most recent version of the software to achieve certification was Beach-*fx* ver. 1.1.6 in Fiscal Year 2011.

4. Beach-*fx* is an event-based Monte-Carlo lifecycle simulation model designed to accurately evaluate the physical performance and economic benefits and costs of CSRM projects including sandy beach alternatives and/or erosion management structures. The software utilizes an event-based model to simulate and measure the impact of future coastal storm damages over the project life while accounting for risk and uncertainty in the analysis. Beach-*fx* applies a probabilistic storm suite through cross-shore modeling to calculate spatially varying damages in the project area. The system links the predictive capability of coastal evolution models with project area infrastructure information (structure inventory), structural damage functions and economic valuations to estimate the costs and benefits of alternative project designs. This enables Beach-*fx* to provide a more realistic treatment of CSRM project evolution and optimize commonly applied approaches. The software evaluates shoreline change and economic consequences associated with three damage drivers: inundation, erosion, and wave attack. Beach-*fx* is intended to accomplish the following analytical tasks:

- Evaluates shoreline changes and economic consequences.
- Track individual damage drivers (inundation, erosion, wave attack) to allow for evaluation of alternative plans and response.
- Illustrate shoreline changes and resulting damages graphically.
- Facilitate evaluation and communication of findings.

5. The analyses that Beach-*fx* makes are a combination of meteorology, coastal engineering and economic evaluations which trigger an action based on the occurrence of previous events. As a data-driven model, its technical framework incorporates inherent risk and uncertainty associated with CSRM, represented coastal processes, and combines engineering and economic behavior.

6. A complete discussion of the workflow and computation logic in Beach-*fx* is provided in the Beach-*fx* User's Manual on the ERDC website. The following links provide a more detailed overview of the software and access to the user's manual:

- a. <http://www.beach-fx.com/default.aspx>
- b. <http://hdl.handle.net/11681/1854>

SUBJECT: Recommendation for Planning Model Certification of Beach-*fx* v 2.0 with SBEACH Forcing for Use in Estimating Economic Consequences of Coastal Storm Events

7. The model review team consisted of three internal reviewers and the model review lead. The internal review team includes subject matter experts in economics and in coastal hydraulics and hydrology. The internal reviewers were Lori Hadley, Senior Coastal Engineer, SAJ; Idris Dobbs, Senior Coastal Economics Modeler, NAN; and Preston Oakley, Planning Program Manager, NAD. They provided a detailed review of the software for useability as well as verified coastal processes and economic consequences. Larry Cocchieri, Deputy Director for National Operations, PCX-CSR, operated as review team lead with significant assistance from Rusty Permenter, Research Hydraulic Engineer, ERDC-CHL.

8. Beach-*fx* consists of three main components: the GUI interface, the storm response extraction routine, and the main processing routine to calculate morphology and damages. The GUI is tested by setting up and running the cases that are the foundation for this certification effort, the storm response extraction routine, for both SBEACH and CSHORE, has been validated with assistance from the USACE Jacksonville District, and the present effort documented here provides verification of the main processing portion of the Beach-*fx* model.

9. Due to the complexity of the model and the fact that the current version of the model, version 2.0, was developed from the previously certified model (version 1.1.6), this certification effort will be limited to evaluation and verification of model features that have been updated and/or added since implementation of version 1.1.6. While Beach-*fx* version 2.0 may be employed using shoreline response data from either the SBEACH or CSHORE cross-shore change models, the current evaluation will use only SBEACH shoreline response data. Note that the storm response extraction routine verification applies to the importation of both SBEACH and CSHORE model data.

10. The following seven modifications to Beach-*fx* 1.1.6 were identified for evaluation and testing:

- a. Batch-runs
- b. Identical Upland and Berm Elevations
- c. Inter-tested Nourishment
- d. Planform Rate Application
- e. Preclude Rebuilding Beyond Limits
- f. Restoration of Upland Width After Emergency Nourishment
- g. Back Bay Flooding Revision

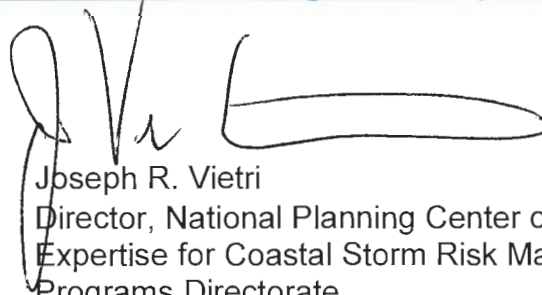
The modifications listed above were validated to be working correctly based on the testing and evaluation conducted as part of the certification effort.

SUBJECT: Recommendation for Planning Model Certification of Beach-*fx* v 2.0 with SBEACH Forcing for Use in Estimating Economic Consequences of Coastal Storm Events

11. Explanations and evaluations of the modifications are detailed in the Planning Model Certification Report, reference 1h.

12. This Planning Model Certification expires after seven years on 17 October 2030.

13. The point of contact is Larry Cocchieri, Deputy Director for National Operations for the PCX-CSR, (917) 539-4174 and Lawrence.J.Cocchieri@usace.army.mil



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