**Certification Review Plan for the Modified EPA Salt Marsh Habitat Model**

**1. Purpose:** The purpose of this review plan is to outline the requirements necessary for review of the "Modified EPA Salt Marsh Habitat Model". The technical quality of the model will be reviewed, as well as its conformance with current Corps policy.

**2. References and Guidance:**

EC 1105-2-412, Assuring Quality of Planning Models. March 31, 2011.

**3. Background:** This model was developed specifically for use on the Currituck Sound Ecosystem Restoration feasibility study, for the purposes of measuring environmental benefits accruing to estuarine marsh habitats from various project alternatives. The model is based on a published model by the USEPA that was developed for salt marshes in the Northeast U.S. The PDT used the basic framework of this model, but made changes to variables and scaling of those variables so that it would be more applicable for use in the Currituck Sound study area. The original model and modified model are discussed below:

Original EPA Model

The EPA model represents a stand-alone assessment tool based on wildlife habitat values of coastal wetlands. The model quantifies salt marsh health and function through the valuation of marsh characteristics and the presence of habitat types. The USEPA model quantifies habitat values based on marsh characteristics and the presence of habitat types that contribute to use by terrestrial species. Model's developers identified 79 birds, 20 mammals, and 6 amphibian and reptile species that utilize New England salt marsh habitat at some life stage. Habitat requirements of these species were determined through a search of published literature, unpublished reports, anecdotal information from wetland ecologists and personal observations of the model's creators. From the available information, the developers identified common habitat types associated within salt marshes, or those that were reported as being used by at least 3 bird or mammal species. These habitat types, as well as the habitat requirements of salt marsh fauna, form the basis of the salt marsh assessment model.

The model consists of eight wetland and landscape components that are used to assess and evaluate salt marsh wildlife habitat values (Figure 1). Several of the components are directly based on the different habitat types found in and around marshes or ecosystems that are linked to salt marshes. Other components reflect the anthropogenic alteration of these habitats. The remaining components take into account the size, morphology, and landscape positions of the marsh, which may be important to territorial species and those that require adjacent upland habitats. The eight components are (1) marsh habitat types, (2) marsh morphology, (3) marsh size, (4) degree of anthropogenic modification, (5) vegetative heterogeneity, (6) surrounding land use, (7) connectivity, and (8) vegetation types. Each component, in turn, consists of several categories. For example, the "Habitat Type" component consists of ten categories including

shallow open water, tidal flats, pannes, wooded islands, and low marsh. A complete description of each habitat component and the overall framework of this model are included in the McKinney and Wigand (2006) paper.

The model user assigns a rating of low, moderate, high or absent to each model category. The rating is given a numerical score and a weighting factor to reflect faunal habitat requisites. For example, one category of the habitat component involves the presence of shallow water. If open shallow water habitat makes up >20% of the marsh, the category is given a numeric score of "5". If open shallow water habitat is absent from a salt marsh, the category is given a "0". The value of each category is multiplied by a weighting factor. The output produced by the USEPA model is a numerical score, an overall relative wildlife habitat assessment score for the marsh, which is calculated by summing subtotals for each of eight habitat components of the model (McKinney et al. 2009a). The maximum wildlife habitat assessment score possible from the USEPA model is 784, with small, impaired marshes receiving values below 100. The values and weighting factors assigned to each model component are contained in McKinney et al. (2009a).

The scores and weighting factors for each component were developed and tested on a group of 16 salt marshes in Narragansett Bay, Rhode Island. The study and resulting conclusions are described in two peer reviewed papers; "Assessing the wildlife habitat value for New England salt marshes: I. Model and application" and "Assessing the wildlife habitat value of New England salt marshes: II. Model testing and validation".

| Component | Categories | Criteria |
|---|---|---|
| I. Salt Marsh Size Class | Very small (under 5 ha)<br>Small (5 – 25 ha)<br>Medium-sized (26 – 125 ha)<br>Large (126 – 200 ha)<br>Very large (over 200 ha) | Marsh area |
| II. Salt Marsh Morphology | Salt meadow marsh<br>Meadow / fringe marsh<br>Wide fringe marsh<br>Narrow fringe marsh<br>Marine fringe marsh | Marsh morphology |
| III. Salt Marsh Habitat Types | Shallow open water<br>Tidal flats<br>Low marsh<br>Trees overhanging water<br>High marsh<br>Pools<br>Pannes<br>Wooded islands<br>Marsh-upland border<br>Phragmites | Presence or abundance |
| IV. Extent of Modification | Little to no ditching<br>Moderate ditching<br>Severe ditching<br>Little to no tidal restriction<br>Moderate tidal restriction<br>Severe tidal restriction | Degree of modification |
| V. Salt Marsh Vegetation | Aquatic plants<br>Emergents<br>Shrubs<br>Trees<br>Vines | Presence or abundance |
| VI. Vegetative Heterogeneity | High heterogeneity<br>Moderate heterogeneity<br>Low heterogeneity | Number of habitat edges |
| VII. Surrounding Land Cover | Open water<br>Natural land<br>Maintained open land<br>Developed land | Presence or area |
| VIII. Connectivity | Sand or cobble beach<br>Coastal dunes or overwash<br>Other salt marsh wetland<br>Brackish wetland or pond<br>Freshwater wetland or pond<br>Upland meadow<br>Upland forest | Presence or area |

FIGURE 1: WETLAND ASSESSMENT COMPONENTS AND THEIR ASSOCIATED CATEGORIES OF THE USEPA MODEL.

Modified EPA Model

The Wilmington District Project Delivery Team (PDT) reviewed the model for potential use in conducting an Environmental Benefits Analysis (EBA) of wetlands in the Currituck Sound Ecosystem Restoration Feasibility Study. Conceptually, the PDT thought that the EPA model was sound and could be applied for the purposes of an EBA. For instance, the variables used in the model were all related to habitat or ecosystem function, and most were applicable to any estuarine wetland system. Additionally, the EPA model was based on the habitat preferences of a suite of 105 species, 100 of which are also found in the Currituck Sound study area. However, a major issue the PDT found with applying the model "as is" to the Currituck study was the reference domain of the model. The variables in the EPA model were scaled based on a reference set of wetlands in Rhode Island, while Currituck sound is located within Virginia and North Carolina. Additionally, the estuarine wetlands in Currituck sound are hydrologically wind-tide driven, and thus more irregularly flooded and less saline then the marshes considered in New England. Therefore, not all the habitat types included in the EPA model are relevant for the Currituck estuarine wetlands.

Because the model was otherwise conceptually sound, the PDT felt that the EPA model could be adjusted for use in the Currituck study by removing some of the variables, and rescaling the remaining variables based on a reference set of wetlands located within the Currituck Sound. Additionally, the PDT decided to replace the measurements of connectivity in the model with what they believed to be both a more robust metric and one that would better capture project benefits, the Functional Linkage Index (Lin 2009).

**4. Documentation to be provided by proponent:**

Five documents will be provided to the reviewers. Three of these cover the existing EPA model, and are all previously published items. These are:

1. McKinney, R.A., and Wigand, C. 2006. A framework for the assessment of the wildlife habitat value of New England salt marshes. EPA/600/R-06/132. Office of Research and Development. Washington, DC 20460.

2. McKinney, R.A., Charpentier, M.A., and Wigand, C. 2009. Assessing the wildlife habitat value of New England salt marshes: I. Model and application. Environmental Monitoring and Assessment. 154:29-40.

3. McKinney, R.A., Charpentier, M.A., and Wigand, C. 2009. Assessing the wildlife habitat value of New England salt marshes: II. Model testing and validation. Environmental Monitoring and Assessment. 154:361-371.

The fourth item for review is a document developed by the PDT which details the modified EPA model that is being proposed for use in the Currituck Sound study:

4. Adapting the EPA New England Salt Marsh Habitat Model for Use in the Currituck Sound Ecosystem Restoration Feasibility Study.

The fifth item that will be provided to reviewers is a published journal article regarding the Functional Linkage Index:

5. Lin, J.P. 2009. The Functional Linkage Index: A metric for measuring connectivity among habitat patches using least-cost distances. *Journal of Conservation Planning*, 5, pp. 28-37.

**5. Type/Scope of Review**

Qualifications for ATR member for Ecological Outputs:

- Experience with 2 or more methods of conducting ecological output evaluation
- Had some sort of HEP or Eco Output training/expertise
- Senior-level experience in ER projects
- Familiarity with spreadsheets (familiar with standard best programming practices is the optimal but not required)
- Expertise with coastal wetland ecology and function
- Familiarity with landscape ecology concepts

**Charge questions for reviewers of *Modified EPA Salt Marsh Model***

Input from members of this review panel is being sought to help a US Army Corps of Engineers Ecosystem Restoration Planning Center for Expertise determine the degree to which the subject model(s) can be described as technically sound relative to its/their design objectives. In addition to the underlying theory, conceptualization, and computational aspects of the model(s), reviewers are asked to comment on aspects of the model that potentially affect its usability and reliability as a potential producer of information to be used to influence planning decisions.

While the specific review questions included below are intended to prompt the panel for information specific to the Ecosystem Restoration Planning Center of Expertise's efforts to certify this planning model for continued/broader application, please feel free to offer comments believed relevant and appropriate to any elements of the technical quality and usability of the model(s) as documented in the provided review materials. Accordingly, please provide responses to the sought scientific and technical topics listed below and perform a broad review of the ***Modifed EPA Salt Marsh Model*** focusing on your areas of expertise, experience, and technical knowledge.

**Charge Questions**

*General Questions*

1. Are the model's design objectives and intended uses clearly communicated?

2. To what extent does the model meet the expressed design objectives?
3. To what extent is the model suitable for the expressed intended uses?

*Technical Quality*

4. Comment on the quality of the model's technical documentation.
5. Comment on the technical quality of the model relative to its expressed design objectives.
6. Comment on the temporal and spatial granularity with which the model is designed to be applied.
7. Comment on the geographic range/applicability of the model. Could the model be applied to a broader geographic range with modifications to the variables/functions?
8. Comment on the degree to which the assumptions and limitations of the model are clearly communicated.
    a. Comment on the degree to which apparent limitations impact the ability of the model to be used for characterization of system/habitat resources.
    b. Comment on the degree to which apparent limitations impact the ability of the model to be used for forecasting of system/habitat resources.
    c. Comment on the degree to which apparent limitations impact the ability of the model to be used for planning and forecasting of impacts resulting from a project or action.
    d. Please provide recommendations for resolving or overcoming identified limitations.
9. Comment on the degree to which the model is based on well-established contemporary theory.
10. Does the model adequately emulate or otherwise address the suite of critical ecosystem attributes necessary to characterize system/habitat resources?
11. Does the model effectively allow for reasonable variation of variables critical to the intended uses (i.e., application of the model during planning of water resource and restoration activities)?
12. Are the input requirements of the model evident to the user (i.e., types of inputs as well as assumed/intended accuracy and precision)?
13. Is it evident to the user how the inputs are used by the model?
14. Comment on sensitivities of the model and identify the variables/factors to which the model is most sensitive.
15. Comment on the precision and accuracy of the model outputs and identify which variables/factors have the greatest impact on model precision and accuracy.
16. Are assumptions critical to valid application clearly identified and characterized such that violation of a critical assumption would be apparent to the user?
17. Comment on the degree to which model assumptions might invalidate the model's use for specific applications.
18. Comment on the degree to which the model facilitates/accommodates sensitivity, uncertainty, and risk analyses.
19. Comment on the degree to which the model can be used as a tool to forecast conditions anticipated to occur during the design lifecycle of a water resource and restoration activities project (i.e., from 1 to 50 years).
20. Comment on the degree to which the model delivers information adequate for the purpose of supporting determinations of compensatory mitigation.
21. Are the formulas used in the model(s) correct?
    a. Are model computations adequately documented?

b. Are model computations correct throughout the document?
c. Are model computations (mathematical logic) appropriate?

22. Comment on the degree to which the model is inconsistent with USACE policies and accepted procedures.
23. Comment on the degree to which the model is configured to accept/facilitate modification of assumptions and inputs regarding future global events such as, but not limited to, global climate change.

*System Quality*

24. Comment on the hardware, software, and operating system requirements of the model (if any) and the degree and the degree to which they complicate use of the model.
25. Comment on the degree to which the model has been tested for errors.
26. Comment on the capacity of the model to inform users of erroneous or inappropriate inputs.
27. Comment on the degree to which post-audits of model applications are documented (i.e., documentation of a validation process whereby statistical comparisons of conditions resulting from a planned action/project are made to model outputs produced during the planning of the action/project)? If so:
    a. do results of the validation process indicate the model's tendency to reasonably characterize existing conditions;
    b. do results of the validation process indicate the model's tendency to reasonably forecast future conditions; and
    c. what model outputs were found to most greatly deviate from actual conditions (please comment on the likely cause of the deviation if possible)?

*Usability*

28. Is user documentation user friendly and complete?
29. Comment on the model's practicality and application/input requirements.
30. Comment on the availability of the data required by the model.
31. Comment on the understandability of model output(s).
32. Comment on the transparency of model output(s).
33. Comment on how useful the model is for characterization of near-term conditions.
34. Comment on how useful the model is for characterization of future conditions
35. Comment on the usability of the model for selecting the best course/plan of action.
36. Comment on your perception of the level of difficulty likely to be encountered when attempting to assess the model's sensitivities to alternative ranges/values of inputs?
37. Are the model's functions and computations transparent and do they allow for easy verification of calculations and outputs?
38. Comment on the model's ease of use.

## 6. Description of Tasks

The reviewers shall:

a) Review all documentation provided, as per the scope of review outlined above.

b) Provide comments regarding the model through Dr Checks. Comments should follow a four part structure:

1. The review concern
2. The basis for the concern
3. The significance of the concern
4. The probable specific action needed to resolve the concern

c) Review responses to the provided comments and provide either an initial "concur" or "non-concur" with those responses. In cases where there is an initial "non-concur", the reviewer will work with the model proponent in order to attempt to come to concurrence.

d) Provide a summary of review findings.

e) The model will have two reviewers. The reviewer or reviewers should alone or combined have the necessary expertise to address all of the review questions being presented. Reviewers may also provide additional comments regarding the adequacy of the models, even if they are not directly related to one of the specific questions listed.

**7. Certification Review Team Composition**

Two reviewers have been identified to conduct this review.

1. Dr. Deborah Shafer – USACE ERDC

Dr. Shafer is a Research Marine Biologist in the Environmental Laboratory, US Army Engineer Research and Development Center (ERDC). She earned a Ph.D. in Marine Science from the University of South Alabama in 2007, a Master of Science degree in Biology North Central Louisiana University in 1996, and aBachelor of Arts degree in Biological Science from California State University, Fullerton in 1979. She has more than 20 years of research experience in developing and assessing impacts and benefits resulting from proposed USACE projects. Dr. Shafer's research interests include the following:
• Seagrass and coastal wetlands restoration and creation
• Impacts of dredging and overwater structures on seagrass resources
• Beneficial uses of dredged materials for coastal habitat creation
• Development of HGM functional assessment protocols for coastal ecosystems
• Physiology of an introduced seagrass species in the Pacific Northwest.
She also holds an adjunct faculty position at the University of Maryland Center for Environmental Sciences Horn Point Laboratory where she is actively engaged in research on large-scale restoration of submerged aquatic vegetation communities in collaboration with a number of university faculty members. She is nationally recognized as a leading expert in the physiological tolerances of an introduced seagrass species on the Pacific Northwest coast, *Zostera japonica*.

2. Dr. Angie Sowers – USACE Baltimore District

Dr. Angie Sowers is an Integrated Water Resource Management Specialist with the U.S. Army Corps of Engineers, Planning Division, Baltimore District, Civil Project Development Branch. Angie serves as a technical advisor responsible for oyster restoration, and the broad scope of integrated water resources management (IWRM) analyses including modeling and integration prepared for master plans, and proposed and authorized Civil Works projects. Angie works on various projects within the Chesapeake Bay watershed including island restoration, oyster restoration, small navigation, and watershed planning. Prior to joining USACE, Ms. Sowers earned a Ph.D. in paleoecology, a M.S.E in Environmental Engineering and Chemistry, and a B.S in Chemical Engineering at The Johns Hopkins University.

**8. Schedule of Deliverables**

TBD

**9. Cost Estimate**

$15,000.