DEPARTMENT OF THE ARMY
MISSISSIPPI VALLEY DIVISION, CORPS OF ENGINEERS
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REPLY TO
ATTENTION OF:

CEMVD-PD-N 9 April 2013

MEMORANDUM FOR CECW-CP (*name redacted*)

SUBJECT: Recommendation for Certification of HEC Ecosystem Functions Model (HEC-EFM) and HEC-GeoEFM

1. References:

   a. Engineering Circular 1105-2-412: Assuring Quality of Planning Models, dated 31 March 2011.
   b. Model Certification Plan, HEC Ecosystem Functions Model (HEC-EFM) and HEC GeoEFM, dated January 2013 (Enclosure 1)
   c. HEC-EFM Ecosystem Functions Model, HEC-GeoEFM, a Spatial Accessory for HEC-EFM, Certification Report, Version 2.0 (HEC-EFM), Version 1.0 (HEC-GeoEFM), July 2011. (46 pp.) (Enclosure 2)
   d. HEC-EFM Ecosystem Functions Model Quick Start Guide, Version 2.0 November 2009 (48 pp.) (Enclosure 3)
   e. HEC-GeoEFM, A Spatial Accessory for HEC-EFM (Ecosystem Functions Model), Version 1.0, June 2011 30 pp. (Enclosure 4)
   f. Final Planning Model Quality Assurance Review Report for the Hydrologic Engineering Center Ecosystem Functions Model (HEC-EFM) and HEC-GeoEFM: A Spatial Accessory for HEC-EFM, Battelle Memorial Institute and CDM Smith, July 17, 2012 81pp. (Encl 5)

2. The National Ecosystem Planning Center of Expertise (ECO-PCX) recommends certification of the HEC Ecosystem Functions Model (HEC-EFM; versions 2.0 and 3.0) and HEC-GeoEFM (version 1.0). Please coordinate this recommendation with the HQ Model Certification Team.

3. The USACE Institute for Water Resources Hydrologic Engineering Center developed HEC-EFM and HEC-GeoEFM to support field offices designing ecosystem restoration projects and managing water and ecosystem resources. HEC is the USACE Center for Expertise in the area of surface and groundwater hydrology, river hydraulics, planning analysis, real-time water control management and other closely associated technical subjects.

4. HEC-EFM and HEC-GeoEFM are software tools that help analyze ecosystem responses to changes in flow regimes of rivers and connected wetlands. Together these tools enable project teams to visualize existing ecologic conditions, highlight promising restoration sites, and assess different ecosystem restoration and management alternatives.

In USACE restoration planning, HEC-EFM and HEC-GeoEFM are used to predict habitat provision under different restoration alternatives. Resulting habitat areas would then be used in the incremental cost analysis required by USACE planning guidance during plan formulation to identify the most promising alternative.

HEC-EFM and HEC-GeoEFM help users assess the ecological implications of water resource decisions by focusing on questions such as:

- How much habitat is generated by a particular water management strategy or configuration of river channels and wetlands?
- Where is the habitat?
- Are habitat areas connected?
- Where does it make sense to protect or restore habitat?

5. The process of applying HEC-EFM and HEC-GeoEFM involves three phases: statistical analyses, hydraulic modeling, and the use of GIS to perform spatial analyses. Applications of HEC-EFM do not need to complete all three phases to produce meaningful output. It is helpful to think about the HEC-EFM applications as having two levels of detail, statistical and spatial.

Data requirements of HEC-EFM applications are related to the level of detail desired by the modeler. Statistical analyses alone require only hydrologic gage data and the relationships between hydrology and ecology. Spatial applications using HEC-GeoEFM require digital topography, a geo-referenced hydraulic model, and other site data displayed and assessed via Geographic Information Systems (GIS) in HEC-GeoEFM.

HEC-EFM computes river flow and stage-related statistics to characterize ecosystem dynamics of the flow regime. Statistical criteria are defined as combinations of four parameters: season, duration, rate of change, and percent exceedence. Prior applications have used these features to define links between hydrology and ecology for both biota (vegetation, benthic macroinvertebrates, fish, and waterfowl) and processes (recruitment of large woody debris, depth to shallow ground water, and channel migration). Statistical results can be useful in determining the direction (positive, negative, or no change) and magnitude of ecosystem responses under different restoration or management alternatives.

6. HEC-EFM and HEC-GeoEFM have been rigorously reviewed, tested and verified under standard HEC good-modeling standards. Written user guidance (Encl 2-4) as well as a series of lectures, workshops and webinars have been developed to help users understand the role and application of HEC-EFM and HEC-GeoEFM. HEC technical support is available to assist model users.

7. The ECO-PCX reviewed HEC-EFM and HEC-GeoEFM in accordance with reference 1.a. Battelle Memorial Institute managed the external review of the model to assess the technical quality, system quality and usability of HEC-EFM and prepared a model review

report (Encl 5). The review team included PhD-level experts in hydrology and hydraulics, stream/river ecology, GIS, software programming.

There were 10 final panel comments on the model – two comments of high significance, three of medium significance and five of low significance. The two comments of high significance related to the limitations associated with implementing HEC-EFM and HEC-GeoEFM in Visual Basic 6 and ArcGIS 9.3 and the addition of quantification of statistical changes to habitat availability in addition to quantifying statistical changes in flow. Both comments were concurred with. The software was updated to be compatible with current versions of Visual Basic and ArcMap. The recommendations on adding capability to quantify statistical changes in habitat availability will also be added in future versions. All comment responses are found in Encl 5, Appendix C.

8. The model meets USACE technical quality standards. It is based on well-established contemporary theory regarding ecosystem response to changes in flow regimes. Key analytical requirements include daily mean flow and daily mean stage data and defined relationships between system hydrology and ecology. Key assumptions are defined and are acceptable. The model is in compliance with USACE policies and procedures. The model development team has conducted rigorous testing to ensure formulas and model computations are correct.

9. The model meets USACE system quality standards. The software developed and ArcGIS integration are appropriate platforms and are available to most users. The model developers acknowledge the challenge associated with maintaining compatibility with software languages, programming platforms, and related software tools, which are continually being updated by others. The model developers plan to periodically update compatibility issues. As stated above, the model has been tested and validated. The testing and validation process is well-documented.

10. The model meets USACE usability standards. Input data is readily available and results are understandable and useful in project analysis. A User Guide for Installation and Application and training are available.

11. Model application requires above average computer knowledge. Technical review teams should include a senior-level hydraulic engineer and a senior-level biologist/ecologist with experience in stream restoration associated with modified flow regimes. The technical review team should evaluate relationships between hydrology and ecology that are defined as input to the HEC-EFM model.

12. In summary, the ECO-PCX recommends certification of HEC-EFM versions 2.0 and 3.0 and HEC-GeoEFM version 1.0. The models apply sound contemporary theory, are computationally correct, in compliance with USACE policies, have acceptable system quality and meet usability criteria. Please notify the ECO-PCX of the findings of the Model Certification Panel.

Signed (name redacted)

Encl (5)

Operating Director, Ecosystem
Restoration Planning Center of Expertise

CF (w/out enclosures; *names redacted*):
CECW-PC
CECW-CP
CECW-PB
CEIWR-HEC
CEIWR-ZA
CEIWR-GR
CEMVD-PD-N
CEMVR-PD-P