IDENTIFYING IMPACTS TO ESTUARINE WETLANDS FROM THE SAVANNAH HARBOR EXPANSION PROJECT

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Abstract: The US Army Corps of Engineers, Savannah District is leading a cooperative interagency evaluation of the environmental effects of the Savannah Harbor Expansion Project. The team is developing and applying state-of-the-art tools to identify potential impacts from the proposed project alternatives and various means to mitigate for any adverse effects from those alternatives. This paper describes the tools that have been developed and how they are being applied to provide the public and the decision-makers with the best information possible on the viability of this project.

INTRODUCTION

The Georgia Ports Authority (GPA) believes that deepening the Savannah Harbor Navigation Project will allow cargos to be transported through Savannah Harbor more cost-effectively. GPA prepared a feasibility report that evaluated that proposal and Congress conditionally authorized the improvement – the Savannah Harbor Expansion Project – in 1999. One of the conditions of the authorization is that further studies be conducted to identify more thoroughly the expected project impacts to wetlands.

One of the major concerns of the project is the effect that a deepening could produce on palustrine and estuarine wetlands and their associated wildlife and fishery resources. Tidal freshwater marshes provide highly diverse habitats, are especially vulnerable, and have become increasingly rare in the Southeast. As the harbor has been modified over the years, salinity has intruded further into the estuary, converting much of the historically tidal freshwater marsh to brackish and saltmarsh habitat. This is particularly germane to the Savannah National Wildlife Refuge that is located in the upper end of the harbor. The refuge was founded and continues to function as a freshwater refuge for migratory birds and waterfowl. During the recent drought of 1998-2001, increased salinity levels resulted in observable changes to marshes within the Refuge.

The US Army Corps of Engineers (Corps) is leading a cooperative effort to evaluate the proposed harbor deepening. The US Fish and Wildlife Service (USFWS), the Environmental Protection Agency (EPA), and the National Marine Fisheries Service (NMFS) are Federal agencies that are serving as Cooperating Agencies in the development of a Tier II Environmental Impact Statement (EIS). GPA also serves as a Cooperating Agency in the development of the EIS. The states of Georgia and South Carolina are assisting through a phased-review of the work being performed on the project.

Work has centered in six different areas: (1) field investigations to document seasonal and spatial distribution of wetland vegetation in the estuary; (2) development of computer models that allow predictions of potential changes to wetland vegetation and communities; (3) development of computer models that allow predictions of changes in hydrodynamic conditions; (4) development of a relationship between salinity levels in the tidal rivers and those experienced by wetland vegetation within their root zone; (5) coordination between natural resource agencies on the techniques needed to adequately identify impacts from harbor deepening alternatives; and (6) impact assessment.

The Georgia Ports Authority has funded the technical work conducted during these investigations via the work of independent contractors, federal and state resource agencies.

FIELD INVESTIGATIONS

Applied Technology & Management, Inc. (ATM) was one of the contractors employed by GPA. ATM conducted detailed wetland field investigations in the estuary in 2001 and 2002, as well as greenhouse and laboratory studies to determine the responses of various wetland species to changes in salinity. GPA also funded the Florida Cooperative Fish and Wildlife Research Unit through the US Fish and Wildlife Service to conduct separate field investigations in 2001 and 2002. Those

studies included monitoring of vegetation, salinity, wildlife usage, and vegetative transplants. Both organizations documented their findings in reports that have been provided to natural resource agencies for review (ATM 2003 and USGS-FCFWRU 2003). On GPA's behalf, ATM had previously extensively monitored water quality parameters within the estuary during the summers of both 1997 and 1999.

DEVELOPMENT OF WETLAND MODELS

In combination with literature values, both ATM and the Florida Coop Unit used the field data they obtained to each develop a relationship between salinity levels, water surface elevations, soil types, and vegetation type or community. Both predictive relationships were integrated into a GIS-based computer model of the lower estuary that was developed by ATM. The Marsh Succession Model (MSM) that resulted can predict the wetland vegetation or community that is expected on a site (given the salinity, tidal flooding and soil type). The two relationships allow dual predictions to be made for the resulting vegetation. The GIS-based grid covers all the wetlands in the lower estuary from the Interstate 95 Bridge to near the mouth of the harbor where only saltmarsh is found.

DEVELOPMENT OF HYDRODYNAMIC MODELS

Predictions of salinity and tidal flooding are needed by the Marsh Succession Model. The predictions are developed through use of a separate hydrodynamic and salinity computer model. Based primarily on the data ATM collected in 1997 and 1999, ATM developed a computer model for this purpose. In 2004, federal reviewing agencies recommended a shift to a model developed by EPA Region IV to establish a Total Maximum Daily Load (TMDL) for the harbor for dissolved oxygen. This model is also based primarily on the 1997 and 1999 ATM data. Both the ATM and the EPA models allow for state-of-the-art 3-dimensional representation. As of January 2005, work is still underway to enhance the performance of the EPA-developed model. If the enhancements are found to be viable, they will be used for the final impact assessments for the Savannah Harbor Expansion Project. If the enhancements are not effective, the final impact assessments will be based on the EPA model released in August 2004 (EPA 2004).

TRANSLATING RIVER SALINITIES TO THE MARSH ROOT ZONE

The hydrodynamic model makes predictions of water level and salinity parameters within the confines of the estuarine rivers and main tidal creeks. The project needed a way to translate salinity predictions in those hydraulic channels to the marshes where the vegetation occurs. To accomplish this, GPA employed the Columbia, South Carolina office of the US Geological Survey (USGS) to develop a tool to translate those predictions across the estuary to the marsh root zones. The USGS used data mining techniques to develop an artificial neural network model of the estuary. By examining historic data, the USGS was able to develop relationships between the salinity at specific points within the river and other locations spread across the marsh.

COORDINATION

The Corps has extensively coordinated with the federal and state reviewing agencies as the impact assessment tools have been developed. The agencies have been consulted – and have approved – the type and extent of the field data to be collected. They have also been apprised of the progress of the model developers. The reviewers have discussed and provided their views on the input conditions they believe is appropriate for the impact assessment runs.

IMPACT ASSESSMENT

Impact assessment modeling is underway. This modeling will provide the basis for three different predictions of impact to the estuarine wetlands from the proposed harbor improvements. The first technique will use the salinity contours produced by the hydrodynamic model. This technique uses averaged high-tide salinity predictions of 0.5 ppt salinity as the threshold between freshwater marshes and saltmarsh. The acreage affected by the movement in the salinity contour will be one measure of the effect of a proposed harbor modification.

The second and third techniques use outputs from the hydrodynamic model as inputs to separate wetland succession models. The models will be linked as shown below in Figure 1.

Numerous scenarios will be analyzed. Alternative depths will be evaluated, as will several other variables, including river flow and rate of sea level rise. Sensitivity analyses will be conducted to assess the variability of the predictions in response to changes in input assumptions, as well as identifying the confidence one can place in the impact predictions.

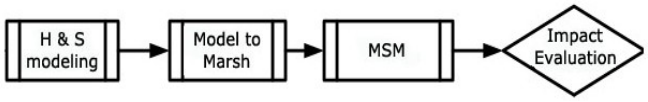

Figure 1 **Model Linkage**

The project team intends to consider the results of all three techniques in their evaluation of potential impacts to wetlands. It will also use these techniques to identify the effectiveness of potential mitigation measures. These evaluations will be conducted during the later half of 2005.

The team recognizes that even with the best science possible, uncertainty will still exist in predictions of future biological responses to changed physical conditions. To accommodate that uncertainty, we intend to include monitoring and adaptive management as part of any mitigation plan.

SUMMARY

Federal and state agencies are working cooperatively to identify and evaluate the likely environmental effects of the Savannah Harbor Expansion Project. The project team is developing and applying state-of-the-art tools to identify potential impacts from the proposed project alternatives and methods to mitigate for any adverse effects from those alternatives. The team intends to include monitoring and adaptive management to accommodate the inevitable uncertainty that is associated with predictions of the future. We fully recognize the environmental value of natural resources in the estuary. We believe that the techniques being used are the best that are presently available and that the procedures being followed will provide the public and the decision-makers with the best information possible. A Draft Environmental Impact Statement that incorporates the results of these evaluations is scheduled for public comment at the end of 2006.

LITERATURE CITED

Applied Technology & Management, 2003. Savannah Harbor Deepening Project Tidal Marsh Studies Data Report. Volumes 1-3.

Environmental Protection Agency, 2004. Draft Total Maximum Daily Load (TMDL) for Dissolved Oxygen in Savannah Harbor Savannah River Basin. EPA Region IV.

Kitchens, W.M. and others, 2003. Tidal Wetland Studies and Tidal Wetland Resource Utilization Studies. US Geological Survey Florida Cooperative Fish and Wildlife Research Unit and the US Fish and Wildlife Service.