Savannah Harbor Expansion Project

Evaluation of Hurricane Surge Impacts with Proposed Mitigation Plan

December 2007

Introduction

This report summarizes the results of hurricane surge impacts with implementation of the proposed mitigation plan to alter flows in the estuary at each alternative navigation channel depth (44 ft, 45 ft, 46 ft, and 48 ft). The two proposed plans are: Plan 6b for the 44 ft depth, and Plan 6a for the 45 ft, 46 ft, and 48 ft depths. Details of each of the mitigation plans are shown in Figures 1 and 2. For details on how these plans were developed and selected, please see the main report document for this project.

The purpose of the hurricane surge modeling is to determine the impacts of deepening the navigation channel and implementation of the proposed mitigation plan and its effect on the propagation of a hurricane storm surge traveling upstream through the estuary and river system.

Figure 1: Plan 6a (proposed mitigation for 45 ft, 46 ft and 48 ft channel depths)

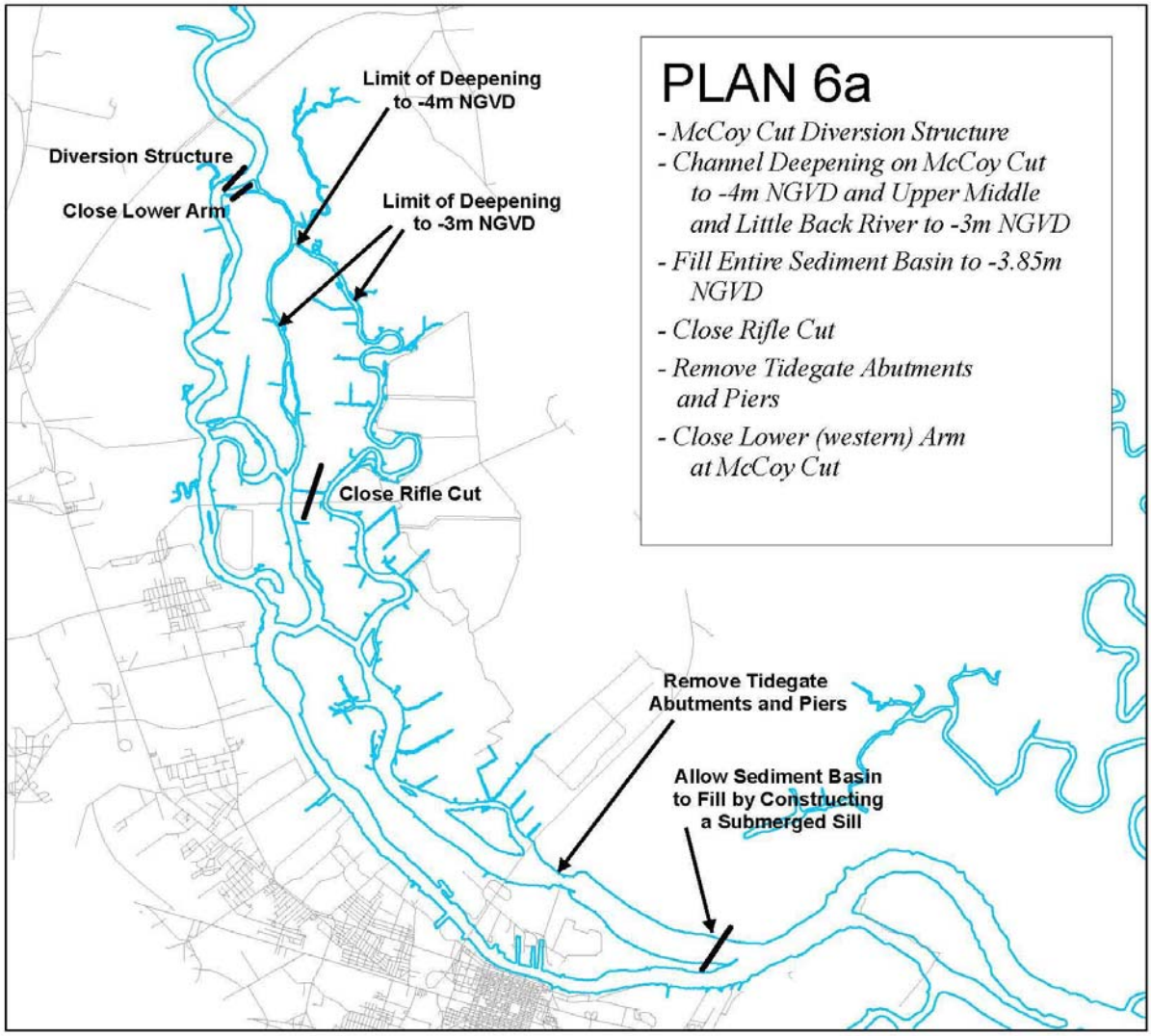
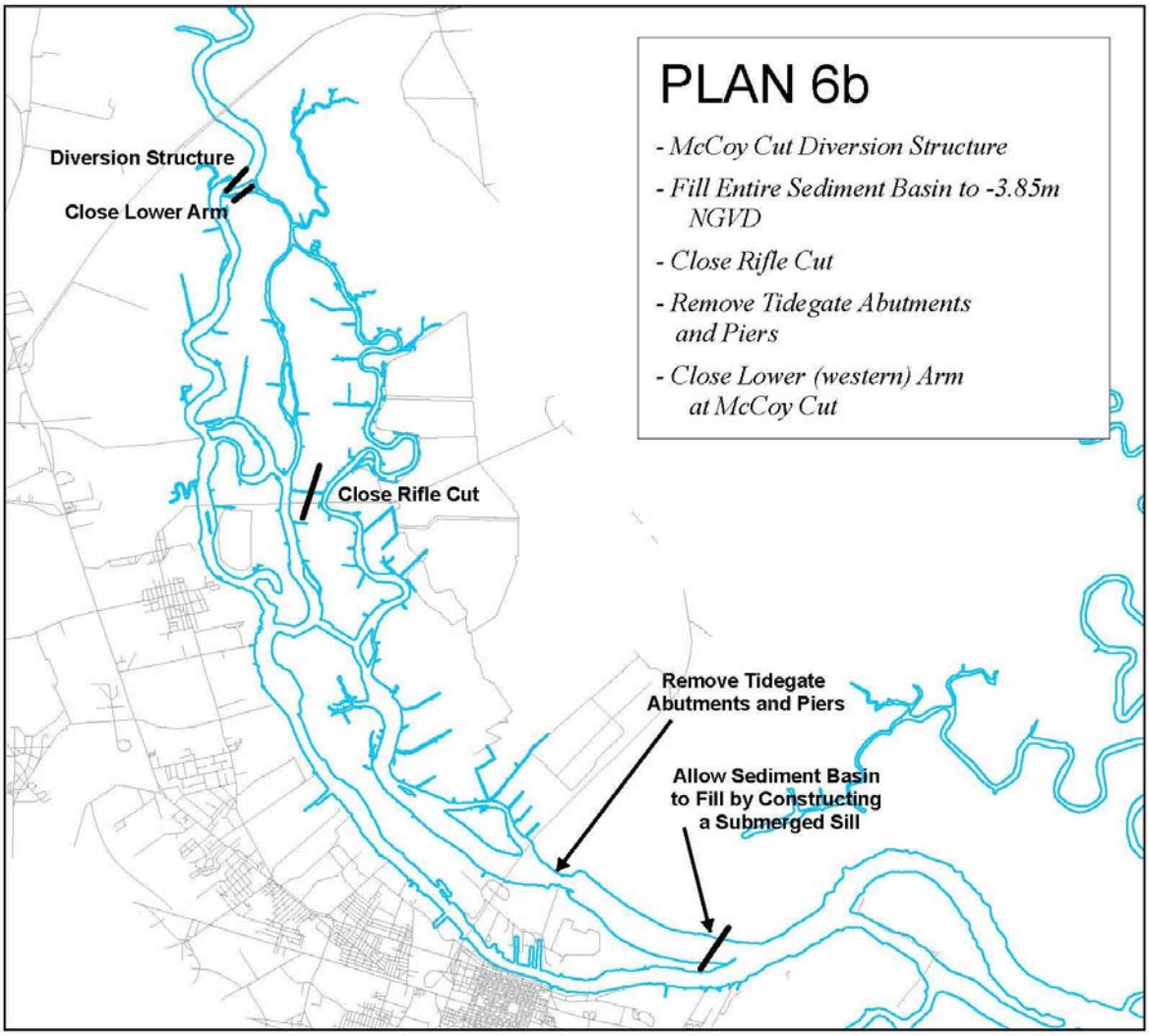


Figure 2: Plan 6b (proposed mitigation for 44 ft channel depth)



Hydrodynamic Model Input

The plans were evaluated using the 3D hydrodynamic model EFDC, which predicts, among other variables, water surface elevations. For the hurricane surge analysis, the water surface elevations are compared at different points in the harbor to determine impacts.

To incorporate a hurricane storm surge in the 3D hydrodynamic model the tidal boundary was modified. The hurricane surge data set was developed by Applied Technology and Management, Inc. (ATM). The data set is based on measured water surface elevations collected at the USGS Customs House gage located in Charleston, SC during Hurricane Hugo which made landfall on September 21, 1989. ATM separated the hurricane storm surge component from the harmonic tidal component. The max increase in water surface elevation for the hurricane storm surge component collected at this gauging station is 7.69 ft. However, the storm surge as Hurricane

Hugo made landfall varied with some places receiving a near 20 ft storm surge. Due to the difficulty in directly applying the storm surge gage data in Charleston to Savannah the data set was ratioed by ATM to create three synthetic storm surges with peaks of 5 ft, 10 ft and 15 ft. For the initial impact analysis all three of the synthetic storm surges were modeled, see *Hurricane Surge Modeling* dated September 23, 2005. However, for the purposes of analyzing the impacts with the proposed mitigation plans only the 15 ft storm surge was modeled.

The modeling time period is late August 1997, which was chosen for several reasons. (1) 1997 closely represents historic average flow conditions at Clyo (the upstream flow boundary, (2) August is close to peak hurricane season when the likelihood of a large storm hitting the Savannah coastline would be more probable, and (3) spring tidal conditions occur on August 19, 1997.

Output Presented

Before presenting the output and discussing the results, the limitations of the EFDC hydrodynamic model grid developed for the Savannah Harbor Expansion Project. The model grid developed for the expansion study was not developed with emphasis on hurricane surge modeling. The shipping channel, Back River system and other smaller side channels are described in detail in the grid, with emphasis on salinity and dissolved oxygen levels in the estuary. The beaches and uplands are not accounted for in the model. The marshes are accounted for, but on a volumetric approach with emphasis on calibration. These areas would likely be impacted during a hurricane and would have a significant role on the propagation of a storm surge throughout the estuary. The model is useful for relative comparative purposes and NOT to describe where flooding would occur during a hurricane.

This report includes analysis of hurricane surge impacts in the estuary. All output was evaluated in the hydrodynamic model (EFDC) at two cells 14_48, which is representative of the water quality conditions near Fort Jackson and 14_126, which is at the I-95 bridge. The analysis includes a table showing peak surge values and two figures that show the water surface elevations over the length of the storm surge. All values presented are water surface elevations in meters-NGVD.

Results

The results of the analysis show that there is little impact expected on hurricane surge at Fort Jackson or further upstream at the I-95 bridge. See Table 1. The figures following the report make for a quick interpretation of the results and show the obvious slight impact to the hurricane surge.

Table 1: Peak Surge Elevations

	Ft. Jackson	Rise in Elev. (Ft. Jackson)	I-95	Rise in Elev. (I-95)
Existing Depth	6.48	-	6.66	-
44 ft Depth, Plan 6b	6.54	0.06	6.82	0.16
45 ft Depth, Plan 6a	6.54	0.06	6.85	0.19
46 ft Depth, Plan 6a	6.55	0.07	6.87	0.21
48 ft Depth, Plan 6a	6.58	0.10	6.90	0.24

All elevations are m-NGVD. All rises in elevation are m.

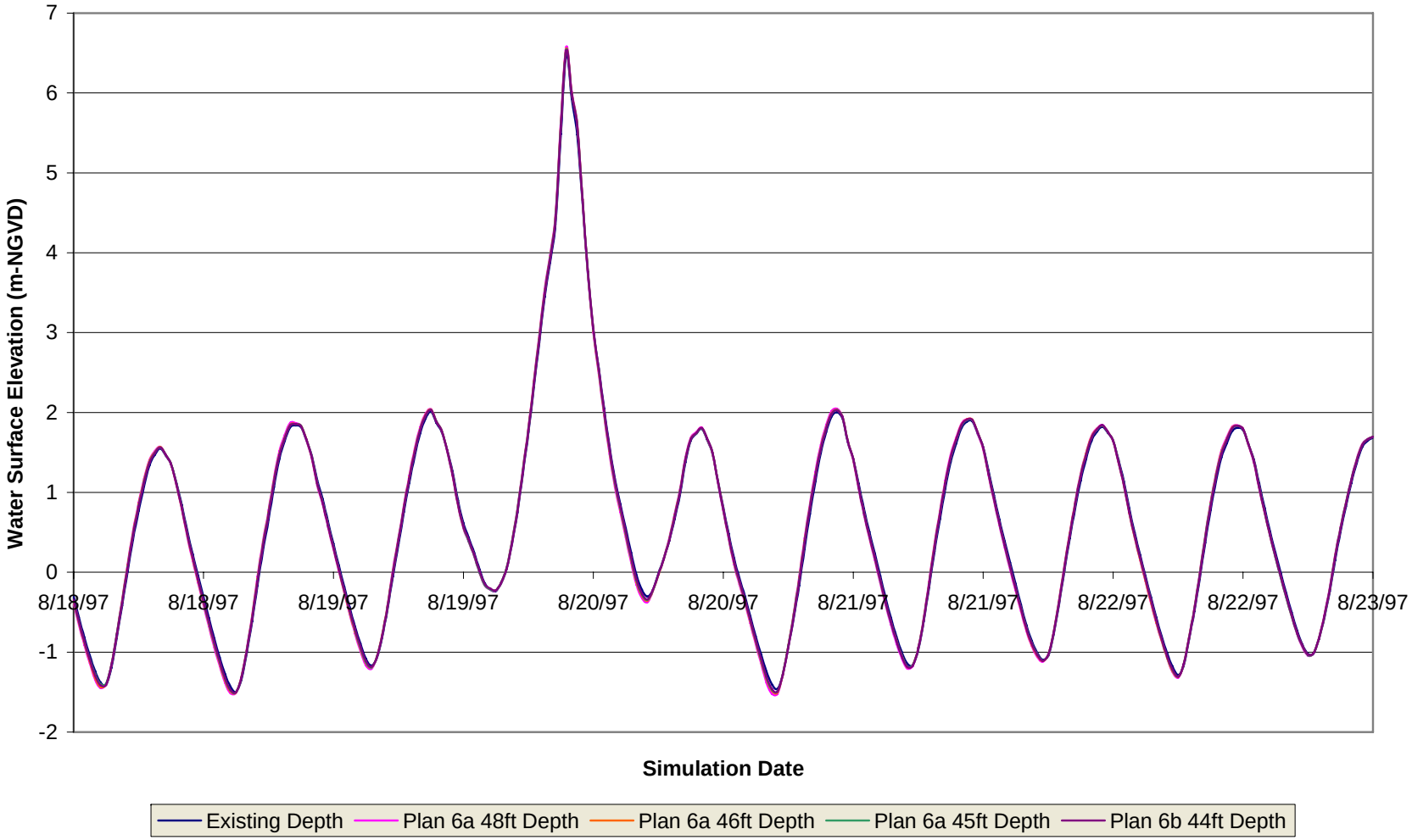
The output results in Table 1 show that the maximum increase in the water surface elevations occur for the 48 ft channel depth (deepening 6ft). At the I-95 bridge this increase is 0.24 m. While this is an increase due to deepening, it is certainly not considered significantly large as compared to the overall storm surge height of 15 ft.

The impacts analysis (*Hurricane Surge Modeling* dated September 23, 2005) showed that the 48 ft channel depth with the surge peak occurring during the spring tidal peak had the greatest impact on the surge height. All other scenarios that were modeled with varying tidal conditions during the surge peak did not have increases as great as the peak-on-peak condition that was also modeled in this analysis. Therefore, it is concluded that the 15 ft storm surge during the spring tide is the worst case and the maximum increases that are predicted are 0.24m.

Conclusion

In summary, Mitigation Plans 6a and 6b are the proposed flow altering mitigation plans to reduce impacts in the estuary. The model results show that a hurricane surge does increase, despite mitigation efforts, but the increases are certainly not significant.

15 ft Storm Surge Comparison at Fort Jackson
(surge timed during peak of spring high tide)



15 ft Storm Surge Comparison at I-95
(surge timed during peak of spring high tide)