1-DIMENSIONAL MODELING OF SEDIMENTATION IMPACTS FOR THE MISSISSIPPI RIVER AT THE WEST BAY DIVERSION

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Abstract The Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), West Bay Sediment Diversion Project is located on the west bank of the Mississippi River, in Plaquemines Parish, Louisiana, 4.7 miles above Head of Passes. The project included the excavation of an uncontrolled diversion channel through the bank of the Mississippi River. Construction was completed in November 2003. The project was designed to restore and maintain approximately 9,831 acres of fresh to intermediate marsh in the West Bay area by diverting fresh water and sediment from the Mississippi River over the 20-year project life.

In theory, the diversion of water and sediment increases the potential for induced sediment deposition in the main channel downstream of the diversion if the diverted sediment to water ratio is less than that of the primary river. Reduced sediment transport capacity without a corresponding reduction in sediment load results in deposition. This is a critical issue on the Mississippi River where increased sediment deposition can have an adverse impact on project purposes such as commercial navigation and flood control. Also, through the West Bay reach, an anchorage area is provided adjacent to the navigation channel. Concerns about increased sediment deposition and resulting increased dredging prompted the CWPPRA Task Force to authorize a study to evaluate the impacts of the West Bay Diversion on increased sediment deposition and dredging within the navigation channel and anchorage area. In response, the Corps of Engineers’ Engineer Research and Development Center, Coastal and Hydraulics Laboratory (ERDC - CHL) prepared a work plan that included 4 primary tasks. Those tasks included a comprehensive channel geometry, discharge, suspended sediment, and bed material data collection program, a detailed geomorphic assessment, 1-D modeling, and multi-dimensional modeling of the West Bay reach. This paper addresses the 1-D modeling effort.

One-dimensional (1D) sediment routing modeling provides the opportunity of evaluating long-term channel changes and delivery of sediments at a regional scale and provides boundary condition input for multi-dimensional modeling. The HEC-6T Sedimentation In Stream Networks software package is being used to develop a model to simulate long term sediment deposition rates within the navigation channel and anchorage area. Fifty year simulations with and without the West Bay Diversion and with and without continued dredging of the anchorage area will be run. A comparison of these simulations will identify both temporal and spatial changes in the sedimentation rates for both with and without diversion alternatives. Ultimately, the results of the 1-D modeling will be incorporated along with the geomorphic assessment and the multi-dimensional modeling results to provide the CWPPRA Task Force with the technical information needed to make decisions on the future operation and management of the West Bay Diversion.
INTRODUCTION

The continued loss of valuable coastal wetlands is a significant problem in Louisiana. One alternative solution is to divert water and sediment from the Mississippi River to restore vegetated wetlands. In 1992, the West Bay Sediment Diversion Project was approved. The project objective was to restore vegetated wetlands in the West Bay area that had over time converted to shallow open water. The project plan was to divert sediments from the Mississippi River at River Mile 4.7R above Head of Passes (AHOP) in an effort to create, nourish, and maintain approximately 9,831 acres of fresh to intermediate marsh in the West Bay area over the projected 20-year project life. Figure 1 is a project location map. The project consisted of the excavation of an uncontrolled diversion channel through the right descending bank of the Mississippi River for the large-scale diversion of sediment. An initial channel was excavated during the fall of 2003. This channel was constructed using a hydraulic cutterhead dredge to the dimensions of 25 feet deep by 195 feet wide. The channel was designed to convey an average discharge of 20,000 cubic feet per second (cfs) at the 50 percent duration state at the gage at Venice, Louisiana. However, measured discharge in 2004 and 2005 indicate that the excavated channel only passed approximately 14,000 cfs. A second phase excavation was planned to expand the channel conveyance to 50,000 cfs. This second phase excavation was never constructed. However, the channel has naturally enlarged since the initial construction in 2003 but has not reached the 50,000 cfs planned capacity. Measured discharge in 2007 and 2008 indicate that the diversion had almost doubled in size to approximately 27,000 cfs. Figure 2 is a photo of the West Bay Diversion construction taken during the fall of 2003.

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Figure 1 West Bay Diversion Project Location Map.

Figure 2 West Bay Diversion Construction During The Fall 2003.
(Photo From USACE, New Orleans District Website)
During the planning of the diversion project, sponsors realized that the diversion could induce shoaling in the main navigation channel of the Mississippi River and the adjacent Pilottown Anchorage Area (PAA). The PAA is a U.S. Coast Guard designated safe harbor outside of the Federally maintained navigation channel. This area is located along the right descending bank of the river from River Mile 6.7 to River Mile 1.5 (Figure 3). Dredging of the main navigation channel is accomplished under the U.S. Army Corps of Engineers’ ongoing Operations and Maintenance Program but additional dredging of the anchorage area is an added feature and cost of the diversion project. After detailed negotiations with the navigation industry, an agreement for maintaining the PAA was developed and executed. As stated in the Cost Sharing Agreement executed between the State of Louisiana and the Corps of Engineers and the budget approved by the CWPPRA Task Force in 2002: “Included as a Project feature is the maintenance of the outermost (eastern) 250-ft-wide strip of the Pilottown Anchorage area and the entire width of the adjoining access area between this strip of the Pilottown Anchorage area and the Mississippi River navigation channel. Advanced maintenance of the Pilottown Anchorage area shall be undertaken to account for the anticipated shoaling induced by the Project.” The project is responsible for this channel maintenance as a direct project cost through the project life, which ends in 2023. Initial advance maintenance dredging was conducted in the PAA in 2003. Subsequent maintenance dredging was conducted in both 2006 and 2009. Due to the magnitude of this dredging, the CWPPRA Task Force authorized a detailed study during 2009 to evaluate the impacts of the West Bay Sediment Diversion on shoaling in the PAA and adjacent navigation channel (percentage of shoaling being caused by the diversion and the percentage being caused by other effects). ERDC – CHL developed a multi task work plan to address the shoaling issue. This work plan included a comprehensive channel geometry, discharge, suspended sediment, and bed material data collection program, a detailed geomorphic assessment, 1-D sediment routing modeling, and multi-dimensional (2D and 3D) hydrodynamic and sediment modeling of the West Bay reach. The results of the 1D modeling effort were integrated with the results of the geomorphic assessment and the multi dimensional modeling to provide a complete evaluation of the impacts of the West Bay Diversion.
HEC-6T Description, Capabilities, Limitations, and Requirements

For the West Bay Diversion evaluation, the HEC-6T Sedimentation in Stream Networks software package was used. The HEC-6T software is an enhanced version of HEC-6, Scour and Deposition in Rivers and Reservoirs. The HEC-6 user’s manual describes HEC-6 as “a one-dimensional movable boundary open channel flow numerical model designed to simulate and predict changes in river profiles resulting from scour and/or deposition over moderate time periods, typically years”. HEC-6T provides computed total sediment discharge passing each cross section and the volumes of deposits or scour accumulated at each cross section from the beginning of the simulation. Model input requirements include channel geometry, upstream boundary conditions, bed gradations, distributary / diversion outflow and sediment concentration, water temperature, downstream boundary conditions, and a user specified sediment transport function. Boundary conditions refer to the water and sediment discharges entering the model and to the stage-discharge relationship at the model’s downstream boundary. There are three external boundary condition parameters: upstream water discharge, upstream sediment discharge by particle size, and downstream water surface elevation. A two phase calibration is required. The first phase includes the calibration of computed water surface profiles to observed profiles. This is accomplished by running the model in the fixed-bed mode for a range of steady-state discharges. Manning’s roughness coefficients are adjusted so that calculated water surface profiles match...
measured stages at available gage locations. The second phase includes sediment calibration. This can be accomplished by simulating observed erosion and deposition and by simulating measured sediment transport. Also, if dredging records are available, calibration to dredging quantities is an option.

The use of HEC-6T has both advantages and disadvantages. HEC-6T provides 4 primary advantages needed for the evaluation of the West Bay Diversion. Those advantages include:

1. HEC-6T allows for long term simulations. For the West Bay Diversion evaluation, 50 year simulations are required.

2. HEC-6T has the ability to simulate dredging activities. For the West Bay Diversion, dredging in both the navigation channel and in the Pilottown Anchorage Area is required.

3. HEC-6T allows for the diversion of both water and sediment and calculates that impact on downstream sediment transport.

4. HEC-6T directly accounts for subsidence which in a long term simulation becomes a significant issue in coastal Louisiana.

The primary disadvantage is that HEC-6T uses average hydraulic and sediment parameters to simulate 3-dimensional processes in 1 dimension. HEC-6T includes no provision for specifying a lateral distribution of sediment load or bed material gradation across a cross section. Normally, deposition and scour are modeled by moving each cross section point within the movable bed an equal amount (the area that is shifted vertically during each time step due to sediment movement). For this study, an option was selected in HEC-6T that preferentially deposits sediment within the dredging template before deposition is distributed over the rest of the moveable bed.

**Modeling Approach** For the West Bay Diversion evaluation, a HEC-6T model as developed by the USACE Vicksburg District (MVK) was used as the base model. The MVK model is part of a regional model being developed for the identification of long term channel maintenance locations within the Lower Mississippi River. Since this model was developed for regional use, modifications were required for the West Bay Diversion evaluation. Additional cross sections were required downstream of Belle Chase, Louisiana (River Mile 76 AHOP) to adequately define the channel geometry within the study reach. The highest density of channel cross sections was required within the Pilottown Anchorage Area reach (River Mile 1.5 to River Mile 6.7). An important part of the West Bay Diversion 1D modeling evaluation was the ERDC data collection. The ERDC collected flow diversion, sediment concentration diversion, and bed material gradation data were compared to the existing values contained in the model. If needed, model values were modified. As model input parameters were modified, a continued check on the model calibration was required. That included water surface profiles, sediment deposition and erosion locations and quantities, dredging locations and quantities, and sediment transport by grain size. Constant subsidence and sea level rise rates were estimated and incorporated into the model. A typical discharge hydrograph which provided a realistic expectation of future flows was selected and duplicated as needed to create a projected 50 year hydrograph. Fifty year downstream water surface elevations were developed that match the time period used in the 50
year discharge hydrograph. The hydrograph was run for 4 alternative scenarios. The first scenario included the West Bay Diversion closed and no dredging in the Pilottown Anchorage Area. Dredging in the navigation channel was permitted as needed. For the second scenario, the West Bay Diversion closed and with dredging in the Pilottown Anchorage Area, an appropriate composite dredging template for the Pilottown Anchorage Area was developed and inserted into the model. This template included required dredging in both the navigation channel and the anchorage area. The second scenario was run. For the third and fourth scenarios, the West Bay Diversion was inserted into the model. This included adding the diverted flow and sediment concentration diversion ratios. The composite dredge template was removed and the third scenario, West Bay Diversion open and no dredging in the Pilottown Anchorage Area, was run. For this scenario, dredging, as required, was permitted in the navigation channel. The composite dredge template was inserted back into the model and the fourth scenario, West Bay Diversion open and with dredging in the Pilottown Anchorage Area, was run. Once all the runs were complete, the final step was to compare sediment deposition locations and quantities and dredging locations and quantities through the Pilottown Anchorage Area reach for each of the four 50 year simulation scenarios to determine the impact that the West Bay Diversion has on the Pilottown Anchorage Area.

ERDC HEC-6T Model Input The model provided by MVK extends some 455 miles from Vicksburg, Mississippi (River Mile 437.28) to Pilots’ Station in Southwest Pass (River Mile -18). The entire model was used for the West Bay effort but the primary focus was on the Belle Chasse, Louisiana (River Mile 76) to Head of Passes (River Mile 0) reach. Model channel geometry was derived from the 1992 Mississippi River comprehensive hydrographic survey. The MVK provided model contained 201 cross sections. ERDC model modifications included adding 28 cross sections between Belle Chasse and Head of Passes to better define the channel geometry through the reach. The greatest increase in cross section density occurred in the Venice (RM 10.6) to Head of Passes reach. That reach includes the PAA and is the primary reach of interest for this study. The average cross section spacing through the PAA reach was 0.425 miles.

Upstream boundary conditions include water discharge and sediment loads. For water discharge, a typical average daily flow hydrograph was selected. This hydrograph includes the 25 year period from 1 January 1984 to 31 December 2008. This period contains several higher flow years (1984, 1991, 1997, 2005, and 2008) as well as several lower water years (1988, 2000, 2007). The highest flow in the hydrograph occurred during 2008. The high flow that year approached the 50 year frequency flow. The 25 year hydrograph was repeated to create the 50 year hydrograph used for the 4 scenario simulations. One of the unknowns in the modeling effort is the accurate prediction of future stages. Model computed sediment loads, deposition and erosion locations, and trends can vary if larger floods or drier periods occur more frequently than contained in the typical hydrograph.

In the HEC-6T model, the percentage of flow leaving the river through diversions / distributaries compared to the flow in the river immediately upstream of that diversion / distributary is an input parameter. The MVK model included 13 distributaries / diversions. The percentage of flow at each distributary / diversion was determined from measured data when available or calculated. The ERDC field data collection program included the acquisition of flow distribution, suspended
sediment concentrations, and bed material gradations within the study reach. Flow distribution measurements were taken at Baptiste Collette Bayou (RM 11.5L), Grand Pass (RM 10.4R), West Bay Diversion (RM 4.7R), Cubits Gap (RM 3.1L), Mississippi River upstream of Baptiste Collette Bayou, Mississippi River immediately upstream of West Bay Diversion, and Mississippi River immediately downstream of West Bay Diversion. Figure 4 is a plot of the flow distributions at Baptiste Collette Bayou, Grand Pass, West Bay Diversion, and Cubits Gap for the 2003 through 2009 time period as compared to the flow in the Mississippi River at Venice. The plot includes the data collected by the ERDC Coastal and Hydraulics Laboratory as a part of this study along with previous measurements obtained by the New Orleans District (MVN). Review of this data indicates that for most flow conditions, Baptiste Collette Bayou and Grand Pass each diverts approximately 12% of the Mississippi River flow at Venice. Cubits Gap diverts approximately 15% of the flow and West Bay Diversion diverts approximately 5% of the flow. A closer look at the flow data at the West Bay Diversion shows an increase in flow through the diversion over time as the diversion has enlarged. The flow distribution increased from about 2% when the diversion was opened in late 2003 to about 7% in 2008 and 2009. For the HEC-6T model evaluation, the flow distribution at West Bay was set at the current rate of approximately 7 percent of the Mississippi River flow at Venice.

The ratio of the sediment concentration in the diverted flow to that in the river immediately upstream of the diversion is a model input requirement. The lack of available accurate sediment concentrations for diverted flow has been a weakness of previous 1-dimensional modeling on the Lower Mississippi River. Sensitivity analysis was usually required with sediment diversion concentration ratios varying from 0 to 1. A ratio of 0 means that no sediment is diverted, while a ratio of 1 means that the concentration in the diverted flow is equal to that in the river. The actual concentration ratios usually fall between 0 and 1. MVK reports that for their model, the Rouse equation was used to determine the sediment concentration for the diverted flow. This method estimates diverted sediment concentrations based on the sediment concentration profile in the river and the depth of the diversion inlet verses the average depth of the river. For this study, ERDC Coastal and Hydraulics Laboratory collected suspended sediment measurements at Baptiste Collette Bayou, Grand Pass, West Bay Diversion, and Cubits Gap. Review of the data indicates that to date, not enough data has been collected to accurately define the sediment concentration diversion ratios over a range of flows. Plus, substantial analysis of the data is required to determine a single ratio based on multiple samples. For example, suspended sediment measurements were made for the Mississippi River at Mile 5.2. This site is located immediately upstream of the West Bay Diversion. At that site, suspended sediment samples are collected along 5 verticals across the channel section. For each of those verticals, samples are collected at 5 different depths which results in 25 suspended sediment samples being collected at that location during each sampling trip. In the West Bay Diversion channel, samples were collected along either 2 or 3 verticals at 5 different depths. That results in either 10 or 15 suspended sediment samples being collected in each sampling trip. The model requires a single sediment concentration diversion ratio for each grain size. Therefore, the sediment concentration of each sample must be determined for each grain size and then weighted to determine a single concentration for each sampling trip. A big advantage to the West Bay Diversion evaluation is that multi dimensional modeling was also conducted. Multi-dimensional models have the ability to compute diverted sediment concentrations. For the West Bay Diversion, the sediment diversion concentration ratios used in the 1-dimensional model were derived from the ADH 2
dimensional model. The magnitudes of these ratios illustrate the complex relationship between diverted sediment concentration, flow, and sediment grain size. For all other diversions in the model, the sediment concentration diversion ratios were determined using the Rouse equation.

The initial bed material gradations in the MVK model were derived from bed material samples collected along the thalweg of the Mississippi River by Nordin and Queen (1989). A 2 year frequency discharge was run through the model for 30 days. This allowed the initial bed gradations to be reworked to the bed to gradations produced by the channel forming discharge. As part of the ERDC field data collection program, bed material samples were collected at 49 locations from River Mile 19.6 through Southwest Pass. Analysis of the bed material gradations indicates definite temporal and spatial variations. For instance, at some locations, bed material distributions varied seasonally (varying discharge) while at other locations, bed material distributions varied laterally across the channel. Due to the variation in the bed material sample gradations and since HEC-6T does not allow for varying gradations either seasonally, with discharge, or laterally across the channel, the bed material gradations were not modified from the MVK model.

In coastal areas, tides, subsidence, and sea level rise are issues that impact sedimentation. For the ERDC model, the 8:00 AM daily stages recorded at the NOAA tidal gage at Grand Isle East Point was used as the downstream boundary condition. NOAA reports that the average difference between high and low tides at Grand Isle is approximately 1.05 feet. The daily stages, over the period of record, will vary throughout the daily tidal cycle capturing the full range of tidal conditions. In this domain, tides provide the greatest impact during periods of low flow when the river’s sediment transport capacity is reduced. Therefore, no attempt to include the
effects of the tidal cycle was included in the model. In south Louisiana, both subsidence and sea level rise are significant and can greatly alter sediment transport rates over a long term simulation. HEC-6T directly accounts for subsidence. Reported subsidence rates along the lower Mississippi River vary from different sources. For the model, subsidence rates were derived from NOAA Technical Report NOS/NGS 50 (Shinkle and Dokka 2004). Subsidence rates vary from 22 mm/year at River Mile 22 to 3 mm/year at River Mile 306. Based on the available data, the subsidence rate at Venice, Louisiana is 16 mm/year. This rate equates to approximately 31.5 inches of subsidence over the 50 year simulations. Subsidence rates in NOAA Technical Report NOS/NGS 50 were computed with an eustatic sea level rise of 1.25 mm/year at Grand Isle. The daily stages were increased at this rate for the 50 year simulations.

HEC-6T allows for the selection of various sediment transport functions. A critical part of the modeling effort is the selection of a transport function that was developed for the sediment characteristics that match the specific river. For the West Bay Diversion modeling effort, the Toffaleti sediment transport function was used. This function was developed for use on large, sand bed rivers like the Mississippi River and has been used successfully on previous 1-dimensional model studies on the Lower Mississippi River.

HEC-6T allows for dredging of the channel by specifying the bottom elevation and lateral extent of a dredge template. The reach of the Mississippi River through the Pilottown Anchorage Area is unique in respect to dredging requirements. Currently the USACE New Orleans District maintains a 750 foot wide navigation channel. The navigation channel through that reach is dredged to an elevation of -51 feet to accommodate the -45 foot channel plus 6 feet of over-depth / advance maintenance dredging. Parts of the navigation channel, especially the reach from Cubits Gap to Head of Passes require dredging annually or more frequently. A 250 foot wide section of the Pilottown Anchorage Area is dredged to various depths (-48, -44, and -41 feet) along its length. This dredging is conducted once every 3 years. HEC-6T does not allow for separate dredging templates or for a complex template with varying depths in the template. Therefore, for the West Bay Diversion evaluation, a composite template was developed. This template attempted to simulate the combined navigation channel and anchorage area dredging. Developed by combining the areas of the navigation channel and anchorage area, the dredging template uses a composite width. This template is used for both scenario simulations where dredging in the Pilottown Anchorage Area was allowed. In the model, both the navigation channel and anchorage area are dredged twice a year, on January 1 and July 1. However, the anchorage area in the prototype is dredged on a three year cycle. The more frequent dredging in the model results in an over estimation of the required dredging in the Pilottown Anchorage Area. The amount of the over estimation is difficult to quantify.

In an HEC-6T model, calibration of both water surface and sediment is required. Water surface elevations are calibrated through channel roughness coefficients. For the MVK model, water surface elevations were calibrated to observed data from 9 gage stations. Model roughness coefficients were initially determined in the calibration phase by using the initial cross section geometry with the model in the fixed bed mode. Roughness coefficients were adjusted to regression equations for observed data at each gage. Roughness coefficients determined during the initial fixed bed calibration produced reasonable results during the movable bed simulation. Sediment is usually calibrated by running a hydrograph for a given period of time and comparing
computed sediment transport and bed erosion and deposition locations and quantities to observed values. Also, if dredging is conducted and records are available, calibration to dredging locations and quantities is an option. For the MVK effort, the model was calibrated to observed deposition downstream of the Old River Control Complex and to observed erosion at Smithland Crossing. The model was also calibrated to measured sediment transport at the Tarbert Landing (River Mile 306.3) and Belle Chasse (River Mile 76.0) gages. Calibration also included the simulation of reported dredging volumes in Southwest Pass and Above Head of Passes. As modifications were made in the ERDC model, frequent checks were made to make sure that the modifications did not affect the model calibration.

**MODEL RESULTS**

As output, the HEC-6T model provides total sediment loads passing each cross section as well as deposition and erosion locations and quantities. Figure 5 is a plot of the total sediment load passing each cross section between River Mile 15 and RM -5 at the end of the 50 year simulation for each of the 4 scenarios. The total sediment load is the combined sand, silt, and clay loads and is presented as relative load compared to the total sediment load passing River Mile 12.5. Any downward trend in the plot represents a reduction in sediment load which would indicate sediment is being diverted and/or deposited in the channel. As the plot shows, the total sediment loads for all 4 scenarios upstream of the West Bay Diversion are extremely similar. As expected, the first big reduction in the total sediment load occurs just upstream of Venice at Baptiste Collette Bayou. At this location, the total sediment load is reduced by 10%. Another 10% reduction occurs at Grand Pass. This indicates that 20% of the total load at RM 12.5 is diverted through Baptiste Collette and Grand Pass. Immediately downstream of Grand Pass, the plot is relatively flat to about Mile 7. From that point downstream to just upstream of the West Bay Diversion, the plot begins to trend downward, indicating sediment deposition is occurring in that reach. For the two scenarios with the West Bay Diversion closed, the plot continues to trend downward to Cubits Gap, indicating that the reach is aggradational even with the West Bay Diversion closed. For the two scenarios with the West Bay Diversion open, an approximate 7% reduction in the total sediment load is computed at this diversion. For these scenarios, the reach between West Bay Diversion and Cubits Gap trends downward, again indicating sediment deposition through this reach. Depending on the scenario, between 13% and 15 % of the total sediment load is being diverted at Cubits Gap. In the reach from Cubits Gap to Head of Passes, the plot trends downward approximately 3% indicating the reach is aggradational. Finally, at Head of Passes, approximately 20% to 25% of the total load is diverted through Pass A Loutre and South Pass. Figure 5 shows that approximately 46% of the total sediment load at RM 12.5 is diverted or deposited between that location and Head of Passes with the West Bay Diversion open. This value is consistent with, but slightly lower than, recent suspended sediment load measurements. Only approximately 38% of the total load at RM 12.5 through the same reach is diverted or deposited with the West Bay Diversion closed. Of the 8% difference, only 5% is being diverted and/or deposited at the West Bay Diversion (between cross sections 4.9 and 4.46) while the remaining 3% is deposited and/or diverted farther downstream above Head of Passes. Note that the deposition rates (line slope between diversions in Figure 5) are significantly higher between Cubits Gap and Head of Passes and in the upper reaches of Southwest Pass than in other portions of the model.
Figure 5 Total Sediment Load Relative To Total Sediment Load at River Mile 12.5 For Modeled Scenario Simulations.

Approximately 40-50% of the total flow and sediment passing just upstream of the Venice discharge range is taken from the river above head of passes through diversions. As a consequence, each reach downstream of Venice is aggradational with deposition increasing in the downstream direction and concentrated below Cubits Gap. From Cubits Gap downstream, the navigation channel functions as an efficient sediment trap. Any increase in the width of the trap produces nearly equal increases in the volume of dredging.

The 1D model performs well in reproduction of deposition and dredging locations but underestimates the best available estimates of deposition rates, particularly in Southwest Pass. The model results indicate that although the West Bay Diversion diverts only 7% of the total flow, the impact on dredging is disproportionately large. The model consistently indicates that the West Bay Diversion accounts for a 20-25% increase in dredging required in the Pilottown Anchorage Area. A similar increase in dredging occurs in the adjacent navigation channel.

Simulations were also conducted to estimate the impacts of dredging in the navigation channel if the anchorage area is not maintained. If only the navigation channel is maintained, the West Bay Diversion accounts for an even larger increase in required dredging.

CONCLUSIONS

The ERDC HEC-6T model was a good first effort at identifying the impacts of the West Bay Diversion on the navigation channel and Pilottown Anchorage Area and has yielded several important insights to the long term sedimentation trends within the study area. The West Bay Diversion can not be analyzed in isolation. It is a part of a complex interacting system of
diversions which influence the morphology of the Mississippi River and Passes. Accurately predicting sedimentation rates and locations in a 50 year simulation for dynamic reaches like the Mississippi River downstream of Venice is difficult. Cumulative impacts of changing flow and sediment losses through multiple distributaries / diversions, subsidence, sea level rise, tidal cycles, salinity, uncertainty of future channel discharge, and continued enlargement of the West Bay Diversion all impact model results. Continued development of the model and sensitivity analyses for the most uncertain variables should be conducted. In the 1-D model, sensitivity analyses include varying specified input parameters to determine what impact changes in those parameters have on model results. Sensitivity analyses for the following parameters would increase the understanding of the impact that each parameter has on sedimentation trends, thus increasing the confidence in the model results:

1. varying sediment concentration ratios at distributaries / diversions
2. varying subsidence and sea level rise rates
3. using different sediment transport functions (recommend Madden-Laursen which treats silt as bed load which may be important in the downstream most reaches of the Lower Mississippi River
4. both wetter and drier typical hydrographs
5. enlarged West Bay Diversion
6. varying dredge templates

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