Mississippi River
West Bay Diversion
Geomorphologic Assessment and
1-D Modeling Plan

Freddie Pinkard and Charlie Little
Research Hydraulic Engineers
ERDC-CHL-River Engineering Branch

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Lane’s Relationship

\[ Q \cdot S \sim Q_s \cdot d_{50} \]

where:

- \( Q \) = water discharge
- \( S \) = channel gradient
- \( Q_s \) = bed material load
- \( d_{50} \) = median size of bed material
Lane’s Balance

(+) SLOPE (-)  (-) D_{50} (+)

WATER  SAND

AGGRADATION  EQUILIBRUM  DEGRADATION
Geomorphic Assessment

Provides the process-based framework to define past and present watershed dynamics, develop integrated solutions, and assess the consequences of remedial actions on channel stability.
Geomorphic Assessment Need

To determine if observed shoaling trends in the Pilottown Anchorage are within the influence of the large-scale, long-term morphological changes occurring within the study reach or a specific result of the impact of West Bay Diversion.
Geomorphic Assessment
Objectives

1. Utilize Available Data to Document the Historic Trends and Changes In Hydrology, Hydraulics, Sedimentation, and Channel Geometry for the Lower Mississippi River

2. Summarize the Local Changes Observed at the Pilottown Anchorage Since Opening of West Bay

3. Evaluate Changes at Pilottown Anchorage with Regard to Historic Trends
Geomorphic Assessment Plan

Spatial Limits
Belle Chasse (RM 75) to Head of Passes (RM 0)

Temporal Limits
1960 to Present
Geomorphic Assessment Tasks

• Data Compilation
• Geometric Data Analysis
• Gage and Discharge Data Analysis
• Dredge Records
• Sediment Data Analysis
• Events Timeline Analysis
• Integration of Results
Geomorphic Assessment
Impact Of Cutoffs

Mississippi River Cutoffs

Locations:
- Memphis
- Hardin
- Helena
- Sunflower
- Jackson
- Ashbrook
- Tarpley
- Leland
- Worthington
- Sarah
- Greenville
- Willow
- Marshall
- Rodney
- Diamond
- Yucatan
- Giles
- Natchez
- Glasscock
- Baton Rouge

US Army Corps of Engineers
ERDC – Coastal And Hydraulics Laboratory
Geomorphologic Assessment
Specific Gage Analysis
Geomorphic Assessment
Specific Gage Analysis
Geomorphic Assessment
Specific Gage Analysis
Geomorphic Assessment Provides

- Status of Current River Water and Sediment Resources
- Characteristics of Sediment Transport in the Lower River
- Historic Sedimentation Trends and Future Projections
- Establishment of Baseline Conditions Critical To Hydrodynamic and Sediment Routing Modeling Efforts
- Formulation of a Conceptual Model to Assess Cause and Effect Within the River in Response to the West Bay Diversion
HEC-6T 1-Dimensional Model

Moveable boundary open channel flow model designed to estimate long term response of the channel (scour and deposition) to a predicted series of water and sediment supply.
1-Dimensional Model Need

Previous 1-D modeling efforts have lacked measured sediment concentrations that exit the river through diversions. Sensitivity level analyses have been conducted. Measured sediment data at the diversion will greatly improve the models capability to accurately predict sediment aggradation / degradation trends downstream.
### Previous 1-Dimensional Modeling

**Effect Of Constant 10 Percent Water Diversion At RM 6.7 On Dredging and Sediment Deposition In Southwest Pass**

<table>
<thead>
<tr>
<th>Sand Concentration in Diversion as Percent of River Concentration</th>
<th>Increase in Mean Annual Dredging* ( \text{yd}^3 \times 10^5 )</th>
<th>Percent</th>
<th>Increase in Mean Annual Dredging and Deposition* ( \text{yd}^3 \times 10^6 )</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>0.44</td>
<td>8.1</td>
<td>0.76</td>
<td>13.0</td>
</tr>
<tr>
<td>50</td>
<td>0.65</td>
<td>12.0</td>
<td>1.01</td>
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<tr>
<td>0</td>
<td>0.87</td>
<td>16.0</td>
<td>1.26</td>
<td>21.5</td>
</tr>
</tbody>
</table>

* Based on 1975–82 hydrograph repeated four times for 32-year period of record.

Previous 1-Dimensional Modeling

Effect Of Constant 10 Percent Water Diversion At RM 6.7 On Dredging and Sediment Deposition In Southwest Pass
HEC-6T 1-Dimensional Modeling

Advantages
1. Allows for long term simulations
2. Includes a dredging option

Disadvantages
1. Uses 1-D to simulate 3-D processes
2. Uniform erosion / deposition across the channel section
3. Sediment concentrations for diversions are a user input
HEC-6T Model Input Requirements

- Channel Geometry
- Mainstem Flow Data
- Mainstem Sediment Data
- Diversion Flow Data
- Diversion Sediment Data
HEC-6T Model Calibration

• Water Surface Profiles calibrated to know flow events.
• Bed Changes calibrated to more recent channel surveys

HEC-6T Model Spatial Limits

• Regional Model from Vicksburg, MS to East Jetty
• Utilize Belle Chasse to Head of Passes reach
HEC-6T Model Simulations

- Add Major Distributaries
- 50 Year Simulation Based on a Selected “Typical Hydrograph”
- Without West Bay Diversion
- With West Bay Diversion
- Utilize Dredge Option
1-Dimensional Modeling Provides

- More Detailed Prediction of Potential Long Term Channel Morphological Changes, Comparing Those for the With and Without West Bay Diversion
- Estimates of Potential Dredge Locations and Volumes, Comparing Those for the With and Without West Bay Diversion
- Boundary Conditions for Multi-Dimensional Modeling
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Questions / Comments?