Appendix A. Mid-Barataria Sediment Diversion Progress Report, Belle Chasse and Diversion 50-year Sediment Budget

Mid-Barataria Sediment Diversion

Progress Report

Belle Chasse and Diversion

50-year Sediment Budget

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Belle Chasse and Mid-Barataria Sediment Diversion 50-year Suspended Sediment Loads

Methodology and Assumptions

1 Overview

This work includes Daily and Flood Year Estimates for a 50-year period (10/01/2019 to 12/31/2069) at the following locations:

- Lower Mississippi River (LMR) at Belle Chasse
  - Water Discharge (obtained from HEC6-T simulations)
  - Suspended Fine and Sand Loads by size-class
  - Suspended Fine Concentration and Sand Concentrations by size-class
- Mid-Barataria Sediment Diversion
  - Water Discharge in the Outfall Channel
  - Suspended Fine and Sand Loads by size-class
  - Suspended Fine Concentration and Sand Concentrations by size-class

2 Belle Chasse

2.1 Discharge

The water discharge at Belle Chasse was obtained from one-dimensional HEC6-T model simulations performed for the Mississippi River Hydrodynamic and Delta Management Study (MRHDM) by the HEC6-T team, led by Tony Thomas.

The HEC6-T model covers the domain between Tarbert Landing (RM 306) and the Head of Passes. Tarbert Landing (RM 306) U.S. Army Corps of Engineers (USACE) Water Discharge measurements from 1961 to 2012 were used to generate the upstream boundary for the model. The data were reorganized and some of the events were repeated to obtain an 80-year time series of flows at Tarbert Landing. The model considers flow extractions for the Morganza and the Bonnet Carré Spillways as well as other cuts or outlets located between Tarbert Landing and Belle Chasse.

The last 50 Flood Years of flows, 2020 to 2069, were used in this study.

2.2 Sediment Load Rating Curves

The following rating curves used for the daily sediment load calculations in the LMR at Belle Chasse were derived from 2008 to 2012 U.S. Geological Survey (USGS) data. In the following equations the suspended sand and suspended sediment loads are in metric tons per day, and the discharge (Qw_{LMR}) is in cubic meters per second (cms). Sediment Concentrations were calculated using the Sediment Loads obtained from the following equations and the discharge values discussed in Section 2.1. These values ($CsSAND_{LMR}$ and $CsFINE_{LMR}$) are used in the formulas detailed in Section 3.2.

Suspended Sand

Suspended Sand Load = $a*[1-\exp(-b*Qw_{LMR})]+c*[1-\exp(-d*Qw_{LMR})]$

where:

a = 7.716E+7
b = 2.485E-7
c = -5.748E+5
d = 4.122E-5

Suspended Sediment (Sand + Fine)

Suspended Sediment Load = $a*[1-\exp(-b*Qw_{LMR})]+c*[1-\exp(-d*Qw_{LMR})]$

where:

a = 1.478E+6
b = 7.043E-5
c = -7.954E+5
d = 1.8E-4

2.3 Sand Size-Class Distribution

The LMR Sand Loads were distributed by size-class based on Myrtle Grove data from 2009 to 2011. The distribution used in the calculations was constant and equal to the average of the measurements considered (Table 1).

Table 1 – Suspended Sand Size-Class Distribution for Belle Chasse

Selected Dates	Fraction of Total 64-250 µm				Total 64-250 µm
	64 µm	96 µm	125 µm	250 µm	
May 11, 2010	0.009	0.089	0.534	0.369	**1.000**
May 15, 2010	0.018	0.126	0.580	0.277	**1.000**
March 30, 2011	0.021	0.129	0.487	0.363	**1.000**
May 14, 2011	0.025	0.133	0.450	0.391	**1.000**
AVERAGE	**0.018**	**0.119**	**0.513**	**0.350**	**1.000**

3 Mid-Barataria Sediment Diversion

3.1 Diversion Discharge

The following approach was used to determine the discharge in the outfall channel:

- The diversion operates when the water discharge in LMR at Belle Chasse equals or exceeds 600,000 cubic feet per second (cfs)
- To estimate the diverted discharge during the operational periods, a curve fitting analysis was performed. The equation used to calculated the diverted discharge is:
    - o Qw Diverted (cfs) = MINIMUM [(-1.11662290e-07*Qw_{LMR}^2 + 2.35451256e-01*Qw_{LMR} – 4.73915414e+04); 75,000cfs]
- The following bullets provide the modeled discharge results used to generate the curve, which are limited to a maximum of 75,000 cfs:
    - o 52,000 cfs are diverted for a River discharge of 600,000 cfs
    - o 66,000 cfs are diverted for a River discharge of 700,000 cfs
    - o 74,000 cfs are diverted for a River discharge of 970,000 cfs
    - o 75,000 cfs are diverted for a River discharge of 1,200,000 cfs or higher.

Figure 1 presents the modeling results used to calculate the diverted discharge as a function of the LMR flow as well as the polynomial second order curve obtained from the results and used in the calculations.

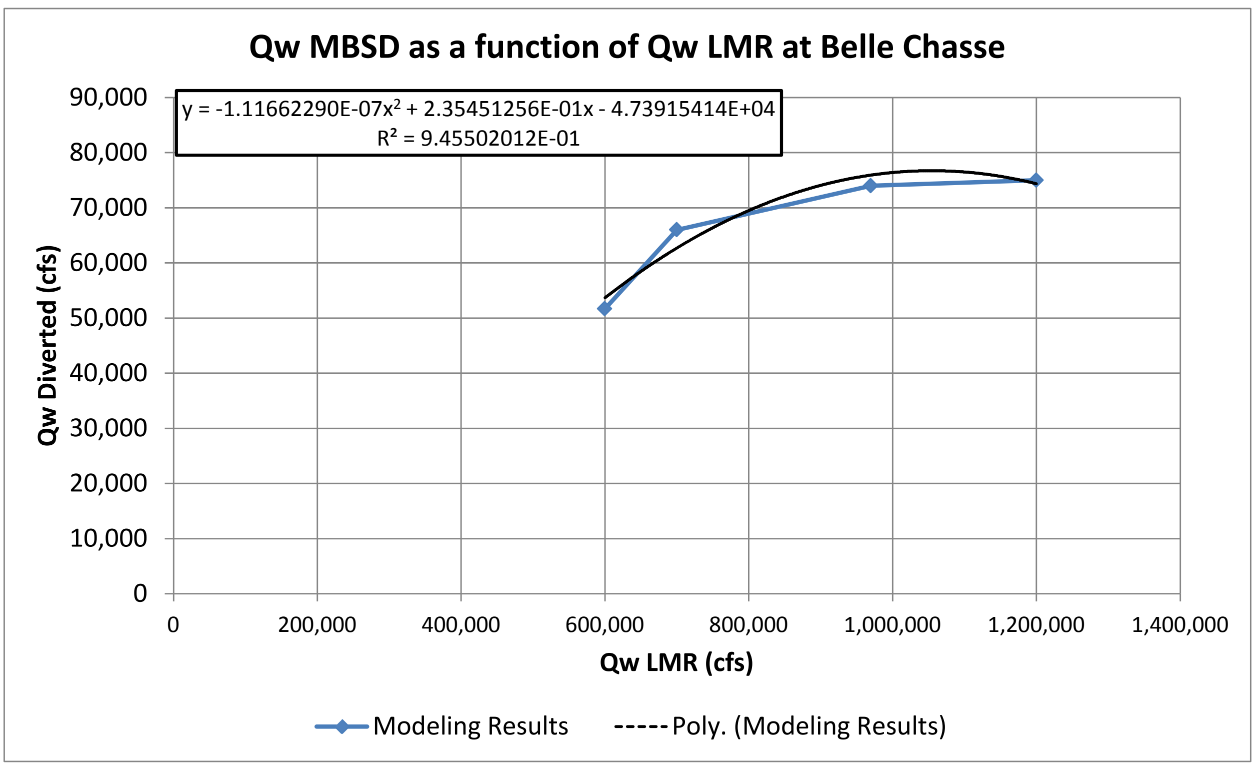

Figure 1 - Water discharge diverted as a function of the LMR water discharge

3.2 Diversion Sediment Loads

The Sediment Loads for the Mid-Barataria diversion were calculated using the following formulas:

- $QsSAND_{diverted}$ = Qw Diverted*$CsSAND_{LMR}$*SWRSAND
- $QsFINE_{diverted}$ = Qw Diverted*$CsFINE_{LMR}$*SWRFINE

3.2.1 Sediment/Water Ratio for Fine Material

SWRFINE was assumed constant and equal to 1.0. This is a conservative approach justified by the fact that SWR for Clay will be 1.0. Thus, all of the fine material is treated identically, as there are no measurements by size-class for fine material.

3.2.2 Sediment/Water Ratio for Sand Size-Classes

SWRSAND is a function of the size-class and the LMR water discharge. For each size-class one curve was used, with base on the numerical modeling results (Table 2). These curves are:

- SWRSAND 64 Microns = -3.84320071e-13*Qw_{LMR}^2 + 8.75507418e-07*Qw_{LMR} + 8.16360171e-01
- SWRSAND 96 Microns = 2.88645565e-14*Qw_{LMR}^2 - 1.30542510e-07*Qw_{LMR} + 1.29288402
- SWRSAND 125 Microns = -4.51580589e-13*Qw_{LMR}^2 + 1.03593004e-06*Qw_{LMR} + 7.51544198e-01
- SWRSAND 250 Microns = -2.30916452e-13*Qw_{LMR}^2 + 1.04434008e-06*Qw_{LMR} + 3.66927876e-01

Table 2 – Sediment Water/Ratio Results obtained with Flow3D simulations

Qw_{LMR} (cfs)	SWR Model Results			
	64 µm	96 µm	125 µm	250 µm
600,000	1.21	1.21	1.22	1.03
700,000	1.23	1.24	1.24	0.79
970,000	1.31	1.18	1.34	1.27
1,230,000	1.31	1.18	1.34	1.27

Figure 2 to Figure 5 display the SWR model results as a function of the LMR discharge and the second order polynomial curves obtained and used in the calculations.

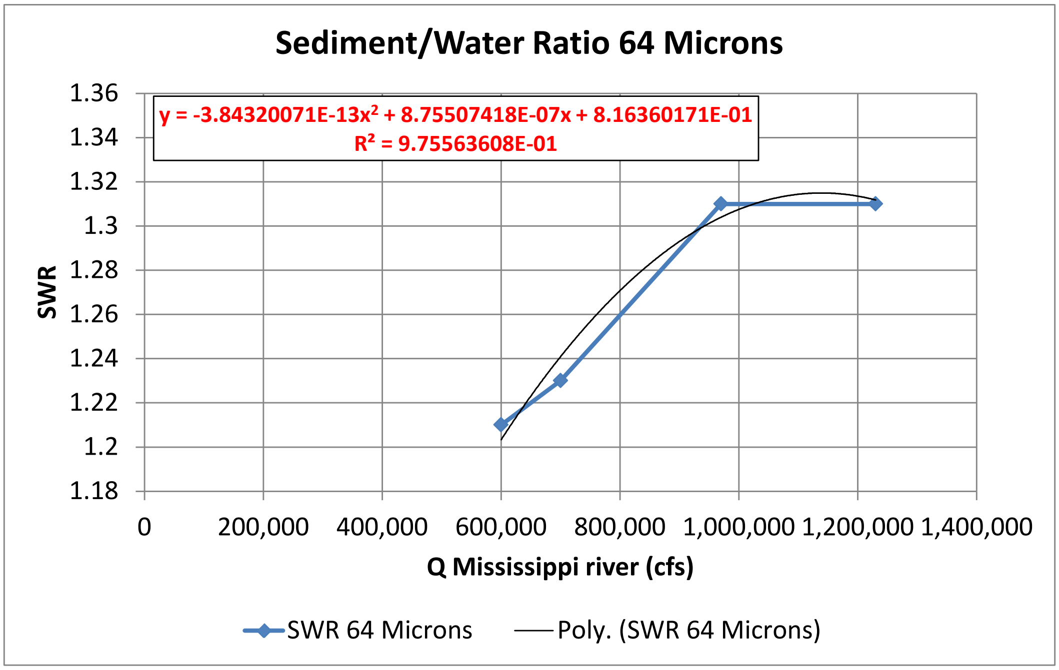

Figure 2 - Sediment Water Ratio Results and Fitting Curve – 64 Microns

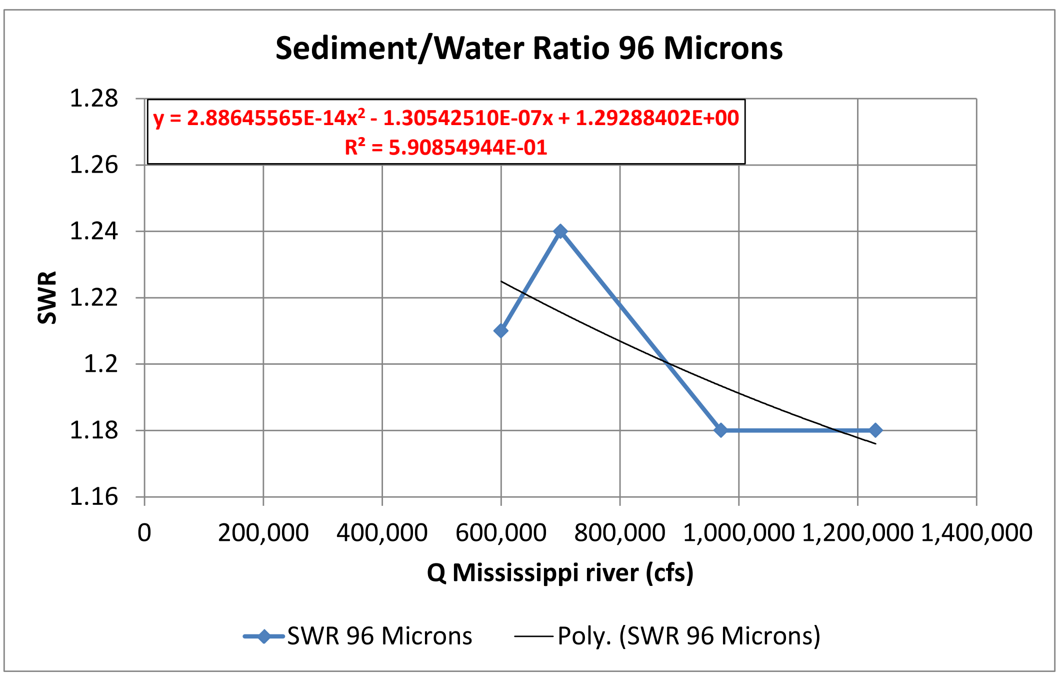

Figure 3 - Sediment Water Ratio Results and Fitting Curve – 96 Microns

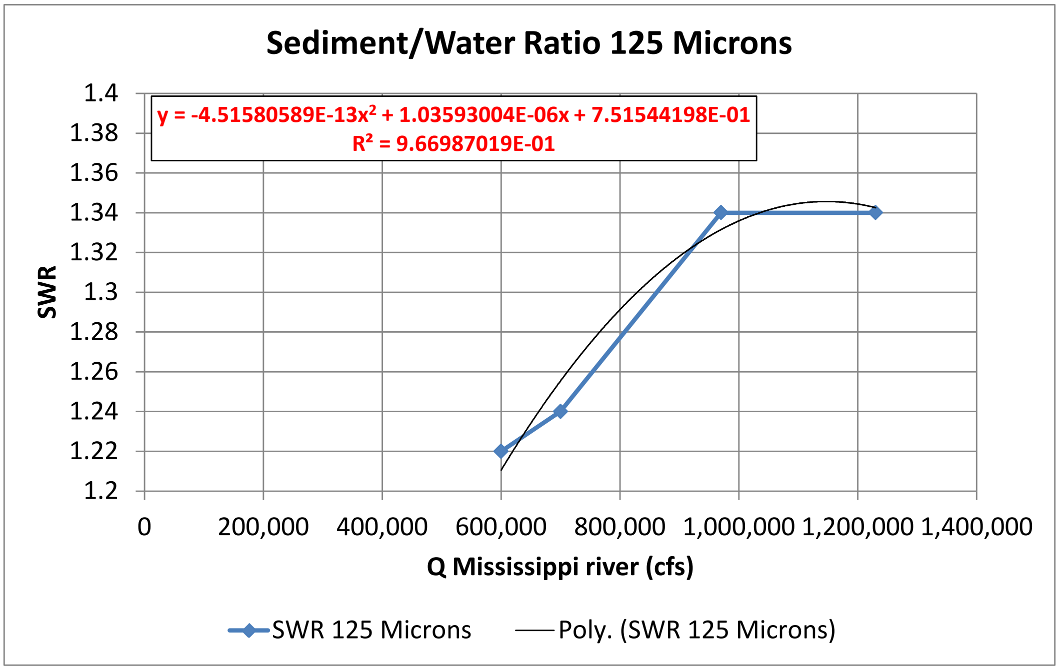

Figure 4 - Sediment Water Ratio Results and Fitting Curve – 125 Microns

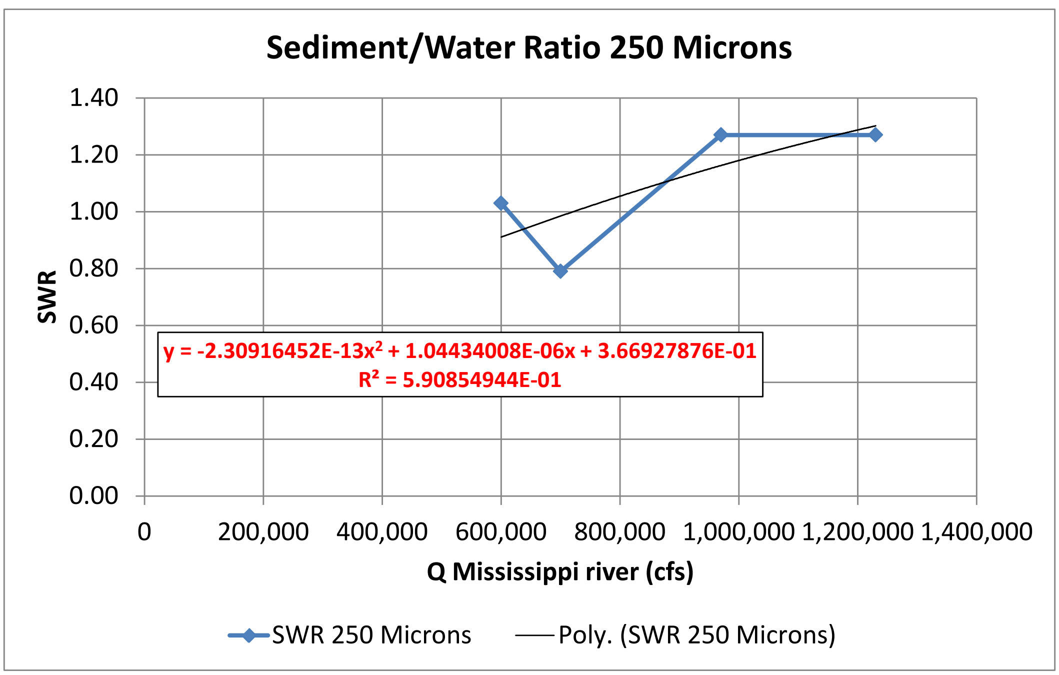

Figure 5 - Sediment Water Ratio Results and Fitting Curve – 250 Microns