Mississippi Valley Division
Regional Planning and Environmental Division South

Upper Barataria Basin, Louisiana Feasibility Report

Appendix A: Annex 16, Barge Gate and Sluice Gate Design

December 2021

Upper Barataria Basin		Barge Gate Design Analysis
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Subject:	Upper Barataria Basin Barge Gate Analysis	
Files:		

Description of Required Support:
H&H branch has been requested to design the barge gate structure where the Recommended Plan's levee alignment crosses at Bayou des Allemands. See Figure 1 for the location of the barge gate structure.

Figure 1 – Barge Gate Location

Methodology:
The sizing of the barge gate structure was based on not exceeding the flow restriction at the railroad crossing (See Figure 2) thus allowing the barge gate structure to convey a similar flow regime. For this exercise, the RR crossing is treated as an open channel not accounting for losses around the piers which leads to a more conservative design. This can be done by using the Continuity Equation (Q = V x A) and its proportionality to the Manning's Equations:
$Q = (1.49/n * A * R^{2/3} * S^{1/2})$.

Figure 2 – Railroad Restriction

Using the channel invert elevation of -10 ft (see Figure 6) and a top of bank elevation of 4 ft (See Figure 3), the total depth is 14 ft at the barge gate structure. At the RR crossing, the channel invert elevation of -20 ft (provided by USFWS) and a top of bank elevation of 4 ft, results in a total depth to 24 ft. Also, the record high stage at the gage located at the Hwy 631 bridge is 3.92 ft (See Figures 4 and 5) which further informs the decision to use 4 ft as the maximum stage achievable.

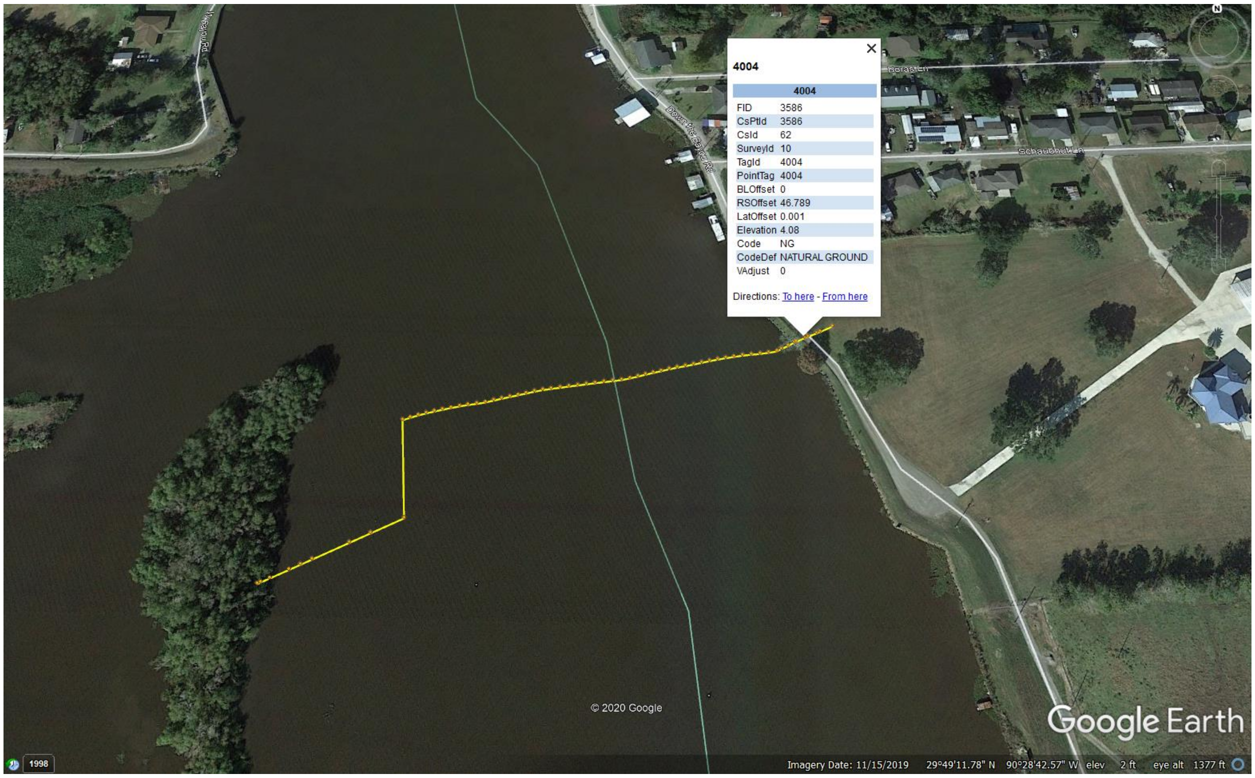

Figure 3 – Bank Elevation

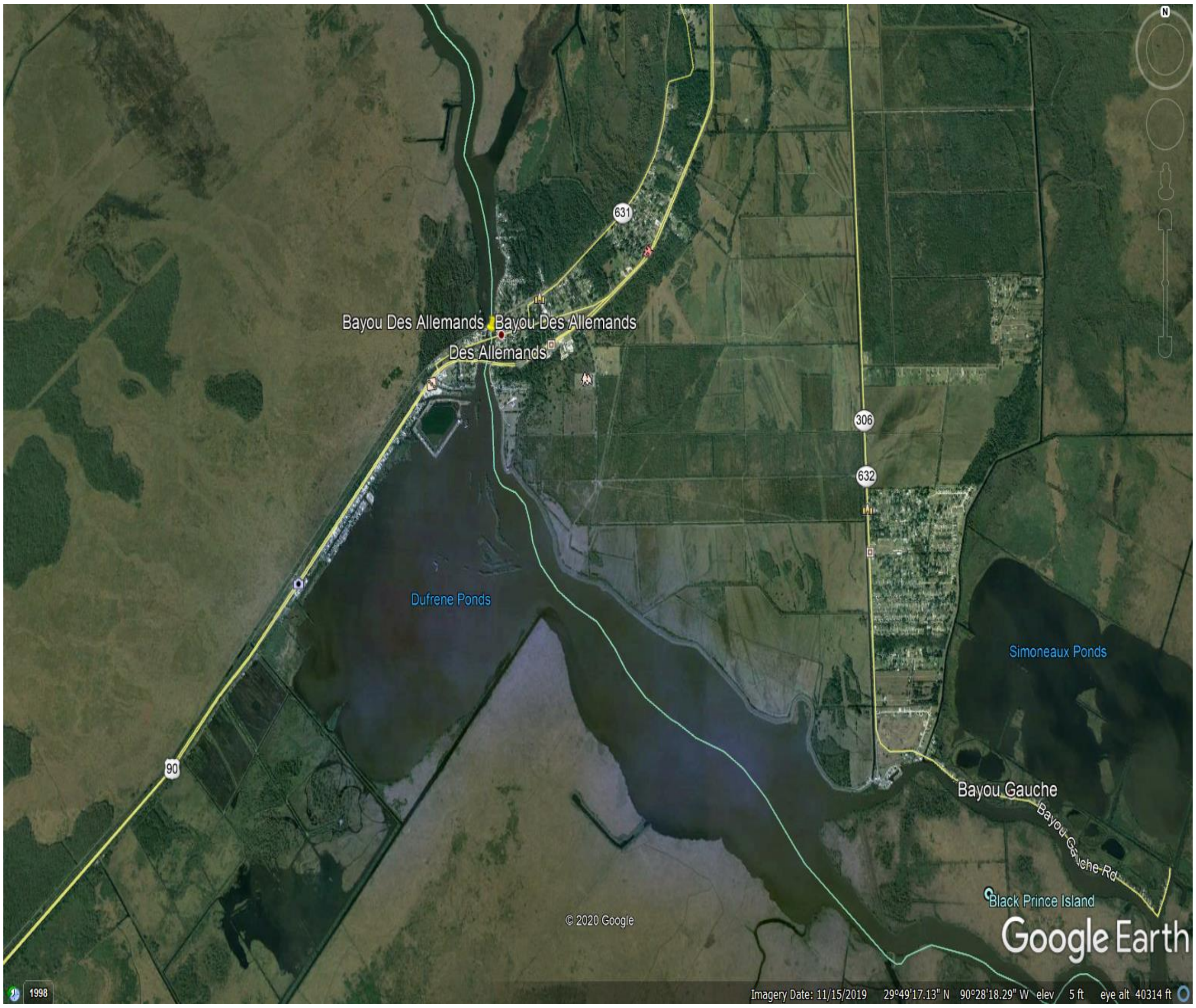

Figure 4 – Location of Bayou Des Allemands at Des Allmands Gage 82700

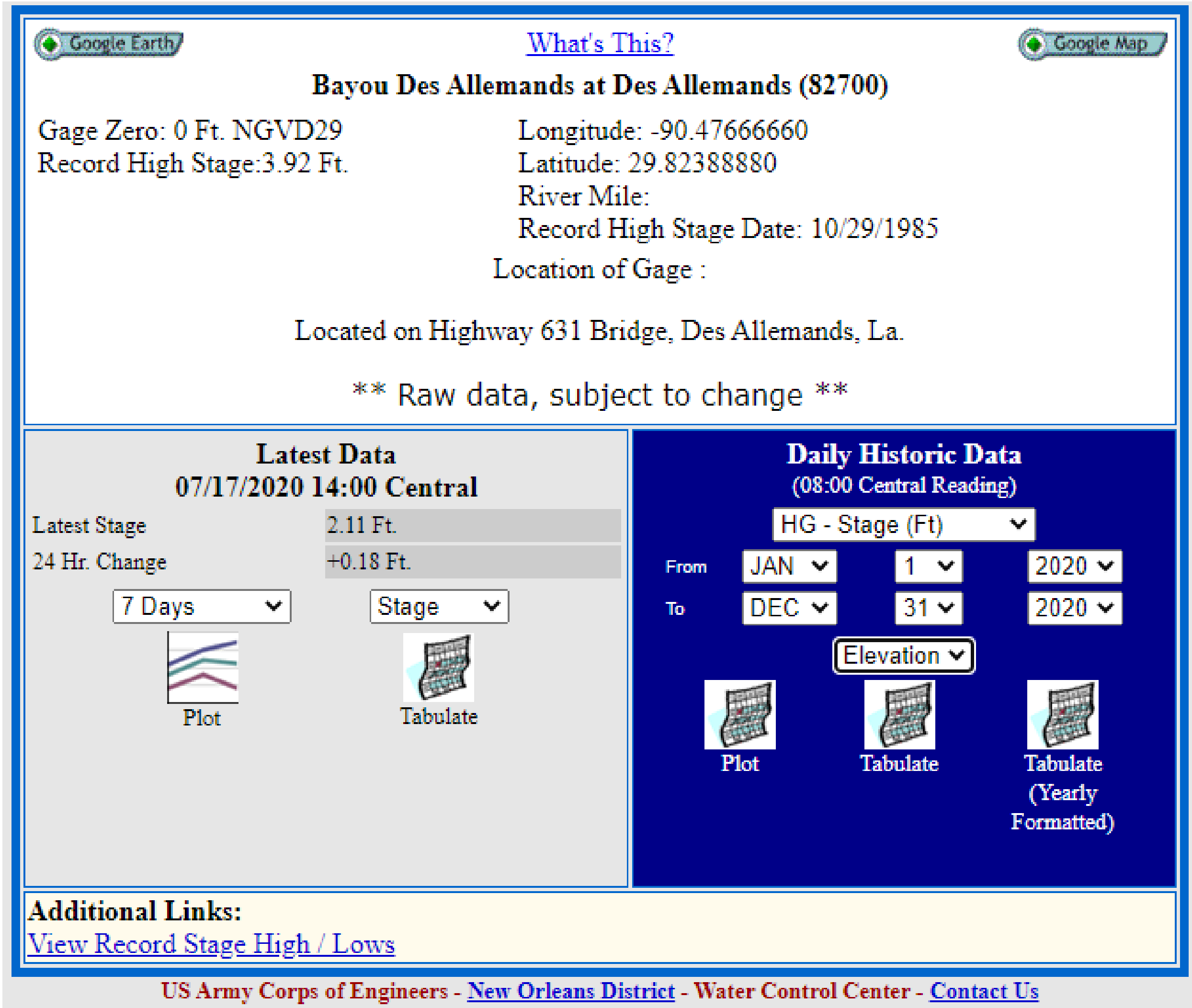

Figure 5 – Bayou Des Allemands at Des Allmands Gage 82700

First, the flow (Q_{RR}) at the railroad crossing is calculated:

Restriction @ RR Crossing

$Q_{RR} = A \times V = A \times (1.49/n \times R^{2/3} \times S^{1/2})$

Q_{RR} = flow rate (cfs)
A = cross-sectional area (ft^2)
V = average velocity (fps)
n = roughness coefficient
R = hydraulic radius (ft)
S = hydraulic slope (ft/ft)

W=	370	ft (see Figure 2)
H=	24	ft
A=	8,880	ft^2
P=	418	ft
R=	21.24	ft
n=	0.035	
S=	0.00004	
V=	2.065	fps
Q_{RR} =	**18,339**	cfs

Next, the flow through the barge gate (Q_B) and sluice gates (Q_{SG}) are calculated.

Barge Gate

$Q_B = A \times V = A \times (1.49/n \times R^{2/3} \times S^{1/2})$

Q_B = flow rate (cfs)
A = cross-sectional area (ft^2)
V = average velocity (fps)
n = roughness coefficient
R = hydraulic radius (ft)
S = hydraulic slope (ft/ft)

W=	270	ft
H=	14	ft
A=	3,780	ft^2
P=	298	ft
R=	12.68	ft
n=	0.013	
S=	0.00004	
V=	3.943	fps
Q_B =	**14,903**	cfs

Sluice Gates

$Q_{SG} = A \times V = A \times (1.49/n \times R^{2/3} \times S^{1/2})$

Q_{SG} = flow rate (cfs)
A = cross-sectional area (ft^2)
V = average velocity (fps)
n = roughness coefficient
R = hydraulic radius (ft)
S = hydraulic slope (ft/ft)

W=	20	ft
H=	14	ft
A=	280	ft^2
P=	48	ft
R=	5.83	ft
n=	0.013	
S=	0.00004	
V=	2.349	fps
Q_{SG} =	658	cfs

N=	**6**	# of sluice gates needed
$N*Q_{SG}$ =	**3,946**	cfs

The flow through the barge gate (Q_B) and total flow through all sluice gates ($N*Q_{SG}$) are then combined and compared to the flow through the restriction at the railroad crossing (Q_{RR}).

Q_B+N*Q_{SG} = **18,850** cfs

Check Q_{RR} = $\boxed{\textbf{18,339}}$ $\leq$ **Q_B+N*Q_{SG} =** $\boxed{\textbf{18,850}}$ cfs **(O.K.)**

Results:

The flow through the restriction at the railroad crossing and through the combination of the barge and sluice gates are approximately the same thus the barge gate and sluice gate structure will not increase the flow constriction that exists at the railroad crossing. Although this exercise shows that 6 sluice gates are needed, the proposed barge and sluice gate structure consists of a 270 ft wide barge gate flanked by 6 - 20 ft wide x 15 ft high tidal interchange sluice gates on each side (**Total of 12**). To prevent the navigation channel from scouring, riprap will be placed at the entrance and exit of the structure. After a storm has passed, the tidal interchange sluice gates will be opened following the step-by-step instructions indicated in the "Water Control Manual" to lower the stage at the protected side before removing the barge gate away. These additional sluice gates provide the local municipality flexibility in the operation and maintenance of the barge gate structure. This barge gate structure combines design characteristics contained in CPRA's Conceptual Design Report and the Donaldsonville to the Gulf Design (See Figures 6 and 7).

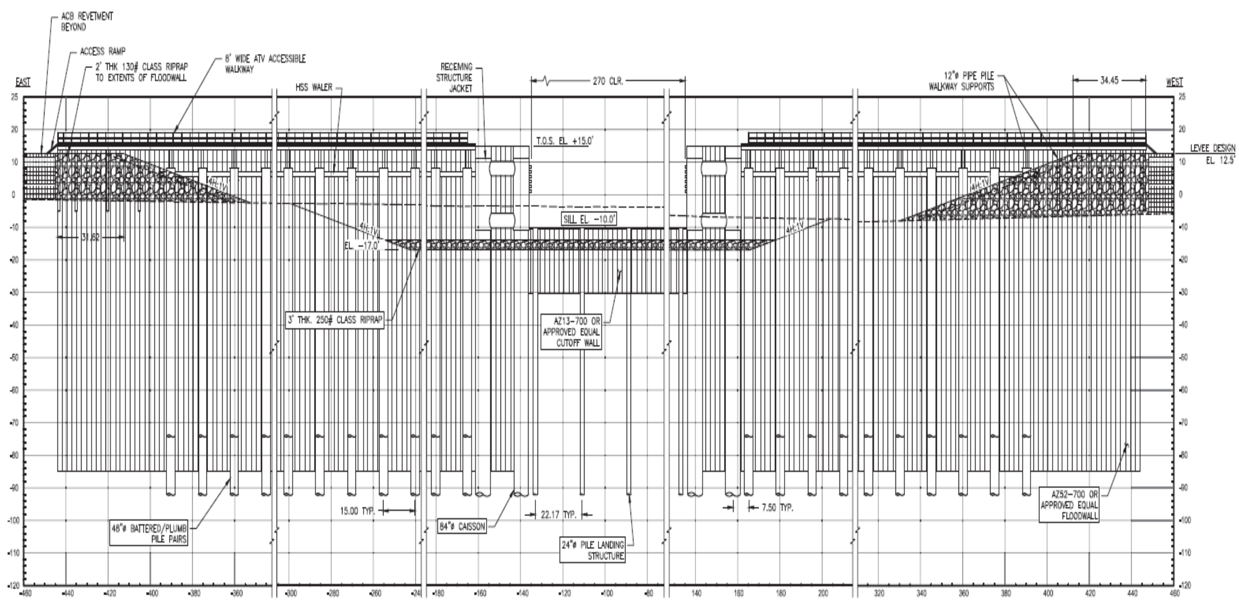

Figure 6 – 270 ft Barge Gate as described in CPRA Conceptual Design Report

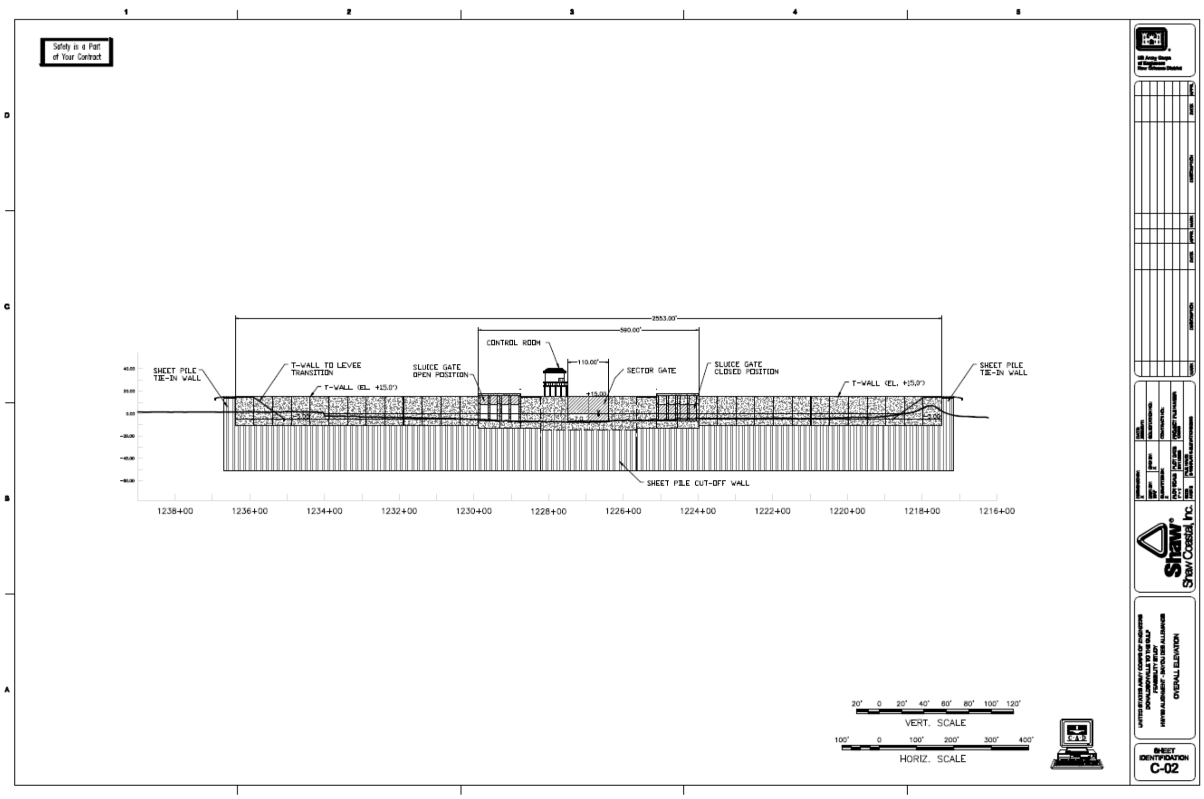

Figure 7 – 20 ft wide x 15 ft high Sluice Gates as described in the Donaldsonville to the Gulf Design