INTERNATIONAL BOUNDARY AND WATER COMMISSION
UNITED STATES AND MEXICO

OFFICE OF THE COMMISSIONER
UNITED STATES SECTION

April 20, 2020

Mr. Tommy Fisher
Fisher Industries
P.O. Box 1034
3020 Energy Drive
Dickinson, ND 58602

Subject: Hydraulic Analysis for the Constructed Bollard Wall in the Rio Grande Floodplain near Mission, Texas

Dear Mr. Fisher:

I refer to the recently constructed bollard fence in the Rio Grande floodplain near Mission, Texas. This 3-mile long bollard fence was built by Fisher Industries along the bank of the Rio Grande upstream of Anzalduas Dam. You had provided us with the latest hydraulic models and report analyzing the hydraulic impacts of the fence project in January 2020. The U.S. Section of the International Boundary and Water Commission (USIBWC) reviewed the submittal and conducted additional modeling and analyses based on the hydraulic modeling procedure we shared with you via email on November 26, 2019. From our analyses, we noted that the constructed bollard fence is not in compliance with the 1970 Boundary Treaty. Specifically, we identified one location where the percent deflection was 10.32%, well in excess of the threshold limit of +5%. We describe below the additional analyses we conducted. We are sharing our hydraulic models and report in the enclosed External Hard Drive so you may conduct additional analyses to mitigate the hydraulic impacts. Mitigation can be attained through various methods, for example: adding a gate(s); realigning the fence; removing floodplain vegetation, or a combination of these alternatives. This is not an exhaustive list of potential mitigation and you should select the mitigation method that is best suited to your project.

We conducted additional hydraulic modeling to assess the hydraulic impacts of the constructed bollard fence using the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center River Analysis System (HEC-RAS) software Version 5.0.7. The hydraulic impacts were evaluated using the design flow of 235,000 cfs for this reach of the Rio Grande. We utilized the 1D/2D HEC-RAS model submitted by Fisher Industries on January 13, 2020 to construct our models for calibration, and existing, and proposed condition analysis. Modifications to the Fisher Model (January 2020) are described in the following sections:

We utilized the same terrain model developed by Fisher Industries using the 2011 LiDAR data and model boundary conditions. The upstream boundary condition was an inflow hydrograph with peak flow equal to the design flow of 235,000 cfs with hydrograph shape similar to that of Hurricane Beulah of September 1967. The downstream boundary condition was normal depth with slope 0.01 foot/foot. We refined the model roughness values during our model calibration runs.

We performed a detailed calibration of Hurricane Beulah flood conditions. We noted that during Hurricane Beulah, a flow of 83,300 cfs was diverted from the Rio Grande at the upstream Mission Inlet that is located about 6.5 miles upstream of Anzalduas Dam. The remaining flow downstream had a peak flow of 135,000 cfs. There is an existing gaging station 0.5 mile downstream of Anzalduas Dam. The peak water surface elevation (WSE) value at this gage was extrapolated upstream of the dam. The model was run with the hydrograph with peak flow of 135,000 cfs and roughness coefficients in the channel and floodplain adjusted so the peak modeled WSE matched the peak WSE upstream of the dam.

The Fisher Industries model divides the modeled area into various regions based on ground cover. We utilized the same regional grouping but adjusted the roughness values for the different regions to obtain a reasonable match of the modeled and observed WSE values for the calibration. The finalized roughness coefficient values based on the calibration model run are shown in **Figure 1.** Channel roughness value is 0.035 with 0.04 for both overbanks. Floodplain comprises row crop (corn), forest and cleared area. Roughness coefficient values for various forest areas vary from 0.08 to 0.3, including some areas with 0.10. Roughness values had to be increased to 0.3 at the downstream areas to match the observed WSE.

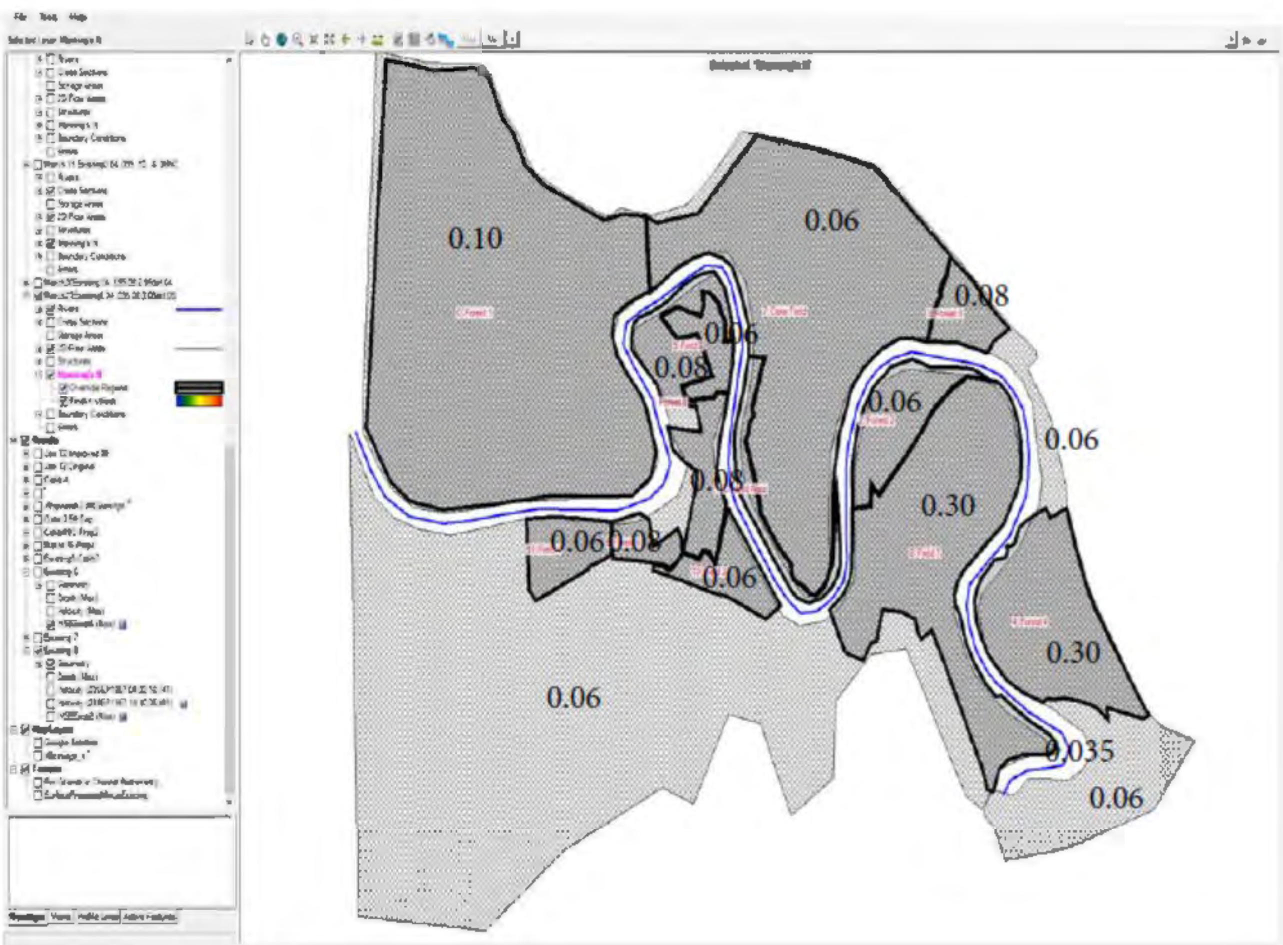

Figure 1: Derived Manning's Roughness Values after Calibration

The existing condition model was the same as the calibration model except for the upstream boundary condition which had the Hurricane Beulah shaped hydrograph with peak flow of 235,000 cfs. The existing condition model was used as a baseline to compare with the proposed condition model to evaluate the hydraulic impacts of the constructed bollard fence. The proposed condition model includes the elements in the existing condition model plus the constructed 18-foot tall fence with bollards rotated 45-degrees with a 5-inch clearance between the bollards. The existing condition model included a lateral weir structure to exchange flow between the 1D channel and 2D floodplain. The constructed bollard fence along the Rio Grande's left bank (35 feet offset) was modeled as a lateral gate on top of the existing condition lateral weir structure. To avoid having a large number of lateral structures to represent the bollard fence in the model, adjacent bollards were combined. The spacings between the bollards were also similarly combined. Twelve (12) adjacent bollards were combined. Therefore, using the multiplier factor of twelve (12) resulted in a bollard thickness of 7.5 feet and spacing of 3.5 feet. This also took into account a factor of 30% debris blockage.

The USIBWC levee at the project site was designed and constructed to have three (3) feet of freeboard above the design flood WSE as estimated by the USIBWC (2003) model. The constructed bollard fence falls between levee stations 130+00 and 190+00.00. WSEs from both existing and proposed 1D/2D models are compared with design flood WSE values to determine if levee freeboard is encroached (**Table 1**). Existing condition model WSE values are close to the design flood WSE values in the USIBWC (2003) model. The more detailed calibration conducted in this study resulted in a better match with the design flood WSE values from USIBWC (2003) and S&B (2008) models. All elevations are based on the North American Vertical Datum of 1988 (NAVD 88).

Levee Station	**Design Flood Elevation, ft (USIBWC 2003)**	**Existing Model WSE, ft**	**Proposed Model WSE, ft**
45+00.00	123.23	123.13	123.30
60+00.00	124.39	124.79	124.79
87+00.00	126.48	126.35	126.34
120+00.00	127.18	127.55	127.19
130+00.00	127.35	127.70	127.27
170+00.00	128.00	127.82	127.40
190+00.00	128.31	127.89	127.44
250+00.00	129.45	128.87	128.45

Table 1: Water Surface Elevation Comparison

Flow deflections were evaluated at several cross-section locations; the shapefiles for the cross-section lines were obtained from Fisher Industries. The highest flow deflection is +10.32% toward the U.S. at cross section 24260 close to the middle of the fence alignment. This deflection value exceeds the +5% threshold. Additional details of the modeling and analyses are included in our report.

Please mitigate this non-compliant flow deflection feature (1970 Boundary Treaty) by using our submitted models to conduct additional modeling. The models along with a report describing the analysis and findings are provided in the enclosed External Hard Drive for your review and appropriate action. We have shared our modeling results with the Mexican Section of the IBWC and will forward any review comments we receive to you for you to address. Please let us know when we can expect your models and report regarding mitigation of the hydraulic impact. After the IBWC reviews the submitted models and verifies there are no adverse hydraulic impacts, the proposed mitigation may be implemented in the field. If the bollard fence is extended upstream or downstream in the future, there may be adverse hydraulic impacts which need to be evaluated using an updated hydraulic analysis.

Also, please include a maintenance plan that addresses:

1) The operation and maintenance plan for mitigating and preventing accumulation of additional debris on the land side of the bollards in excess of the 30% blockage assumed in the modeling.
2) The operation and maintenance plan for management of vegetation. Vegetation growth in excess of the values modeled as shown in Figure 1 shall also be maintained.
3) The operation and maintenance plan to monitor and repair erosion on the river side of the bollards and to maintain the bank. Although the velocity distribution is similar in both existing and proposed condition models, the riverbank modified with 5H:1V slope must be monitored for erosion occurrences and any observed erosion should be repaired by the proponent in a timely manner. Failure to do this along with continued erosion can impact the location of the international boundary line.

If you have any questions regarding this process, please call me at (915) 832-4703, or have your designated engineer contact Dr. Apurba Borah, Lead Hydraulic Engineer in the Engineering Services Division, at (915) 832-4710 or via email at Apurba.Borah@ibwc.gov.

Sincerely,

Wayne Belzer
Acting Principal Engineer

Enclosures:
As Stated