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Hydrodynamics in the Morganza Floodway Report 1: Phase 1 – Model Development and Calibration

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MRG&P
Mississippi River Geomorphology & Potamology Program

Report prepared for the Mississippi River Commission

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Hydrodynamics in the Morganza Floodway Report 1: Phase 1 - Model Development and Calibration

A Report for the U.S. Army Corps of Engineers, MRG&P

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Final report

Prepared for U.S. Army Corps of Engineers, Mississippi Valley Division
Mississippi River Geomorphology and Potamology Program
1400 Walnut Street
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Under Project No. 127672, “Morganza Floodway - Phase One”

Abstract

The Morganza Floodway west of the Mississippi River was evaluated using a two-dimensional Adaptive Hydraulics Model. The study was conducted to develop a better understanding of how the area would flood for pre-2011 flood conditions. The hydraulic roughness values for the floodway were set for the pre-2011 flood conditions. The results from the model run with original tailwater rating curve from the 1950 model study produced gage readings in the floodway within +/- 1 foot of the measured values (U.S. Mississippi River Commission 1950). However, water surface elevations produced from the model run with the revised tailwater rating curve values (which used discharge ratings from the physical model tests results) were even closer to the measured gage data (Maynord 2014). Results indicate that the model correctly simulates flow lines and inundation areas in the flood plain for the 2011 event. However, for other events the model should be updated with the appropriate elevation data and hydraulic roughness values.

Contents

Figures

Figures

Preface

The research documented in this report was conducted as part of the Mississippi River Geomorphology and Potamology (MRG&P) Program, Project No. 127672. The MRG&P Program is sponsored by Headquarters, U.S. Army Corps of Engineers (USACE), and is managed by the USACE Mississippi Valley Division (MVD) in Vicksburg, MS. The MRG&P Technical Director was Dr. Ty V. Wamsley, and the Program Manager was Freddie Pinkard. The MVD Commander was MG Michael C. Wehr. The MVD Director of Programs was Jim Bodron.

The Mississippi River Commission provided Mississippi River engineering direction and policy advice. The Commission members were MG Michael C. Wehr, USACE, President; the Honorable Sam E. Angel; the Honorable R. D. James; the Honorable Norma Jean Mattei, Ph.D.; RDML Shepard Smith, National Oceanic and Atmospheric Administration; BG Mark Troy, USACE ORD; and BG David C. Hill, USACE SWD.

This report was prepared by Gary L. Bell, U.S. Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL); Nathan D. Clifton, ERDC CHL; and David D. Abraham, Ph.D., ERDC CHL.

COL Bryan S. Green was the Commander of ERDC, and the Director was Dr. David W. Pittman.

Unit Conversion Factors

Multiply	By	To Obtain
acres	4,046.873	square meters
cubic feet	0.02831685	cubic meters
cubic inches	1.6387064 E-05	cubic meters
feet	0.3048	meters
gallons (U.S. liquid)	3.785412 E-03	cubic meters
square feet	0.09290304	square meters
square miles	2.589998 E+06	square meters

1 Introduction

Purpose

The U.S. Army Corps of Engineers (USACE), Coastal and Hydraulics Laboratory, conducted a numerical model study of a portion of the Morganza Floodway. The purpose of the model was to evaluate issues related to the operation of the Morganza Floodway for the 2011 flood event. The model was used to predict the extent and timing of inundation in the floodway.

The USACE Mississippi River and Tributaries System Draft 2011 Post Flood Report states (Section IX, pages 6 and 7) the following:

> Better models of the Morganza Floodway and Atchafalaya Basin should be developed to help inform floodway operations and emergency preparedness. During the Flood of 2011, limited modeling capacity made predictions of the impacts of Floodway operation very uncertain.

Thus, the main objective here was to develop an Adaptive Hydraulics (AdH) two-dimensional (2D) numerical model that replicates the conditions during the operation of the floodway in 2011. Phase One uses the gage data combined with the gate discharge data during the 2011 flood event in an effort to hindcast the flooding in the Morganza Floodway. The results of this study, when used in combination with information from other model applications, should produce more reliable predictions. This will greatly benefit residents of the basin with regards to emergency preparedness and decision making.

Background and description

The floodway downstream of the Morganza Control Structure (MCS) is on average 5 miles wide and defined by guide levees running on the eastern and western boundaries. The Phase One study domain ends at Highway 190 (Lottie, LA, on the eastern edge and Krotz Springs on the western edge). This will be the sole topic of this documentation. Located near River Mile (RM) 279.5 on the west side of the Mississippi River 60 miles south and downstream of Natchez, MS (Figure 1), the Morganza Floodway provides a flood bypass to limit the discharge entering New Orleans, LA. The upstream boundary of the model is the MCS.

Figure 1. Morganza Floodway location.

The MCS is a flow control structure that has 125 gates across a 3,906.25 foot (ft)-long controlled spillway. The structure was designed to allow up to 600,000 cubic feet per second (cfs) of water to be diverted from the Mississippi River into the Atchafalaya Basin. The structure's tailrace contains a stilling basin with baffle blocks and a vertical end sill.

The MCS construction was completed in 1954. Since construction, the MCS has been operated twice, once in 1973 and again in 2011. Prior to the 2011 changes (Maynord 2014), the MCS operation procedures were triggered when the Mississippi River discharge at Red River Landing (which is located just upstream of the MCS) reached 1,500,000 cfs with increasing flow. After 2011, the procedure was altered to also operate the MCS when the stage on the Mississippi River side of the structure (Morganza forebay) reaches 57 ft and a Mississippi River discharge forecast of 1,500,000 cfs and rising based upon a 10-day forecast (forebay elevation above 60 ft will spill over the gates).

Site visit

On 22 June 2015, the Morganza Floodway was visited to collect data to construct a 2D numerical model. Multiple locations within the domain were visited. Sites visited included all staff gage locations along the guide levees. Where access was available by boat, channel profiles were taken. Additionally, bridges and berms were inspected for water passage and pier spacing. Finally, the overall landscape of the floodway was evaluated for ground cover and topographical features. Figure 2 displays the GPS locations of these places. The names of these locations are specific to the individual sites and have been documented in field notes (for example, MG1 and MG1 STEP located at the top of Figure 2 are staff gages located on the levee).

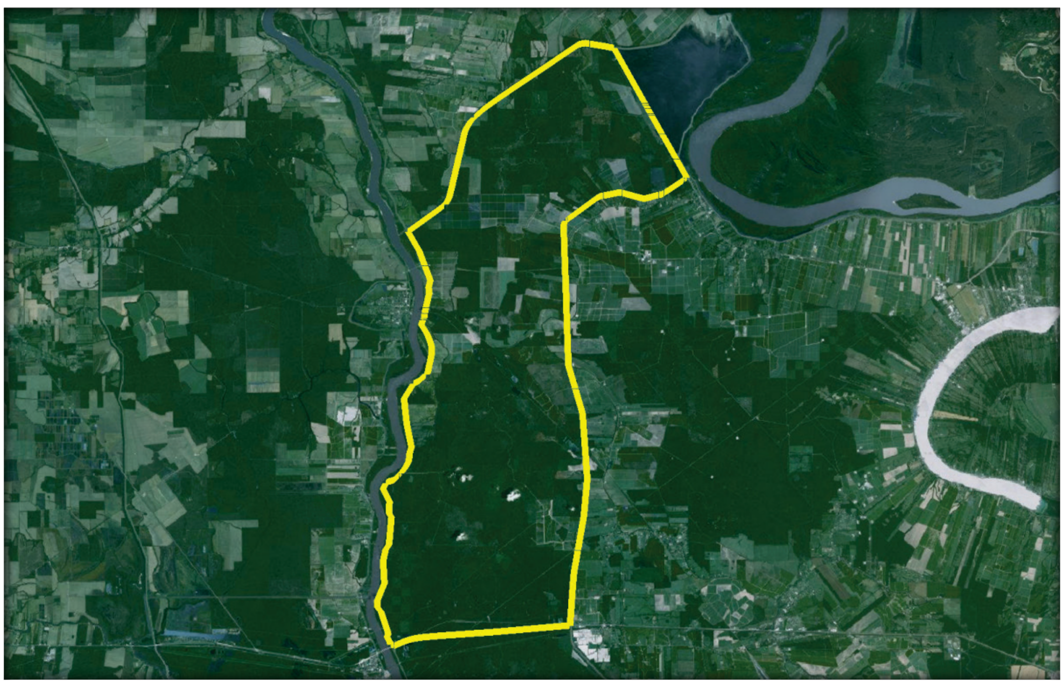
Figure 2. GPS locations of staff levee gages, channel profile measurements, and bridge measurements.

2 Methodology

The hydraulic model investigation was conducted using the AdH numerical code to solve the 2D, depth-averaged, shallow water equations. AdH is a multi-physics, finite element code capable of automatically refining the unstructured computational mesh when necessary to resolve gradients in the flow field (USACE 2015).

The numerical model domain is shown in Figure 3. The model extents are located along the crest centerline of the guide levees, the centerline of the MCS, and the centerline of Highway 190.

Figure 3. Outline of the Morganza Floodway area.



The horizontal datum for the model is the State Plane Coordinate System (Louisiana South, NAD 83), U.S. Survey Feet. The vertical datum is referenced to NAVD88, U.S. Survey Feet. The mesh refinement was varied to resolve the levees, channels, and tributary clusters (tight groupings of individual tributaries can be seen in the southwest area of the model in Figure 4) within the domain. The mesh consists of 515,488 nodes and 1,028,796 elements. Lidar data from the domain were interpolated to the mesh to fully define key features (Figure 5). There is a difference of approximately 18 ft of elevation from the north end of the floodway to the south end of the Floodway.

Figure 4. View of the model elevations (feet).

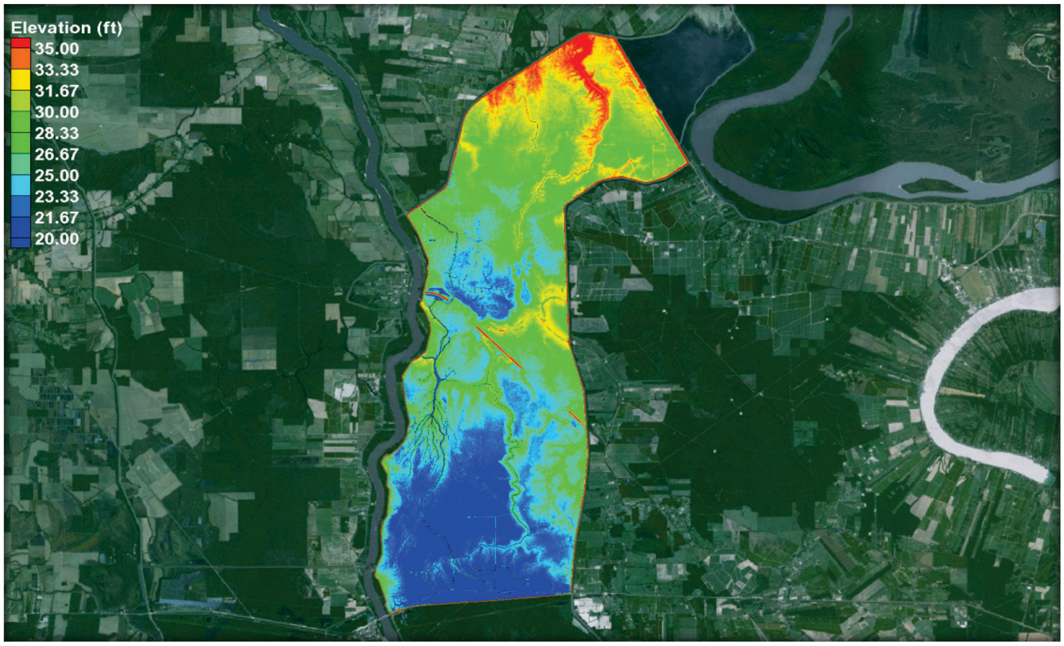


Figure 5. Table 2 from ERDC/CHL TR-14-1, *Scour Protection Downstream of Morganza Control Structure, Morganza, Louisiana* (Maynord 2014).

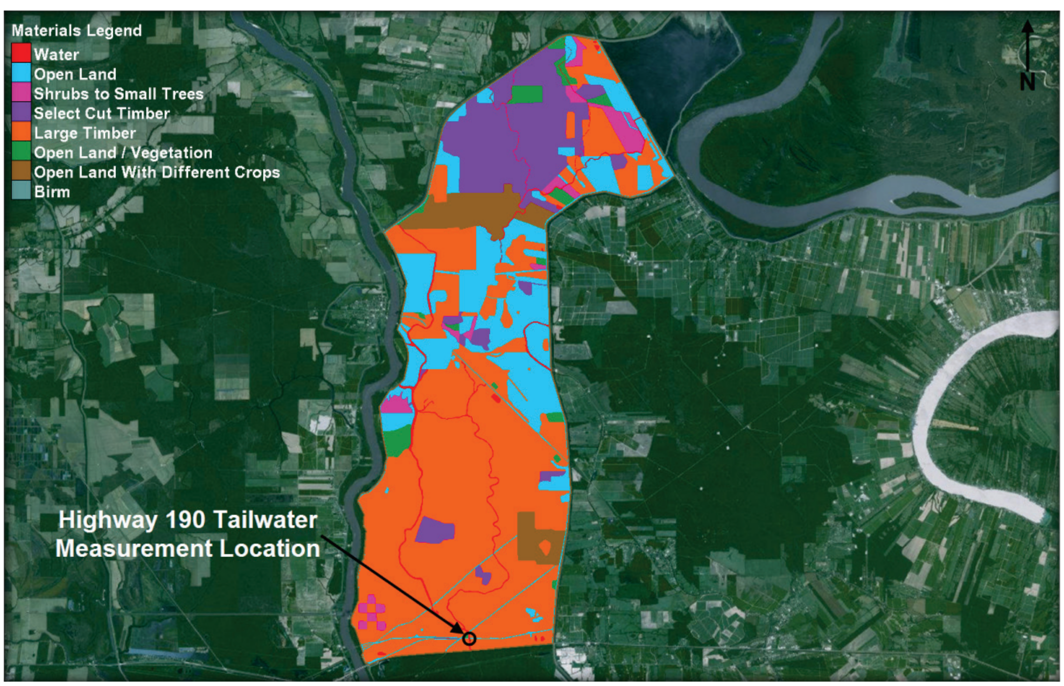
Table 2. Gates open, headwater, tailwater, and discharge during 2011 flood.

		Morganza	Morganza	Q/BAY	Q_total	Total Bays	USGS Q	North Crane Sequence	South Crane Sequence
DATE	TIME	H.W.	TW	cfs	cfs	Open	cfs	Open Bays	Open Bays
5/14/11	0700	59.2	0	0	0	0	-	N/A	N/A
5/14/11	1600	59.3	34.6	10547	10547	1		63	N/A
5/14/11	1800	59.3	34.6	10547	21095	2		63	61
5/15/11	0700	59.5	35.7	10690	21381	2	-	63	61
5/15/11	1000	59.5	36.9	10690	42762	4		63,65	61,62
5/15/11	2000	59.5	39	10690	96214	9		63,64,65,66,69	59,60,61,62
5/16/11	0700	59.5	40.3	10680	96118	9	-	63,64,65,66,69	59,60,61,62
5/16/11	1500	59.5	41.2	10680	117477	11		73,75,77,79,81	44,46,48,50,52,54
5/16/11	2000	59.4	42.3	10513	157689	15		73,75,77,79,81	44,46,48,50,52,53,54,56,58,60
5/17/11	0700	59.4	43.4	10513	157689	15	-	73,75,77,79,81	44,46,48,50,52,53,54,56,58,60
5/17/11	1300	59.4	43.8	10513	157689	15			5,12,19,26,33,40,44,46,48,50,52,54,56,58,60
5/17/11	2100	59.5	43.9	10584	169337	16		80,83,87,91,94,98,101,105,108,112	5,12,16,19,22,26
5/18/11	0700	59.6	44.2	10655	170474	16	130000	80,83,87,91,94,98,101,105,108,112	5,12,16,19,22,26
5/18/11	1600	59.7	44.7	10726	182340	17		71,74,77,80,83,87,91,94,98,101,105,108,112	47,53,56,59
5/18/11	2000	59.6	44.8	10655	181129	17		71,77,80,83,91,98,105,112	12,19,26,33,41,47,50,53,59
5/19/11	0700	59.5	44.9	10584	179920	17	172000	71,77,80,83,91,98,105,112	12,19,26,33,41,47,50,53,59
5/19/11	2000	59.5	45	10584	179920	17		71,73,75,77,80,83,86,88,91,94,98,100,103,105,109,112,115	N/A
5/20/11	0700	59.4	45	10513	178714	17	183000	71,73,75,77,80,83,86,88,91,94,98,100,103,105,109,112,115	N/A
5/20/11	1500	59.3	45.3	10442	177511	17		N/A	9,11,13,15,17,19,21,23,26,29,32,35,38,41,44,47,50
5/20/11	1800	59.3	45.2	10442	177511	17		62,65,68,71,74,77,80,86,92,98	38,44,47,50,53,56,59
5/21/11	0700	59.4	45.1	10513	178714	17	195000	65,68,71,74,77,80,86,92,98	38,44,47,50,53,56,59,62
5/22/11	0700	59.3	45.1	10442	177511	17	185500	65,68,71,74,77,80,86,92,98	38,44,47,50,53,56,59,62
5/23/11	0700	59.1	44.9	10301	175112	17	172000	65,68,71,74,77,80,86,92,98	38,44,47,50,53,56,59,62
5/24/11	0700	58.9	44.8	10160	172723	17	170360	65,68,71,74,77,80,86,92,98	38,44,47,50,53,56,59,62
5/24/11	1500	58.8	44.6	10090	161442	16		65,68,71,74,77,80,86,98	38,44,47,50,53,56,59,62
5/25/11	0700	58.7	44.3	10020	160324	16	178250	65,68,71,74,77,80,86,98	38,44,47,50,53,56,59,62
5/25/11	1600	58.7	44	10020	140283	14		65,68,71,74,77,80	38,44,47,50,53,56,59,62
5/26/11	0700	58.7	43.4	10020	140283	14	163985	65,68,71,74,77,80	38,44,47,50,53,56,59,62
5/26/11	1200	58.8	43	10090	121082	12		65,68,71,74,77,80	47,50,53,56,59,62
5/27/11	0700	58.8	42.3	10090	121082	12	156430	65,68,71,74,77,80	47,50,53,56,59,62
5/28/11	0700	58.7	42.1	10020	120243	12	139080	65,68,71,74,77,80	47,50,53,56,59,62
5/29/11	0700	58.5	41.9	9881	118571	12	135210	65,68,71,74,77,80	47,50,53,56,59,62
5/29/11	1330	58.7	42	10020	110223	11		65,68,71,74,77	47,50,53,56,59,62
5/30/11	0700	58.4	41.3	9901	108908	11	125330	65,68,71,74,77	47,50,53,56,59,62
5/30/11	1500	58.4	41.1	9901	99007	10		65,68,71,74	47,50,53,56,59,62
5/31/11	0700	58.3	40.7	9831	98308	10	120770	65,68,71,74	47,50,53,56,59,62
6/1/11	0700	58.1	40.5	9691	96914	10	108410	65,68,71,74	47,50,53,56,59,62
6/1/11	1500	58	40.3	9622	86598	9		65,68,71,74	50,53,56,59,62
6/2/11	0700	57.9	39.9	9553	85975	9	101690	65,68,71,74	50,53,56,59,62
6/2/11	1500	57.8	39.7	9484	75869	8		65,68,71,74	53,56,59,62
6/3/11	0700	57.6	39.2	9355	74841	8	89710	65,68,71,74	53,56,59,62
6/3/11	1500	57.5	39	9286	65005	7		65,68,71	53,56,59,62
6/4/11	0700	57.2	38.6	9081	63569	7	81160	65,68,71	53,56,59,62
6/5/11	0700	56.6	38.4	8675	60726	7	71684	65,68,71	53,56,59,62
6/6/11	0700	56	38.2	8275	57925	7	74550	65,68,71	53,56,59,62
6/6/11	1100	55.9	38.2	8209	57462	7		97,100,103,106,109,112,115	N/A
6/6/11	1500	55.9	38	8209	41045	5		65,68	56,59,62
6/7/11	0700	55.5	37.2	7946	39731	5	66180	65,68	56,59,62
6/7/11	1400	55.5	37	7946	23838	3		65,68	62

In the initial operation of the floodway, the channels and tributaries can have a significant role in conveying flow away from the structure and into the floodway. Areas where there were trees, crops, open land, etc., had lower resolution for computational efficiency. To model the different land use types, the mesh was divided into different sections/materials so that specific roughness values could be applied to each of the individual land-use types. These are defined as a material type in the model.

Inflow for the model simulations were taken from Table 2 of TR-14-1, *Scour Protection Downstream of Morganza Control Structure, Morganza, Louisiana* (Maynord 2014), which is shown in Figure 5. Figure 5 details the gate operation schedule along with flow values for the 2011 flood event. All model simulations labeled Table 2 UB (uniform boundary) in the following text use the tailwater rating curve discharge values in Figure 5 (original tailwater curve and discharge values). Unless specified otherwise, model simulations were run with a single uniform inflow boundary at the MCS. The inflows were modeled as a single node string along the MCS, which contained sufficient nodes to incorporate the flow through all the gates. The tailwaters used in the model were measurements taken by the U.S. Geological Survey (USGS) at Highway 190 during the 2011 flood (Figure 6).

Figure 6. View of the material boundaries of the model and the tailwater measurement location.



The initial roughness values were assigned based on typical values for various land-use types. For model to prototype validation, two sets of gage data were used to compare measured water surface elevations. One set was the staff gages provided by the New Orleans District. The location of these gages can be seen in Figure 7. The other set of gage data was provided by the USGS (Figure 8). These two data sets were used to adjust the model roughness values based on comparisons of computed results to prototype observations.

Figure 7. Staff gage locations.

Figure 8. USGS pressure gage locations.

3 Model Results: Calibration and Sensitivity Simulations

Inflow sensitivity analysis

Sensitivity runs used the inflow schedule from the table presented in Figure 5 (Maynord 2014) but with the flow uniformly distributed across the entire length of the MCS gates. In reality, the flow was non-uniformly distributed amongst the gates during the flood event to prevent excessive scour at any one location. To make sure that the model results throughout the floodway were not significantly affected by the differing gate inflow locations, additional model runs were performed applying the scheduled inflow at the correct gate locations. This was done by using 125 node strings (with each node string representing one of the 125 gates). The width of each node string was 31.25 ft, corresponding to the distance from center to center of the pier noses. The alternative run consisted of running the same parameters as presented in Figure 5. However, the alternative run also contains the individual gate operation schedule (GOS) which replaced the uniform boundary (UB) condition that was applied to the original simulation. The gate operation schedule can be viewed in Figure 5. Figure 9–Figure 11 illustrate three examples of the simulation Table 2 GOS velocities as the different gates were operated throughout the run. The results at nine gages, using parameters from the model simulations Table 2 UB and Table 2 GOS, compared with field data for the 2011 flood event are shown in Figure 12–Figure 20. All of the gages in the interior of the floodway and some of the main levee gages were compared to give a complete view of the model results throughout the entire floodway. In each figure, the approximate location of the gage can be seen in the miniature floodway inset, superimposed on the figure. The sensitivity analysis showed that results were not significantly different as a result of assuming a uniform flow boundary condition.

Figure 9. Table 2 GOS velocities (feet/second) at time 2 days, 1 hour (49 hours).

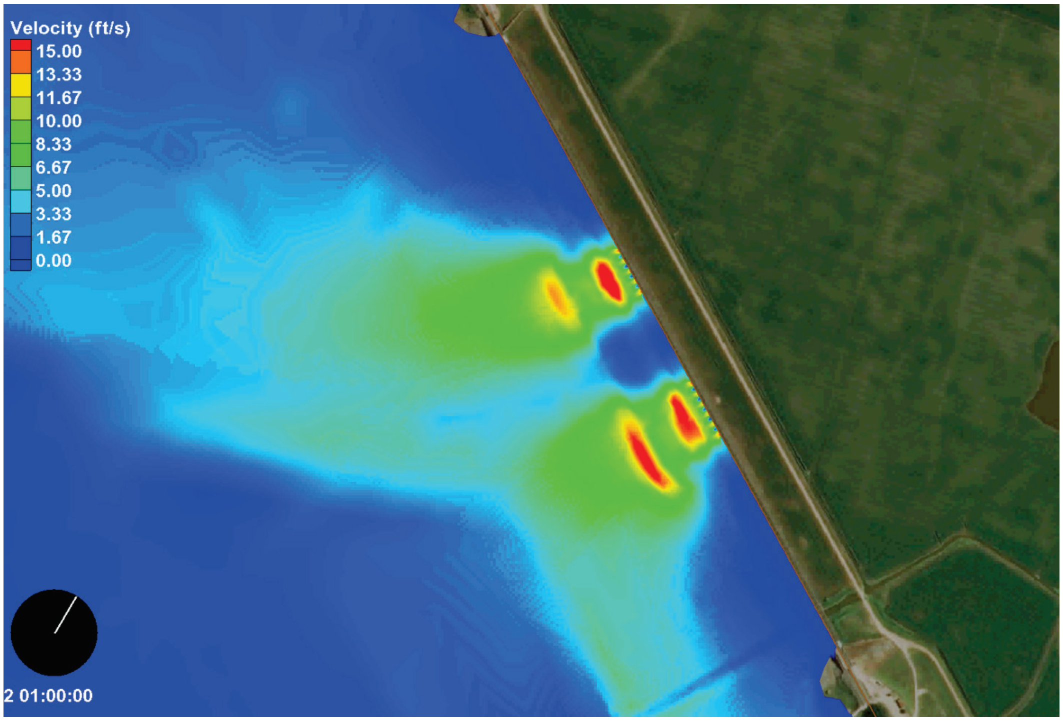


Figure 10. Table 2 GOS velocities (feet/second) at time 3 days, 10.5 hours (82.5 hours).

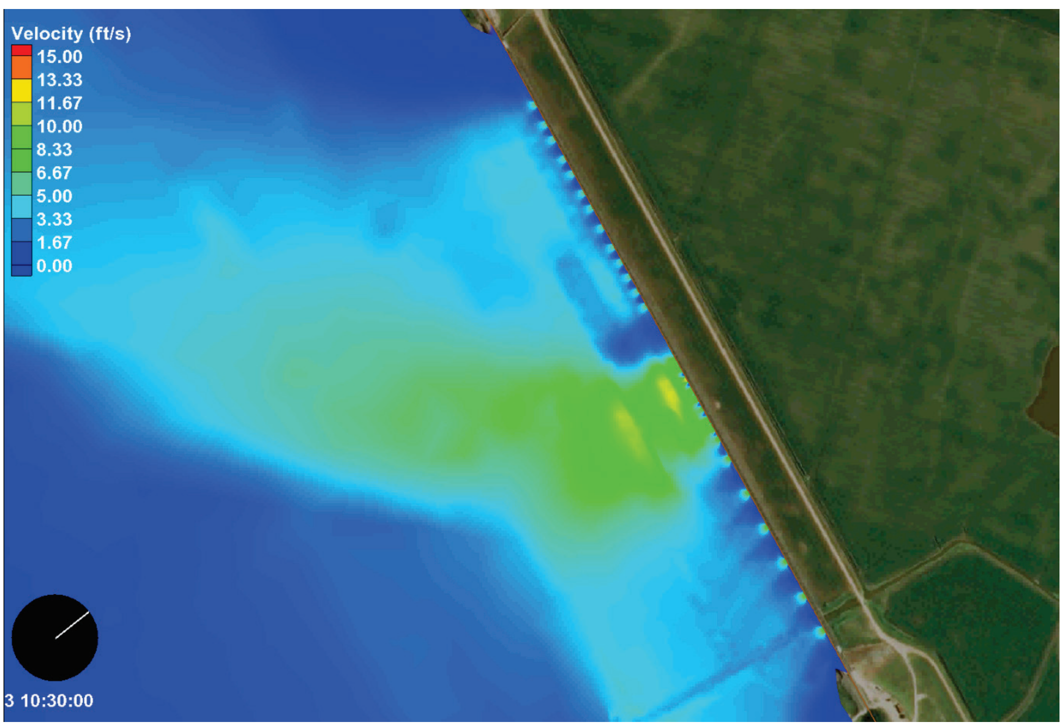


Figure 11. Table 2 GOS velocities (feet/second) at time 6 days 18.5 hours (162.5 hours).

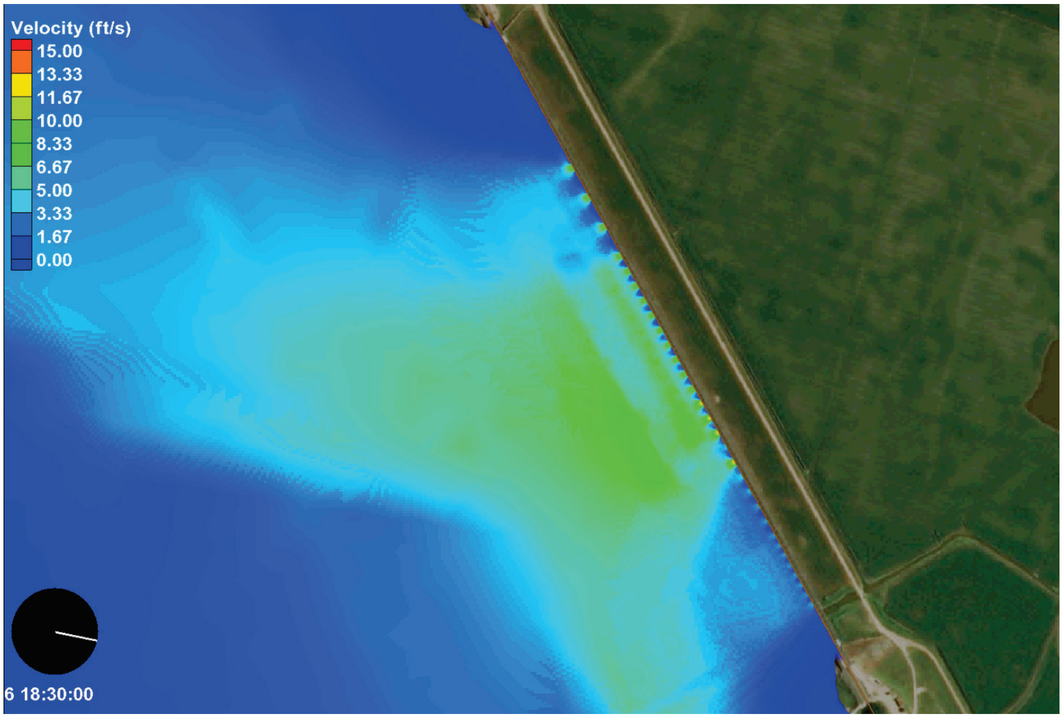


Figure 12. Table 2 GOS, Table 2 UB and measured data at gage A01.

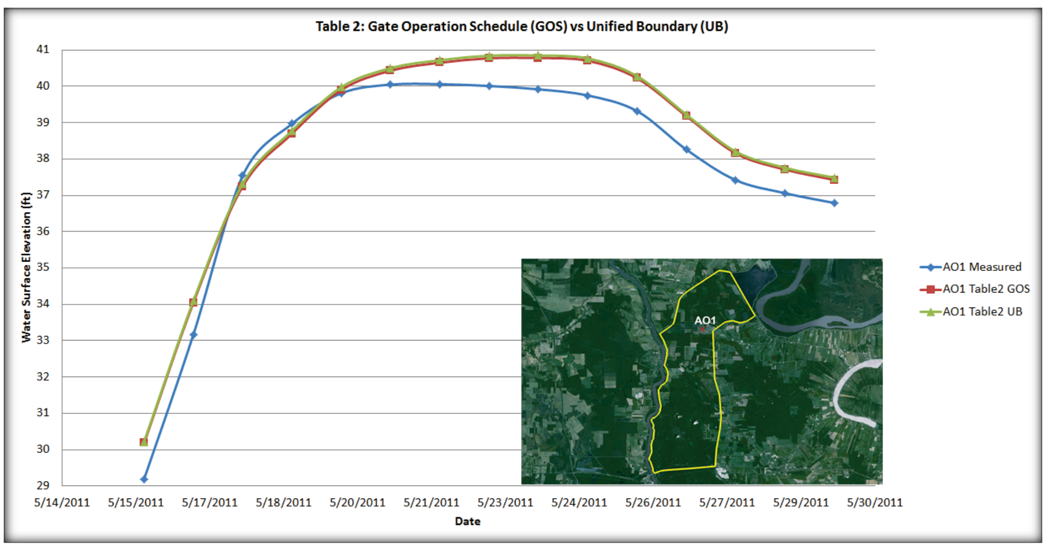


Figure 13. Table 2 GOS, Table 2 UB and measured data at gage AO2.

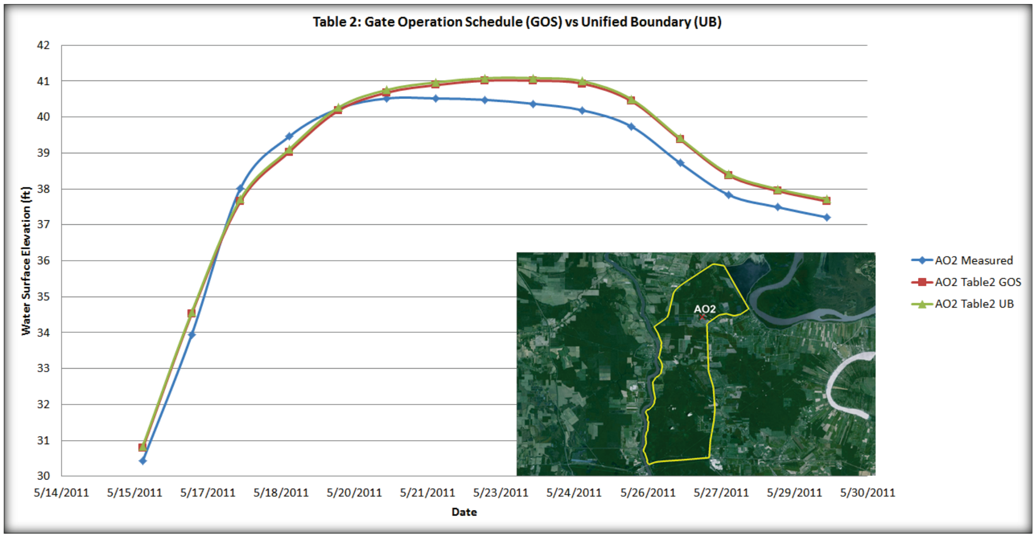


Figure 14. Table 2 GOS, Table 2 UB and measured data at gage AO3.

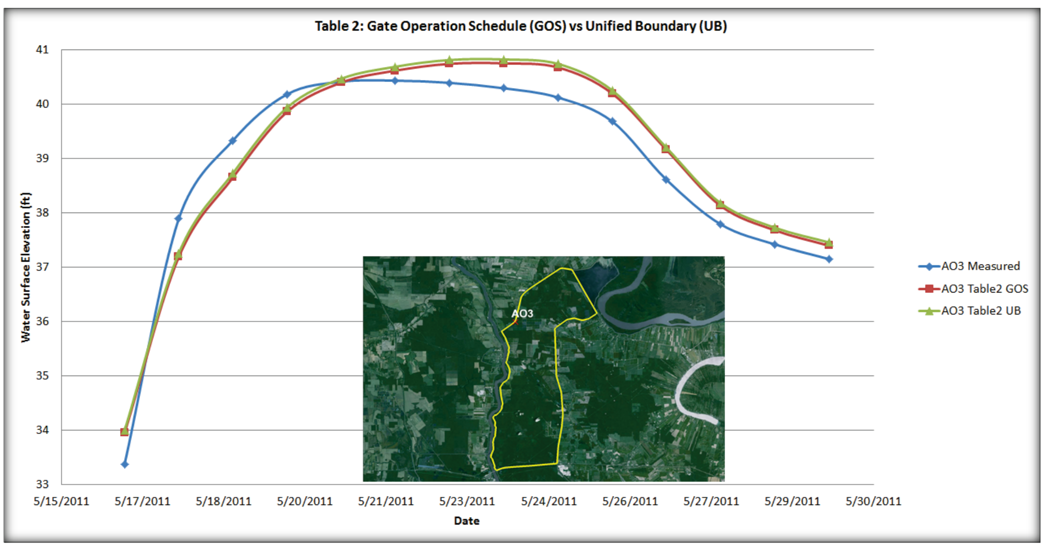


Figure 15. Table 2 GOS, Table 2 UB and measured data at gage AO4.

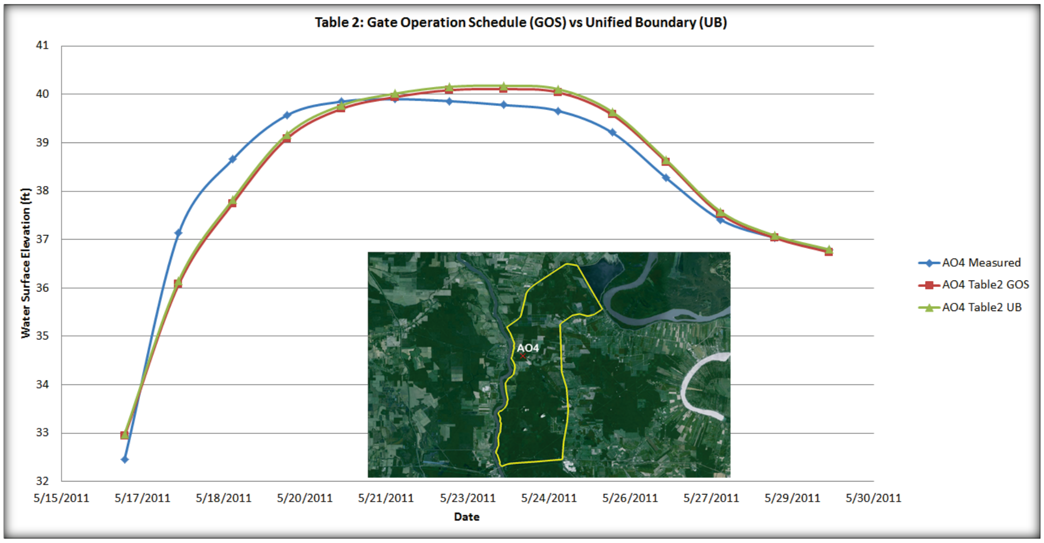


Figure 16. Table 2 GOS, Table 2 UB and measured data at gage AO6.

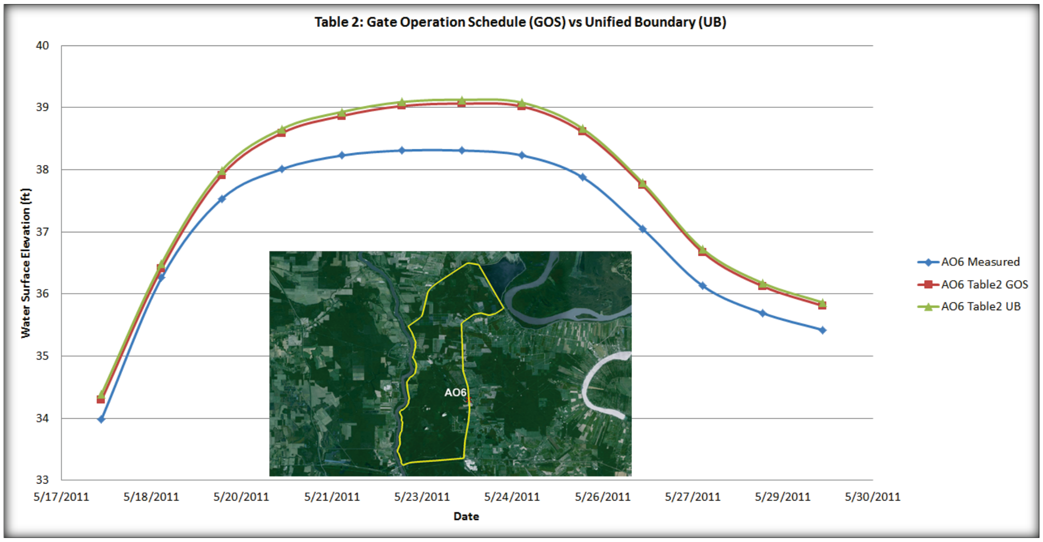


Figure 17. Table 2 GOS, Table 2 UB and measured data at gage AO7.

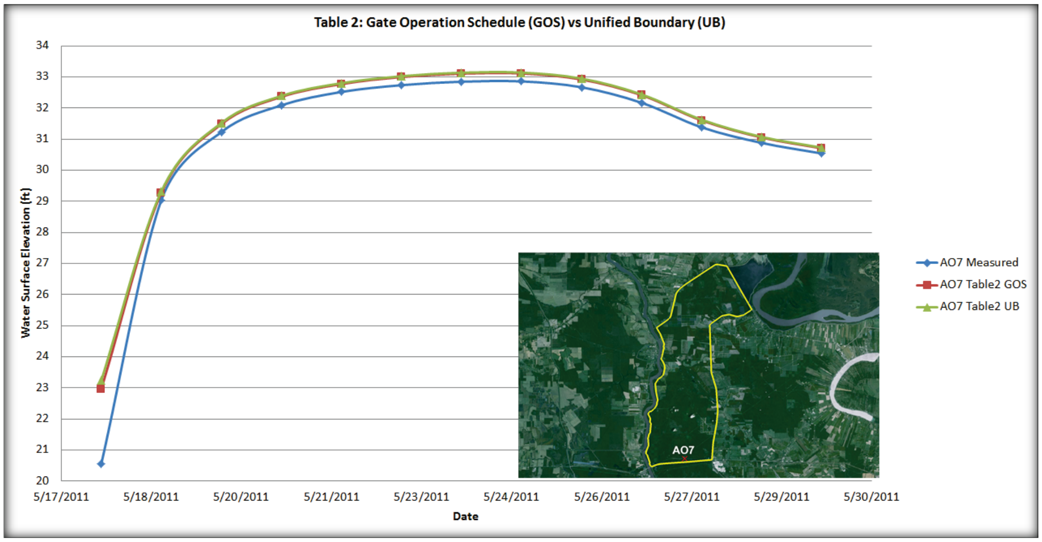


Figure 18. GOS, Table 2 UB and measured data at gage M-G-1.

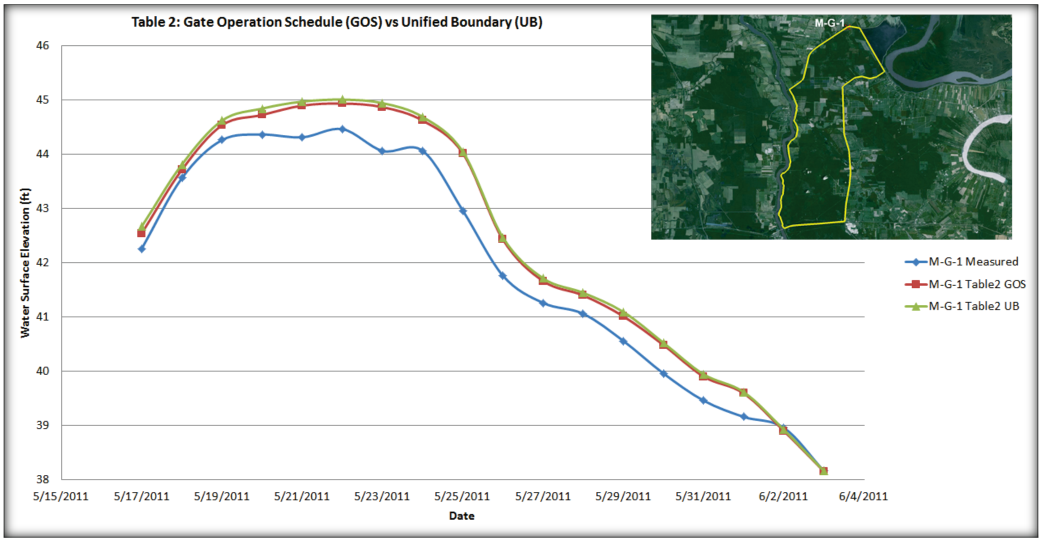


Figure 19. GOS, Table 2 UB and measured data at gage M-H-1.

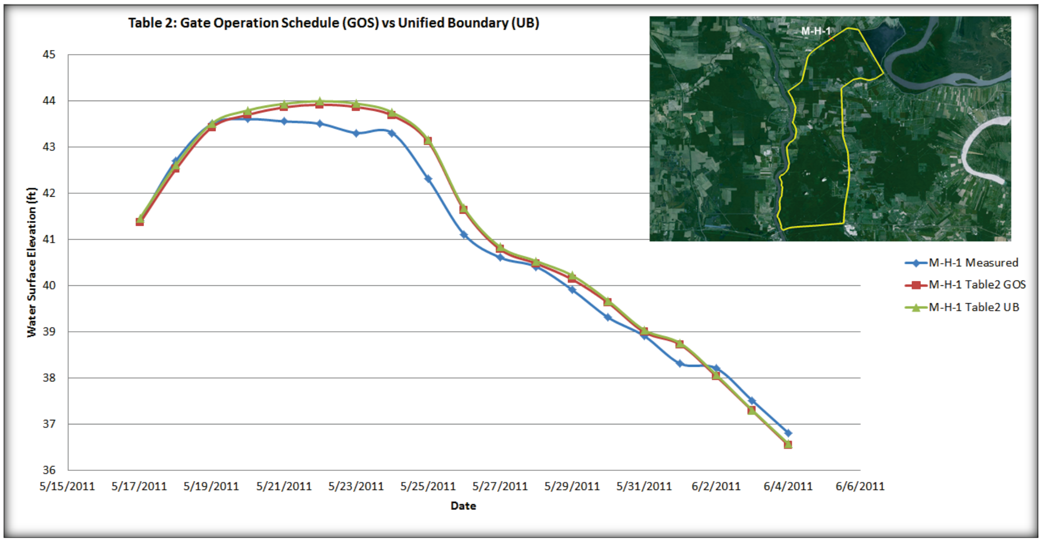
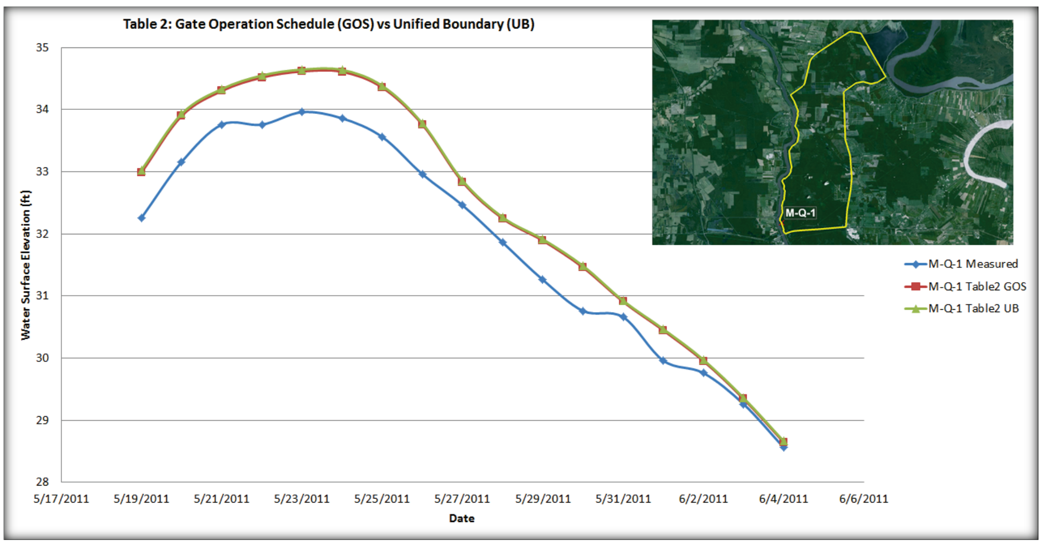


Figure 20. GOS, Table 2 UB and measured data at gage M-Q-1.



Roughness sensitivity analysis

The first 23 model runs were centered on adjustments of model parameters. Hydraulic roughness values (FR MNG card) were changed for each material type as well as values of the MP DTL card. The limit specified on the DTL card does not represent a depth below or above where a node is dry or wet but describes parameters that control the shock capturing and stability parameters applied within AdH for wetting/drying elements[1]. For the material types 4 and 5, which represent select cut timber and large timber, respectively, an FR URV card was applied. This

[1] Adaptive Hydraulics (AdH) Version 4.5 Hydrodynamic User Manual, January 2015.

card specifies the parameters of roughness height, stem diameter, and roughness density. Through comparison of the computed results with the measured water surface data, the parameters were adjusted within reason to match prototype conditions. The model simulation Table 2 UB produced the best results for water surface elevations. Every computed gage was within 1 ft of the prototype water surface data.

4 Model Runs Using a Revised Inflow Curve

The observed headwater and tailwater elevations from the 2011 flood were used with the discharge rating curve from the physical model study to determine revised discharges and a revised tailwater rating curve (Maynord 2014). The revised discharge from the physical model was approximately 6.5% less than the discharge from the original values presented in Figure 5. The percent differences between the two models can be seen in Figure 21. This displays the comparison between both the original and revised tailwater rating curves (revised values can be seen in Figure 22 which presents Maynord's increased flow values) to the measured gage data (the positive values represent a closer value to the measured for the revised tailwater rating curve than the original one). The three gages shown are interior USGS gages in the floodway.

Figure 21. Percent difference between the original and revised tailwater rating curve model simulations.

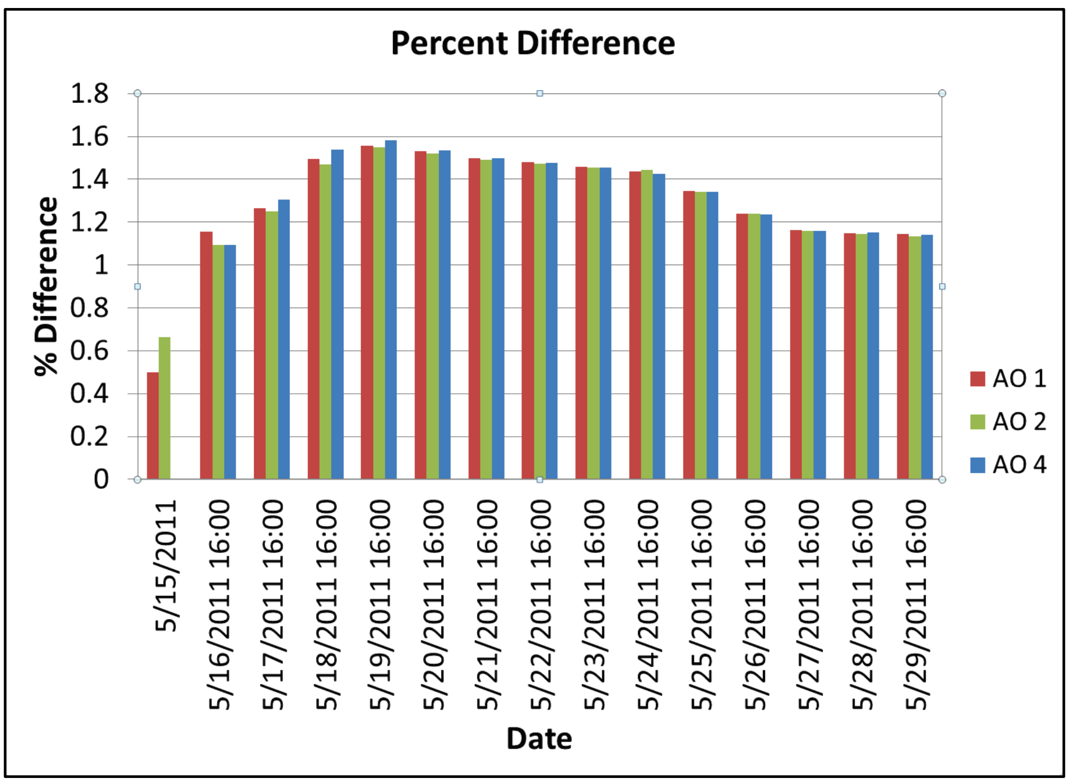


Figure 22. Table 10 from ERDC/CHL TR-14-1, *Scour Protection Downstream of Morganza Control Structure, Morganza, Louisiana* (Maynord 2014).

Table 10. Revised discharge for 2011 flood based on physical model discharge rating.

DATE	TIME	Morganza H.W.	Morganza TW	Q/BAY cfs	Q_total cfs	Total Bays Open	Revised Q cfs
5/14/11	0700	59.2	0	0	0	0	0
5/14/11	1600	59.3	34.6	10547	10547	1	9745
5/14/11	1800	59.3	34.6	10547	21095	2	19489
5/15/11	0700	59.5	35.7	10690	21381	2	19737
5/15/11	1000	59.5	36.9	10690	42762	4	39474
5/15/11	2000	59.5	39	10690	96214	9	88817
5/16/11	0700	59.5	40.3	10680	96118	9	88817
5/16/11	1500	59.5	41.2	10680	117477	11	108554
5/16/11	2000	59.4	42.3	10513	157689	15	147099
5/17/11	0700	59.4	43.4	10513	157689	15	147099
5/17/11	1300	59.4	43.8	10513	157689	15	147099
5/17/11	2100	59.5	43.9	10584	169337	16	157897
5/18/11	0700	59.6	44.2	10655	170474	16	158889
5/18/11	1600	59.7	44.7	10726	182340	17	169873
5/18/11	2000	59.6	44.8	10655	181129	17	168819
5/19/11	0700	59.5	44.9	10584	179920	17	167766
5/19/11	2000	59.5	45	10584	179920	17	167766
5/20/11	0700	59.4	45	10513	178714	17	166712
5/20/11	1500	59.3	45.3	10442	177511	17	165657
5/20/11	1800	59.3	45.2	10442	177511	17	165657
5/21/11	0700	59.4	45.1	10513	178714	17	166712
5/22/11	0700	59.3	45.1	10442	177511	17	165657
5/23/11	0700	59.1	44.9	10301	175112	17	163548
5/24/11	0700	58.9	44.8	10160	172723	17	161438
5/24/11	1500	58.8	44.6	10090	161442	16	150948
5/25/11	0700	58.7	44.3	10020	160324	16	149955
5/25/11	1600	58.7	44	10020	140283	14	131210
5/26/11	0700	58.7	43.4	10020	140283	14	131210
5/26/11	1200	58.8	43	10090	121082	12	113211
5/27/11	0700	58.8	42.3	10090	121082	12	113211
5/28/11	0700	58.7	42.1	10020	120243	12	112466
5/29/11	0700	58.5	41.9	9881	118571	12	110976
5/29/11	1330	58.7	42	10020	110223	11	103094
5/30/11	0700	58.4	41.3	9901	108908	11	101045
5/30/11	1500	58.4	41.1	9901	99007	10	91859
5/31/11	0700	58.3	40.7	9831	98308	10	91239
6/1/11	0700	58.1	40.5	9691	96914	10	89998
6/1/11	1500	58	40.3	9622	86598	9	80440
6/2/11	0700	57.9	39.9	9553	85975	9	79881
6/2/11	1500	57.8	39.7	9484	75869	8	70510
6/3/11	0700	57.6	39.2	9355	74841	8	69518
6/3/11	1500	57.5	39	9286	65005	7	60395
6/4/11	0700	57.2	38.6	9081	63569	7	59096
6/5/11	0700	56.6	38.4	8675	60726	7	56505
6/6/11	0700	56	38.2	8275	57925	7	53927
6/6/11	1100	55.9	38.2	8209	57462	7	53499
6/6/11	1500	55.9	38	8209	41045	5	38214
6/7/11	0700	55.5	37.2	7946	39731	5	36995
6/7/11	1400	55.5	37	7946	23838	3	22197

The discharge variation provided an opportunity to evaluate the model's sensitivity to flowrates. This revised hydrograph was tested in the model simulation Table 10 UB and used a single inflow boundary at the MCS. The resulting water surface elevations are shown in Figure 23–Figure 28. In these figures, the Table 10 UB run can be compared against the Table 2 UB run. In general, the Table 10 UB simulation resulted in better agreement with the measured data than the Table 2 UB run.

Figure 23. Table 10 UB, Table 2 UB, and measured data at gage AO1.

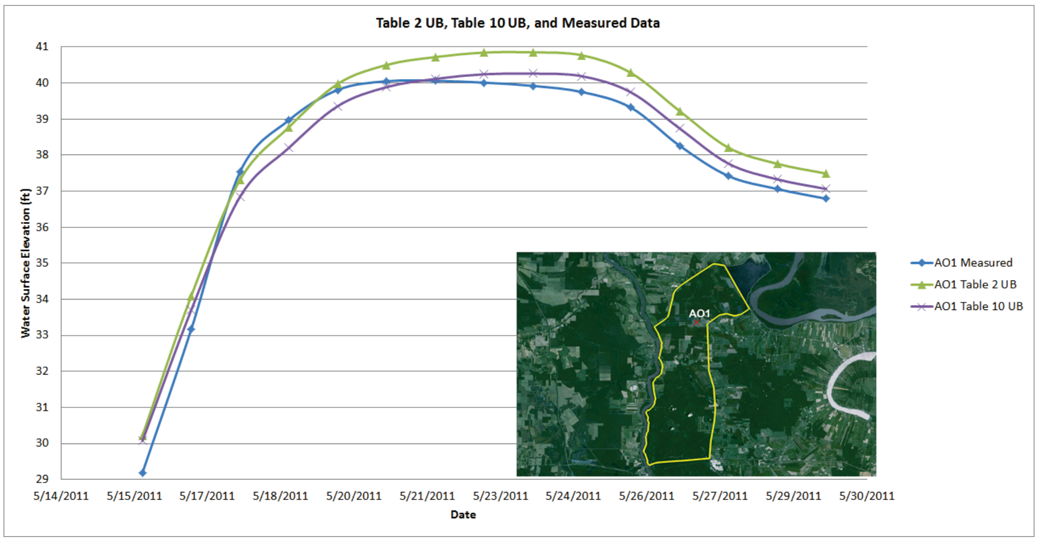


Figure 24. Table 10 UB, Table 2 UB, and measured data at gage AO2.

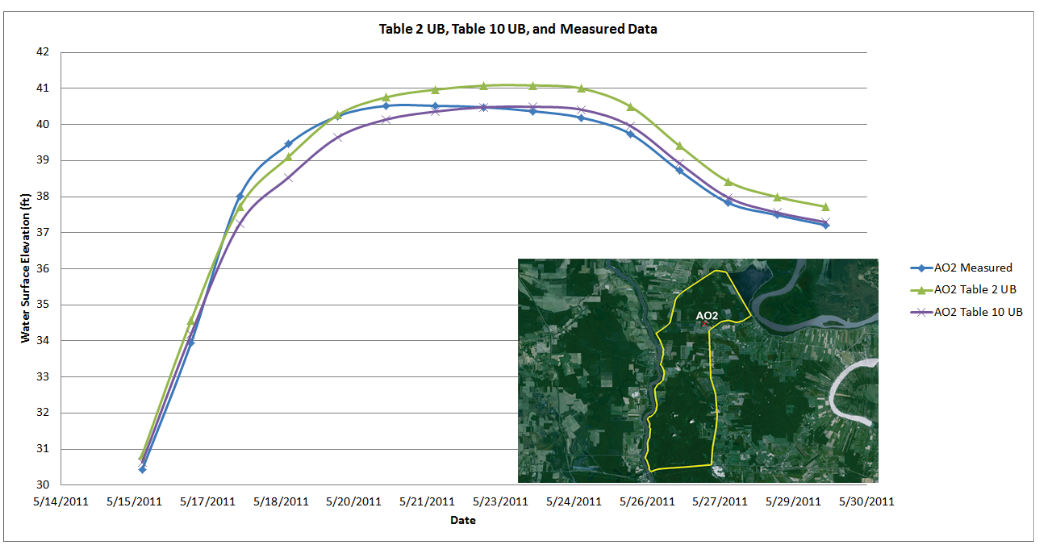


Figure 25. Table 10 UB, Table 2 UB, and measured data at gage AO3.

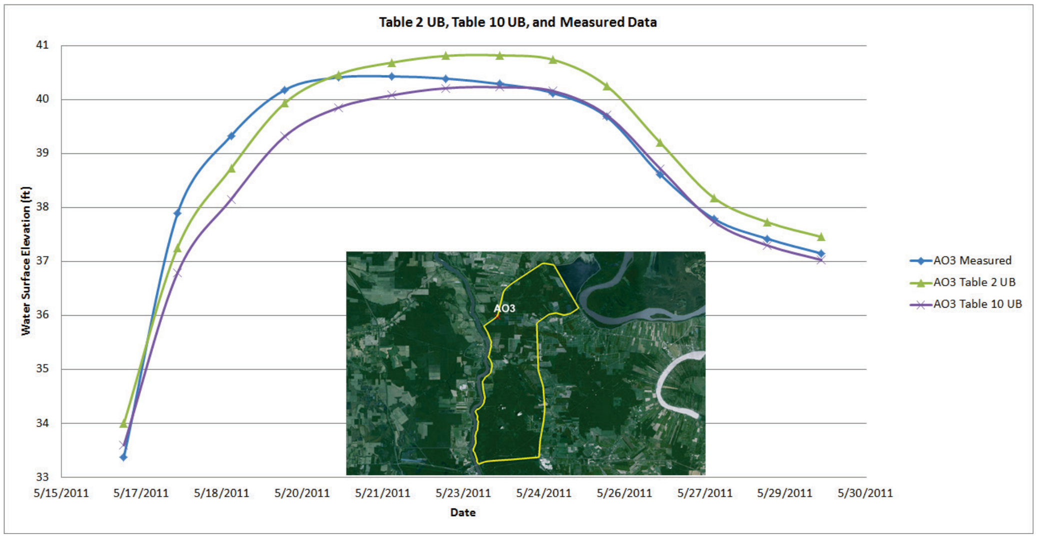


Figure 26. Table 10 UB, Table 2 UB, and measured data at gage AO4.

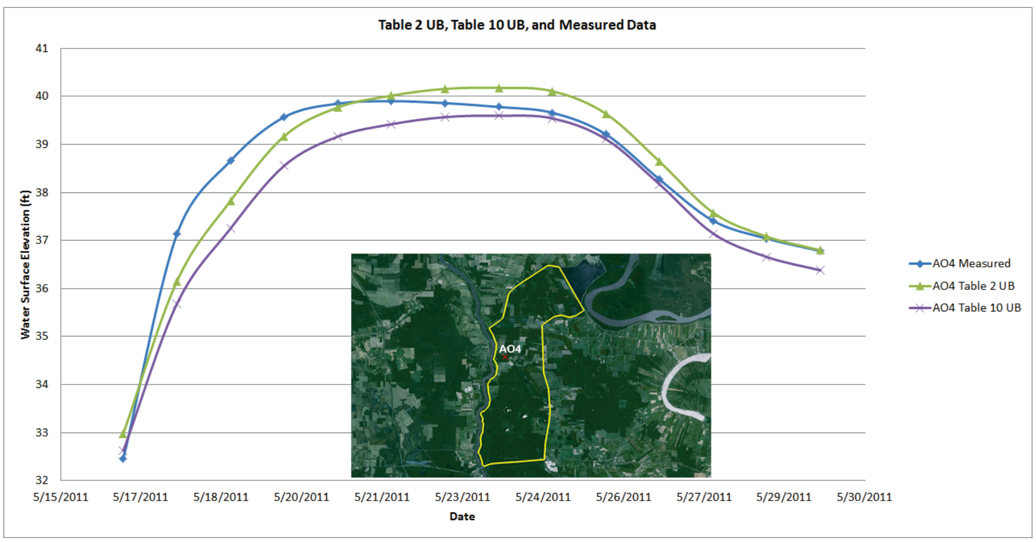


Figure 27. Table 10 UB, Table 2 UB, and measured data at gage AO6.

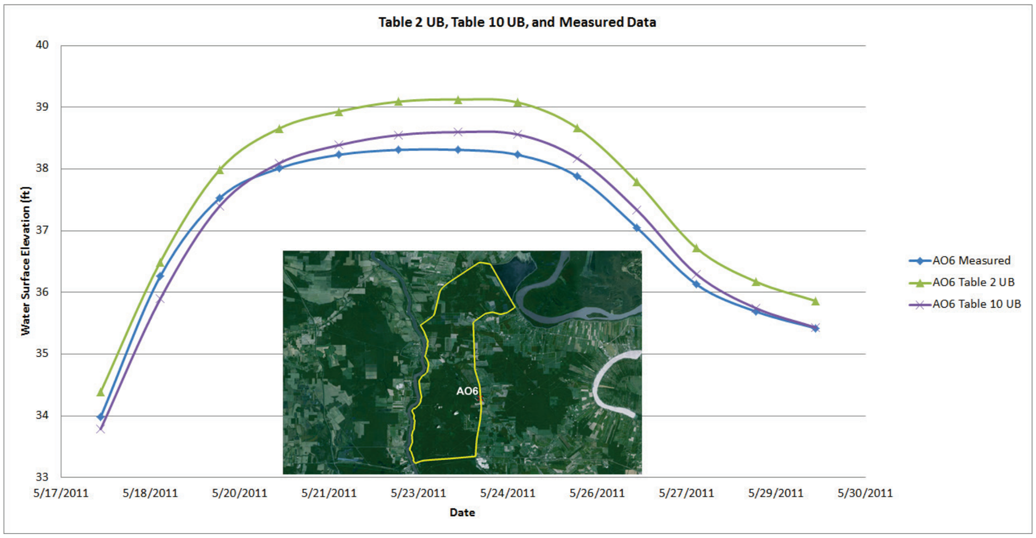


Figure 28. Table 10 UB, Table 2 UB, and measured data at gage AO7.

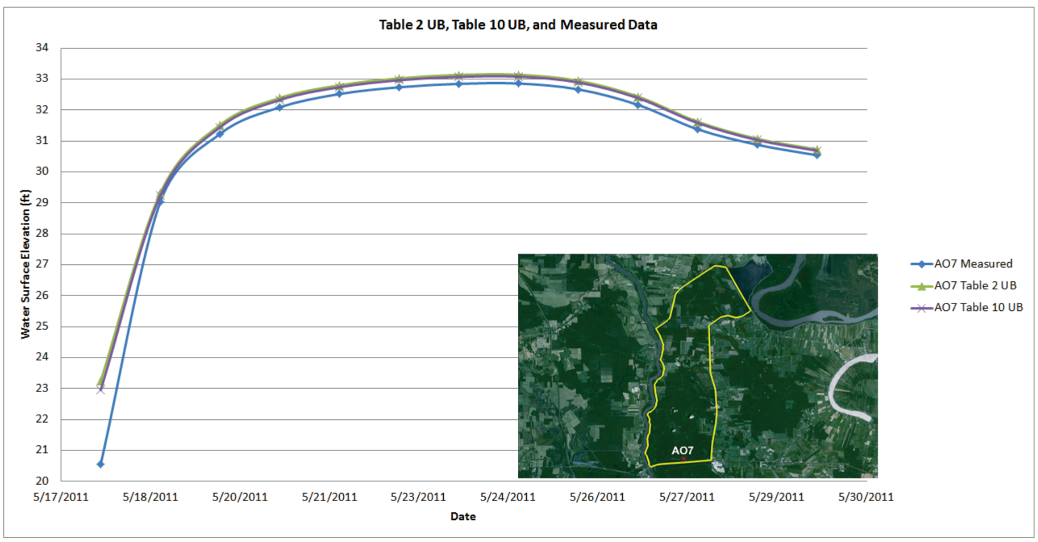


Figure 29–Figure 42 represent time lapse series of water depth contour plots. The Figures illustrate the floodway's dynamic behavior during run Table 10 UB. Figure 29 was included to show the amount of water in the model at time zero of the simulation caused by the artificial tailwater. Any water shown in Figure 29 at time zero represents ponded water that is normally in the domain.

Figure 29. Table 10 UB simulation water depths (feet) at time zero.

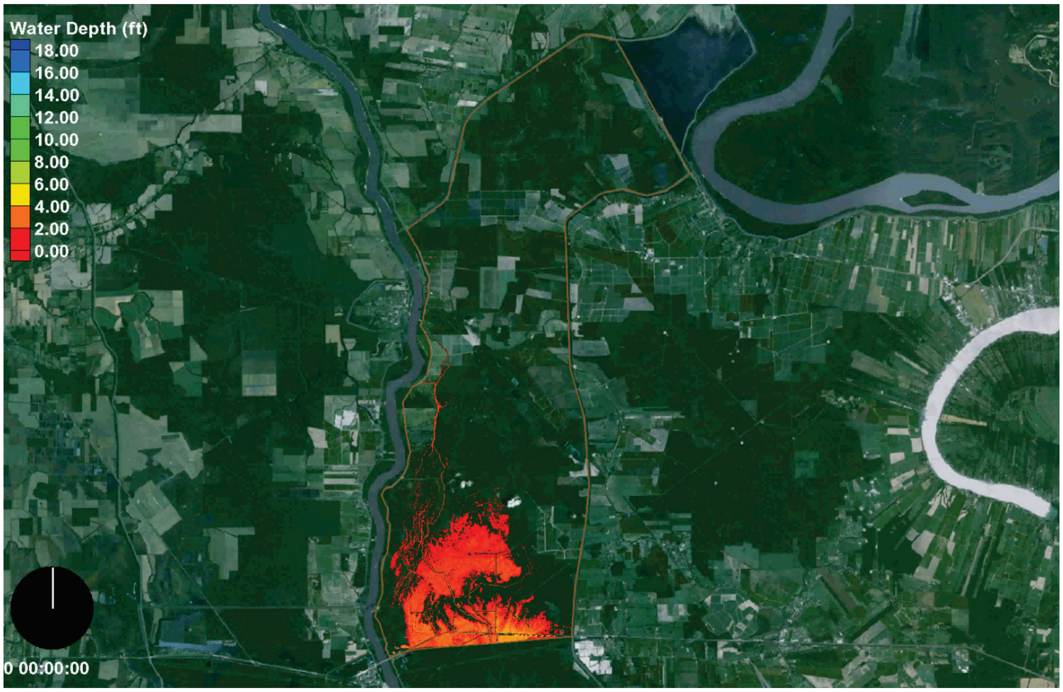


Figure 30. Table 10 UB simulation water depths (feet) at 6 hours.

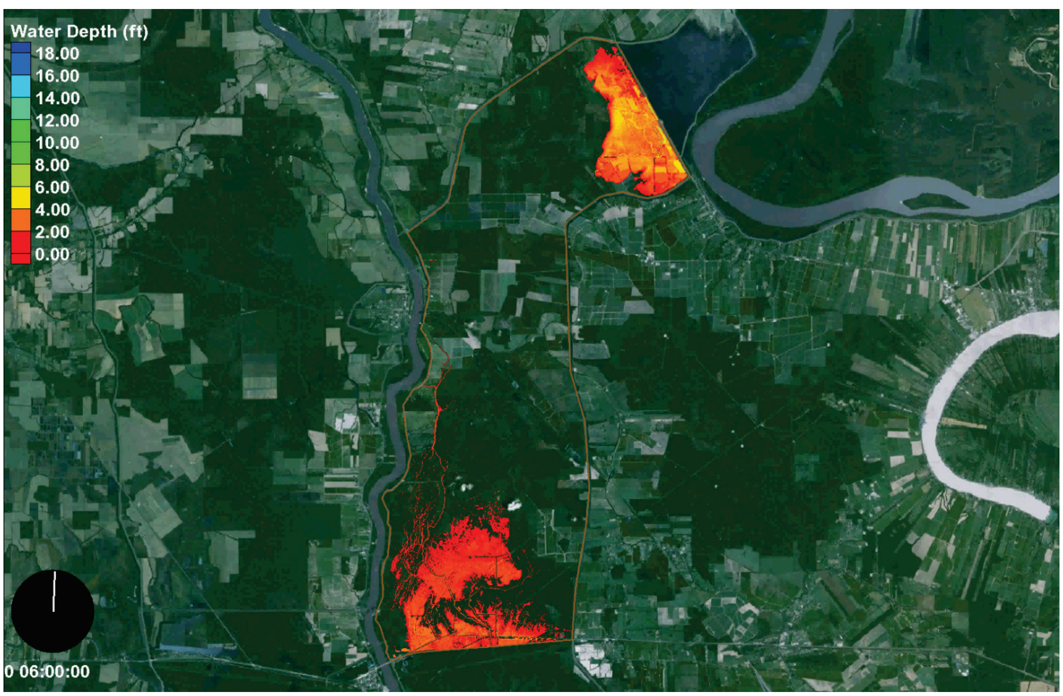


Figure 31. Table 10 UB simulation water depths (feet) at 12 hours.

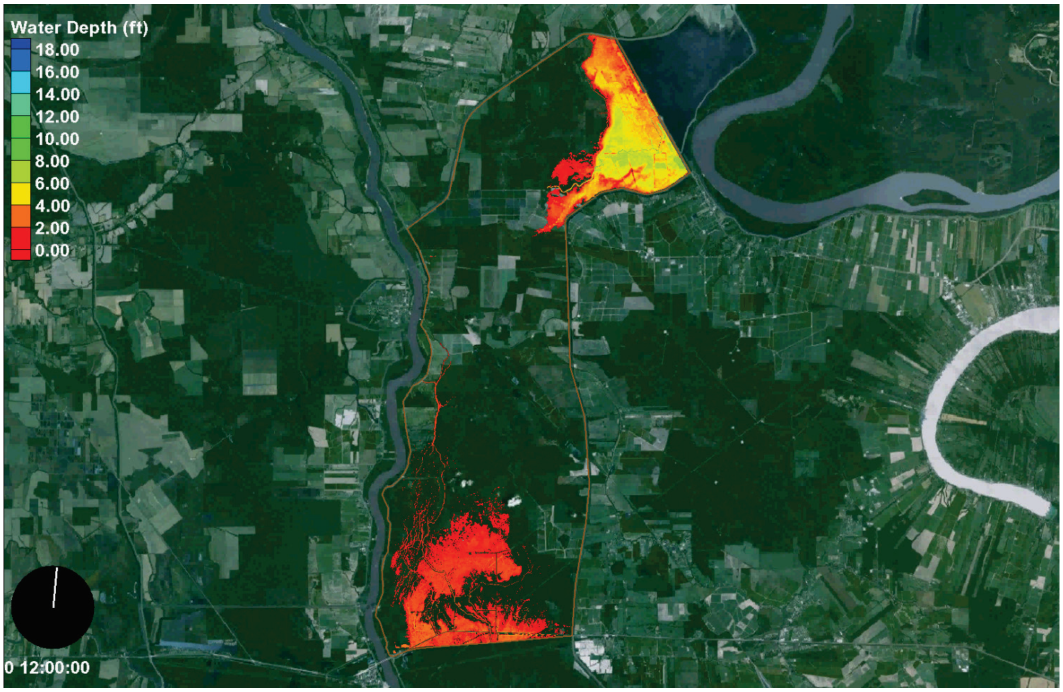


Figure 32. Table 10 UB simulation water depths (feet) at 1 day.

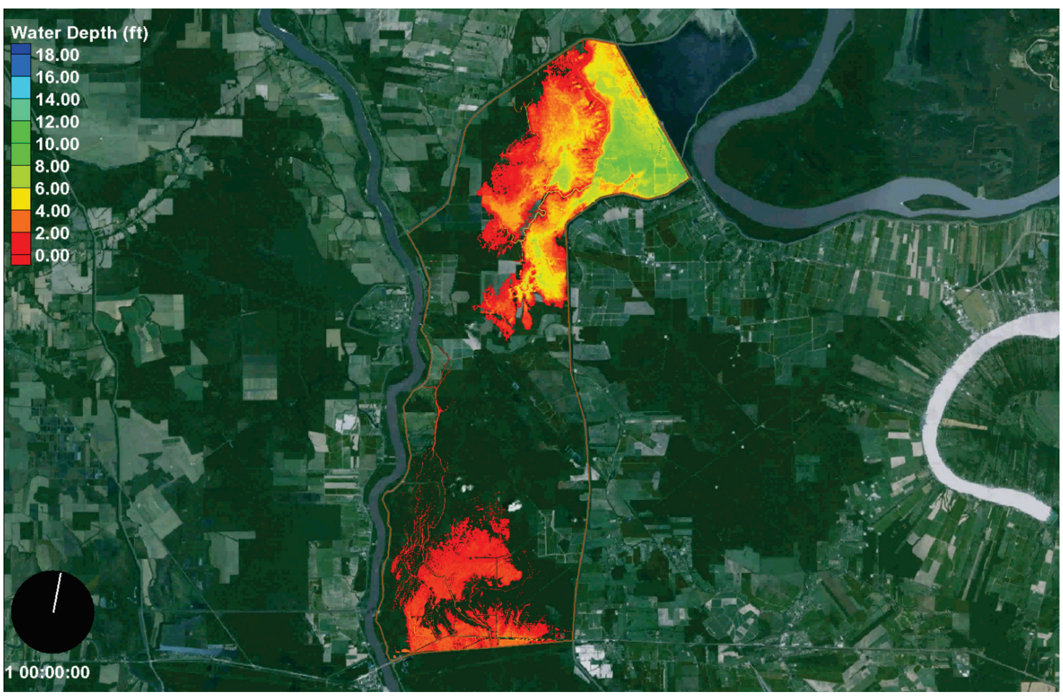


Figure 33. Table 10 UB simulation water depths (feet) at 1 day 12 hours.

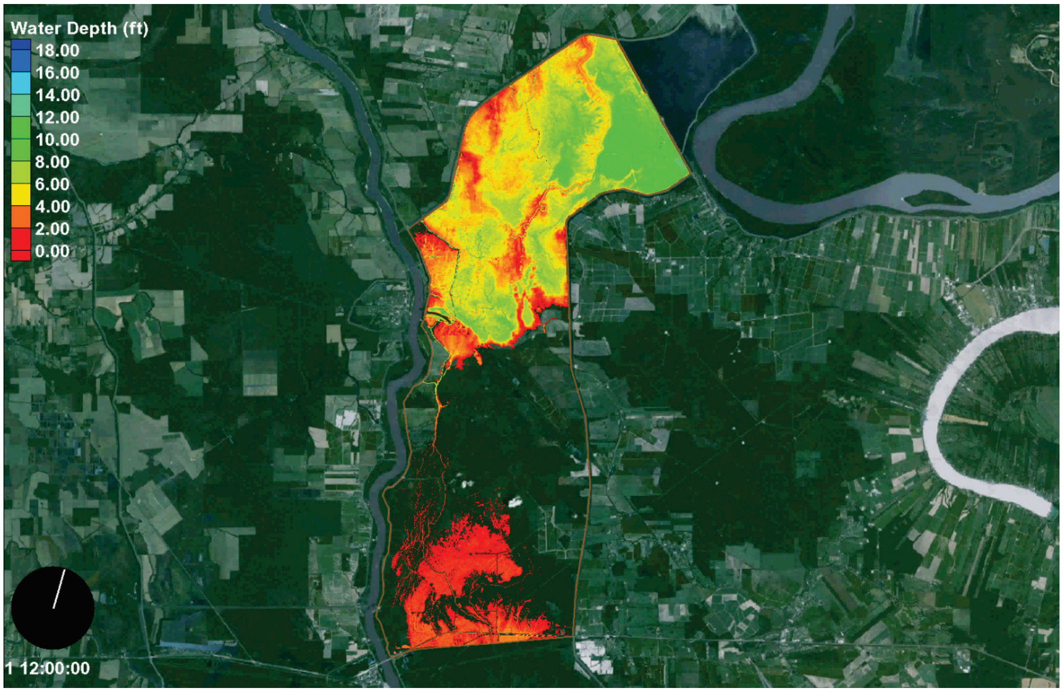


Figure 34. Table 10 UB simulation water depths (feet) at 2 days.

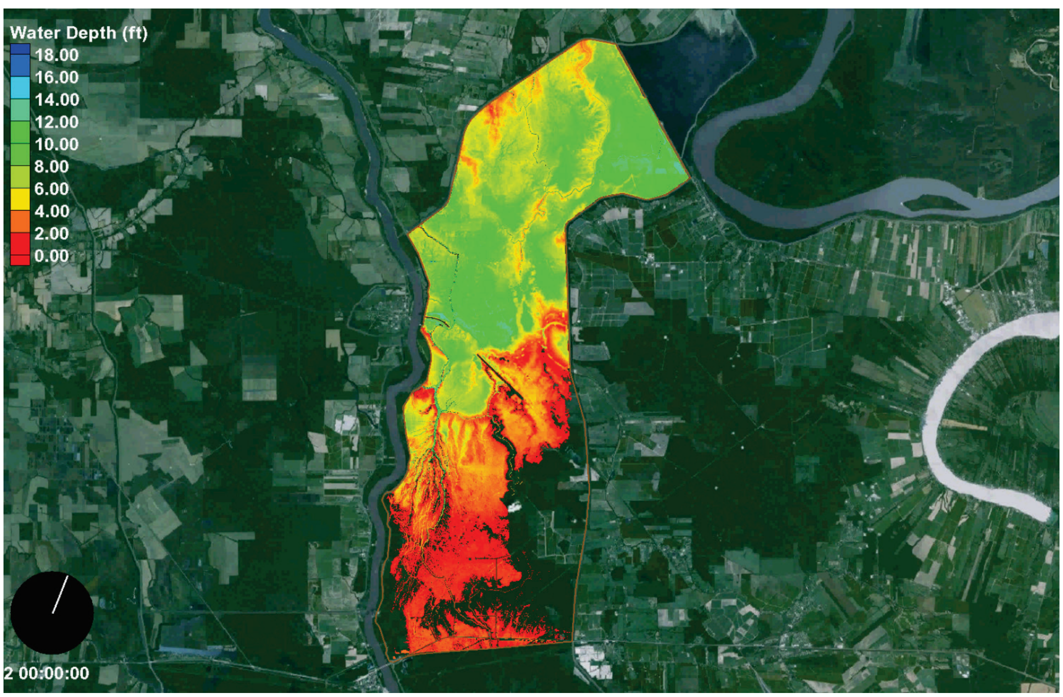


Figure 35. Table 10 UB simulation water depths (feet) at 2 days 12 hours.

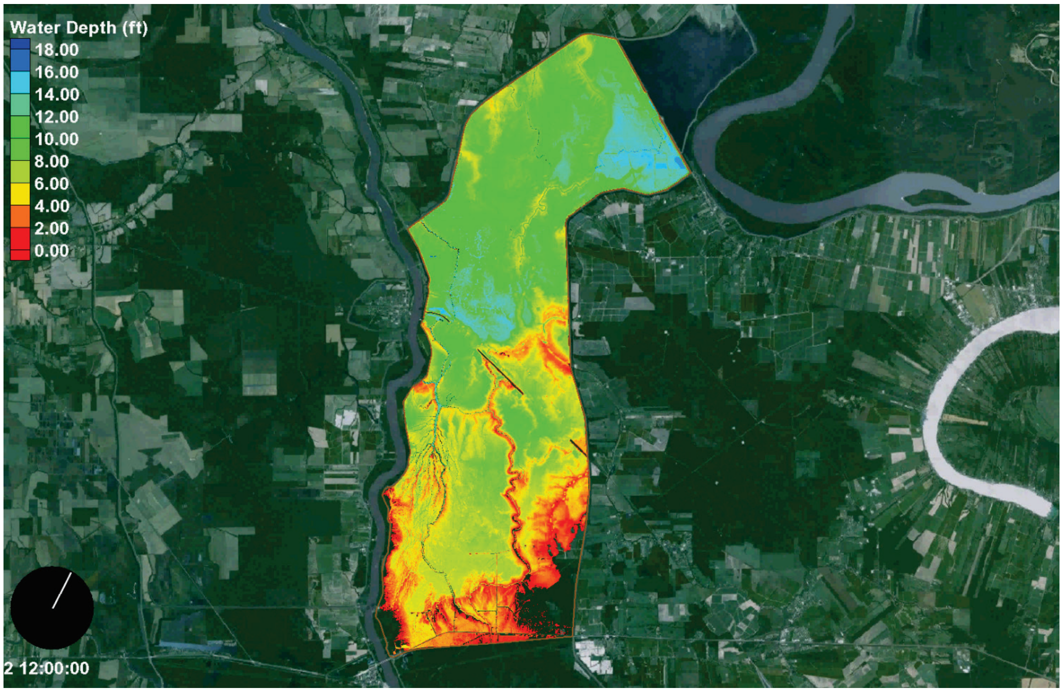


Figure 36. Table 10 UB simulation water depths (feet) at 3 days.

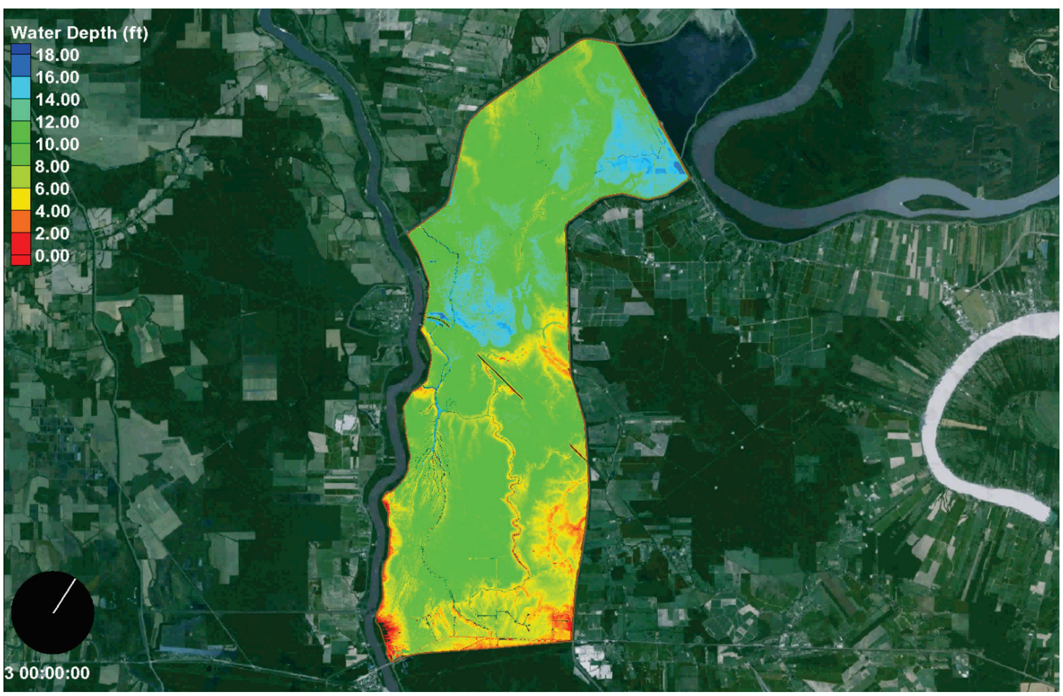


Figure 37. Table 10 UB simulation water depths (feet) at 6 days.

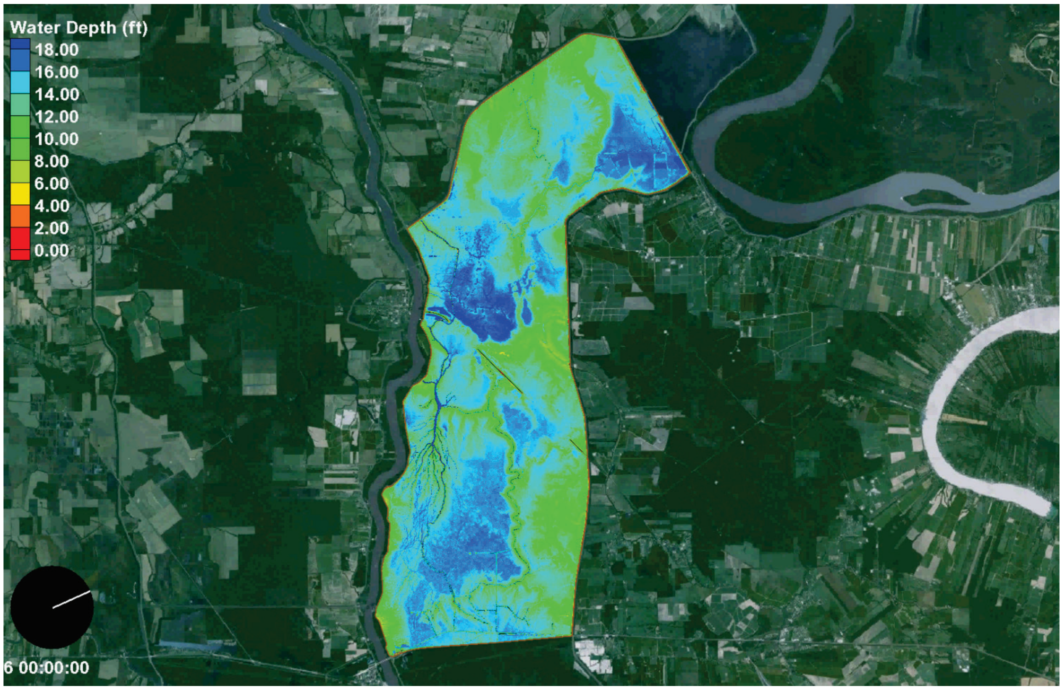


Figure 38. Table 10 UB simulation water depths (feet) at 12 days.

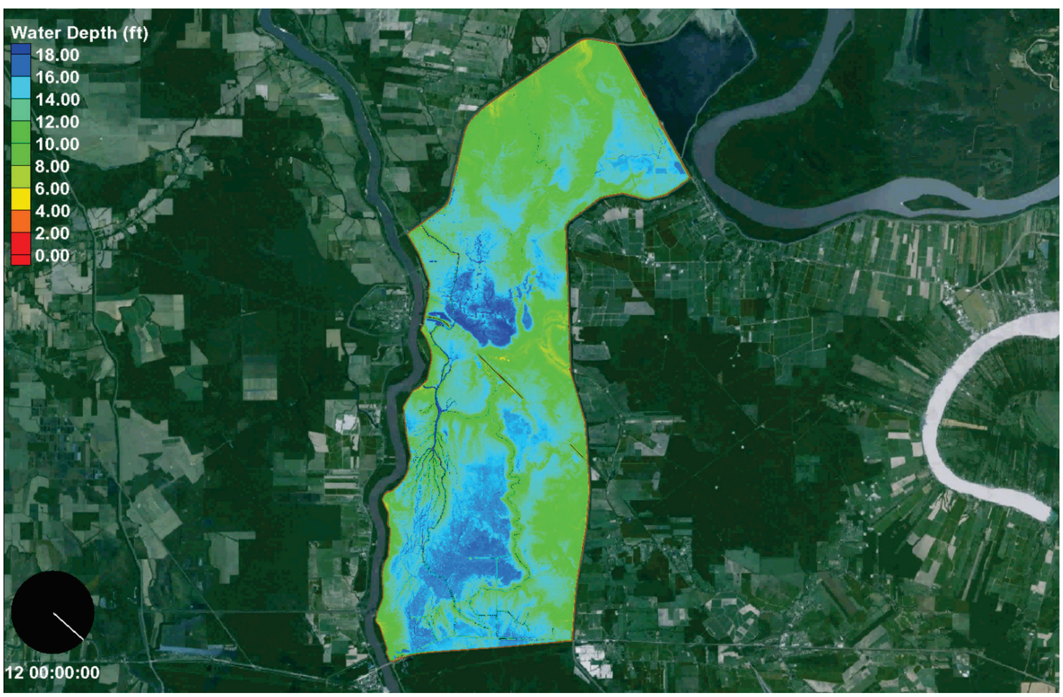


Figure 39. Table 10 UB simulation water depths (feet) at 18 days.

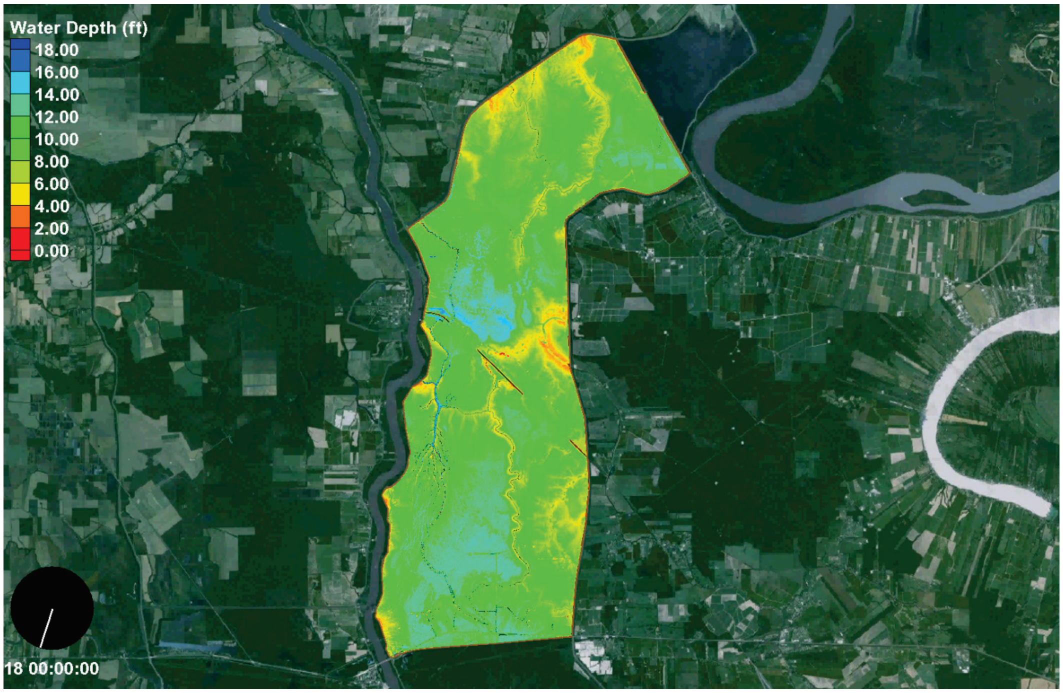


Figure 40. Table 10 UB simulation water depths (feet) at 24 days.

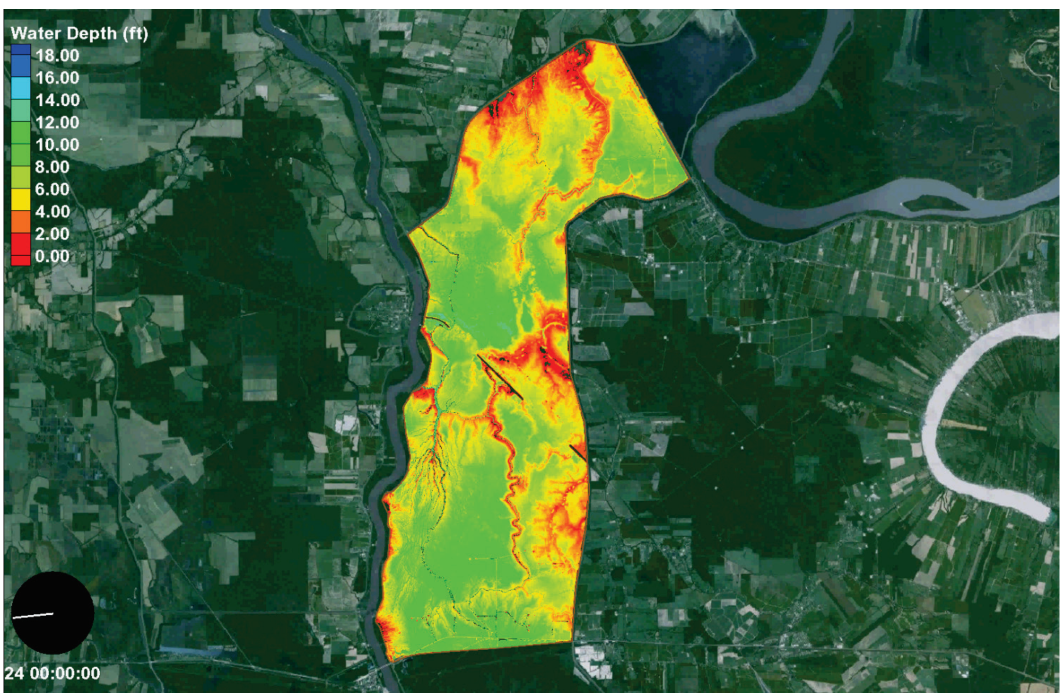


Figure 41. Table 10 UB simulation water depths (feet) at 27 days.

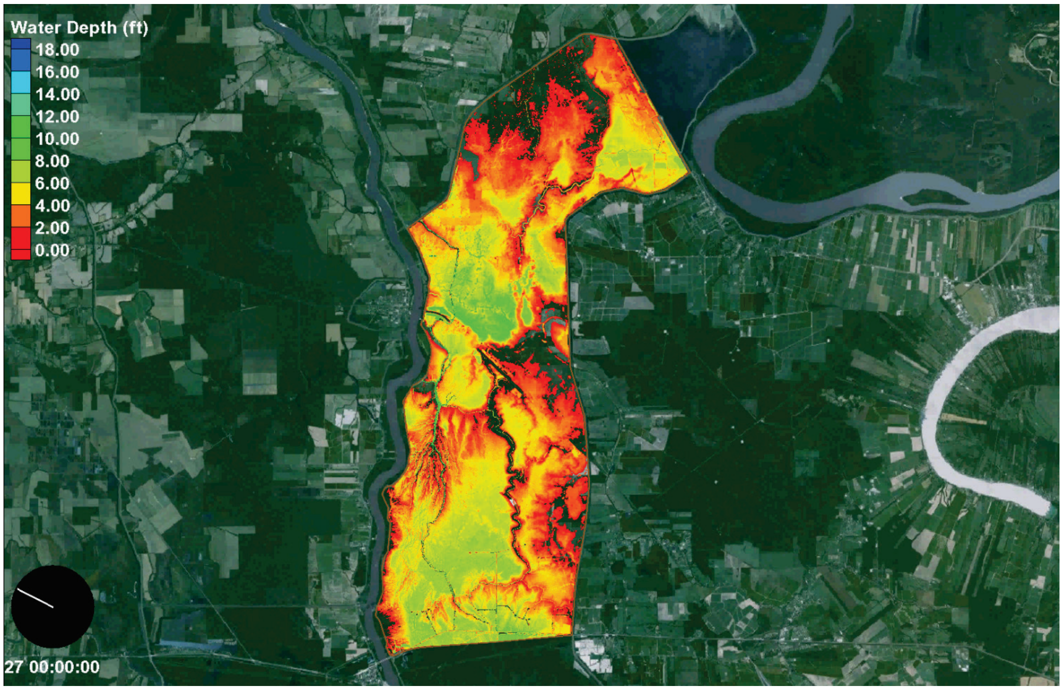
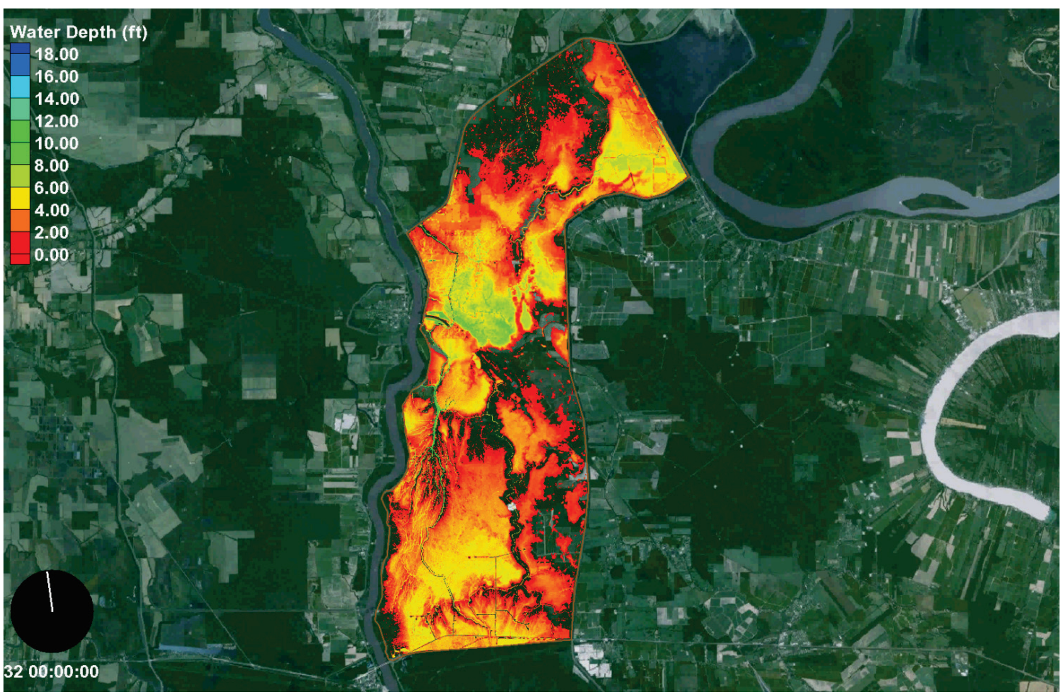


Figure 42. Table 10 UB simulation water depths (feet) at 32 days.



5 Conclusions and Recommendations

In the 2011 flood, predictions of the extent and timing of inundation in the floodway after the gates were opened were inadequate. The developed model represents the Morganza Floodway pre-2011 flood conditions. Phase One used the gage data combined with the gate discharge data during the 2011 flood to represent the flooding of the Morganza Floodway. The results from original tailwater rating curve produced water surface elevations that were never more than 1 ft from the measured gage data from the 2011 flood event. The water surface elevations produced from the revised tailwater rating curve simulation were even closer to the measured gage data.

The model will provide a good predictor of post-2011 flow lines and inundation extents. However, prior to running future events, the model should be updated. This should include elevation data and hydraulic roughness values that match the conditions immediately preceding that event. This is imperative due to the significant variation in flood levels and arrival times associated with increased/decreased vegetative roughness values.

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14. ABSTRACT
The Morganza Floodway west of the Mississippi River was evaluated using a two-dimensional Adaptive Hydraulics Model. The study was conducted to develop a better understanding of how the area would flood for pre-2011 flood conditions. The hydraulic roughness values for the floodway were set for the pre-2011 flood conditions. The results from the model run with original tailwater rating curve from the 1950 model study produced gage readings in the floodway within +/- 1 foot of the measured values (U.S. River Commission 1950). However, water surface elevations produced from the model run with the revised tailwater rating curve values (which used discharge ratings from the physical model tests results) were even closer to the measured gage data (Maynord 2014). Results indicate that the model correctly simulates flow lines and inundation areas in the flood plain for the 2011 event. However, for other events the model should be updated with the appropriate elevation data and hydraulic roughness values.

15. SUBJECT TERMS
Flood control, Floods—Mississippi River, Hydraulics, Hydrodynamics—Mathematical models, Morganza Floodway, Spillways—Louisiana, Stream measurements

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