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Technical Assessment of the Old, Mississippi, Atchafalaya, and Red (OMAR) Rivers: Red and Atchafalaya Rivers AdH Model

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Red and Atchafalaya Rivers AdH Model

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Abstract

The Red River, Atchafalaya River, and the Old River Control Complex (ORCC) Outflow Channel Adaptive Hydraulics two-dimensional depth averaged sediment model (AdH-2D-SED) was used to evaluate the short-term and system-wide sedimentation effects of modifying the operation schedule at ORCC. The changes evaluated were increasing and decreasing the percentage of flow that is diverted to the Atchafalaya River from the Mississippi River at the ORCC and modifying the distributions through four ORCC structures. Sedimentation effects for several operation scenarios were compared to a Base condition for each water year that represented the existing operation protocols. Four dredging scenarios were developed and analyzed. Additionally, two structure options were developed and analyzed. The scenario analyses presented in this report are intended to identify large trends and to make gross assessments of the potential impacts of various proposed operational changes to the ORCC.

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Preface

The investigation documented in this report was conducted for the US Army Corps of Engineers, Mississippi Valley Division (MVD), as part of the Mississippi River and Tributaries Project, under Project No. 478534, and published through the Mississippi River Geomorphology and Potamology (MRG&P) Program. At the time of publication of this report, the MRG&P Program director was Dr. James W. Lewis. The MVD commander was MG Diana M. Holland, and the MVD director of programs was Mr. Edward E. Belk.

The work was performed by the River and Estuarine Engineering Branch of the Flood and Storm Protection Division and the Navigation Branch of the Navigation Division, US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory (ERDC-CHL). At the time of publication of this report, Mr. David May was chief of the River and Estuarine Engineering Branch, and Dr. Cary Talbot was chief of the Flood and Storm Protection Division. The deputy director of ERDC-CHL was Mr. Keith Flowers, and Dr. Ty V. Wamsley was the director.

The commander of ERDC was COL Christian Patterson, and the director was Dr. David W. Pittman.

1 Introduction

1.1 Background

The Mississippi River and Tributaries (MR&T) System contains water management strategies that were developed to pass the high flows that could occur during the Project Design Flood (PDF). These strategies include employment of backwater areas, floodways, historical cutoffs, and diversions. During the PDF event, the Atchafalaya River is intended to provide a large relief to the Mississippi River, receiving one-half of peak flow passing at Natchez, MS. A major diversion of water from the Mississippi River to the Atchafalaya River occurs at the Old River Control Complex (ORCC). The ORCC is located between river mile (RM) 317 and RM 311. Additionally, during the PDF, the Morganza Control Structure (MCS) would pass up to 600,000 cfs[1,2] through the Morganza Floodway into the Atchafalaya River. The MCS is located at RM 280. During the PDF event, the Atchafalaya River carries 1.5 million cfs to the Gulf of Mexico. For these reasons, the Atchafalaya River is an important strategic part of the MR&T System for passing the PDF.

Rivers are dynamic and can exhibit major changes over periods of time. These changes are caused by a multitude of natural and human-induced factors, but some of the most important drivers of river channel changes are the transport, deposition, and erosion of sediment particles within the river. A reach is a section of a river with similar hydrologic conditions, such as discharge, depth, area, and slope. If a reach of river is aggrading, that means that sediment is generally being deposited in the reach, and this aggradation can increase the water surface elevation (WSE) for a particular flow. Conversely, a degrading reach of river generally experiences sediment erosion and would likely have a decreasing water surface elevation for a particular flow. In some cases, a river can take decades to reach a new equilibrium after certain changes. A numerical sedimentation model,

[1] For a full list of the spelled-out forms of the units of measure used in this document, please refer to *US Government Publishing Office Style Manual*, 31st ed. (Washington, DC: US Government Publishing Office 2016), 248-52, https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf.

[2] For a full list of the unit conversions used in this document, please refer to *US Government Publishing Office Style Manual*, 31st ed. (Washington, DC: US Government Publishing Office 2016), 345-7, https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf.

calculating sediment balances and transport through the river, provides a qualitative prediction of channel changes expected in the future.

Major changes have occurred in the Atchafalaya River over the course of the last several decades due to system adjustments and changes in water and sediment inflows. A notable change to the system includes the construction of the Old River Control Structure in 1963. The Auxiliary Structure and Hydropower Structures were added to the ORCC in 1986 and 1990, respectively. The Hydropower Structure is the only privately owned and operated part of the ORCC. Additionally, the J. Bennett Johnston Waterway, a system of locks, dams, and channel realignments between Simmesport and Shreveport along the Red River, was constructed between 1984 and 1994. Over the last several decades, measured data at the Simmesport gage show increased water inflows and decreased sediment inflows to the Atchafalaya River. The upper end of the Atchafalaya River has experienced large declines in WSEs for any particular flow, as seen by a large drop in the specific gage behavior at Simmesport, LA, between the 1930s and 1970s. Since the mid-1980s, the Simmesport specific gage behavior has been more stable. In the lower end of the Atchafalaya River, an increase in WSEs for a given flow has been observed in recent decades.

An Adaptive Hydraulics two-dimensional (AdH-2D) numerical model of the ORCC Outflow Channel, Red, and Atchafalaya Rivers was developed in 2016 as a hydraulics-only model to evaluate the erosion protection downstream of the Overbank Structure of the ORCC. This modeling analysis was conducted for the New Orleans District by ERDC. The 2016 model included four structures of the ORCC (Low Sill, Auxiliary, Overbank, and Hydropower Structures), the Outflow Channel to the confluence of the Red River, 16 mi of the Red River upstream of the confluence and the Atchafalaya River to Simmesport. The 2016 model served as the starting point for the Adaptive Hydraulics two-dimensional depth-averaged sediment (AdH-2D-SED) model OMAR Assessment.

This assessment focuses on proposed operational changes at the ORCC. These include flow distribution changes through the four ORCC structures that divert water from the Mississippi River into the Atchafalaya River. The assessment determines the sedimentation effects of increasing and decreasing the flow volume from the Mississippi River, the effects of depositing dredged material from the Mississippi River into the Outflow

Channel and constructing dike fields in the Outflow Channel to expedite sediment transport to the confluence of the Red River.

1.2 Objectives

The objective of this numerical model investigation was to evaluate different management scenarios and determine their short-term sedimentation effects on the Atchafalaya River from RM 1 to Melville, LA, RM 29.5. The scenarios evaluated consisted of operational change scenarios, dredging scenarios and structural changes.

This effort is a part of the overall Old, Mississippi, Atchafalaya, and Red (OMAR)Rivers Assessment. Table 1 lists the series of reports associated with the overall project, with this report listed in bold font.

Table 1. List of reports included in the overall project.

Vol.	Report Name	Description
1	Main Report	Summarizes the entire project assessment
2	Geomorphic Assessment	Analyzes the historic trends in hydrology, sedimentation, and channel geometry of the river reaches of interest
3	Channel Geometry Analysis	Analyzes the hydrographic surveys over the past 6 to 7 decades
4	Mississippi River HEC-6T Model	Evaluate the long-term and system-wide sedimentation effects on the Mississippi River
5	Atchafalaya River HEC-6T Model	Evaluate the long-term and system-wide sedimentation effects on the Old, Atchafalaya, and Red Rivers
6	Mississippi River Multi-Dimensional Model	Evaluate the short-term effects on the Mississippi River
7	**Red and Atchafalaya Rivers Adaptive Hydraulics (AdH) Model**	Evaluate the short-term effects on the Old, Atchafalaya and Red Rivers
8	HEC-RAS Model	Investigate how water is stored in the Lower Red River floodplain
9	HEC-RAS BSTEM Analysis of the Atchafalaya River	Compare the relative impact of various scenarios on bank retreat in the upper portion of the Atchafalaya River

1.3 Approach

The 2016 ORCC AdH-2D hydraulics model was modified by extending the model limits upstream on the Red River to Lock and Dam #1, RM 44.9, and downstream on the Atchafalaya River to Melville, LA. Hydraulic calibration

and verification were conducted on the extended model limits and then sediment transport capabilities were added to the model.

Sixteen different scenarios of either operational modifications, dredge material placement, or river training structures were simulated for three different water years. Model scenarios were evaluated by examining bed displacement throughout the system and comparing sediment loads on the Red River, Atchafalaya River, and Outflow Channel to examine how sediment delivery to the Atchafalaya is affected.

2 Model Development and Calibration

The OMAR Assessment uses an AdH-2D-SED model of the Red River, Atchafalaya River, and the ORCC Outflow Channel. The adaptive feature of AdH consists of its ability to dynamically refine and relax the mesh resolution such that both model accuracy and model performance are optimized. The ability of AdH to allow the domain to wet and dry as flow conditions change is suitable for floodplains. AdH can simulate subcritical and supercritical flow conditions within the same domain. Boundary conditions can also be specified for both flow conditions. AdH can simulate the transport of conservative constituents, such as dye clouds, as well as sediment transport that is coupled to bed and hydrodynamic changes. AdH calculates the transport of cohesionless sediment, cohesive sediment, and mixed sediments. The model is capable of running multiple grain sizes in a single simulation.

2.1 Model boundary

The model area includes 244,844 acres and is made up of 100,209 nodes and 198,944 elements. Model extents are outlined in yellow in Figure 1. The model includes the lower 43.9 mi of the Red River up to Red River Lock and Dam #1, 1.4 mi of the Black River, and 29.5 mi of the Atchafalaya River down to Melville, LA. The model also includes the Hydropower, Overbank, Low Sill, and Auxiliary outfall channels as well as the Outflow Channel.

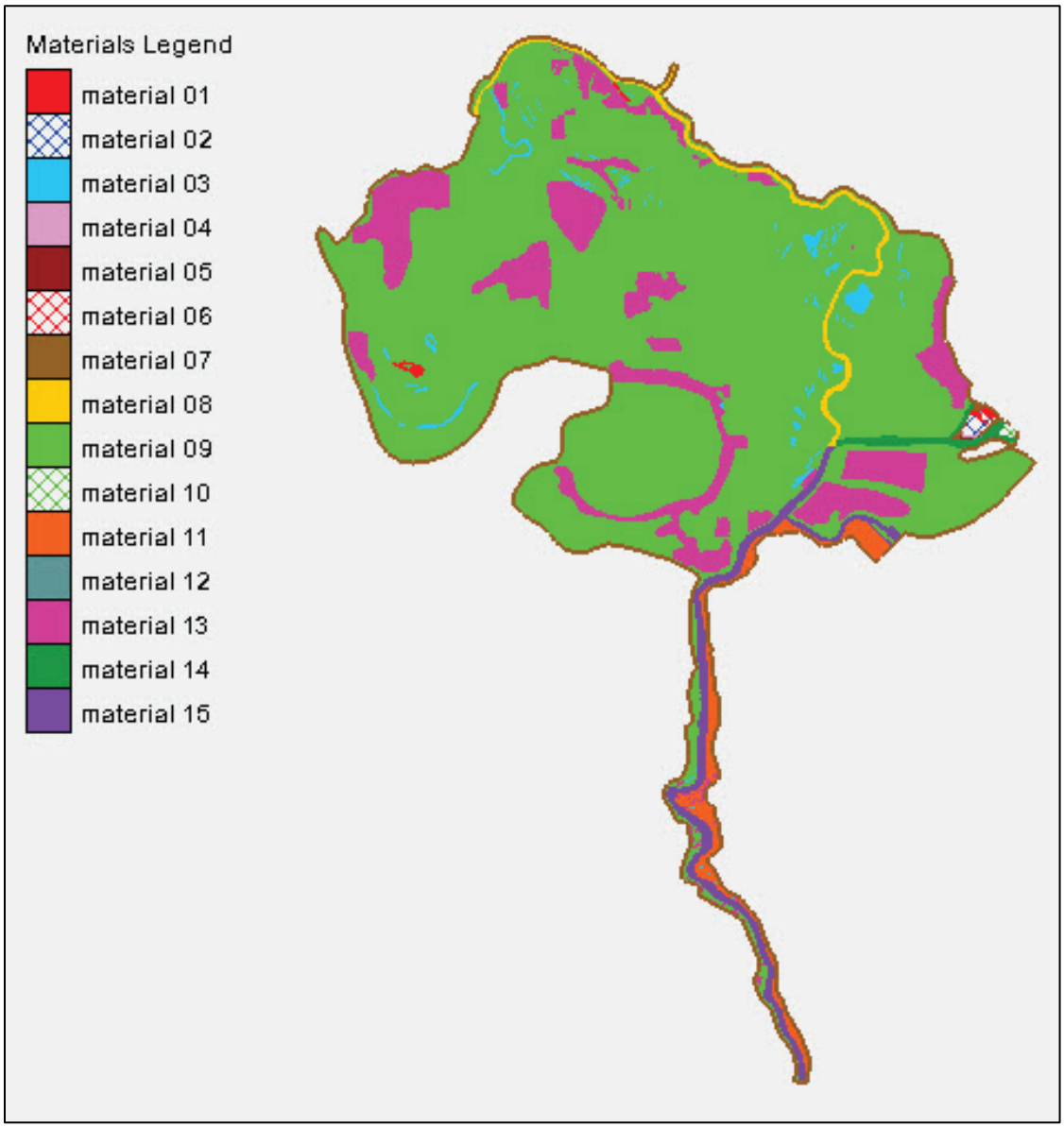
Model elevations are in meters and referenced to NAVD88. Elevation values were assigned using 2012 multibeam data for the channel bathymetry and 2010 bare earth lidar for the floodplains.

Figure 1. Model boundary.

2.2 Model material types

The base length of the elements in the river channels and outflow channel vary between 45 and 75 ft. Element sizes transition from 75 ft near the top bank of the channels to 1,800 ft at the extreme boundaries in the floodplain. Fifteen different material types (Figure 2) were used in the construction of the model and assigned to each element dependent on the land-use function.

Figure 2. Material types.



Each material type is assigned a Manning roughness coefficient and is manipulated during model hydraulic calibration to achieve a known WSE by giving known discharges entering the model domain (Table 2).

Table 2. Description of materials and Manning's *n* value.

Material Number	Description of the Material	Mannings *n* Value
1	Overbank tailbay	0.025
2	Overbank floodway trees	0.056
3	Lakes	0.024
4	Riprap	0.039
5	Gabions	0.024
6	Overbank guide levees	0.03
7	Study area overbank	0.05
8	Red River channel	0.023
9	Floodplain	0.056
10	ORCC island	0.04
11	Lock overbank	0.075
12	Concrete mattress	0.023
13	Fields	0.05
14	Outfall canal	0.0315
15	Atchafalaya channel	0.0315

2.3 Hydraulic boundary conditions

Flow input to the model can be specified at six locations: Red River Lock and Dam #1, Black River at Acme, LA, ORCC Hydropower, ORCC Overbank, ORCC Low Sill, and ORCC Auxiliary Structure. Model outflow is controlled by the use of a tail-water boundary at Melville that controls the WSE. Stage and discharge data for the three base years (Water Year [WY]2008, WY2012, and WY2013) were downloaded from rivergages.mvr.usace.army.mil.

2.4 Sediment transport capabilities

To simulate sediment transport, the model requires transport functions, an incoming sediment load, and specified sediment bed gradations. This model uses Wright-Parker noncohesive suspended entrainment equations (Wright-Parker 2004) and the van Rijn bedload entrainment equations (van Rijn 1984). The model also uses the Egiazaroff noncohesive hiding factor (Egiazaroff 1965) to simulate the transport of seven grain sizes (Table 3).

Table 3. Grain diameter and classification.

Classification	Grain Diameter (mm)
Very Fine Sand (VFS)	0.088
Fine Sand (FS)	0.177
Medium Sand (MS)	0.353
Coarse Sand (CS)	0.707
Very Coarse Sand (VCS)	1.41
Very Fine Gravel (VFG)	2.82
Fine Gravel (FG)	5.65

Incoming sediment loads on the Red and Black Rivers were controlled by the use of an equilibrium boundary. Sediment inputs through the ORCC structures were specified concentrations that were determined from a separate model of the Mississippi River.

Sediment samples from multiple data collection efforts were used to specify appropriate starting sediment gradations for the Red River, Outflow Channel, and Atchafalaya River. Details on the sediment sampling are presented in Appendix H. The sediment bed was initialized by simulating first 2 months of WY2008. During the initialization run, the geometry of the model was held constant, but the sediment was allowed to move. This resulted in the model sorting the different grain sizes, causing armoring in higher velocity areas, and fining of bed sediments in lower velocity depositional portions of the bed to create a more realistic starting bed gradation.

2.5 Model calibration

Model hydraulic calibration focused from 1 March through 30 April 2016 due to having measured discharge data on the Black River at Acme during that time frame, which allows for increased confidence in the model inflows. WSEs produced using the final calibrated parameters, which were used for the remainder of the assessment, were compared to gage data (USACE 2019) at three gage locations: Acme (Figure 3), in the Outflow Channel (Figure 4), and at Simmesport (Figure 5). All AdH calculated WSE are within 8 in. of the observed values during the calibration period.

Figure 3. Calibration Run 6 water surface elevation (WSE) time series Acme US Geological Survey (USGS) gage.

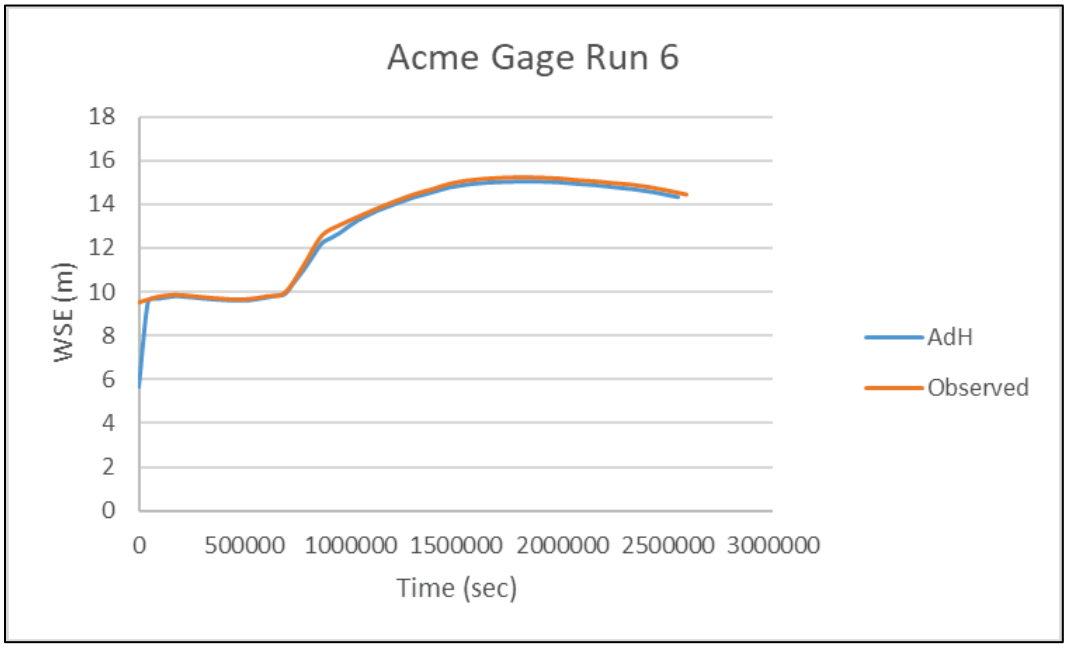


Figure 4. Calibration Run 6 WSE time series Outflow USGS gage.

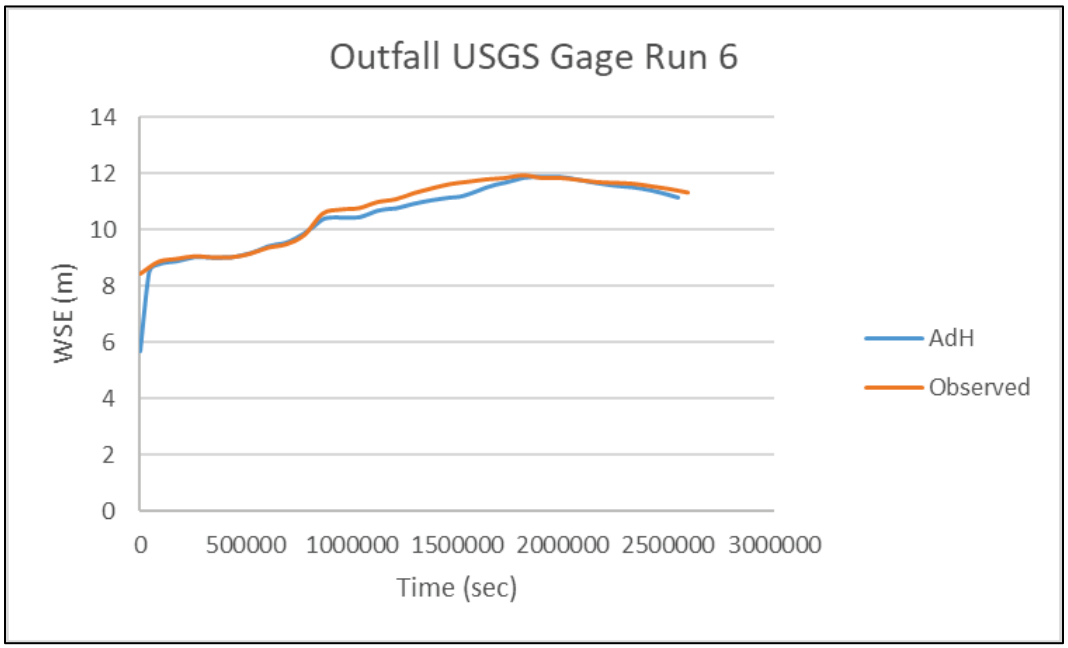
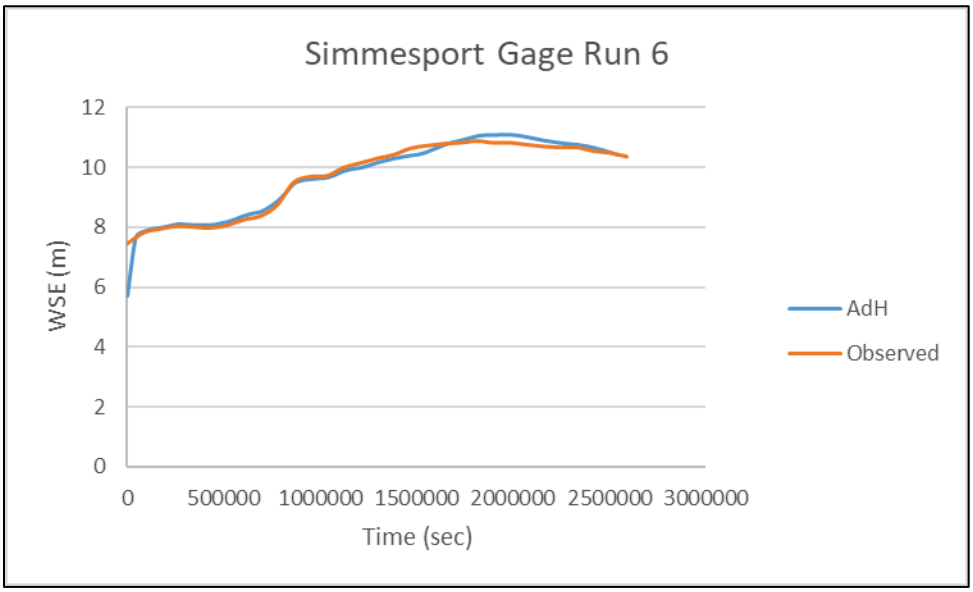


Figure 5. Calibration Run 6 WSE time series Simmesport USGS gage.



2.6 Model scenarios

A series of simulations were used to determine the impacts of various flow conditions and scenarios on the morphologic response of the Red and Atchafalaya Rivers. The scenarios were chosen by the OMAR Assessment steering committee. Table 4 shows the list of scenarios used in this analysis and their short descriptions. These scenarios are described in more detail in the OMAR Vol. 1 Main Report (Lewis et al. 2022).

Table 4. List of hypothetical scenarios.

Scenario	Explanation
1	Base projection of continuing current operations (no flushing)
2	Base projection of continuing current operations (with flushing similar to how it happens now)
3	"Ratio 1," as defined in Design Memorandum 17 (USACE 1980): This is a scenario where there is no hydropower, and a large amount of flow goes through the Auxiliary Structure.
4	"Ratio 1 with hydropower", (as defined in Old River Control O&M Manual 1988). Basically hydropower shares with Auxiliary. **Low Sill will not be used in this scenario.** Anything that would go to Low Sill in the table of the O&M Manual will add to Auxiliary instead.
5	60/40 during high flow, and 70/30 on long-term basis through water volume tracking.
6	80/20 during high flow, and 70/30 on long-term basis through water volume tracking.

Table 4. (cont.) List of hypothetical scenarios.

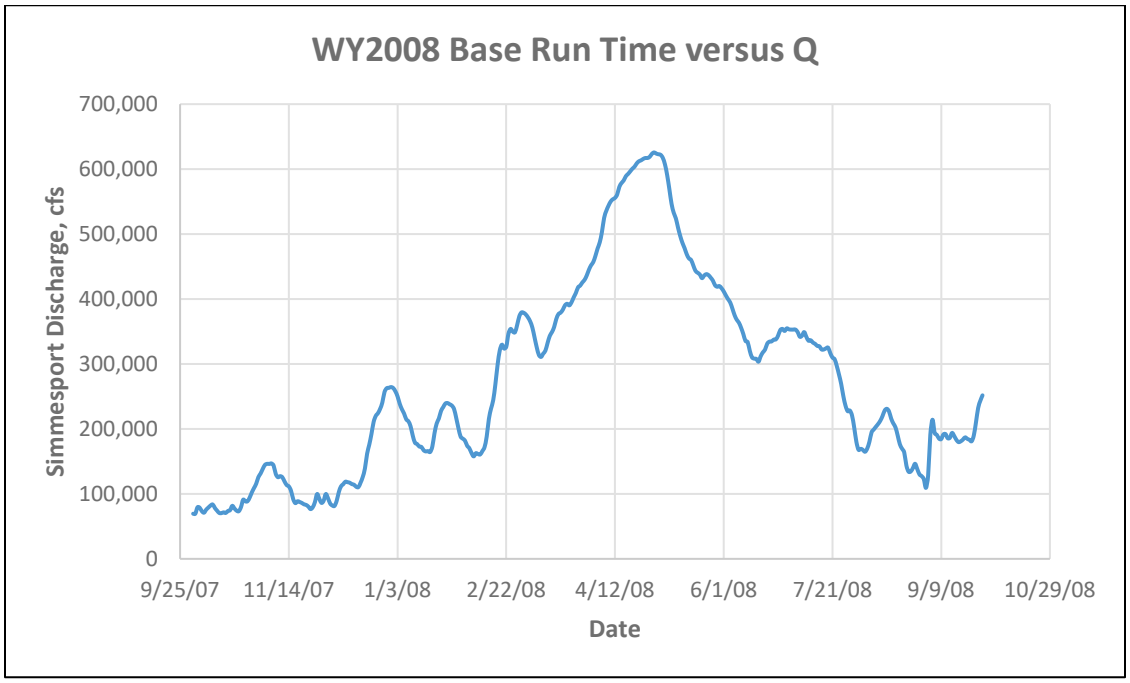
Scenario	Explanation
7	Push all flow over 1.25M cfs at Tarbert through ORCC (up to a limit of what the Atchafalaya can handle). 70/30 on long-term basis through the use of a payback/tracking system.
8A	Daily 80/20 without any constraints
8B	Daily 80/20 with Low Sill head differential constraint
9	Daily 60/40
10	Maintain 70/30. Increase Auxiliary and decrease Hydropower, based on conditions.
Dredging scenarios	
11 (A)	Atchafalaya River: Permanent sediment increase just downstream of the hydropower outflow / Low Sill confluence (to represent continuous dredging)
12 (A)	Atchafalaya River: Permanent sediment increase into the deep spot of the Low Sill outflow channel (to represent continuous dredging)
13 (A)	Atchafalaya River: Sporadic placement of sediment just downstream of the hydropower outflow / Low Sill confluence (to represent annual dredging)
14 (A)	Atchafalaya River: Permanent sediment increase into the hydropower channel (to represent continuous dredging)
River training structure scenarios	
19	Dikes near the confluence of Low Sill and Auxiliary outflow channels
20	Dikes in the Old River Outflow channel, just upstream of the confluence with the hydropower channel

3 Water Year (WY) 2008

3.1 Base Run bed displacement data (BDD)

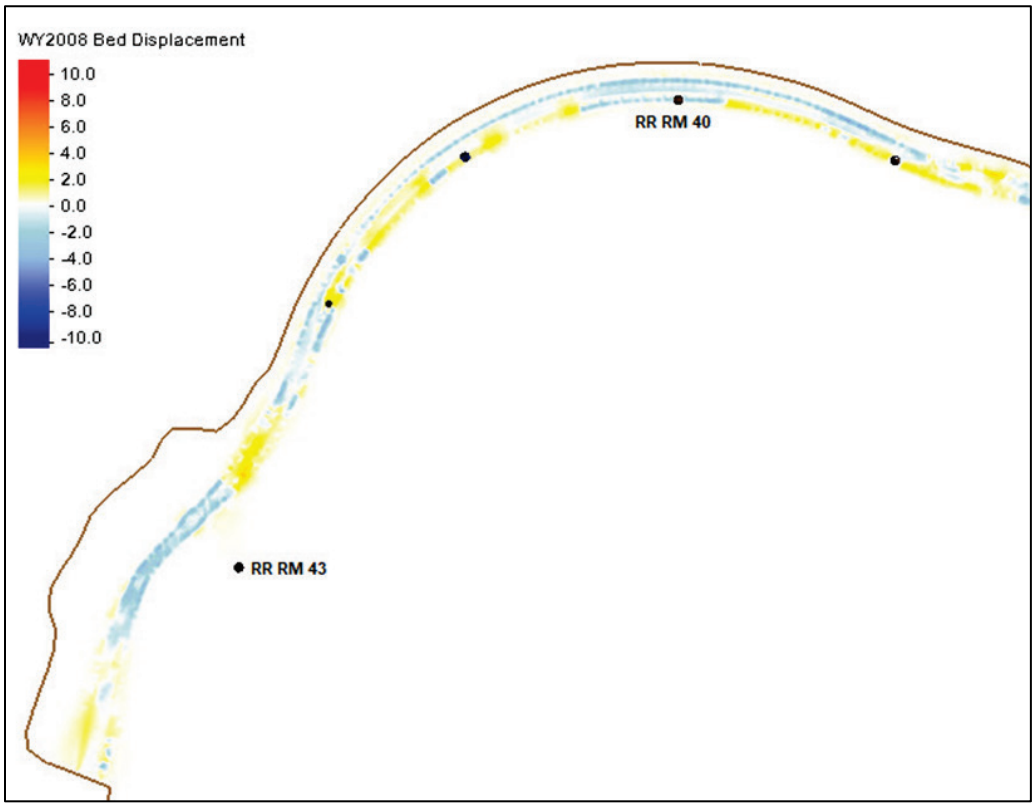
The Base Run was a simulation of the actual historic data for WY2008. WY2008 was a high flow water year with over 625,000 cfs passing Simmesport. Figure 6 is the WY2008 Base Run Hydrograph. Base Run sediment transport trends are used to compare against the scenarios listed in Table 4.

Figure 6. WY2008 Base Run hydrograph.



The bed displacement data (BDD) calculated during the WY2008 Base Run and all scenario simulations are located in Appendix: A–WY2008 Bed Displacement Data. The BDD in Figure 7 presents a screen capture of the Surface Modeling System (SMS) software used to visualize the bed transformation for the last time step of WY2008. Figure 7 shows Red River, River Mile (RR RM) 43.9 to RR RM 39. The legend is in meters and is color coded to visualize the sediment transport trends over the whole water year. For the Base Run, a screen capture for every 5 mi of river channel was recorded and is located in Appendix: A–Base Run.

Figure 7 . WY2008 Base Run bed displacement data (BDD) RR RM 43.9–RR RM 39.



The Red River Lock and Dam #1 is the beginning of the modeled area and is located approximately at RR RM 44. The yellow areas show approximately 1 m of aggradation, and the light blue areas reflect 1 m of scour. The upper reaches of the Red River are fairly constant as only flows passing the structure influence the sediment transport. This area is outside the backwater influence of the operation of the ORCC.

Figure 8 presents Base Run BDD for RR RM 35–RR RM 30. RR RM 34.2 is the approximate location of the confluence of the Red and Black Rivers (Acme). Approximately 1.5 mi of the Black River channel were modeled in the simulations. This is the upper limit to the backwater effect of the operation of the ORCC. Larger amounts of sediment deposition and erosion are detected in the area downstream of the confluence. Flow from the Black River can be attributed to this sediment transport trend.

Figure 8. WY2008 Base Run BDD RR RM 35–RR RM 30.

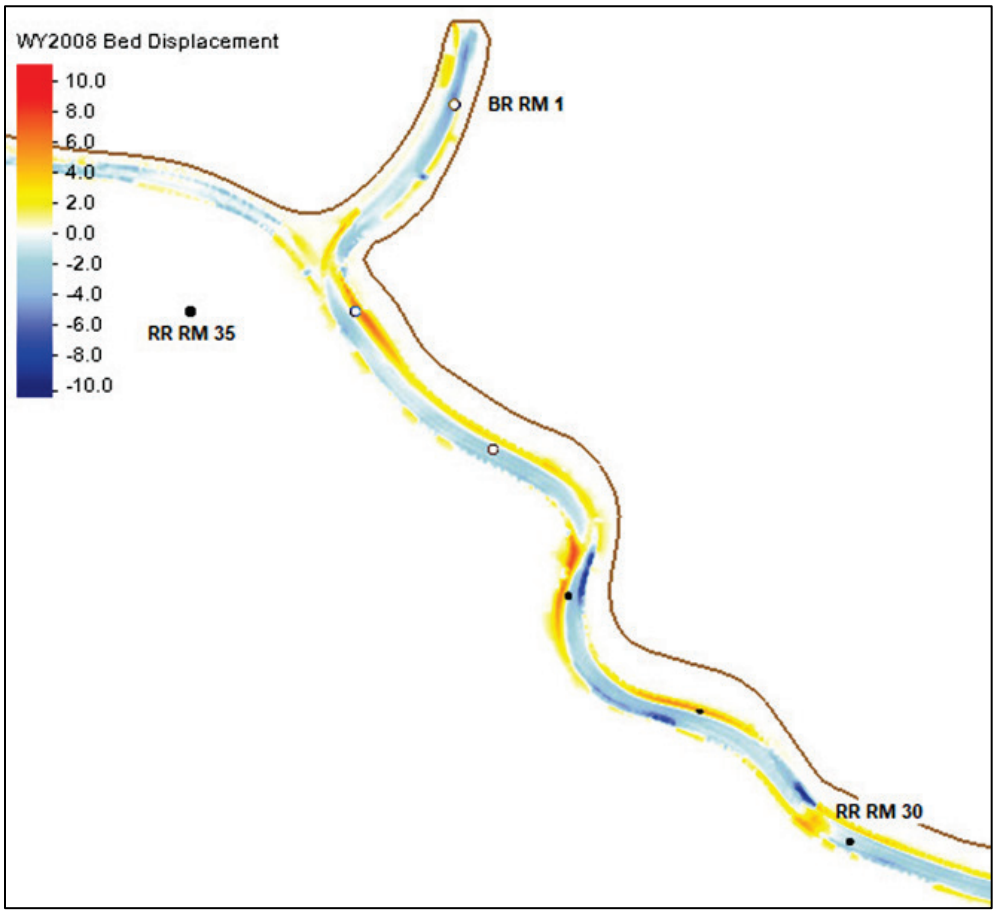


Figure 9 shows sediment transport trends between RR RM 25 to RR RM 18. Aggradation and degradation trends consist of larger amount of deposition on inner bars downstream of bend ways and larger degradation lagging further downstream than directly in the bend. This can be attributed to the two-dimensional effect of the model simulation. The Coriolis Effect is simulated using a vorticity card but lags in the downstream direction from what is seen in the field, that is, scour along the outer bank in the bend way.

RR RM 15 to RR RM 10 and the Outflow Channel (Figure 10) reflect a large quantity of deposition at the confluence of the Red River and the Outflow Channel. This can be attributed to the backwater effect of large flow conditions at the ORCC during any flow condition. Also note that the large scour hole below the Low Sill Structure shows aggradation. This is a result of the two-dimensional nature of the model with no vertical component of velocity to continue scouring sediment from this location.

Figure 9. WY2008 Base Run BDD RR RM 25–RR RM 18.

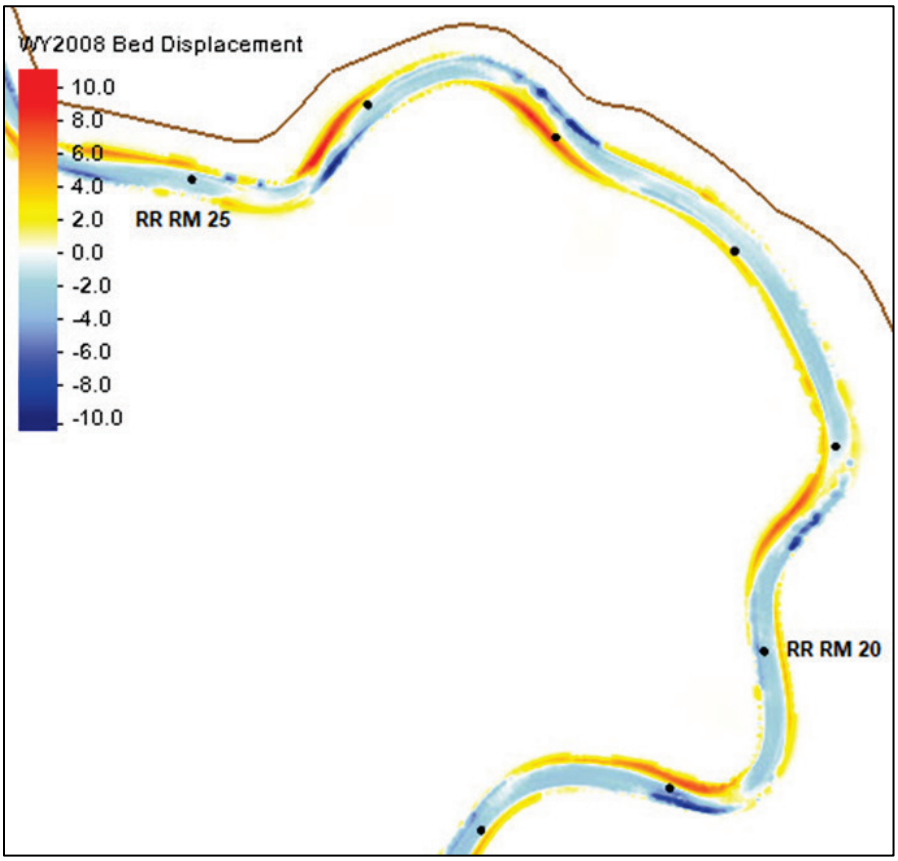


Figure 10. WY2008 Base Run BDD RR RM 15–RR RM 10 and Outflow Channel.

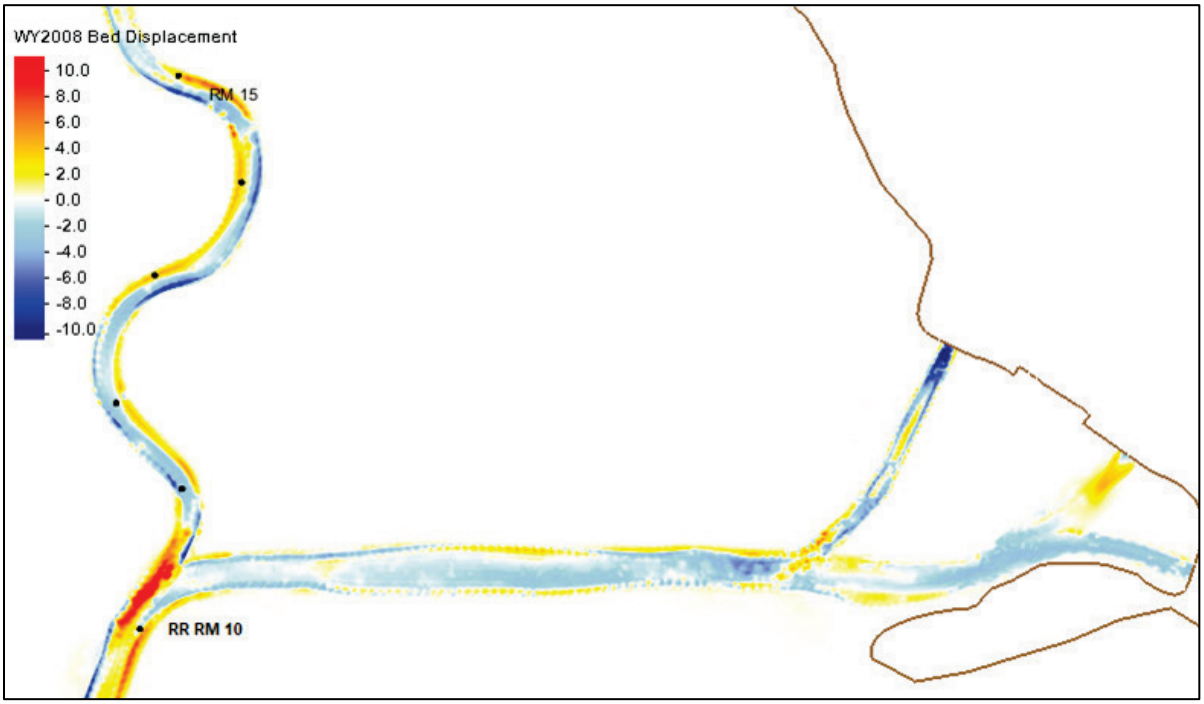
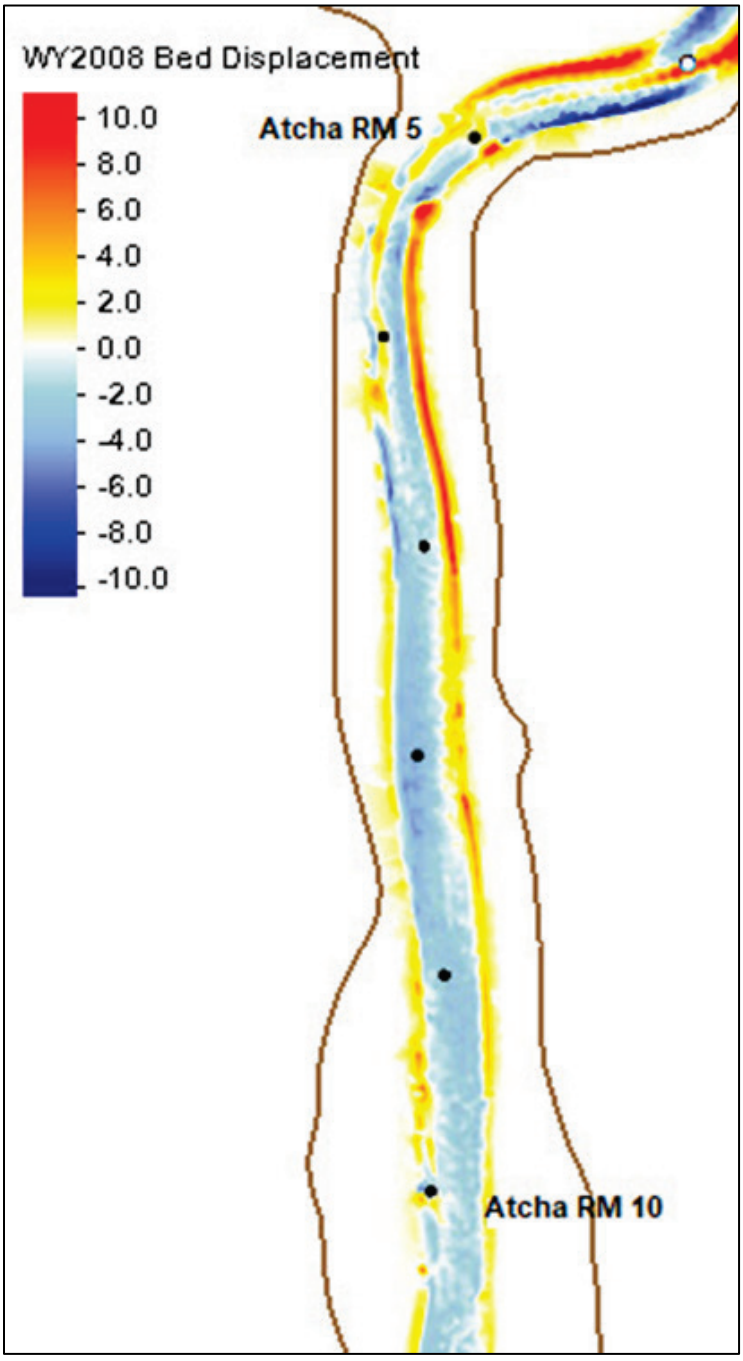


Figure 11. WY2008 Base Run BDD Atchafalaya (Atcha) RM 5–Atcha RM 10.



Atcha RM 5 to Atcha RM 10 (Figure 11) is the location where the parallel levees start. The brown lines represent the model limits that are the levee protection. Note that this acts as a flow control for the Atchafalaya River and contributes to the backwater effect that inundates areas upstream of this feature. Simmesport is located at approximately Atcha RM 5.

Figure 12. WY2008 Base Run BDD Atcha RM 25–Atcha RM 29.

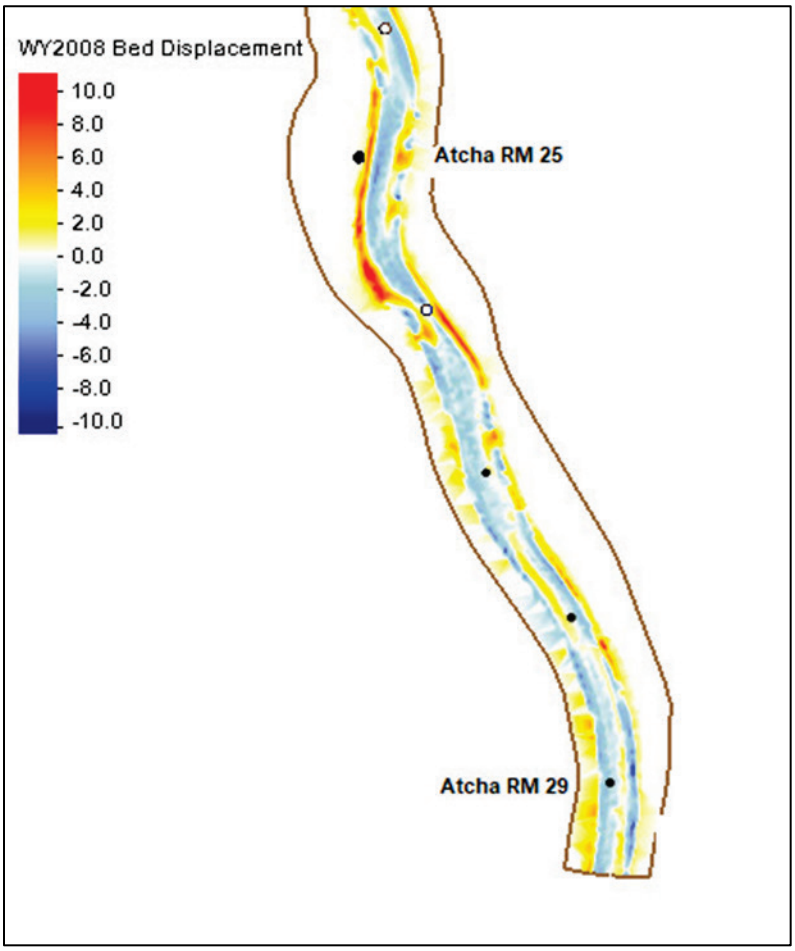


Figure 12 details the BDD from Atchafalaya River Mile (Atcha RM) 25 to Atcha RM 29.5. Atcha RM 29.5 is the end of the modeled area and is located at Melville, LA. Tailwater elevations were set using the US Geological Survey (USGS) gage located at Melville, LA.

Appendix A has every 5 mi of the modeled river channels BDD for viewing for the base year and every 10 mi for all scenarios simulated.

3.2 Scenario 3 bed displacement data

Scenario 3 consists of the flow conditions for WY2008 adjusted to Ratio 1 with no Hydropower flows. Figure 13 is the BDD for RR RM 43 to RR RM 40 and the BDD are the same trends identified in Figure 7 Base Run conditions. The upper reaches of the Red River are fairly constant as only flows passing the structure influence the sediment transport. This area is outside the backwater influence of the operation of the ORCC.

Figure 13. WY2008 Scenario 3 BDD RR RM 43–RR RM 40.

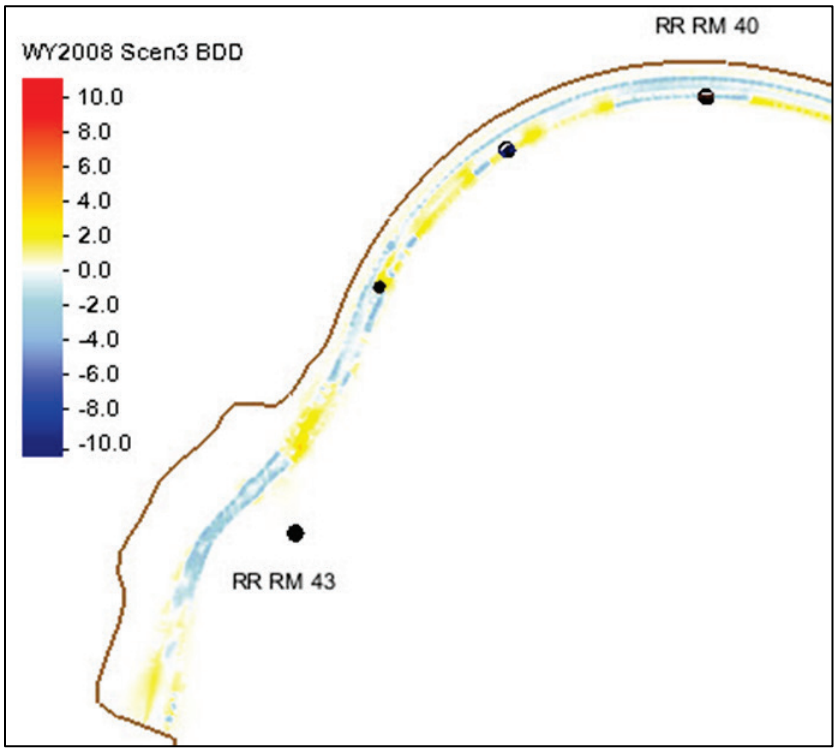


Figure 13 and Figure 14 have no appreciable difference than the Base Runs presented in Figure 7 and Figure 8.

Figure 14. WY2008 Scenario 3 BDD RR RM 35–RR RM 30.

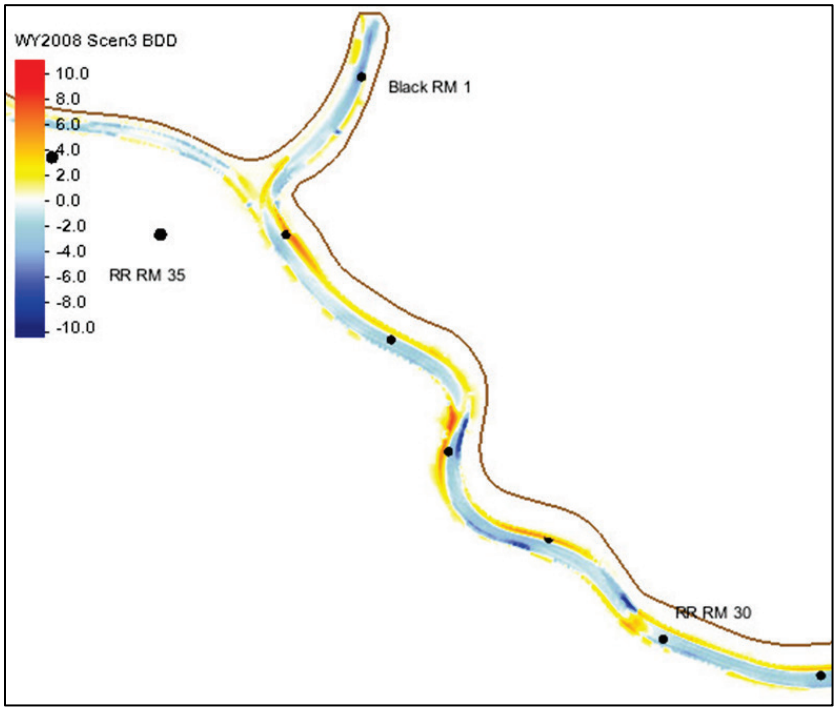


Figure 15 is no change compared to Figure 9 of the Base Run.

Figure 15. WY2008 Scenario 3 BDD RR RM 25–RR RM 20.

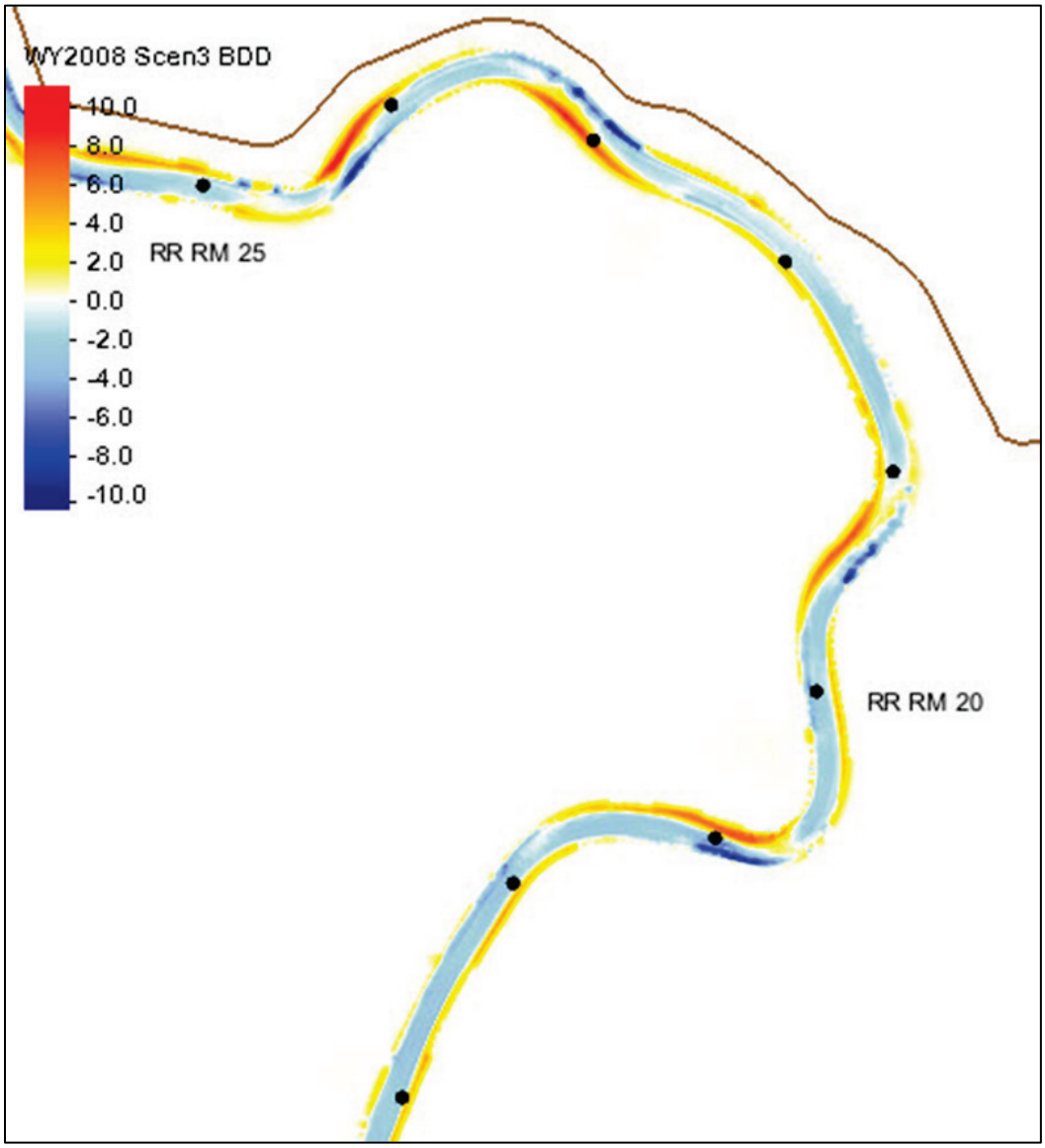


Figure 16 for Scenario 3 is much different as no flow through the hydropower unit drops sediment out at the confluence of the hydropower outfall channel and downstream in the Outflow Channel. There is also significant erosion at the confluence of the Low Sill and Auxiliary Structure outfall channels and downstream of that confluence. However, there is no change in the Red River between RR RM 15 and RR RM 10.

Figure 16. WY2008 Scenario 3 BDD RR RM 15–RR RM 10 and Outflow Channel.

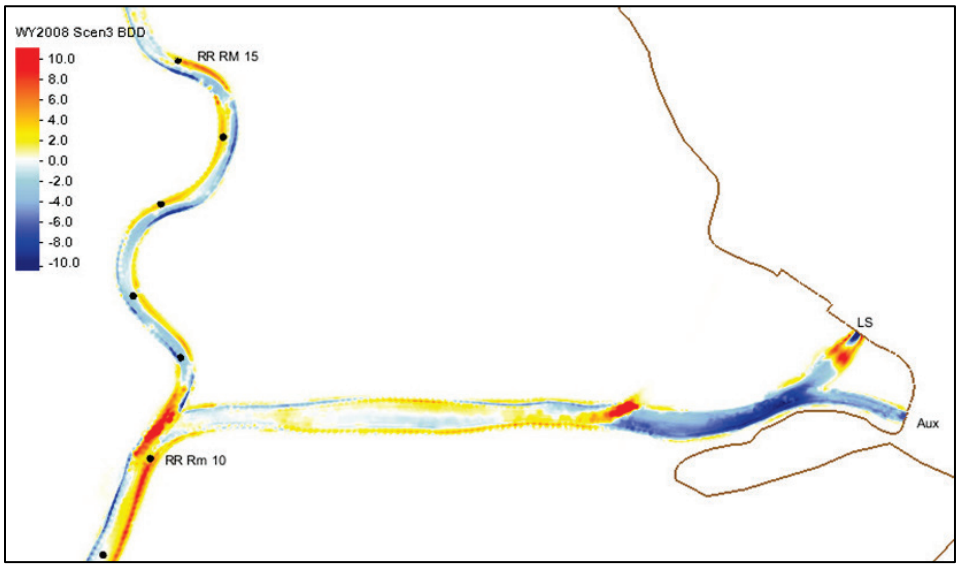
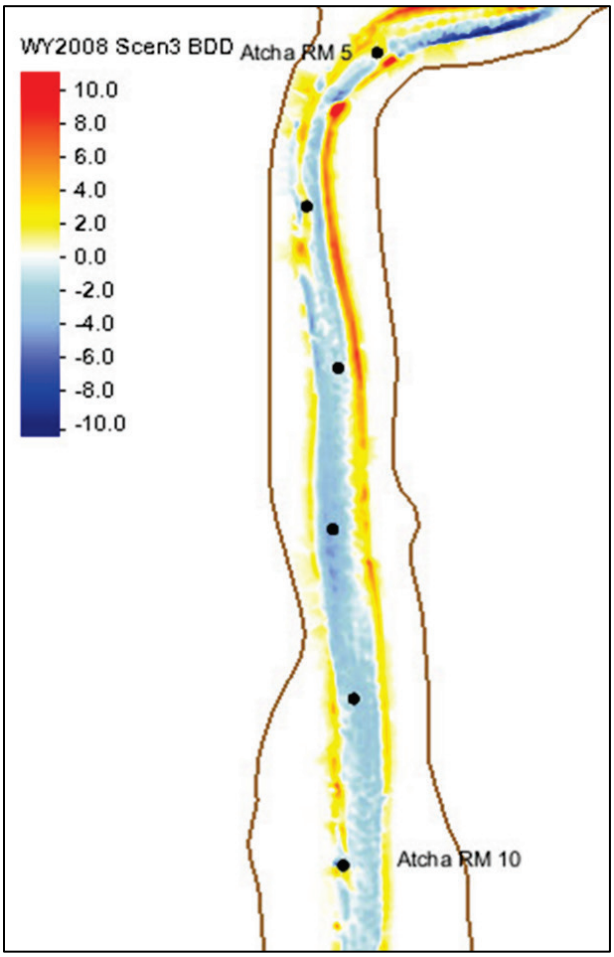
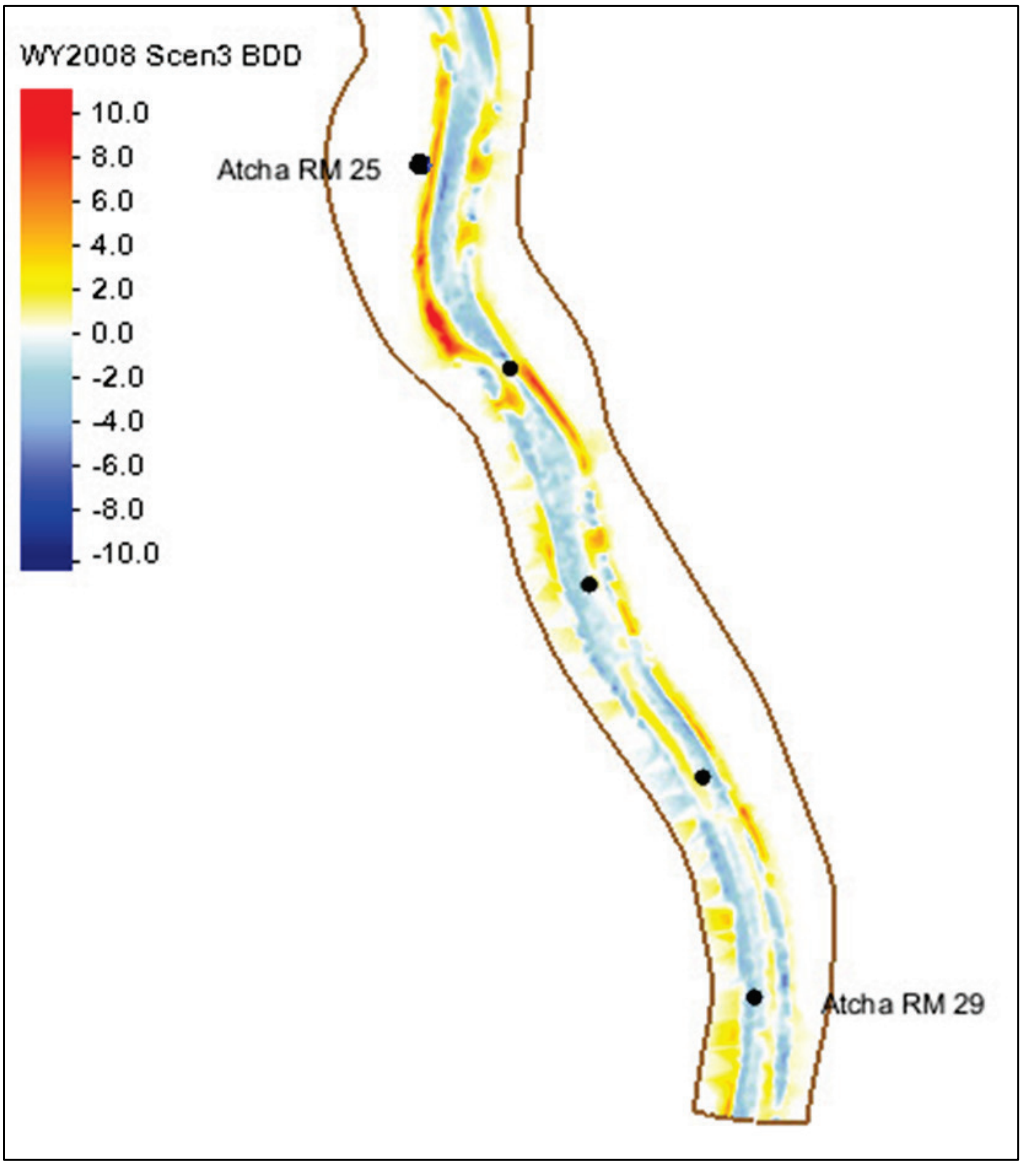


Figure 17. WY2008 Scenario 3 BDD Atcha RM 5-Atcha RM 10.



Comparing sediment transport trends of Figure 17 and Figure 18, there is not much change from the Base Runs, Figure 11 and Figure 12. No change in the trends in the Atchafalaya River for Scenario 3.

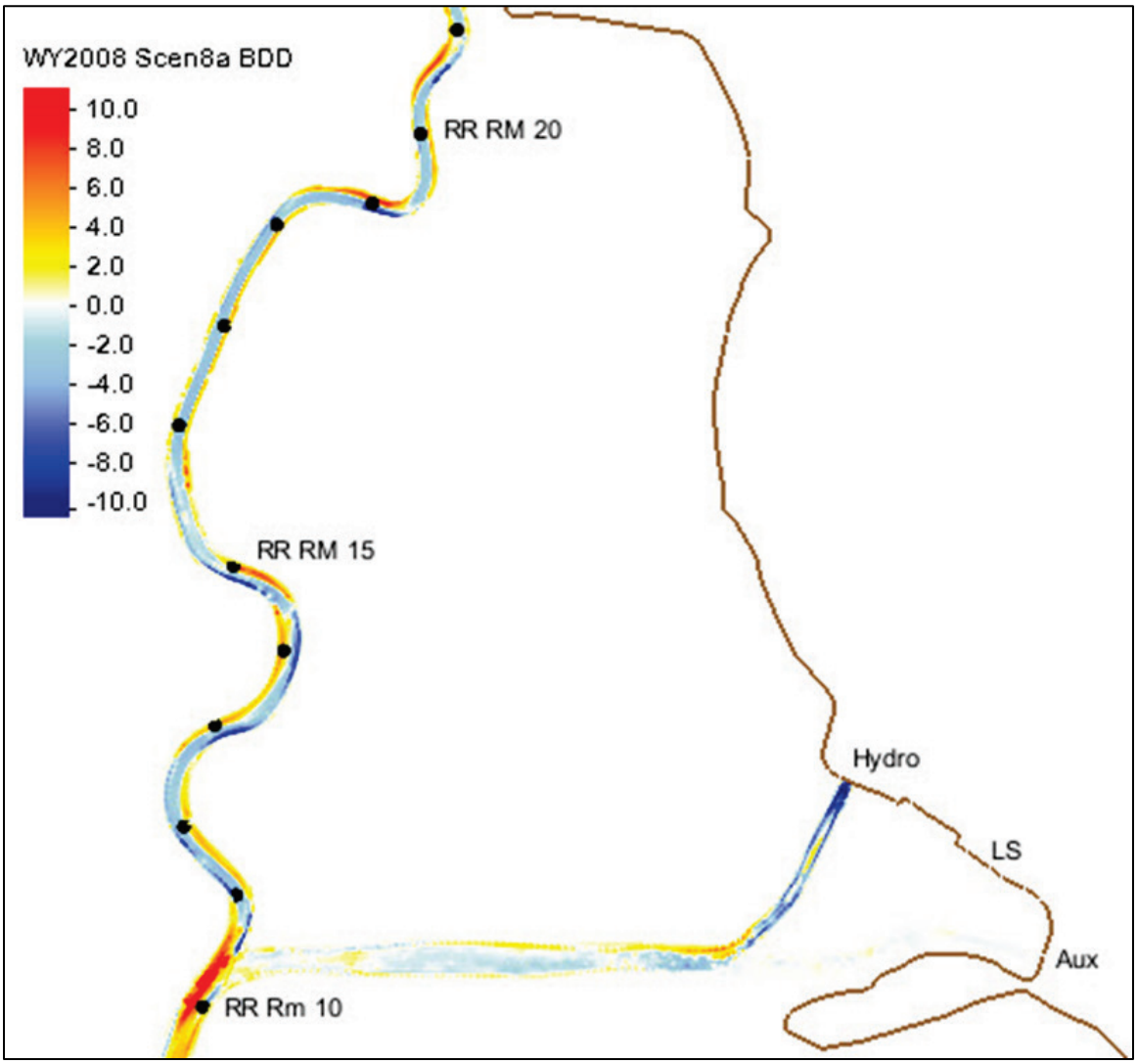
Figure 18. WY2008 Scenario 3 BDD Atcha RM 25-Atcha RM 29.



3.3 Scenario 8a bed displacement data

Scenario 8a is an 80/20 split with no constraints and is one of the lower flow scenarios. For the upper reach on the Red River, there is no change to the sediment trends. In the Outflow Channel (Figure 19), there is slightly more deposition as less energy to transport sediment than Figure 10 Base Run.

Figure 19. WY2008 Scenario 8a BDD RR RM 20–RR RM 10 and Outflow Channel.



Significantly less sediment deposited in Figure 20 and Figure 21 as less flow did not transport as much sediment to the Atchafalaya River as the Base Run, Figure 11 and Figure 12.

Figure 20. WY2008 Scenario 8a BDD Atcha RM 5-Atcha RM 15.

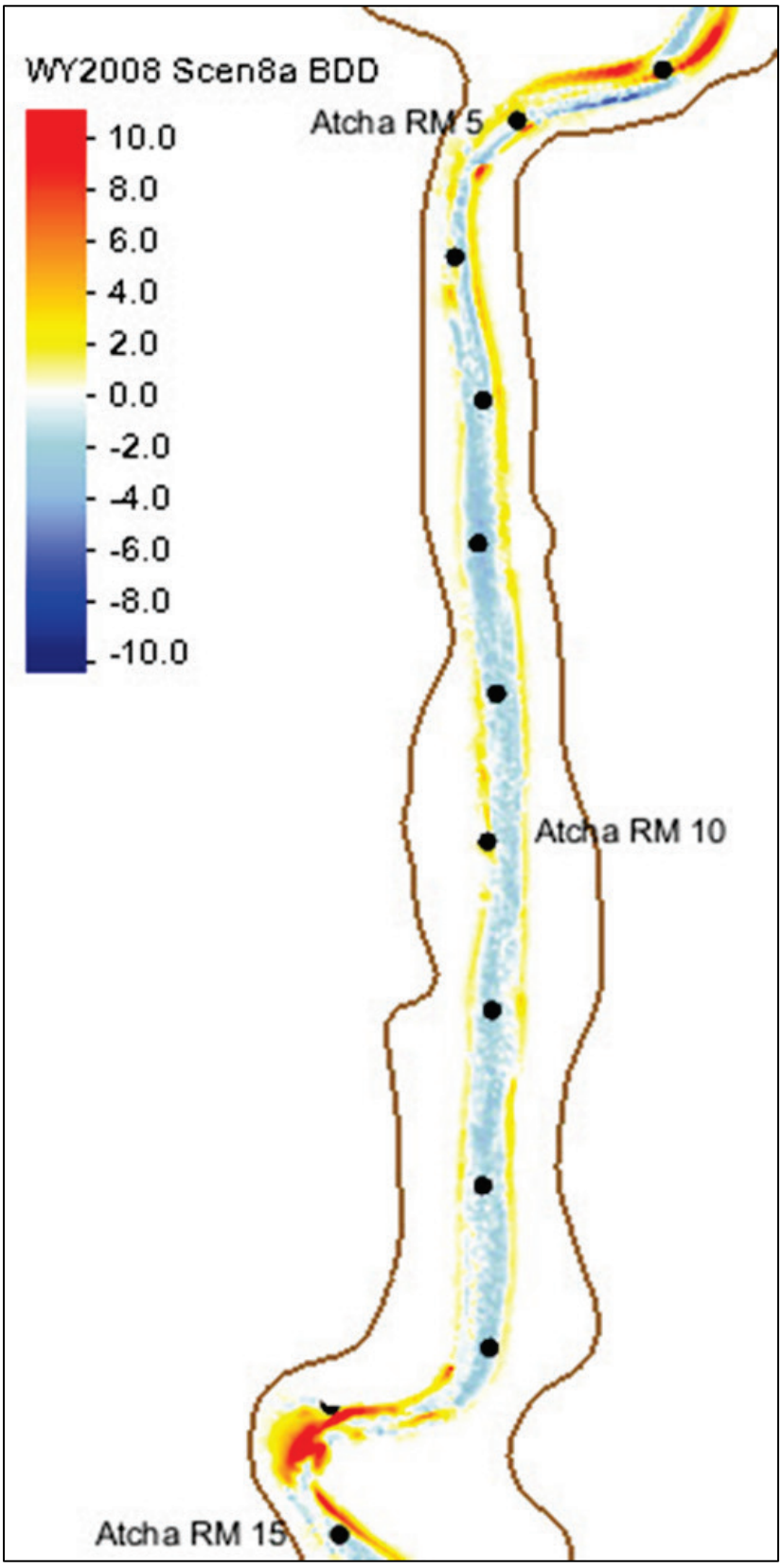
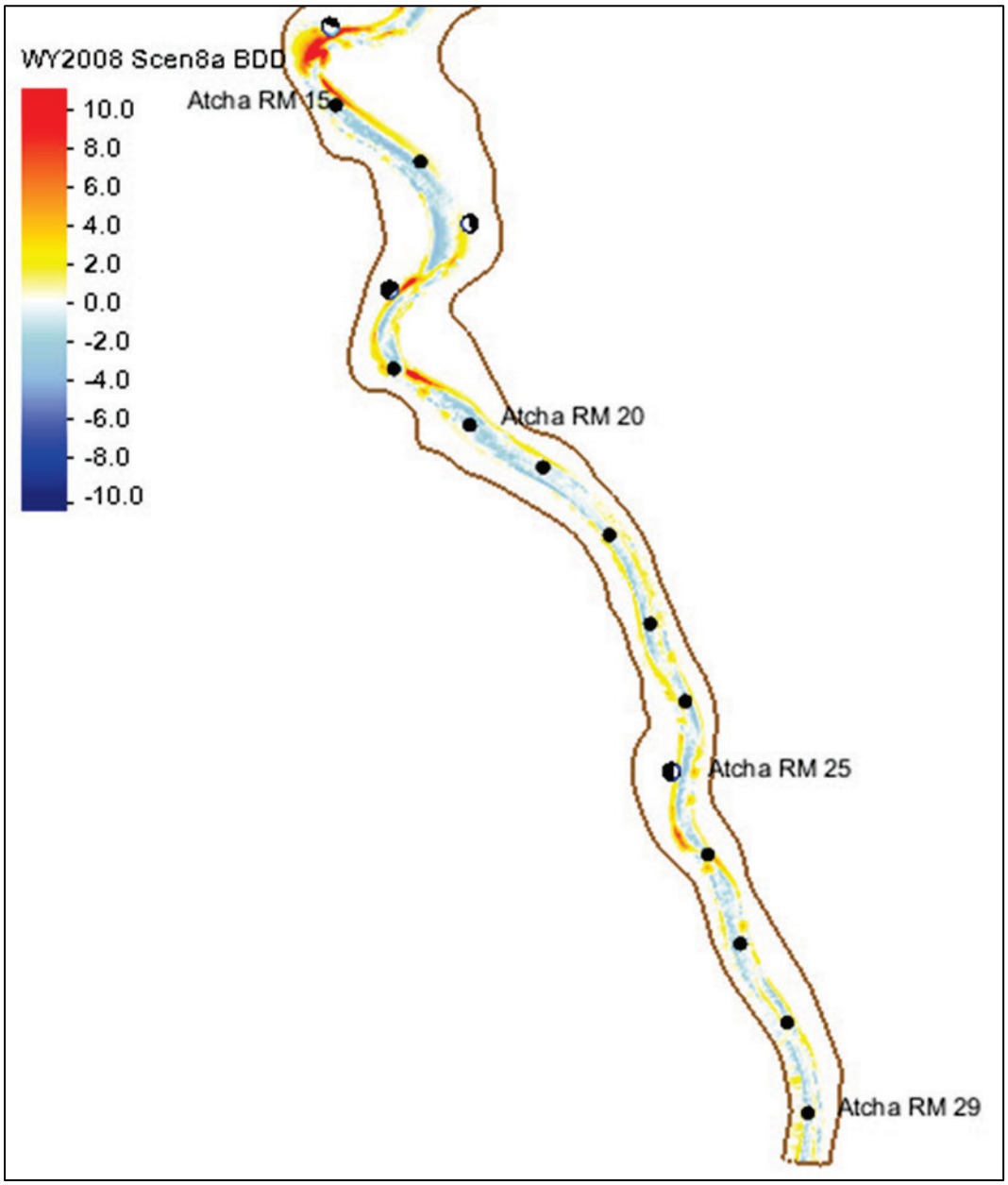


Figure 21. WY2008 Scenario 8a BDD Atcha RM 15-Atcha RM 29.



3.4 Scenario 9 bed displacement data

Scenario 9 consisted of a 60/40 split. Scenario 9 is the highest flow rates for the Red and Atchafalaya Rivers side of the ORCC. The reach of the Red River resulted in the same sediment transport trends as the base condition upstream of the confluence with the Outflow Channel. Figure 22 shows significant change as the Outflow Channel did not deposit as much sediment in the channel. However, significant amounts were deposited above top bank in the floodplain along the south bank line.

Figure 22. WY2008 Scenario 9 BDD RR RM 15–RR RM 10.

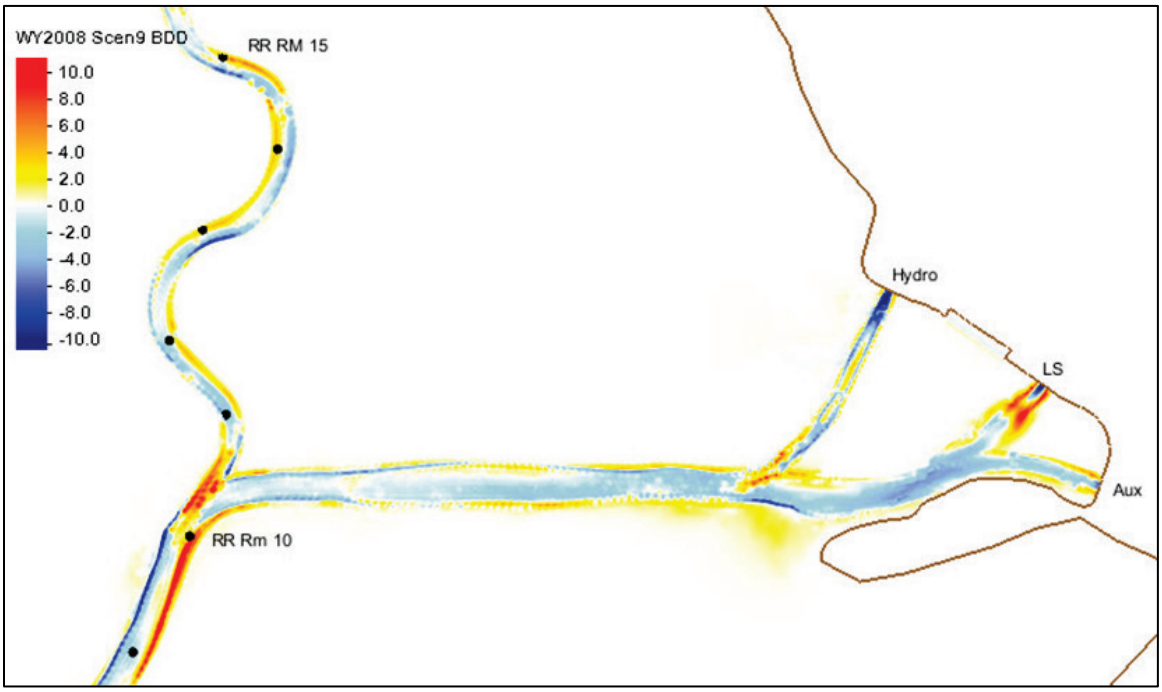


Figure 23 and Figure 24 show the same trends as the Base Run but with higher deposition and lower scour than Figure 11 and Figure 12.

Figure 23. WY2008 Scenario 9 BDD Atcha RM 5-Atcha RM 10.

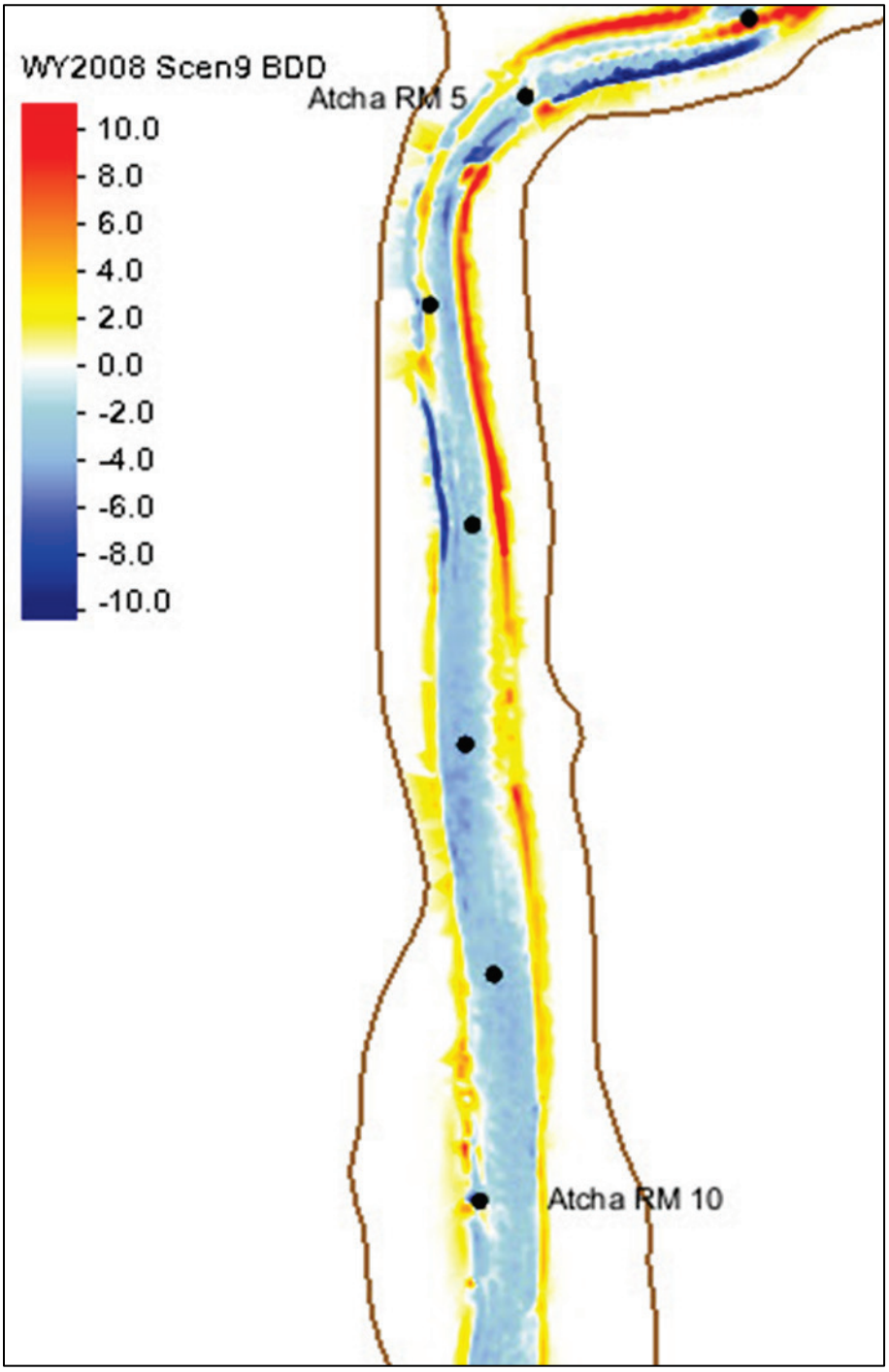
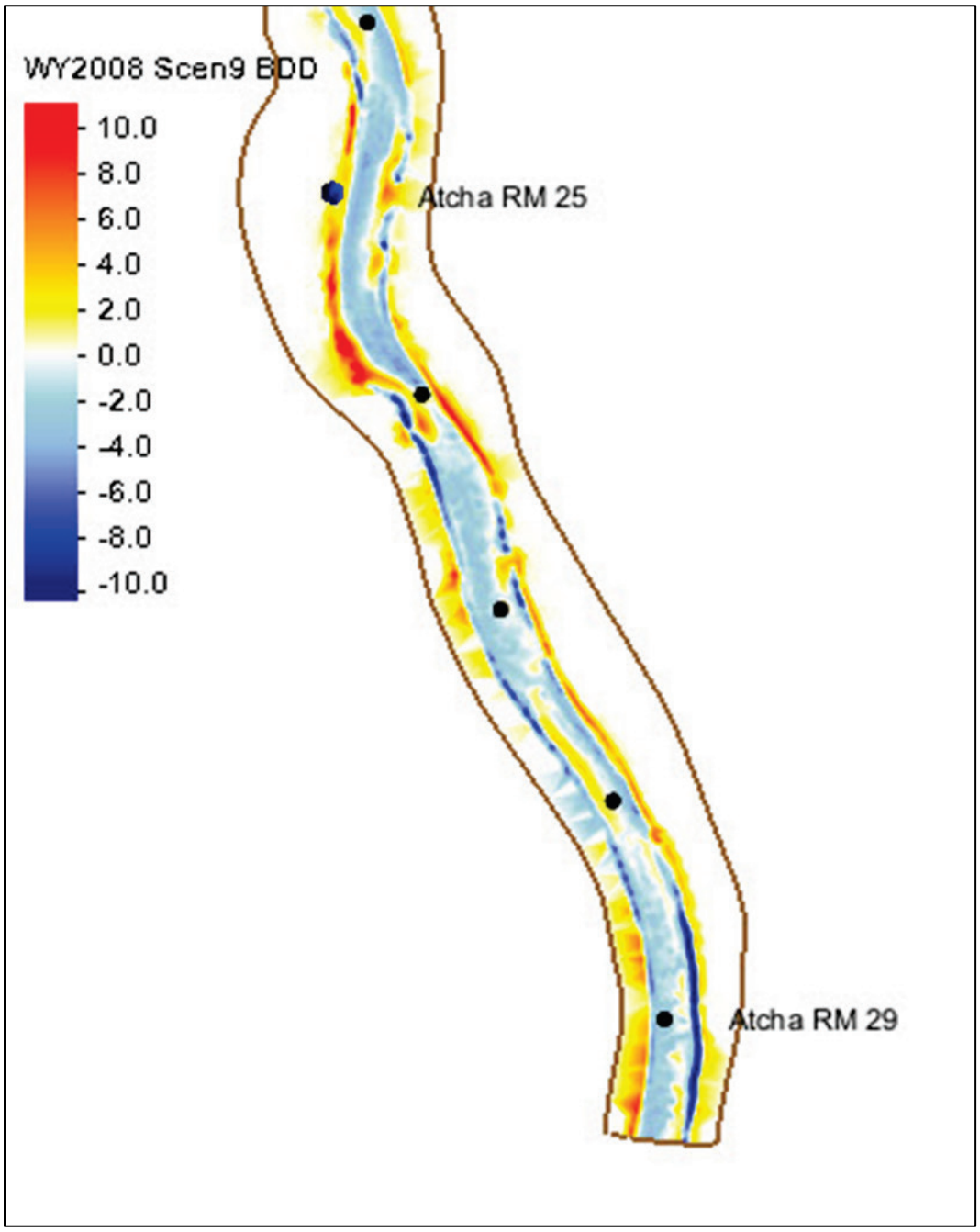


Figure 24. WY2008 Scenario 9 BDD Atcha RM 25-Atcha RM 29.



3.5 Dredge placement scenarios 11–14 bed displacement data

Dredging operations on the Mississippi River at various locations were investigated in *OMAR Assessment: Multi-Dimensional Sediment Analysis of ORCC Scenarios with Respect to Mississippi River Morphology* report. The result of that effort was to place the dredged material at a rate of 4.75 million tons/yr at four different locations downstream of the ORCC. Scenarios 11–14 are the dredge placement operations simulated and are depicted in Figure 25 and Table 5. Table 6 lists the sediment gradation for each scenario. Scenario 14 is different due to being dredged from a different location in the Mississippi River.

Figure 25. Dredge placement Scenarios 11–14.

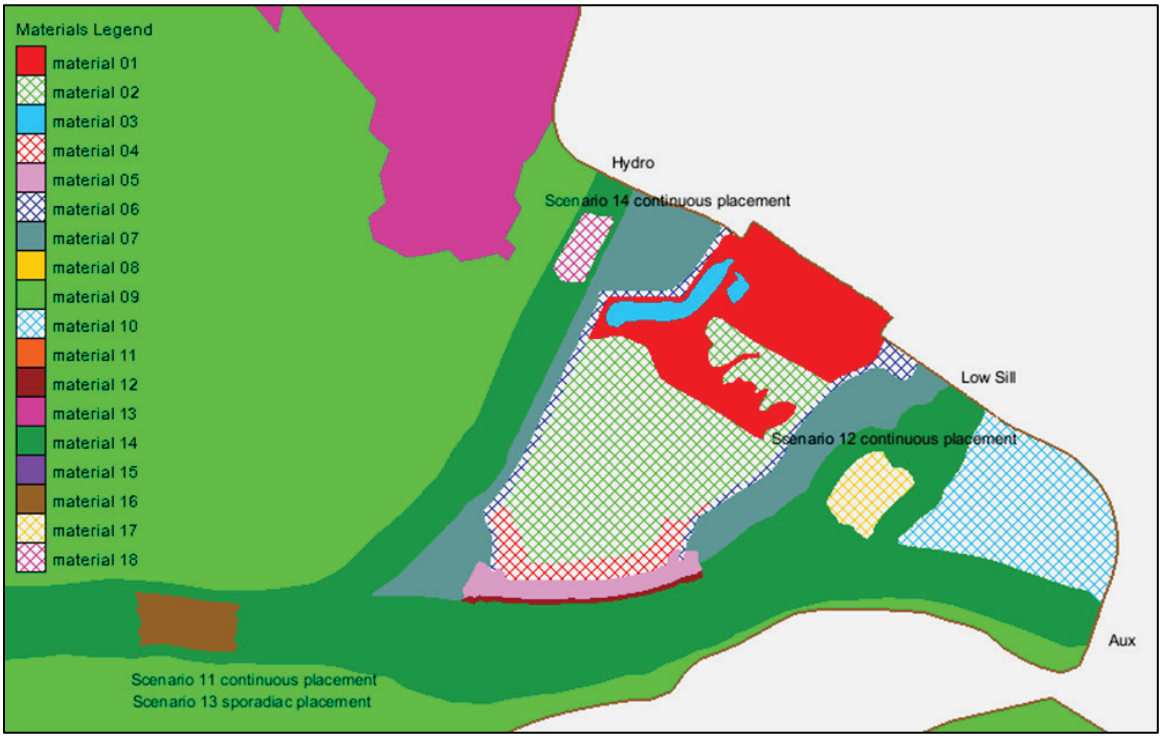


Table 5. Dredge placement conditions.

Scenario	Location	Placement Type	Rate
11	USGS-GAGE	Continuous	.079328 cm/sec
12	LOW SILL	Continuous	.079328 cm/sec
13	USGS-GAGE	Sporadic	???
14	HYDROPOWER	Continuous	.079328 cm/sec

Table 6. Dredge placement sediment gradations.

SCENARIO	POROSITY	VFS	FS	MS	CS	VCS	VFG	FG
11	0.35	0.17%	5.31%	53.73%	26.89%	2.40%	6.09%	5.41%
12	0.35	0.17%	5.31%	53.73%	26.89%	2.40%	6.09%	5.41%
13	0.35	0.17%	5.31%	53.73%	26.89%	2.40%	6.09%	5.41%
14	0.35	1.06%	10.25%	62.50%	23.90%	2.23%	0.04%	0.02%

BDD is presented in Figure 26 for Scenario 11. The WY2008 Base Run flow conditions were simulated while continuously placing dredge material just downstream of the Outflow Channel and Hydropower outfall channel confluence. The Outflow Channel aggrades at the location of the dredge material release and immediately downstream of that point. Flow goes around the release point along the north and south bank lines and shows erosion along these locations. Downstream of the Outflow Channel and Red River confluence the sediment trends are not affected, but there is slightly more deposition in areas that are aggrading.

Scenario 12 BDD (Figure 27) shows sediment depositing in the large scour hole just downstream of the Low Sill Structure (red area) at the release point of the dredge material. This is a result of the lack of vertical components of velocity in the two-dimensional model. Flow is diverted around the release point and erodes the blue area. There is no change in the sediment trends downstream.

Figure 28 presents Scenario 13 BDD sporadically releasing the dredge material. Flow erodes through the middle of the release point. Deposition occurs on either side and downstream along the bank lines. Downstream of the Outflow Channel and Red River confluence the sediment trends are not affected, but there is slightly more deposition in areas that are aggrading.

Figure 26. WY2008 Scenario 11 Outflow Channel.

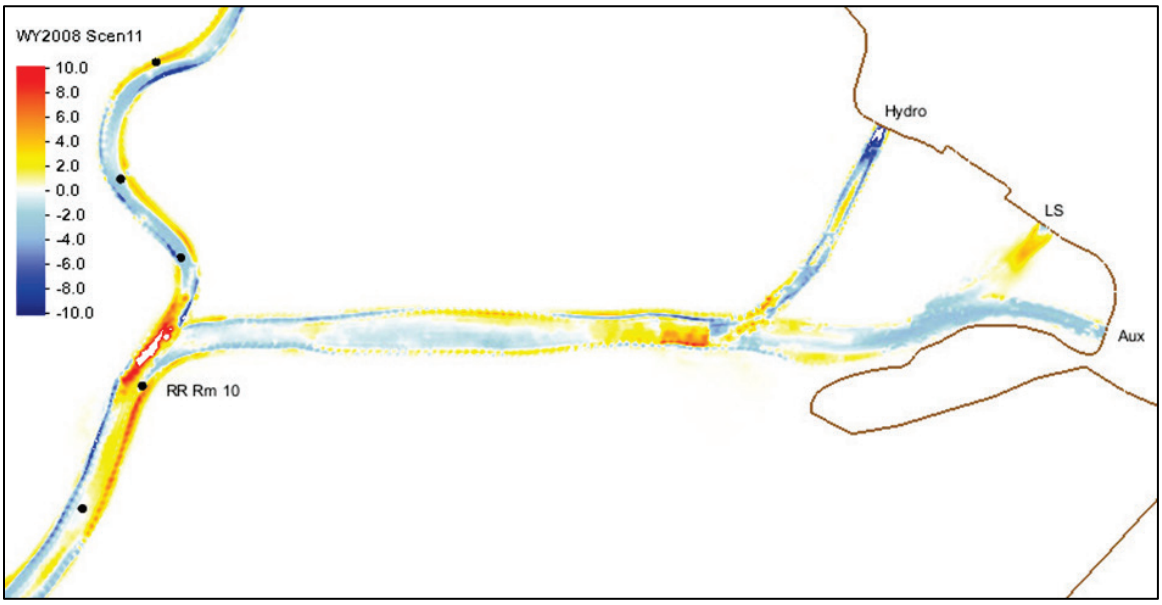


Figure 27. WY2008 Scenario 12 Outflow Channel.

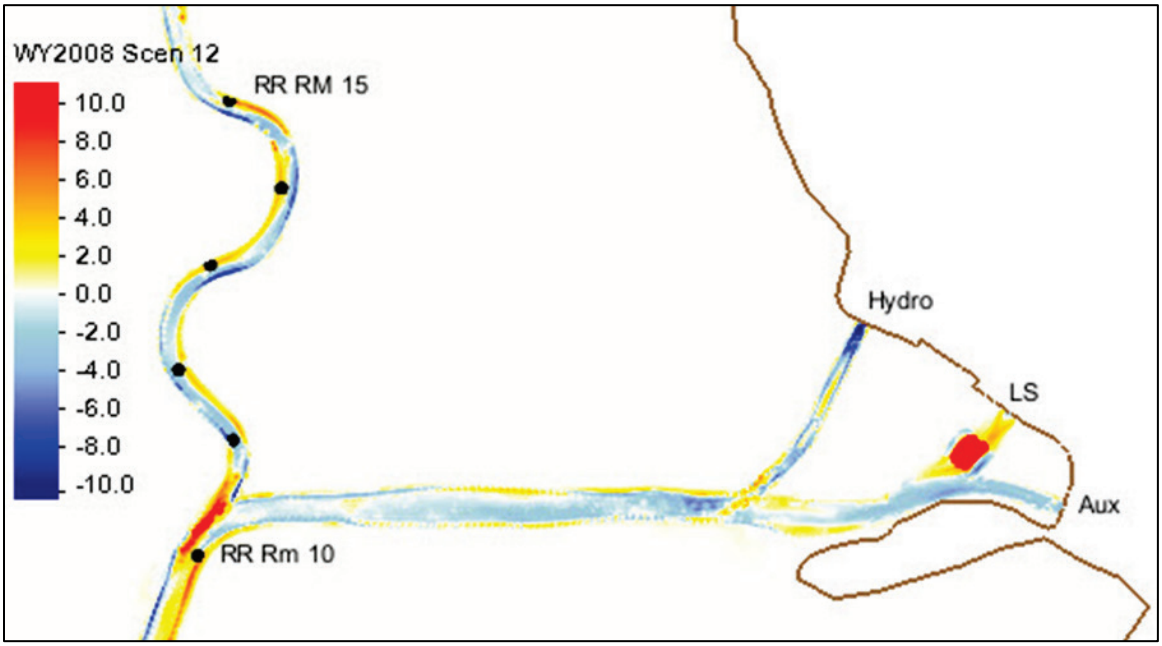
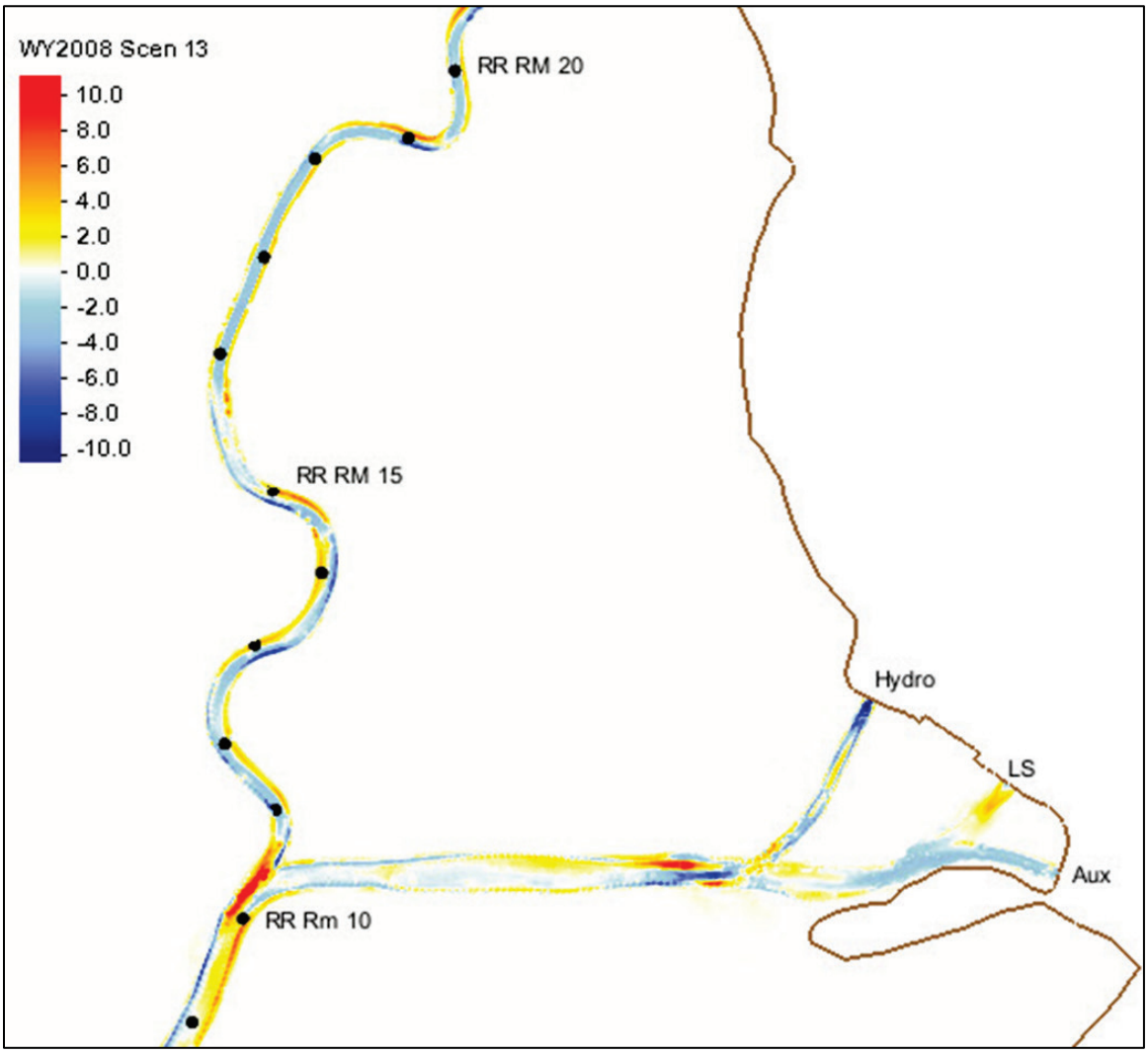


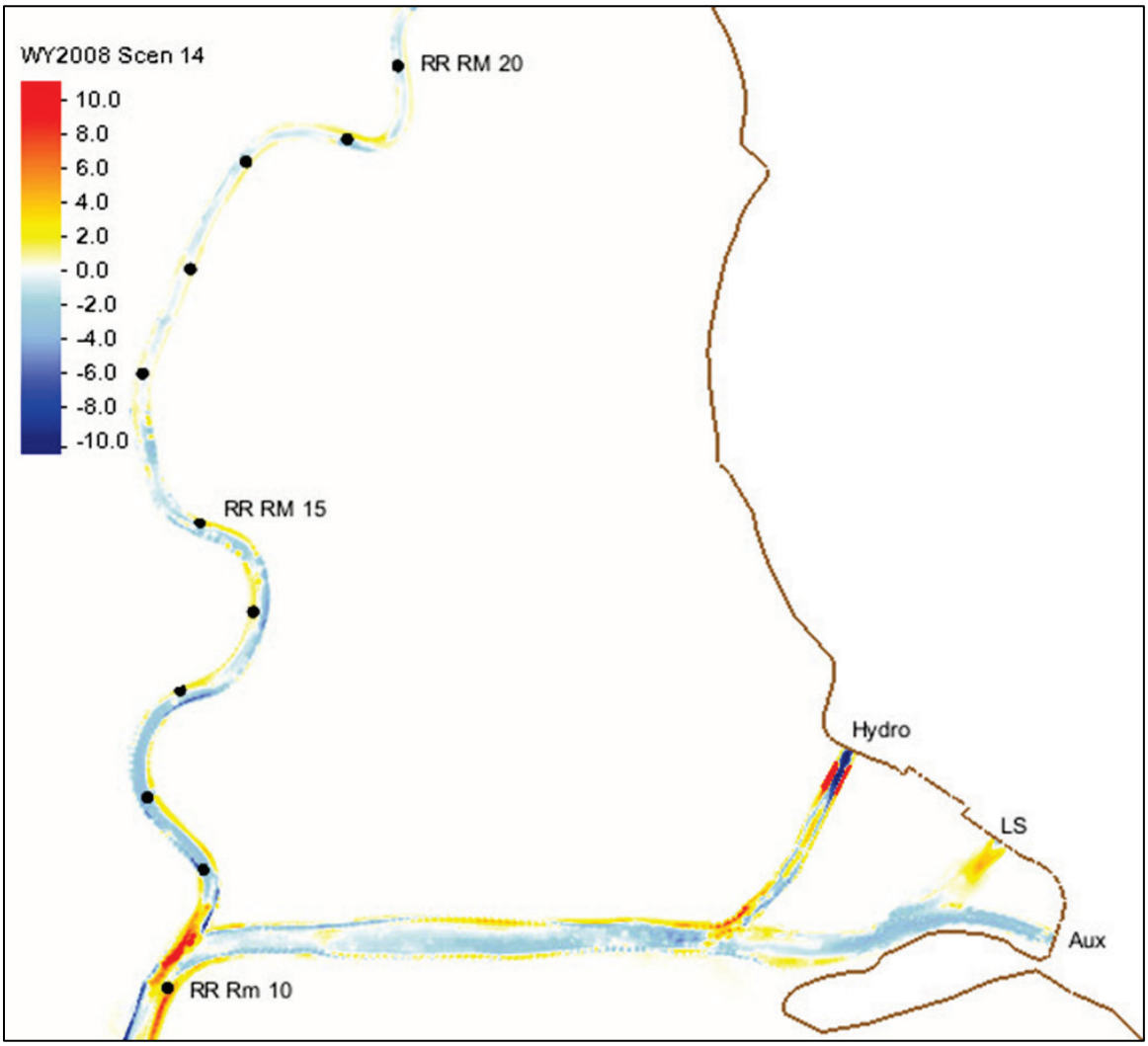
Figure 28. WY2008 Scenario 13 Outflow Channel.



In Scenario 14 BDD (Figure 29), dredge material is continuously released downstream of the hydropower structure. The bulk of the material is deposited along the banks of the hydropower channel with flow eroding through the center of the release point. More sediment is deposited in the Hydropower Channel than the Base Run. Downstream sediment trends are the same with slightly more sediment deposited than the Base Run.

The BDD for all river miles (Scenarios 11–14) are in Appendix A: WY2008 Bed Displacement Data, Plates 93–120.

Figure 29. WY2008 Scenario 14 Outflow Channel.



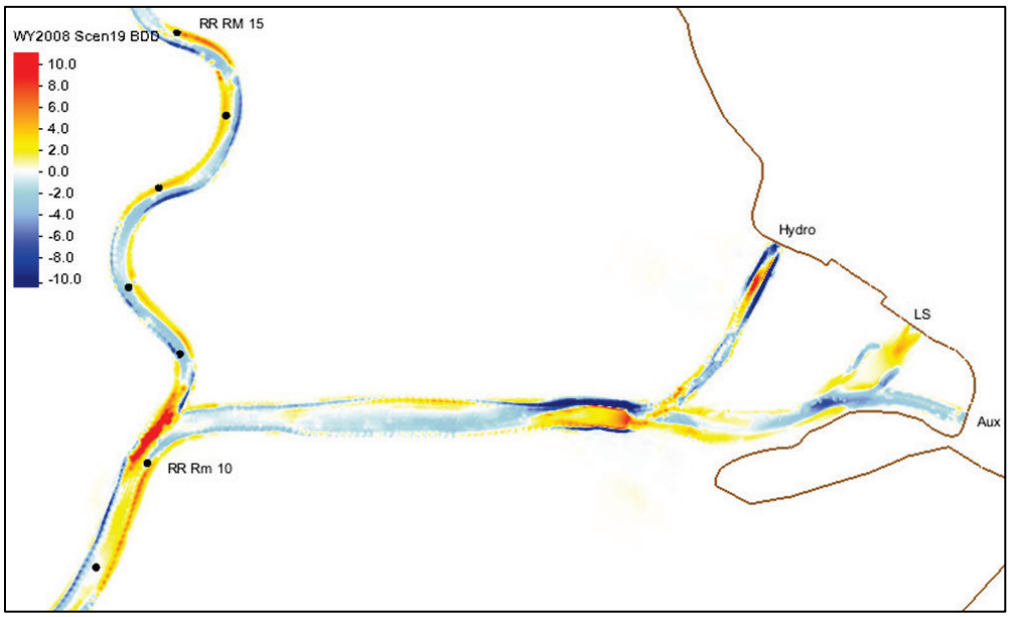
3.6 Structure Options Scenario 19 and 20

Structure Options simulated two separate dike fields in the Outflow Channel. The dike elevation was set infinity high as to maximize the drag coefficient and the dikes were always above the water surface elevation. Scenario 19 consisted of 15 dikes arrayed in Figure 30.

Figure 30. Structure Option Scenario 19 dike locations.

BDD in Figure 31 shows scour downstream of the most easterly two dike fields and deposition along the south bank above the top of bank. Downstream of the most westerly two dike field's sediment deposits in the center of the Outflow Channel forcing the flow to attack the north and south banks, thus, eroding areas along the bank lines.

Figure 31. WY2008 BDD Scenario 19 Outflow Channel.



Scenario 20 consisted of seven dikes along the south bank of the Outflow Channel (Figure 32).

Figure 32. Structure Option Scenario 20 dike locations.

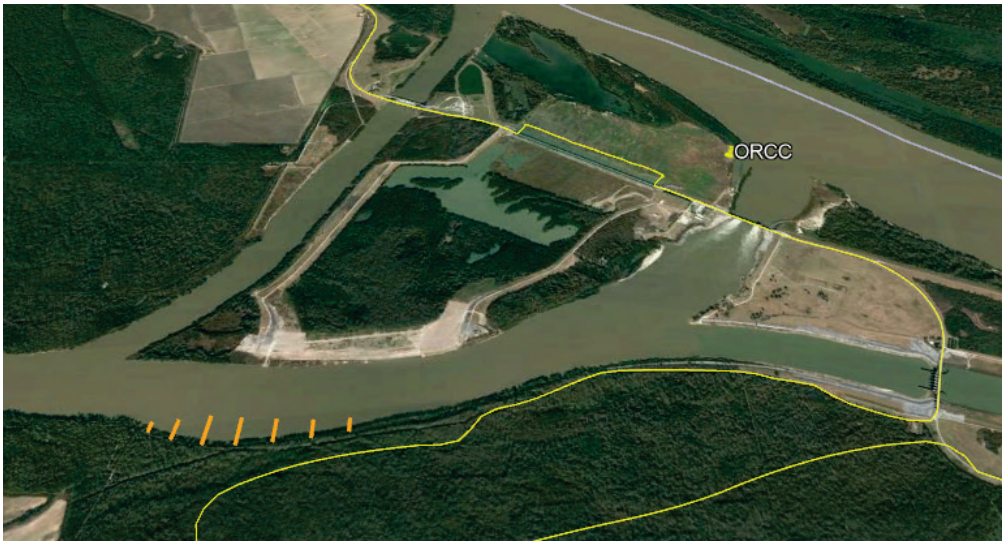
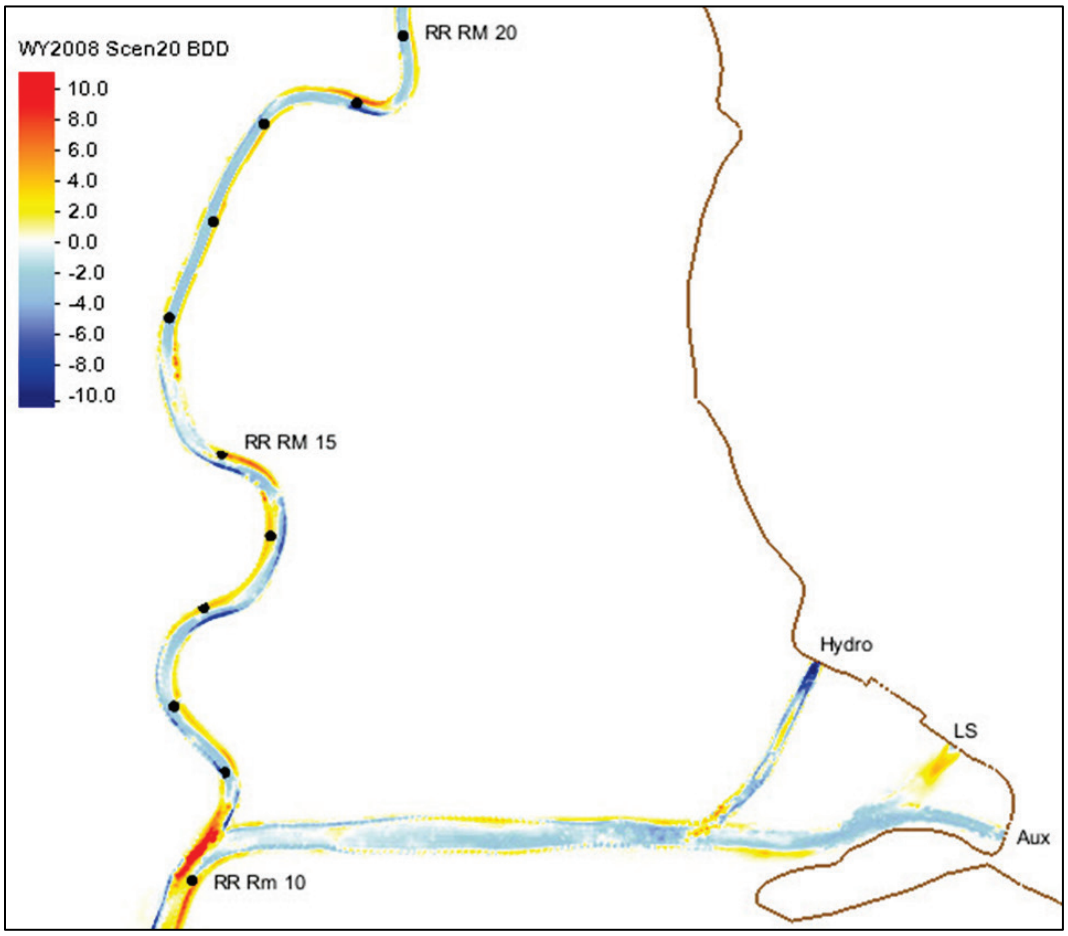


Figure 33. WY2008 BDD Scenario 20 Outflow Channel.

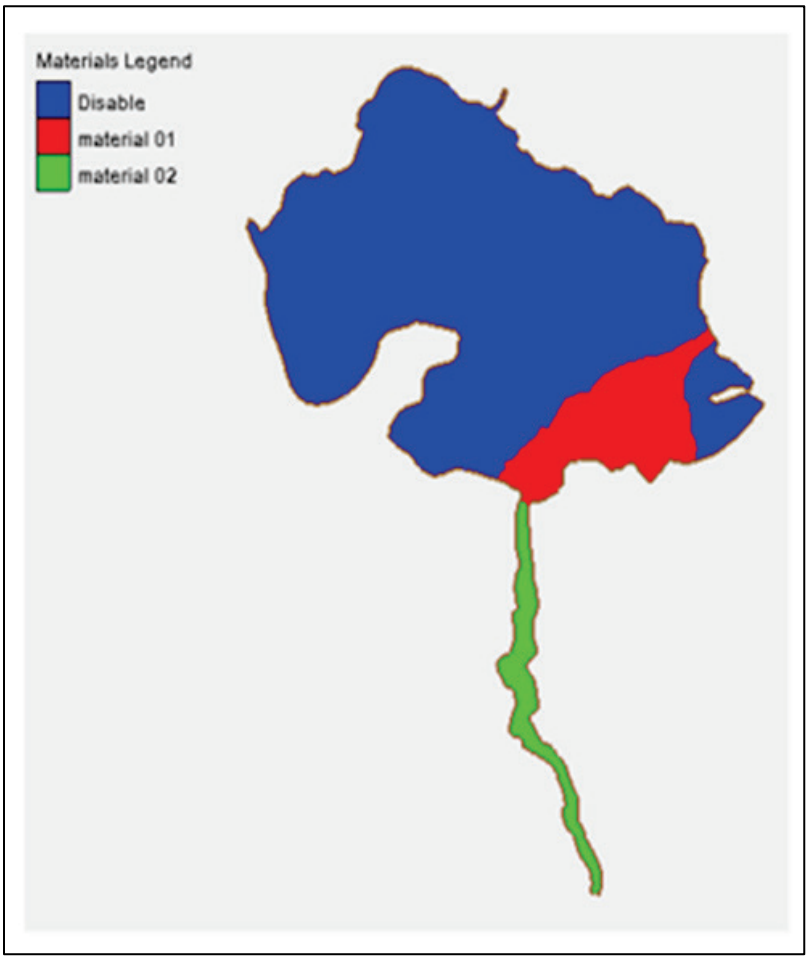


Deposition occurred throughout the dike field, and the center of the Outflow Channel eroded deeper than the Base Run. There was no appreciable change of sediment trends from the Base Run downstream of Scenario 20 dike field (Figure 33).

3.7 WY2008 bed sediment volume change (BSVC)

Bed sediment volume change (BSVC) was calculated in each simulation by material. Figure 34 is the material legend for the material areas. Material 1 is designated by the red area and Material 2 by the green area (Simmesport to Melville). Appendix B: WY2008 Bed Sediment Volume Change contain the BSVC plots of materials 1 and 2 for Base Run, Scenarios 3–10, Dredge Placement Scenarios 11–14, and Structures Options Scenarios 19 and 20.

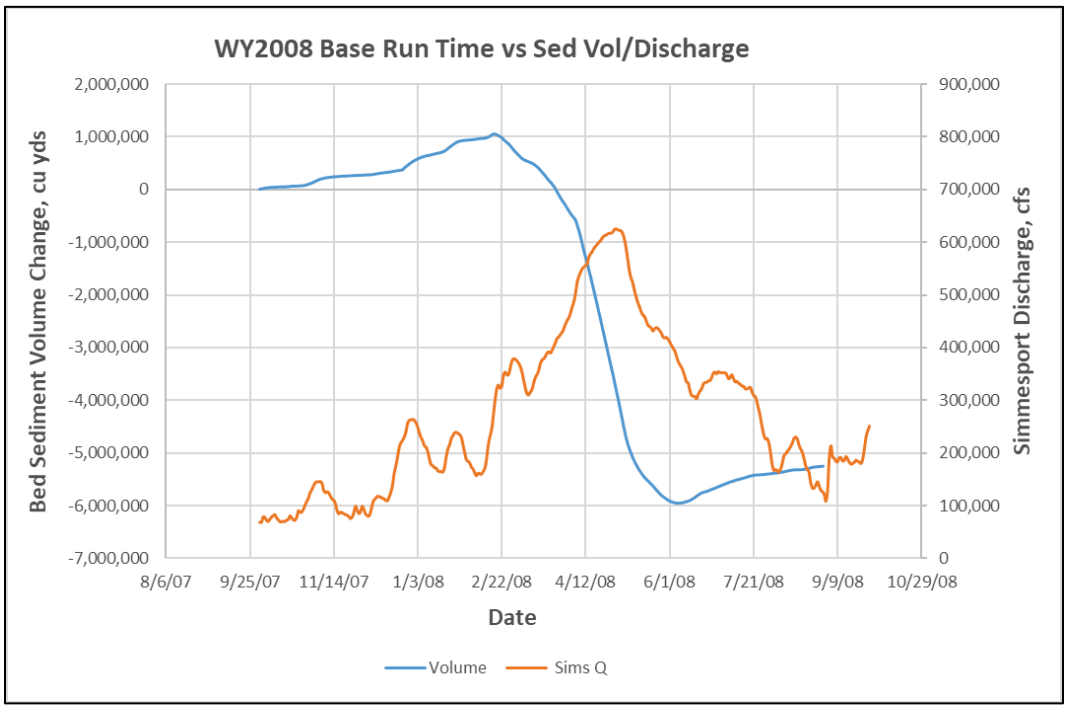
Figure 34. Bed sediment volume change (BSVC) legend.



3.7.1 Material 1 Base Run and Scenarios 3–10

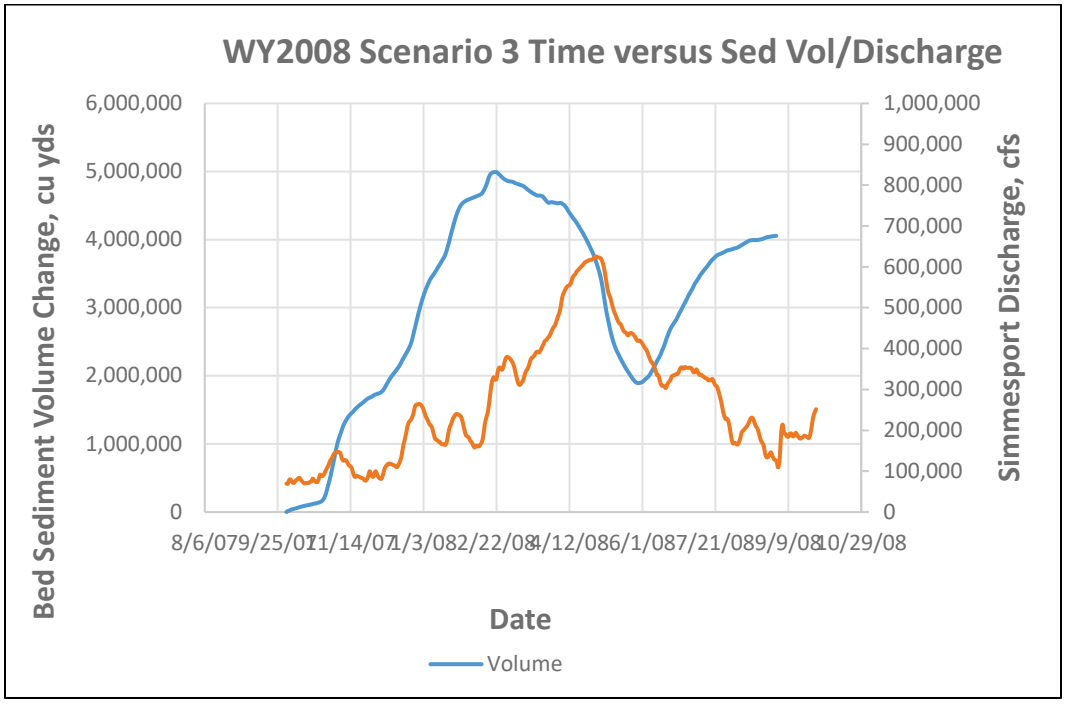
WY2008 Base Run time history plot verses material 1 bed sediment volume change and Simmesport discharge (Figure 35) produced over 5 million cu yd of eroded bed material. Simmesport discharge less than 325,000 cfs material 1 area aggraded and greater than 325,000 cfs degraded. Maximum Simmesport discharge is 625,000 cfs.

Figure 35. Material 1 Base Run time versus sediment volume change/Simmesport discharge.



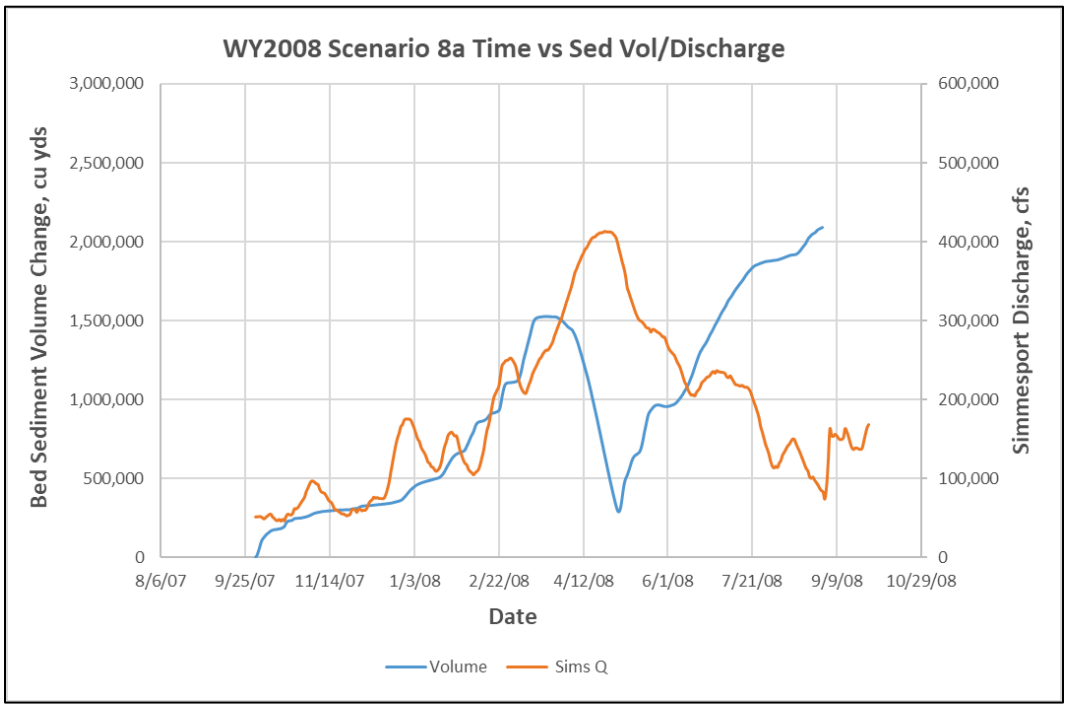
WY2008 Scenario 3 BSVC (Figure 36) aggraded in excess of 4 million cu yd. Maximum discharge is 625,000 cfs.

Figure 36. Material 1 Scenario 3 time versus sediment volume change/Simmesport discharge.



WY2008 Scenario 8a BSVC (Figure 37) aggraded in excess of 2 million CY Maximum discharge is 410,000 cfs.

Figure 37. Material 1 Scenario 8a time versus sediment volume change/Simmesport discharge.



WY2008 Scenario 9 BSVC (Figure 38) degraded in excess of 5.25 million cu yd. Maximum discharge is 830,000 cfs.

The discharge threshold for erosion and deposition for material 1 WY2008 was 325,000 cfs at Simmesport. Figure 39 presents the time history of BSVC Base Run and Scenarios 3–10. Lower flow split scenarios 3, 8a, and 8b are consistently aggradational overall. Higher flow split Base Run and Scenarios 4, 5, 6, 7, 9, and 10 were degradational.

Figure 38. Material 1 Scenario 9 time versus sediment volume change/Simmesport discharge.

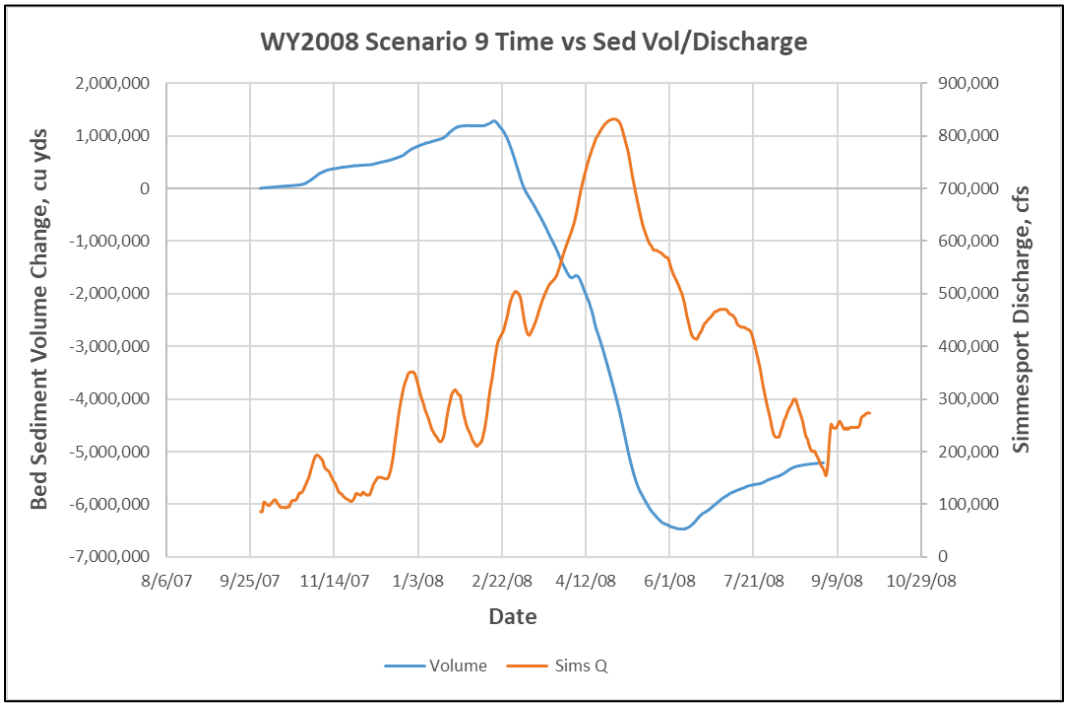
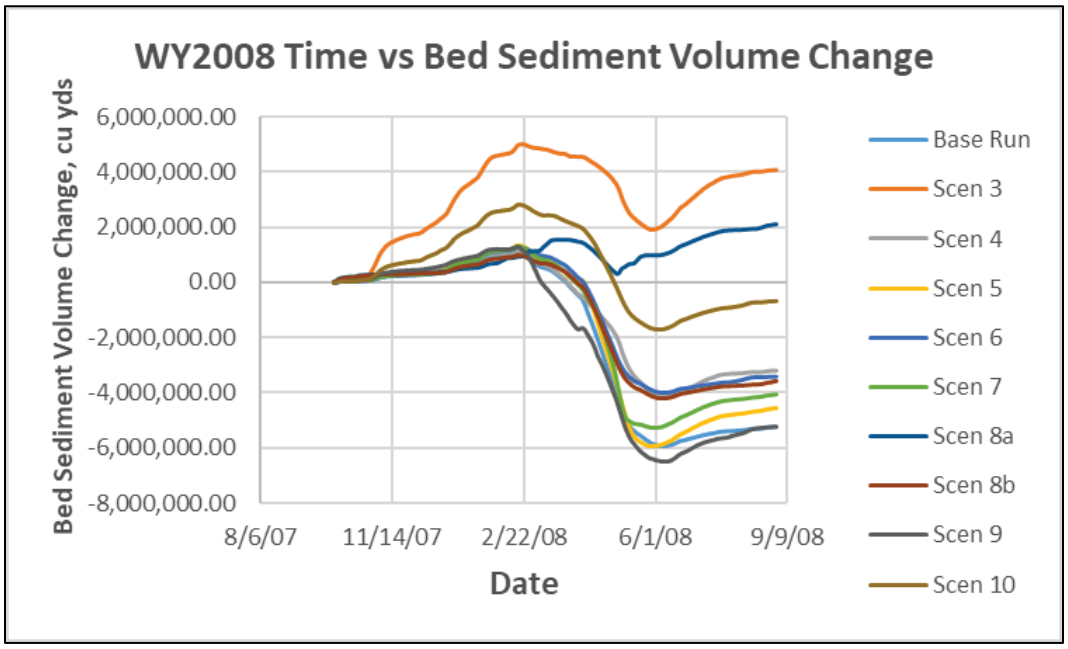


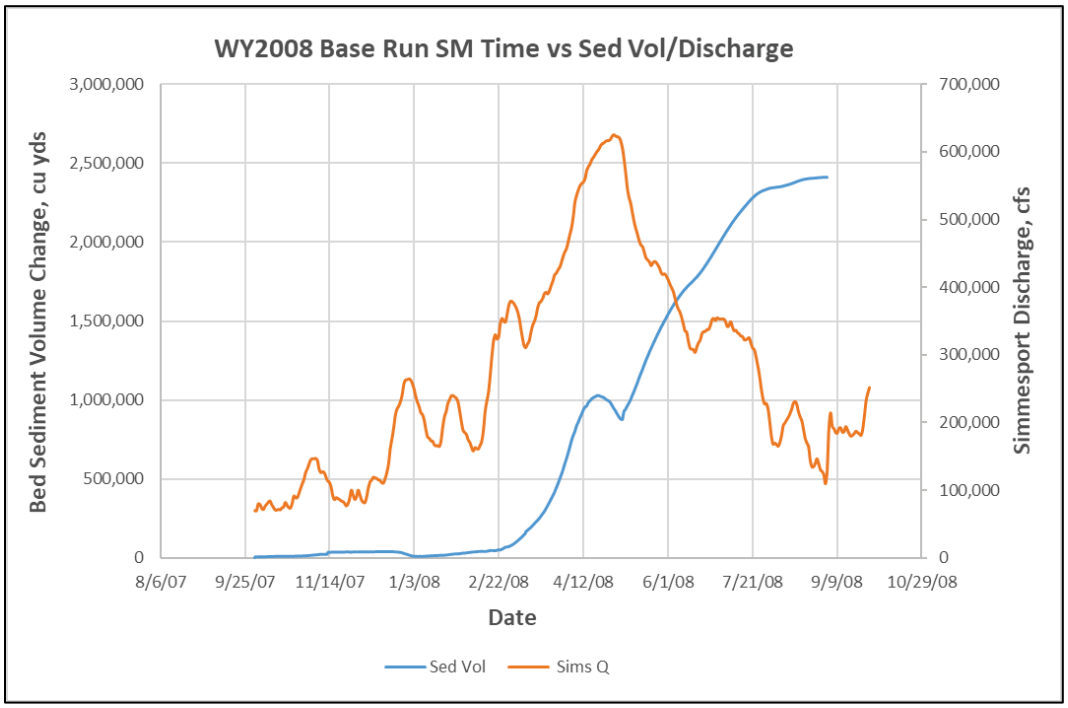
Figure 39. Material 1 all scenarios time versus sediment volume change.



3.7.2 Material 2 Base Run and Scenarios 3–10

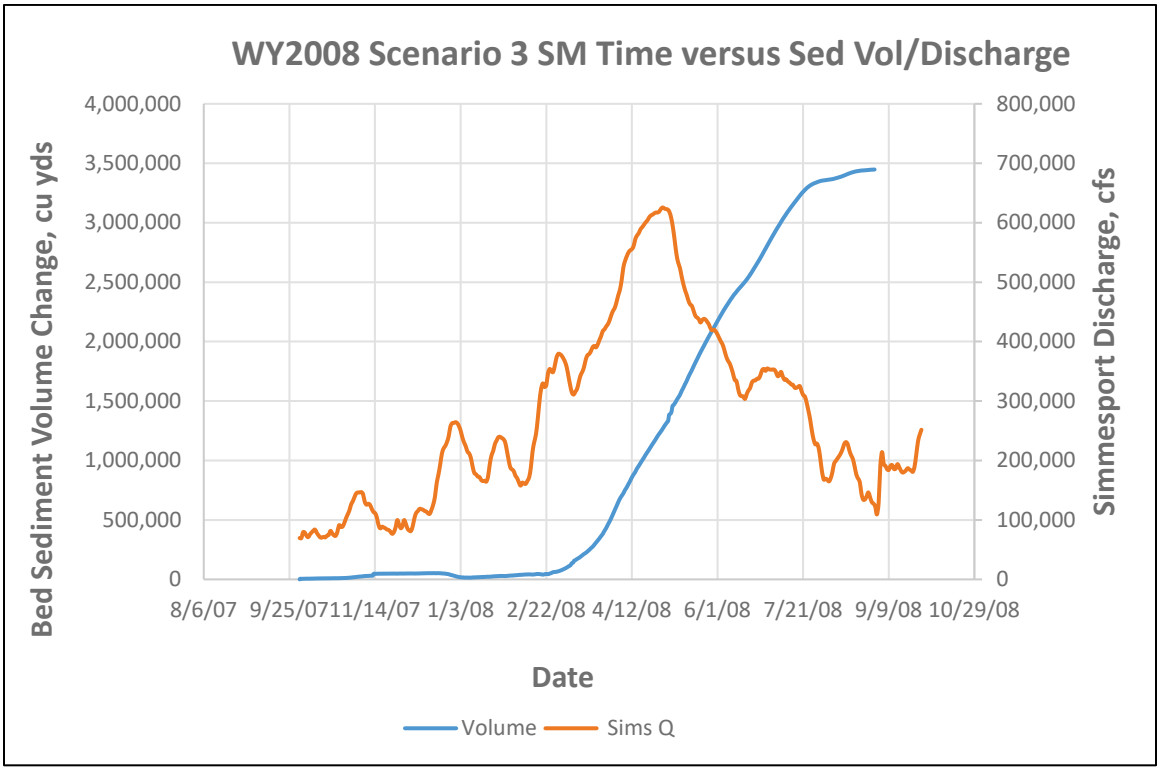
WY2008 Material 2 Base Run in Figure 40 produced 2.4 million cu yd of aggraded bed material. The erosion and deposition discharge threshold between Simmesport and Melville is 600,000 cfs.

Figure 40. Material 2 WY2008 Base Run time versus BSVC/Simmesport discharge.



WY2008 Material 2 scenario 3 in Figure 41 produced slightly less than 3.5 million cu yd of aggraded bed material. Maximum discharge was 540,000 cfs, therefore, aggrading the whole water year.

Figure 41. Material 2 WY2008 Scenario 3 time versus BSVC/Simmesport discharge.



WY2008 Scenario 8a (Figure 42) aggraded 2.4 million cu yd over the water year with a maximum discharge of 410,000 cfs.

Figure 42. Material 2 WY2008 Scenario 8a time versus BSVC/Simmesport discharge.

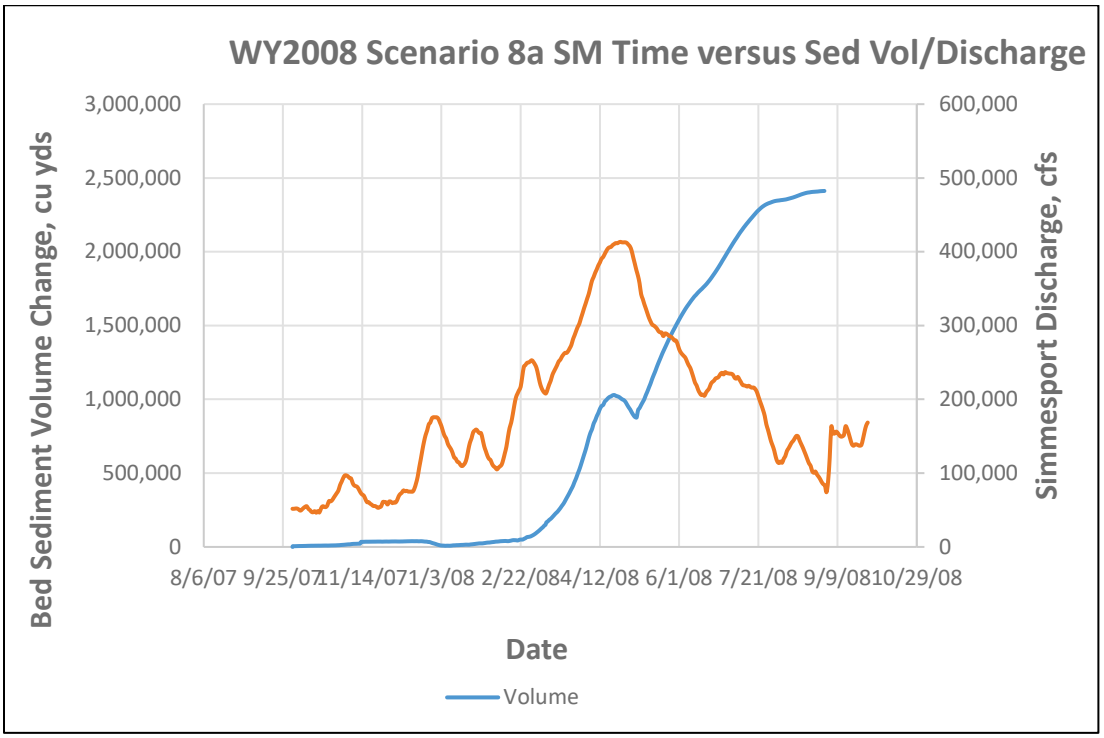
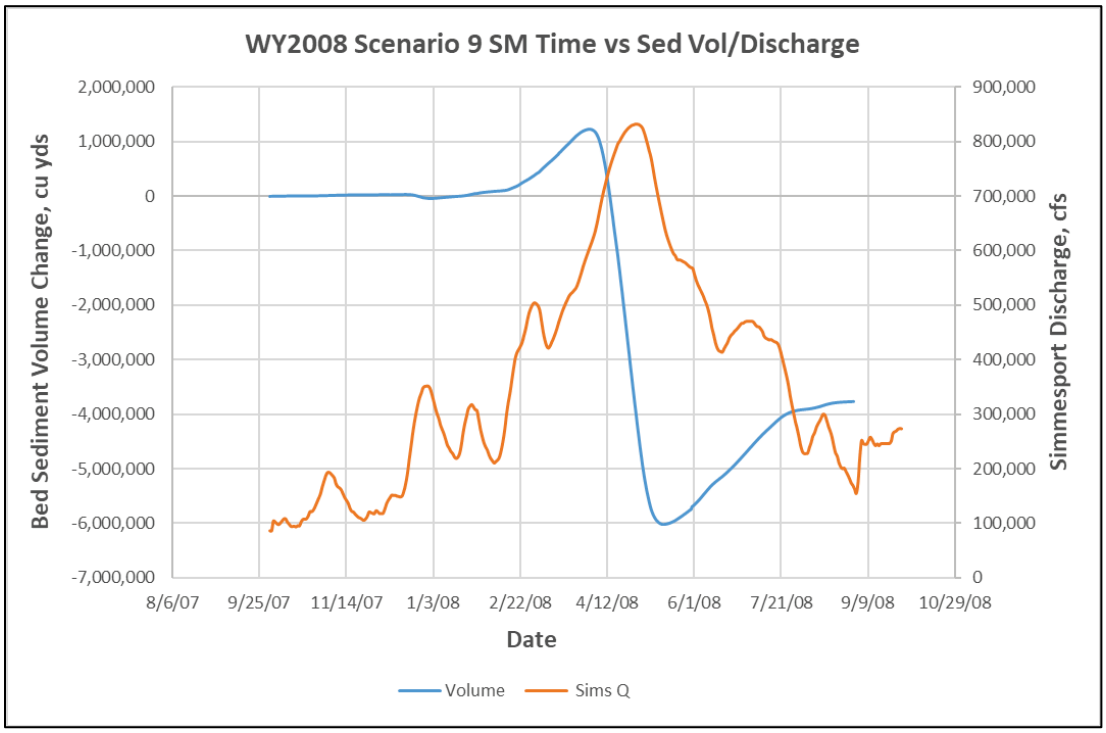


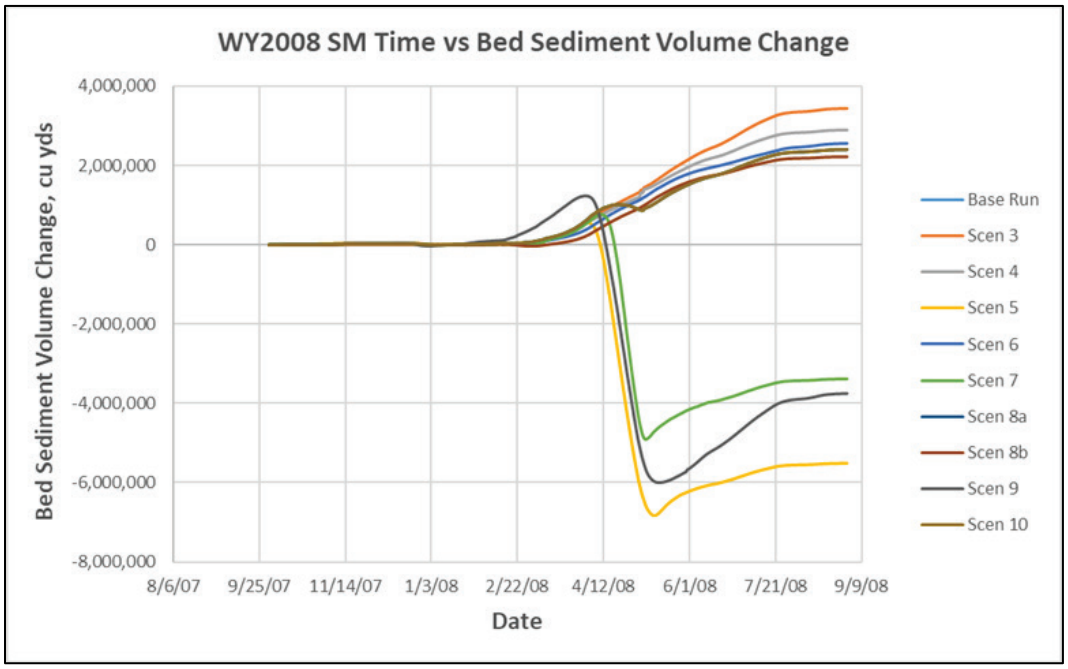
Figure 43 shows Scenario 9 eroding 3.8 million cu yd with a maximum discharge of 830,000 cfs.

Figure 43. Material 2 WY2008 Scenario 9 time versus BSVC/Simmesport discharge.



WY2008 Base Run and Scenarios 3–10 BSVC (Figure 44) show Scenarios 5, 7, and 9 as degrading over the water year. These are the only scenarios exceeding the 600,000 cfs discharge from Simmesport to Melville.

Figure 44. Material 2 WY2008 Base Run and Scenarios 3–10 time versus BSVC.

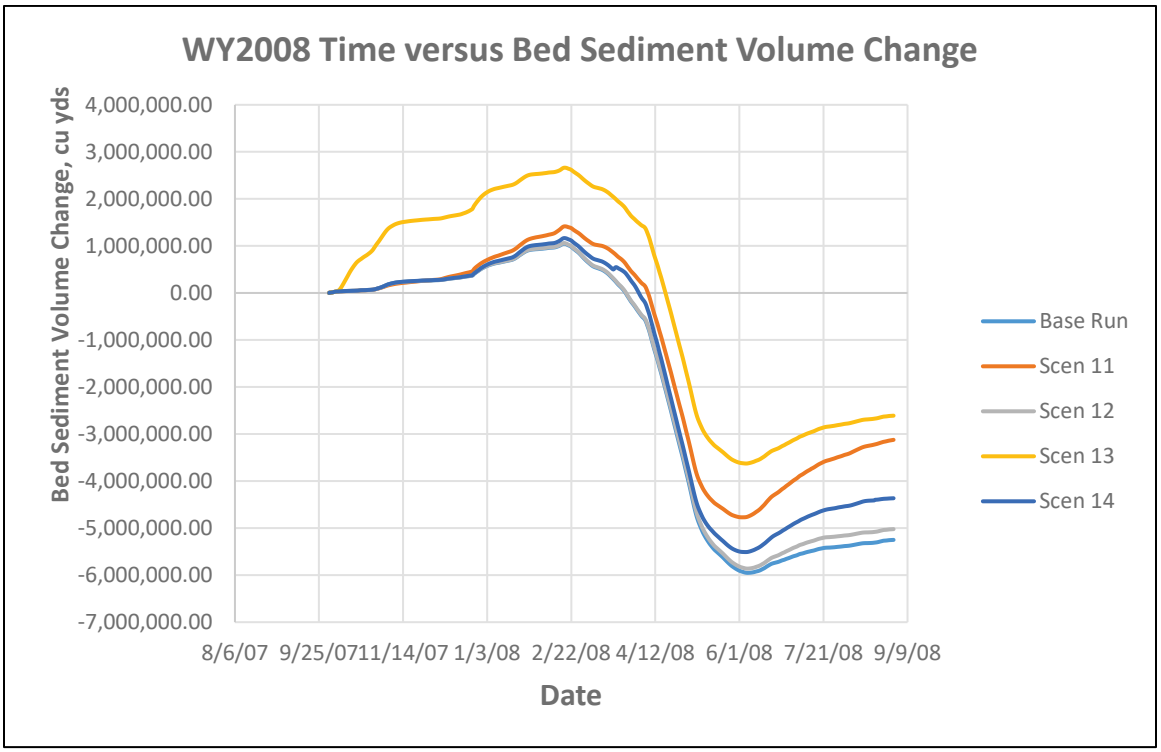


3.7.3 Material 1 BSVC dredge placement Scenarios 11–14

Time series plots of the BSVC and Simmesport discharge for Material 1 Scenarios 11–14 are located in Appendix B Plates 26–29. Figure 45 presents a summary plot of the dredge placement scenarios BSVC. The location and rate of dredge material release (Figure 25) are the difference in the amount of deposition and erosion. Scenario 13 dredge material was sporadically released as shown in Figure 25 and results in more deposition and less erosion than the Base Run. Scenario 11 dredge material was continuously released at the same location with slightly more deposition and less erosion. Scenario 12 and 14 dredge material was continuously released downstream of the Low Sill and Hydropower structures respectively (Figure 25). In Scenario 12, due to the two-dimensional effect of the model having no vertical component of velocity, deposits in the scour hole downstream of the Low Sill Structure mostly remain at that location or immediately downstream. The release point of the dredge material is upstream of the boundary for material 1 (Figure 34) for both Scenario 12 and 14. Therefore, any deposition upstream of the USGS gage in the Outflow Channel may not be transported to the area of Material 1.

For Scenario 12 this accounts for less sediment deposition and slightly less erosion than the Base Run. Scenario 14 released downstream of the Hydropower Unit is slightly less erosive than the Base Run. Scenario 14 deposits sediment in the Hydropower exit channel that is not transported to the USGS gage in the Outflow Channel and not accounted in the Material 1 area (Appendix A: Plate A.117).

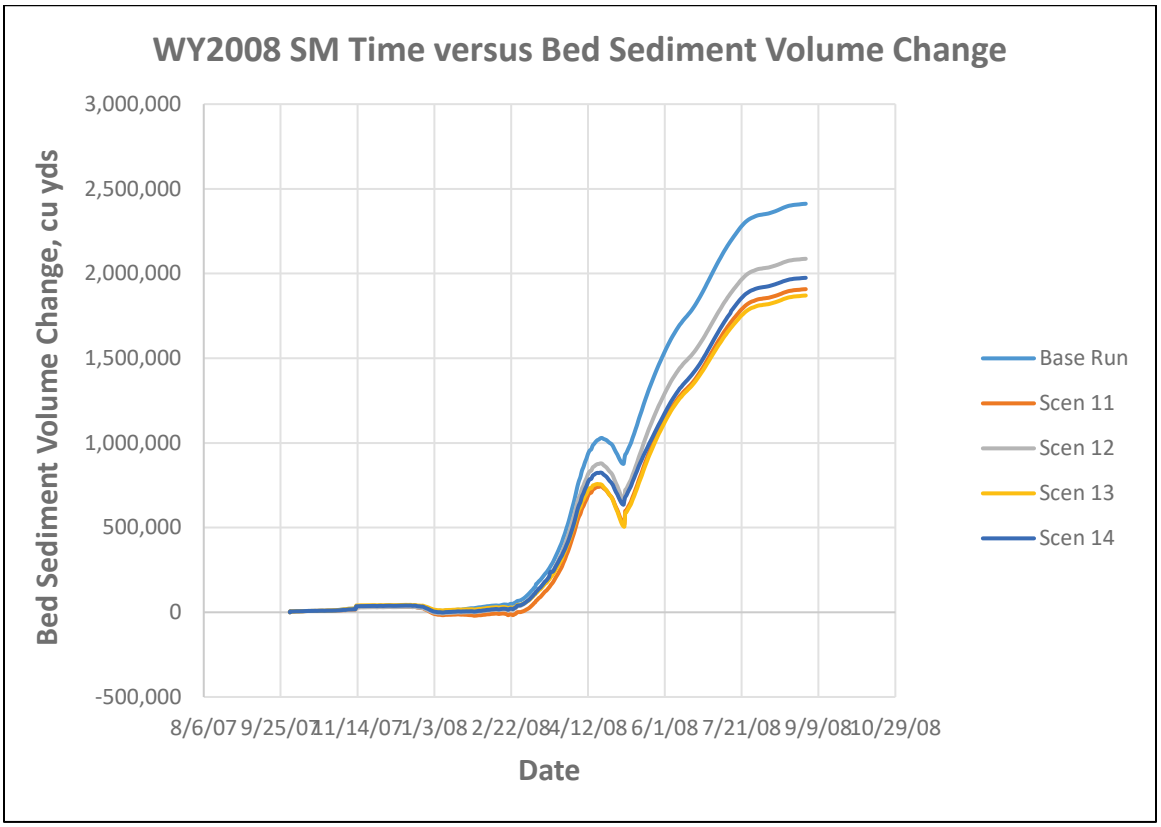
Figure 45. Material 1 WY2008 Base Run and Scenario 11–14 time versus BSVC.



3.7.4 Material 2 BSVC dredge placement Scenarios 11–14

Time series plots of the BSVC and Simmesport discharge for Material 2 Scenarios 11–14 are located in Appendix B: Plates 32–35. Figure 46 is a summary Material 2 BSVC plot of the Base Run and Scenarios 11–14. All scenarios deposit less sediment than the Base Run in Material Area 2. This can be explained by Material Area 1 (Figure 45) eroded less bed material into material area 2; thus, there was less sediment to deposit than the Base Run.

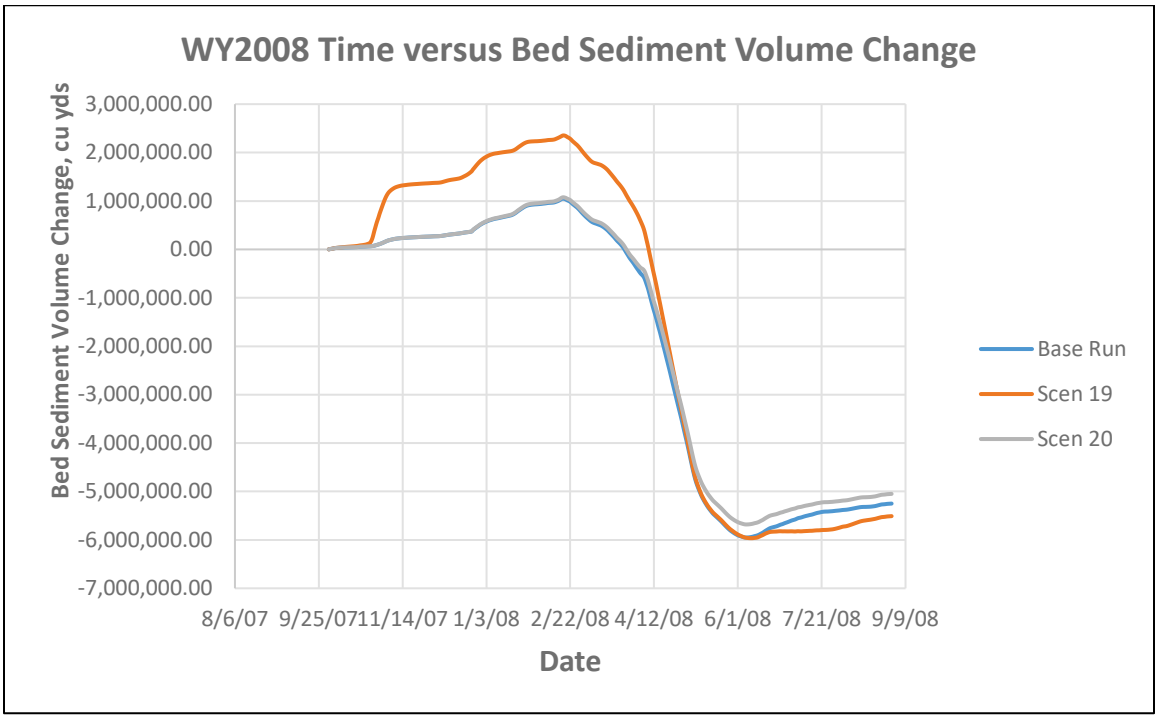
Figure 46. Material 2 WY2008 Base Run and Scenario 11–14 time versus BSVC.



3.7.5 Material 1 BSVC Structure Options Scenarios 19 and 20

Both Structure Options are located upstream of the beginning of Material Area 1 (USGS gage) in the Outflow Channel. Scenario 19 dike configuration and location is shown in Figure 30. Figure 47 presents the summary of the Material 1 for BSVC Base Run and Scenarios 19 and 20. Scenario 19 deposits more sediment and erodes slightly more than the Base Run. Time series plots of the BSVC and Simmesport discharge for Material 1 Scenarios 19–20 are located in Appendix B: Plates B.38–39.

Figure 47. Material 1 WY20008 Base Run, Scenario 19 and 20 time versus BSVC.

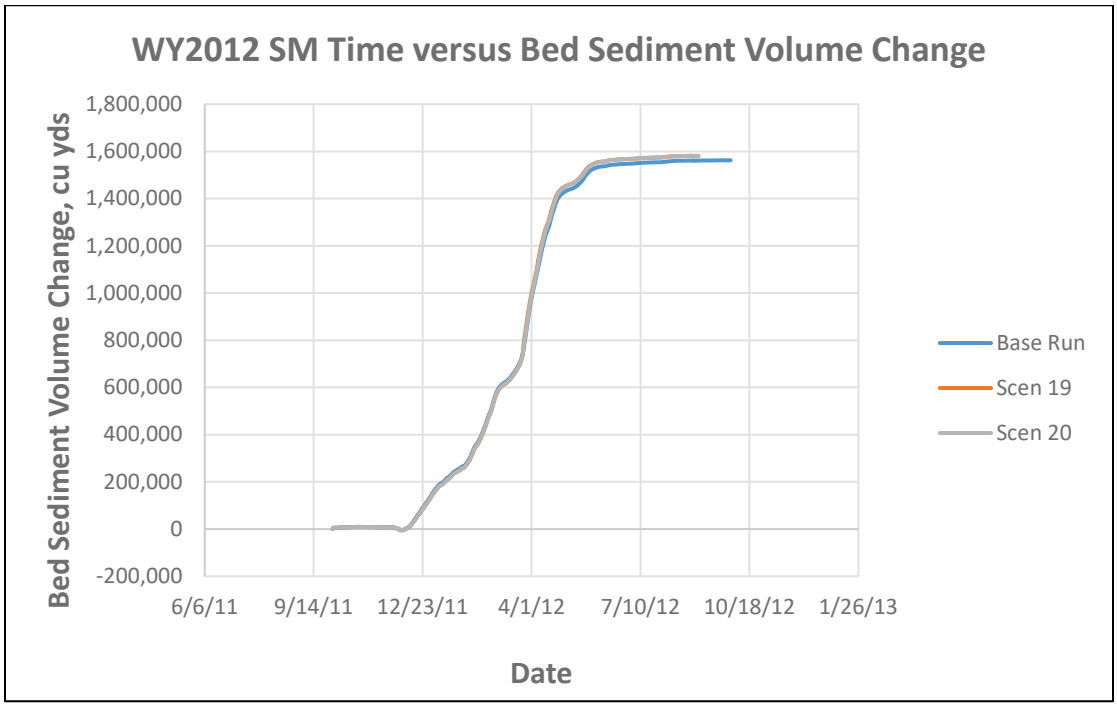


Scenario 20 dike configuration and location is shown in Figure 32. Scenario 20 in the depositional phase (Figure 47) is the same as the Base Run. Slightly less sediment is eroded due to sediment being trapped in the dike field.

3.7.6 Material 2 BSVC Structure Options Scenarios 19 and 20

Time series plots of the BSVC and Simmesport discharge for Material 2 Scenarios 19–20 are located in Appendix B: Plates B.42–43. There is no appreciable change of BSVC from the Base Run between Simmesport and Melville (Figure 48).

Figure 48. Material 2 WY2008 Base Run, Scenario 19 and 20 time versus BSVC.

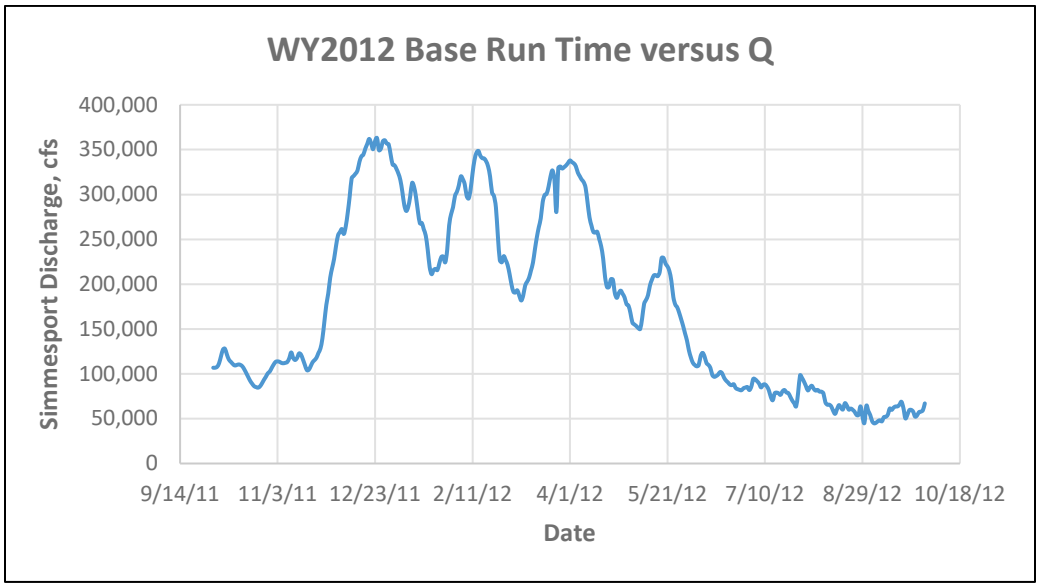


4 WY2012

4.1 Base Run bed displacement data

The Base Run included a simulation of the actual historic data for WY2012. WY2012 was a low flow water year with under 150,000 cfs passing Simmesport for 7 months of the year. Figure 49 is the WY2012 Base Run hydrograph. Base Run sediment transport trends are used to compare against the scenarios listed in Table 4. The scenario discharges were adjusted from the WY2012 discharges.

Figure 49. WY2012 Base Run hydrograph.



The BDD calculated during the WY2012 Base Run and all scenario simulations is located in Appendix D: WY2012 Bed Displacement Data. The BDD in Figure 50 presents a screen capture of the Surface Modeling System (SMS) software used to visualize the bed transformation for the last time step of WY2012. Figure 50 shows RR RM 15 to RR RM 10 and the Outflow Channel. The legend is in meters and is color coded to visualize the sediment transport trends over the whole water year. For the Base Run, a screen capture for every 5 mi of river channel was recorded and is located in Appendix D: WY2012 Base Run.

Figure 50. WY2012 Base Run BDD RR RM 15–RR RM 10 and Outflow Channel.

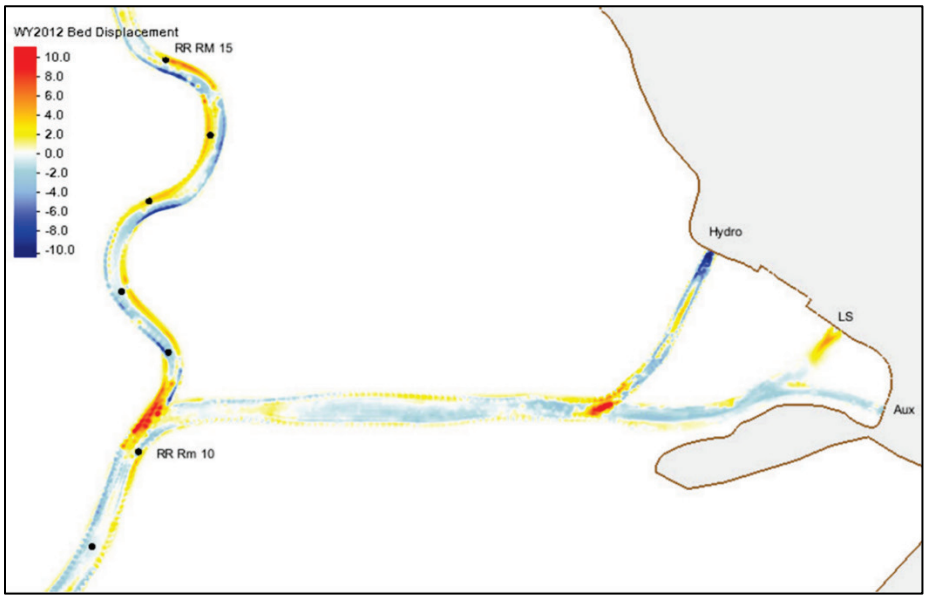
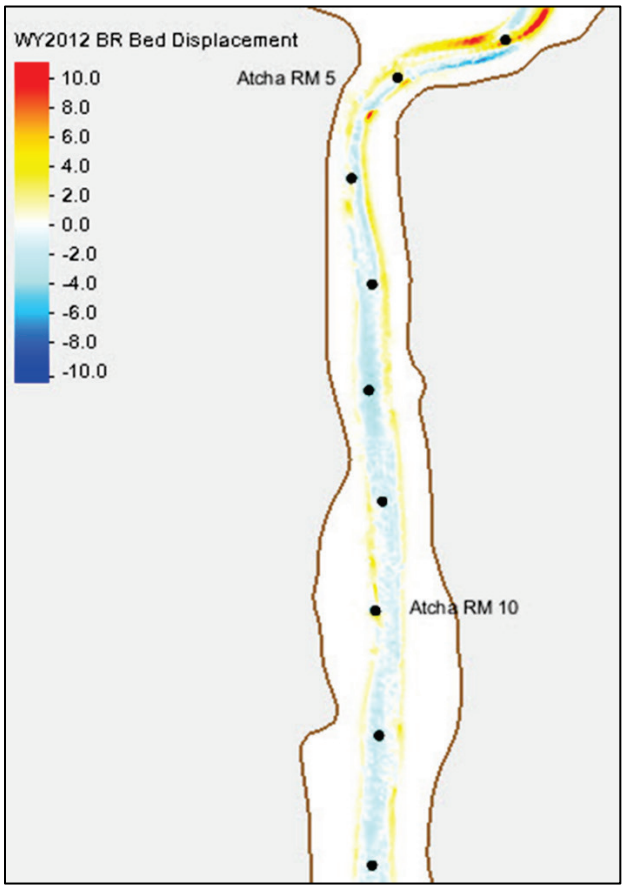


Figure 51 presents the WY2012 Base Run BDD Atcha RM 5–10.

Figure 51. WY2012 Base Run BDD Atcha RM 5-Atcha RM 10.



4.2 Scenario 3 bed displacement data

Scenario 3 consist of the flow conditions for WY2012 adjusted to Ratio 1 with no Hydropower flows. Figure 52 is the BDD for RR RM 15 to RR RM 10 and the Outflow Channel. Sediment deposition is significantly greater than the Base Run downstream of the confluence of the Outflow Channel and Hydropower outfall channel. Increased flow through the Low Sill and Auxiliary Structure increases the erosion of the Outflow Channel upstream of the Outflow Channel and Hydropower outfall channel confluence compared to the Base Run (Figure 50). The upper reaches of the Red River are fairly constant as only flows passing the structure influence the sediment transport. This area is outside the backwater influence of the operation of the ORCC.

Figure 52. WY2012 Scenario 3 BDD RR RM 15–RR RM 10 and Outflow Channel.

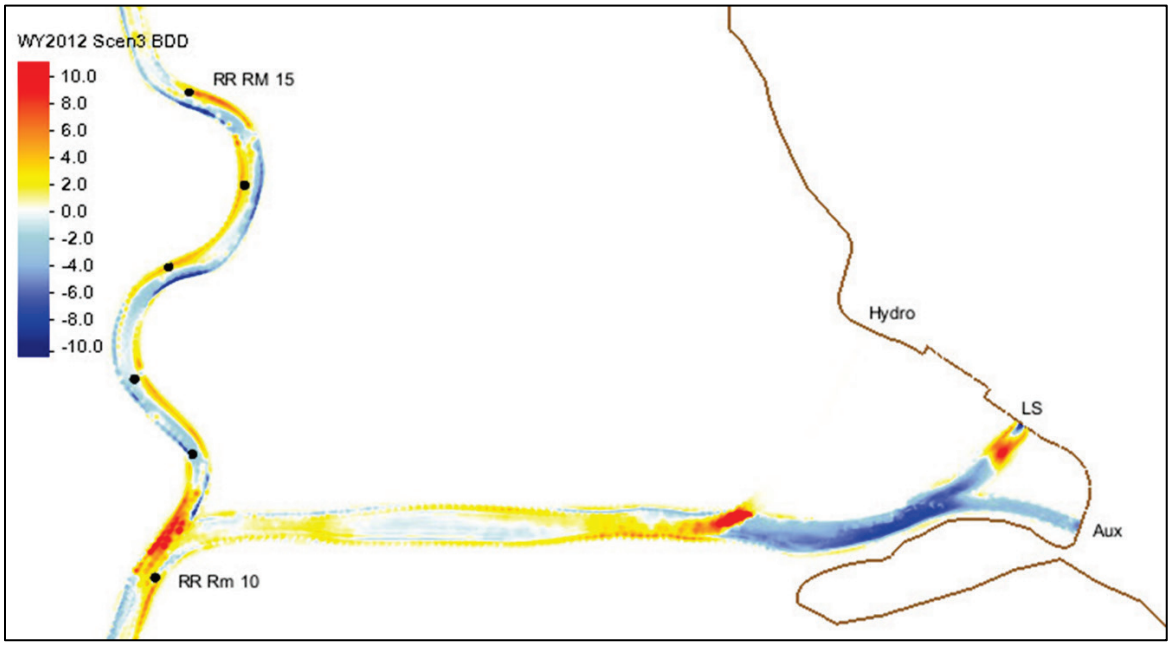
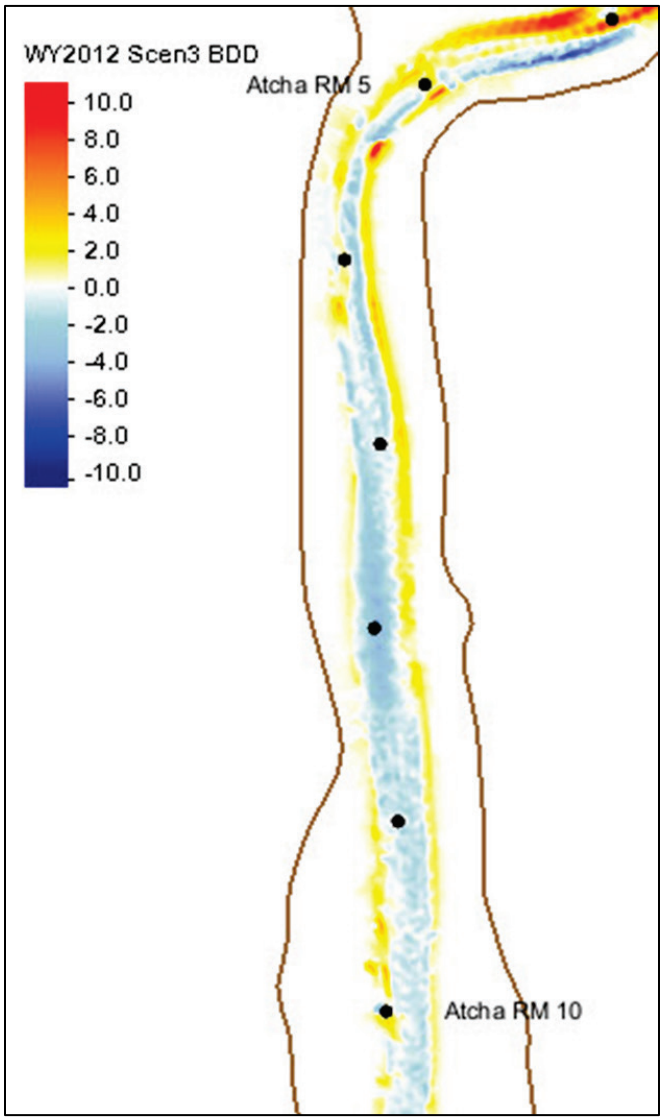


Figure 53 shows more deposition and more erosion than the Base Run (Figure 51). This is the sediment transport trend on all reaches on the Atchafalaya River to Atcha 29.

Figure 53. WY2012 Scenario 3 BDD Atcha RM 5-Atcha RM 10.



4.3 Scenario 8a bed displacement data (BDD)

Scenario 8a is an 80/20 split with no constraints and is one of the lower-flow scenarios. For the upper reach on the Red River, there is no change to the sediment trends. In the Outflow Channel (Figure 54), there is slightly more deposition as there is less energy to transport sediment than Figure 50 Base Run.

Figure 54. WY2012 Scenario 8a BDD Outflow Channels.

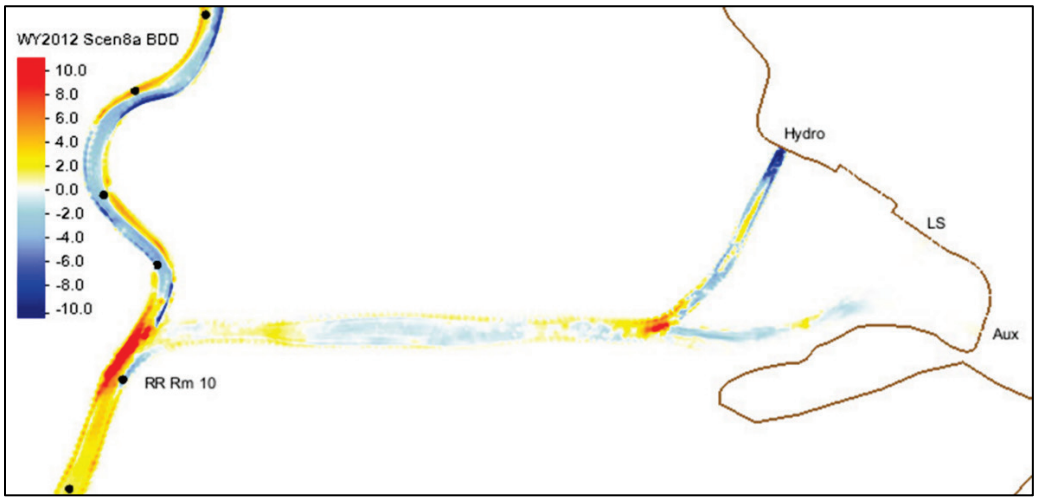
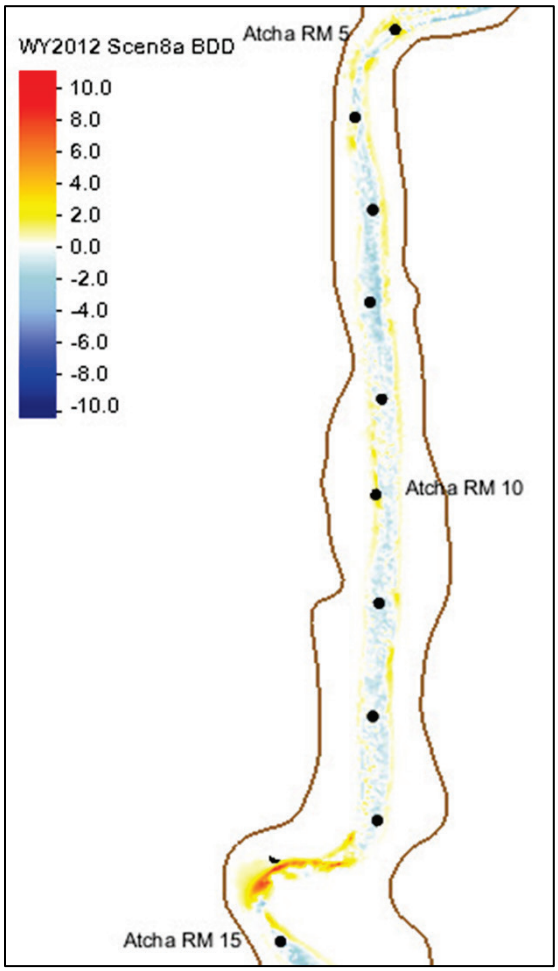


Figure 55 (Scenario 8a) presents less deposition and erosion than Figure 51 (Base Run).

Figure 55. WY2012 Scenario 8a BDD Atcha RM 5-Atcha RM 15.



4.4 Scenario 9 BDD

Scenario 9 consisted of a 60/40 split, which simulated the highest flow rates for the Red and Atchafalaya Rivers side of the ORCC. The reach of the Red River resulted in the same sediment transport trends as the base condition upstream of the confluence with the Outflow Channel. Figure 56 shows change as the Outflow Channel did not have as much deposited and more erosion than Figure 50 Base Run.

Figure 56. WY2012 Scenario 9 BDD Outflow Channel.

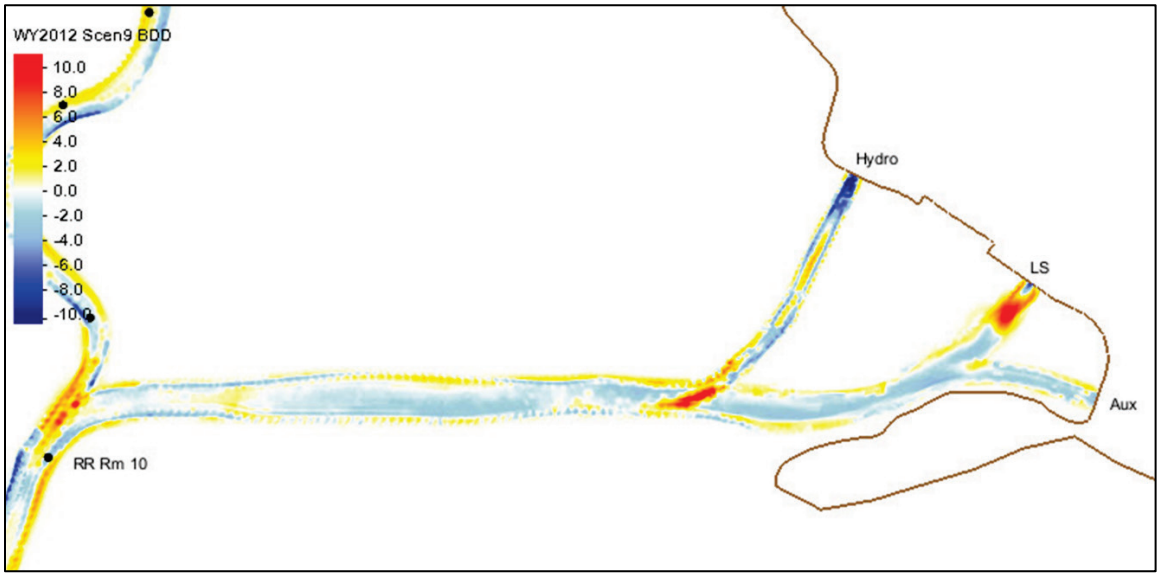
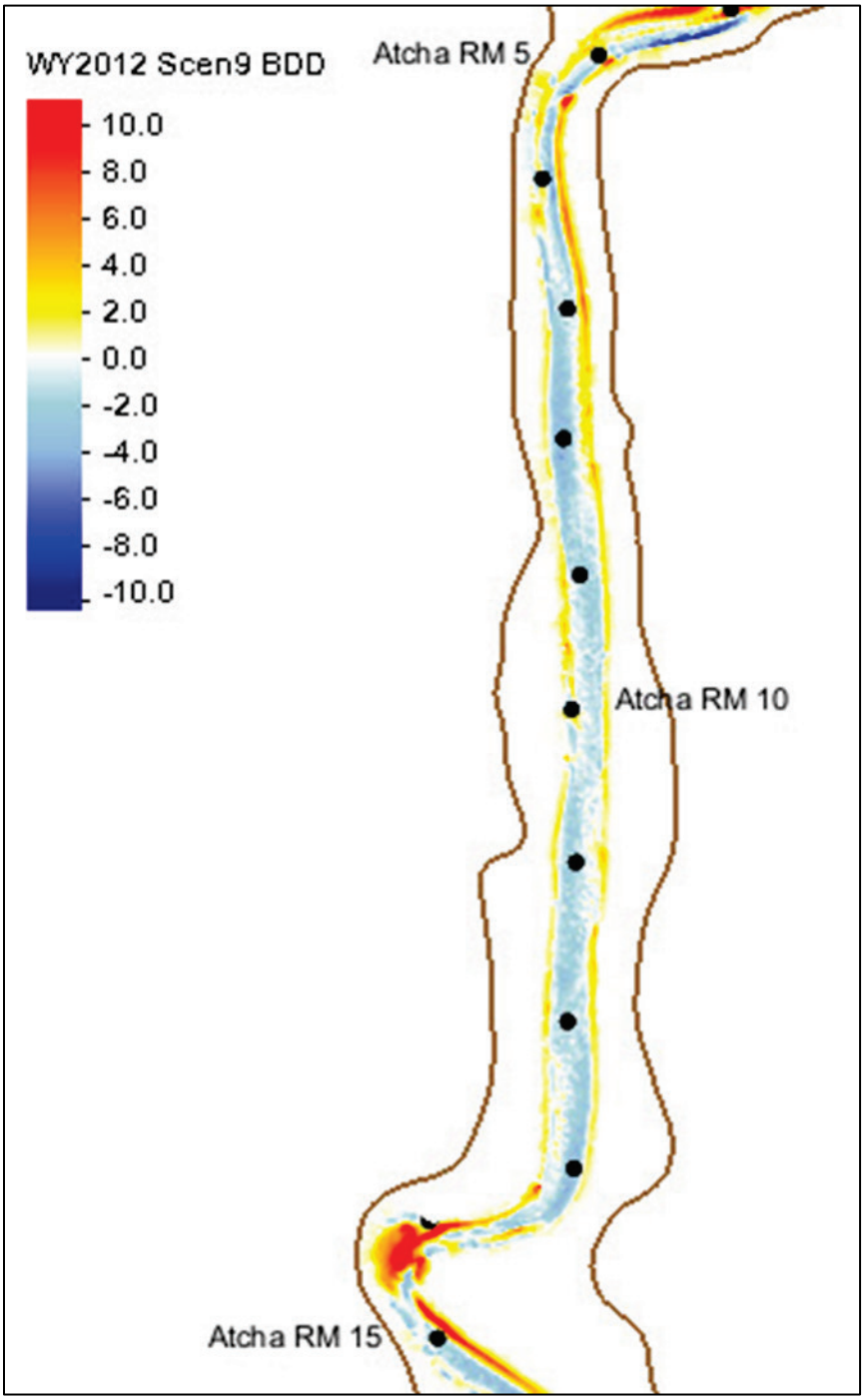


Figure 57 shows more deposition and erosion than the Base Run in Figure 51. These are the conditions for the lower Red River downstream of the confluence with the Outflow Channel and the Atchafalaya River to the end of the modeled area.

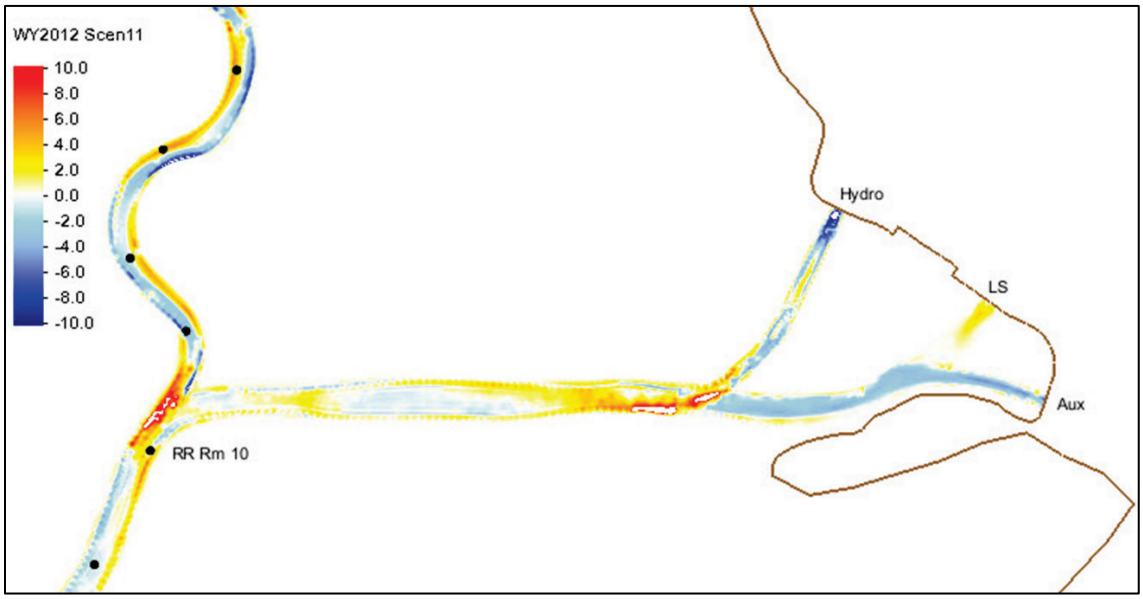
Figure 57. WY2012 Scenario 9 BDD Atcha RM 5-Atcha RM 15.



4.5 Dredge Placement Scenarios 11–14 BDD

Dredging operations on the Mississippi River at various locations were investigated in a separate report. The result of that effort was to place the dredged material at a rate of 4.75 million tons/yr at four different locations downstream of the ORCC. Scenarios 11–14 are the dredge placement operations simulated and are depicted in Figure 25 and Table 5. Table 6 lists the sediment gradation for each scenario. Scenario 14 is different due to being dredged from a different location in the Mississippi River.

Figure 58. WY2012 Scenario 11 BDD Outflow Channel.



BDD is presented in Figure 58 for Scenario 11. The WY2012 Base Run flow conditions were simulated while continuously placing dredge material just downstream of the Outflow Channel and Hydropower outfall channel confluence. The Outflow Channel aggraded at the location of the dredge material release and immediately downstream of that point. Flow goes around the release point along the north bank line and shows erosion along this location. Downstream of the Outflow Channel and Red River confluence the sediment trends are not affected, but there is slightly more deposition in areas that are aggrading.

Scenario 12 BDD (Figure 59) shows sediment depositing in the large scour hole just downstream of the Low Sill Structure at the release point of the dredge material. This is a result of the lack of vertical components of velocity in the two-dimensional model. Flow is diverted around the release

point and erodes the blue area. The white area at the release point outlined in red is an indication that the deposition was greater than the scale in the legend. The releases from the Auxiliary Structure erode the Outflow Channel down to the confluence with the Hydropower outfall channel. There is no change in the sediment trends downstream.

Figure 59. WY2012 Scenario 12 BDD Outflow Channel.

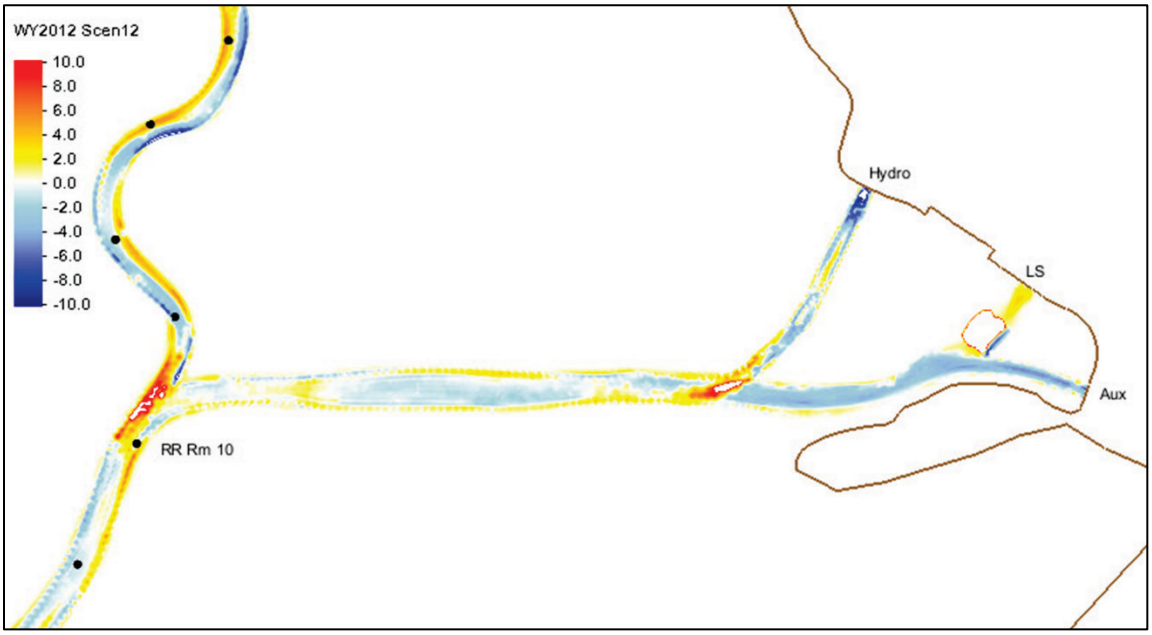


Figure 60 presents Scenario 13 BDD sporadically releasing the dredge material. Flow erodes through the middle of the release point. Deposition occurs on either side and downstream along the bank lines. Downstream of the Outflow Channel and Red River confluence the sediment trends are not affected, but there is slightly more deposition in areas that are aggrading.

In Scenario 14 BDD (Figure 61), dredge material is continuously released downstream of the hydropower structure. The bulk of the material is deposited along the banks of the hydropower outfall channel with flow eroding through the center of the release point. More sediment is deposited in the hydropower outfall channel than the Base Run. The white areas at the release point outlined in red indicate that the deposition was greater than the scale in the legend. Downstream sediment trends are the same with slightly more sediment deposited than the Base Run.

The BDD for all river miles (Scenarios 11–14) are in Appendix D: WY2012 Bed Displacement Data, Plates D.86–D.113.

Figure 60. WY2012 Scenario 13 BDD Outflow Channel.

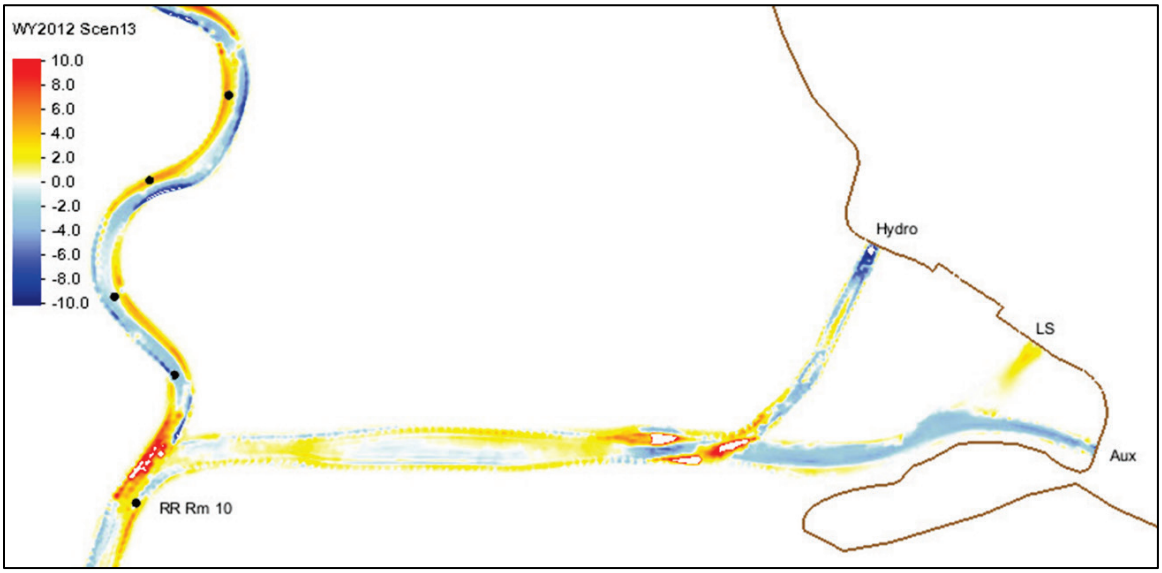
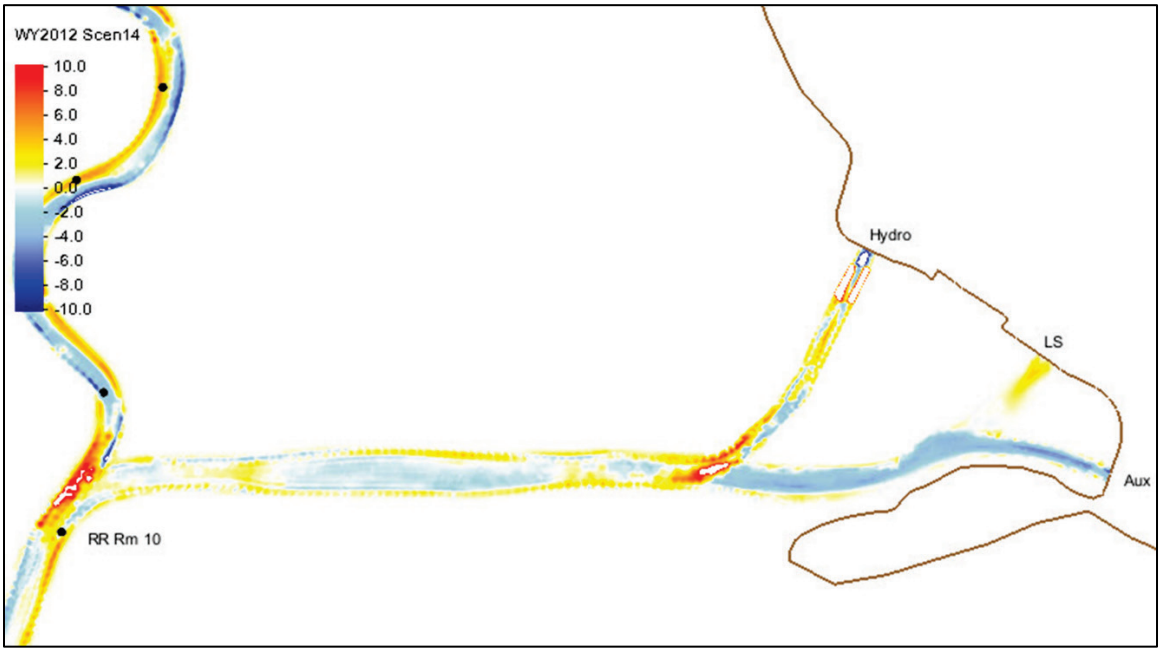


Figure 61. WY2012 Scenario 14 BDD Outflow Channel.



4.6 Structure Options Scenarios 19 and 20

Layout of the dike configuration for Scenarios 19 and 20 are shown in Figure 30 and Figure 32, respectively. WY2012 being a low-flow year did not present any differences for Scenarios 19 (Figure 62) and 20 (Figure 63) compared to the Base Run.

Figure 62. WY2012 Scenario 19 BDD Outflow Channel.

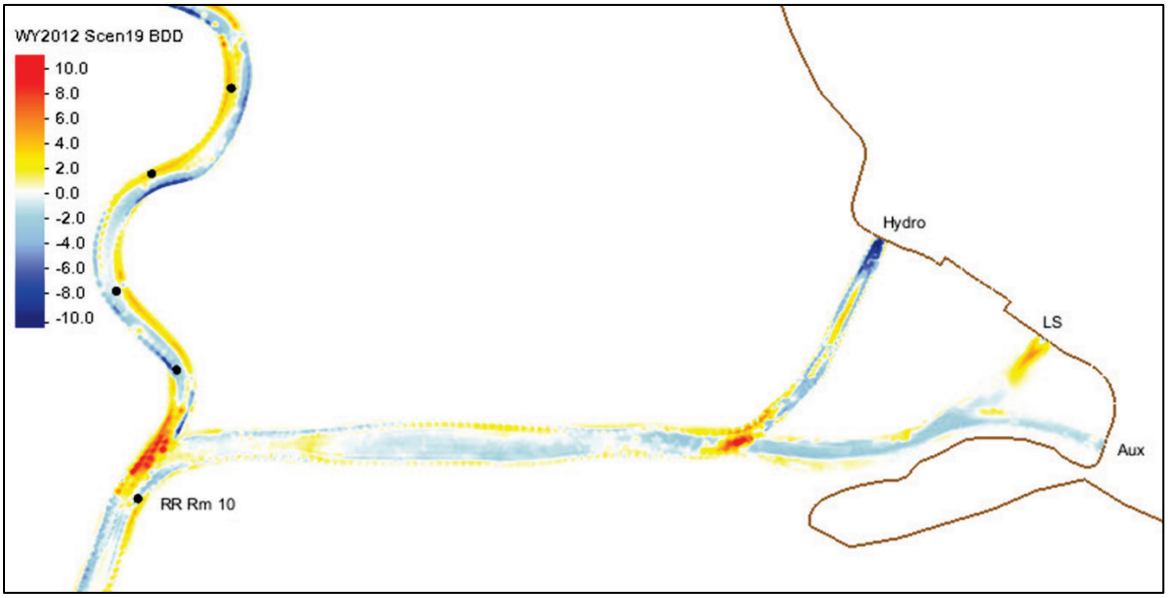
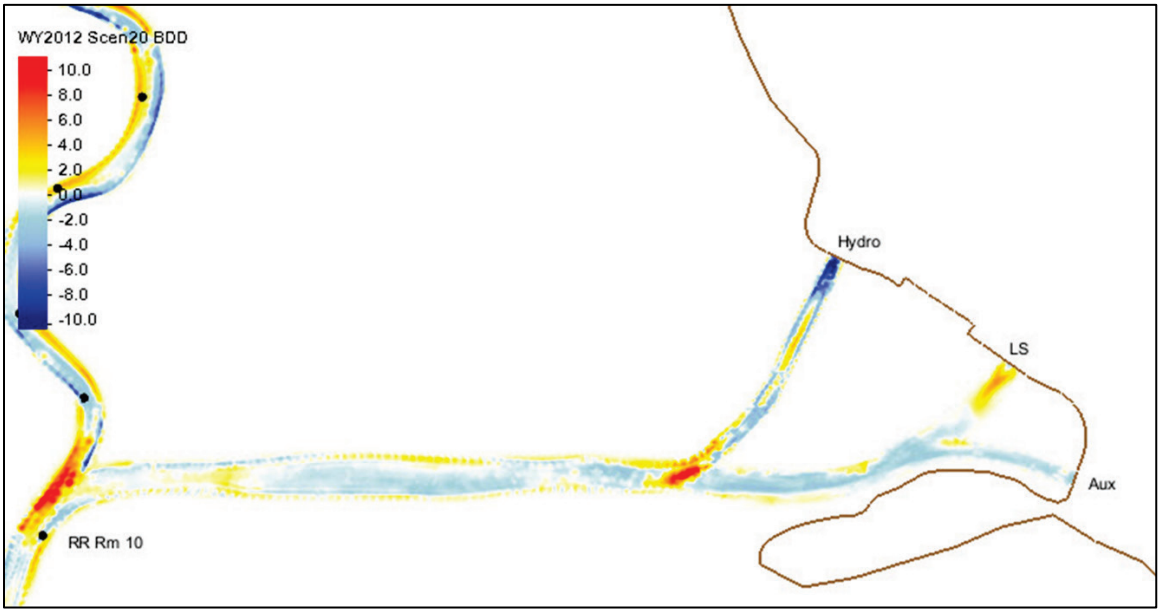


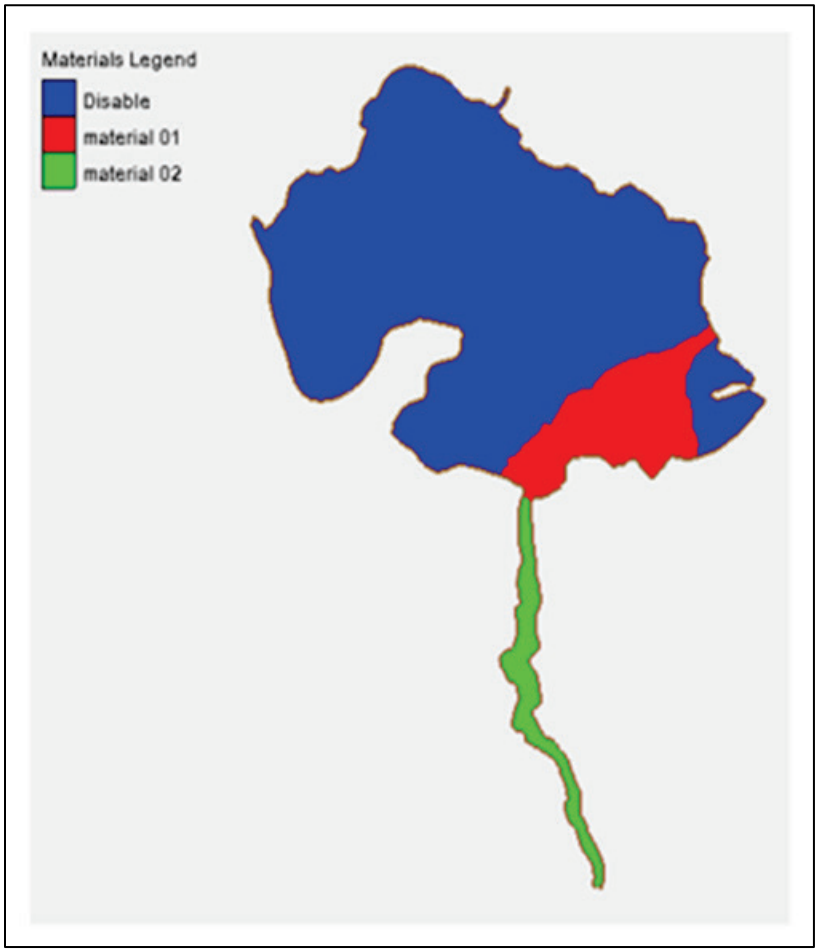
Figure 63. WY2012 Scenario 20 BDD Outflow Channel.



4.7 WY2012 BSVC

The BSVC was calculated in each simulation by material. Figure 64 is the material legend for the material areas. Material 1 is designated by the red area and Material 2 by the green area (Simmesport to Melville). Appendix E: WY2012 BSVC contain the BSVC plots of materials 1 and 2 for Base Run, Scenarios 3–10, Dredge Placement Scenarios 11–14, and Structures Options Scenarios 19 and 20.

Figure 64. Material Legend.



Material 1 Base Run and Scenarios 3–10 WY2012 Base Run time history plot verses material 1 BSVC and Simmesport discharge (Figure 65) produced 2.34 million cu yd of bed material deposition. Simmesport discharge is less than 325,000 cfs Material 1 area aggraded and greater than 325,000 cfs degraded. Maximum Simmesport discharge is 356,000 cfs.

WY2012 Scenario 3 BSVC (Figure 66) aggraded 7.62 million cu yd. Maximum discharge is 351,000 cfs.

Figure 65. Material 1 WY2012 Base Run time versus sediment volume change/Simmesport discharge.

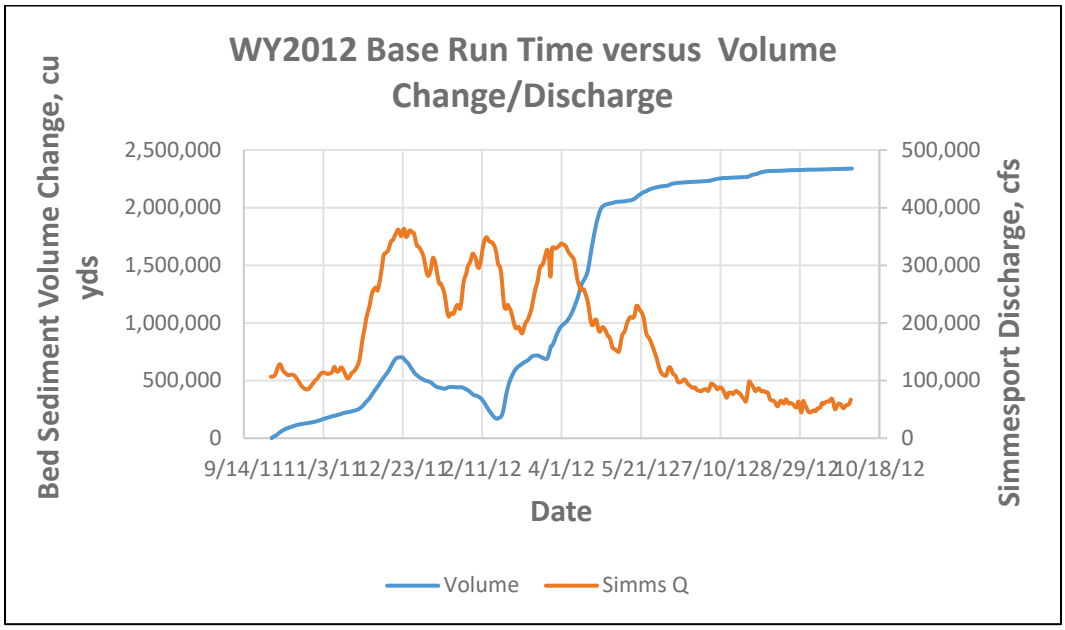
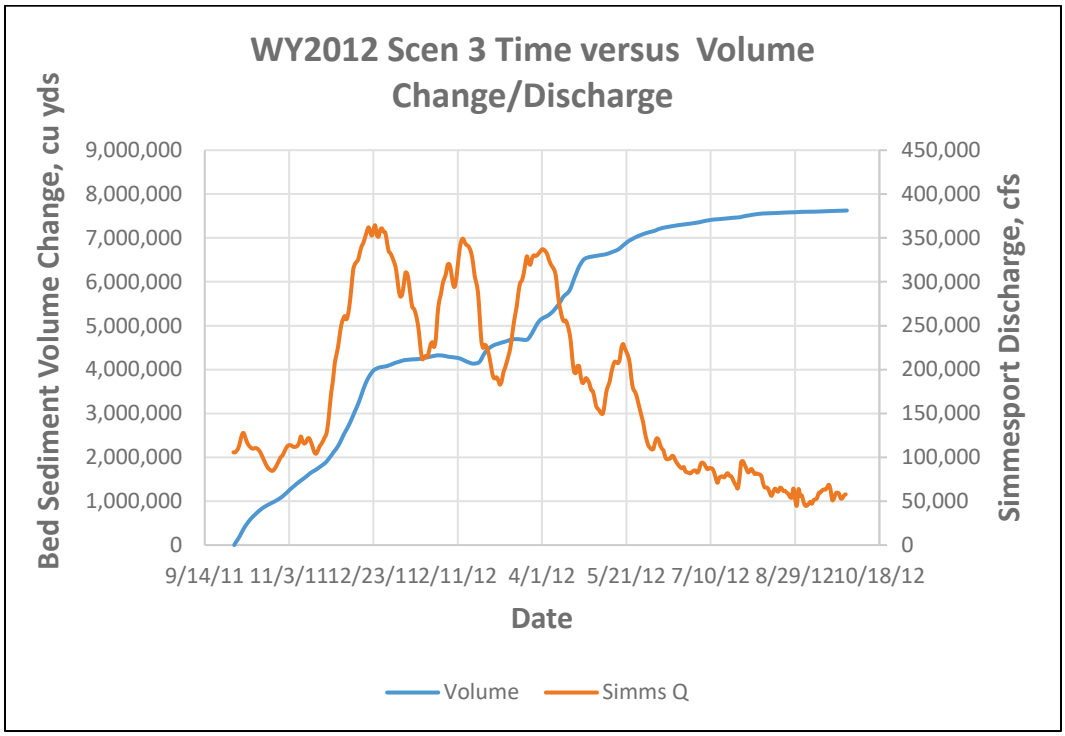
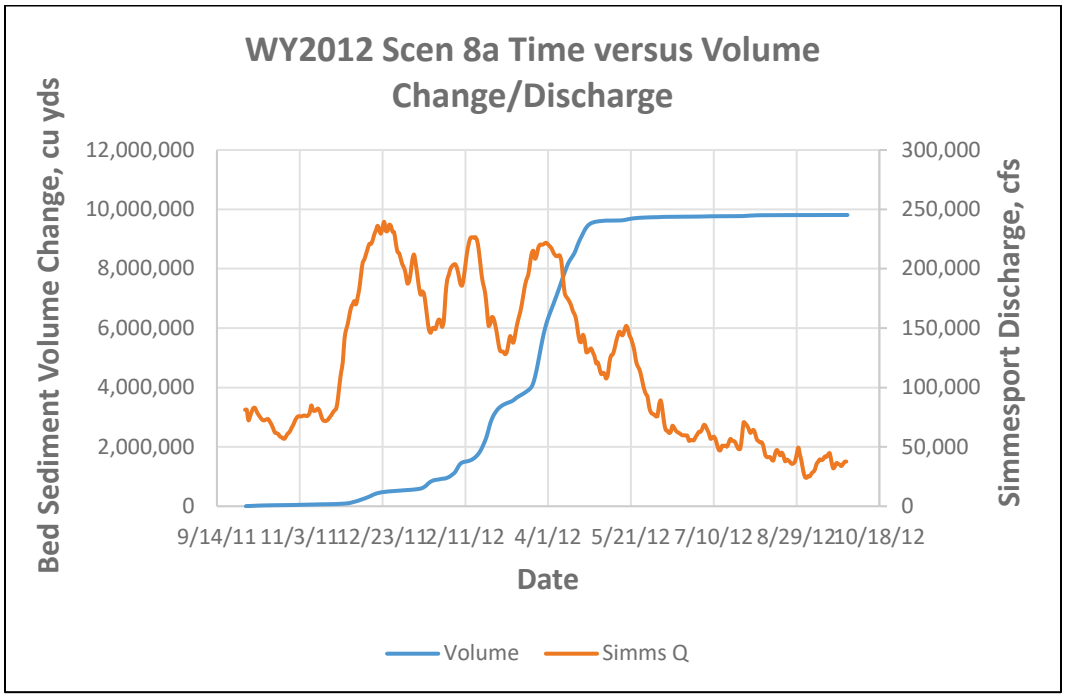


Figure 66. Material 1 WY2012 Scenario 3 time versus sediment volume change/Simmesport discharge.



WY2012 Scenario 8a BSVC (Figure 67) has aggradation of 9.8 million cu yd. Maximum discharge is 235,000 cfs.

Figure 67. Material 1 WY2012 Scenario 8a time versus sediment volume change/Simmesport discharge.



WY2012 Scenario 9 BSVC (Figure 68) has degradation of 559,000 cu yd. Maximum discharge is 235,000 cfs.

Figure 69 presents the time history of BSVC Base Run and Scenarios 3–10. All scenarios aggraded except Scenario 9, which degraded. All plots of BSVC can be located in Appendix E: WY 2012 BSVC–Material 1 Base Run and Scenarios 3–10, Plates E.2–E.11.

Figure 68. Material 1 WY2012 Scenario 9 time versus sediment volume change/Simmesport discharge.

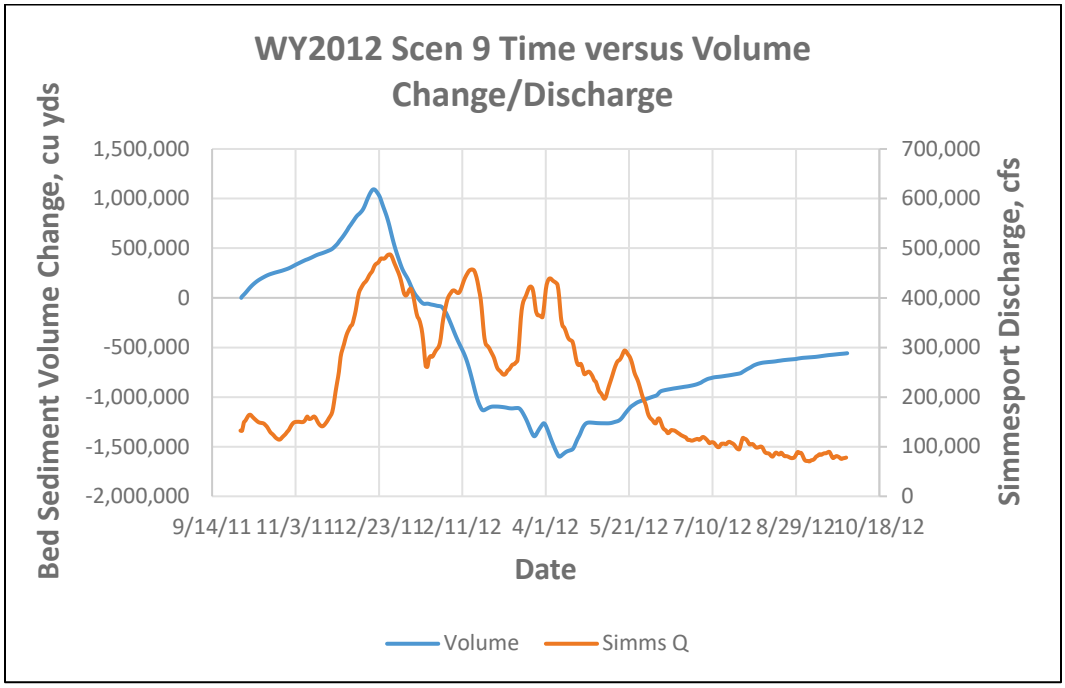
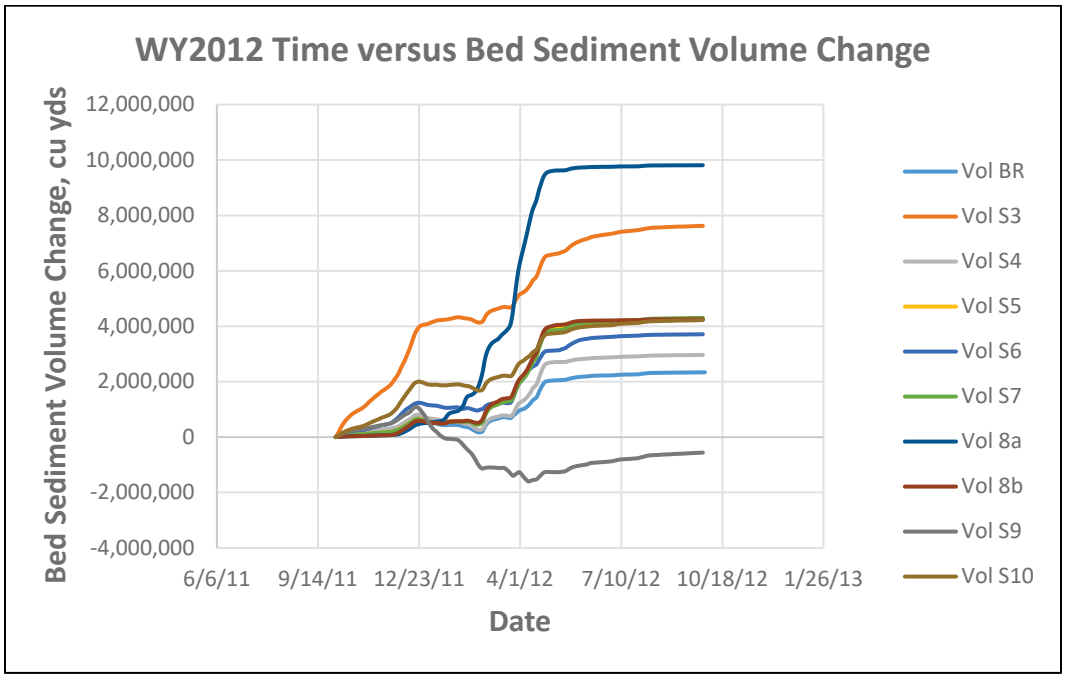


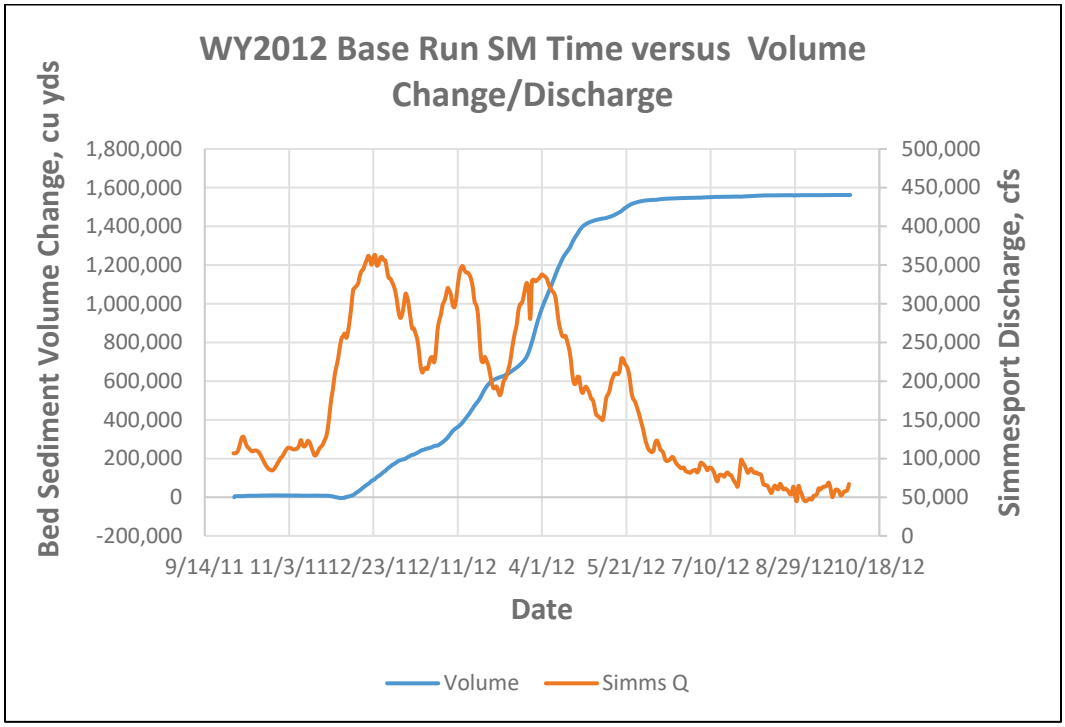
Figure 69. Material 1 WY2012 Base Run and Scenarios 3–10 time versus sediment volume change.



4.7.1 Material 2 Base Run and Scenarios 3–10

WY2012 material 2 Base Run in Figure 70 produced 1.56 million cu yd of aggraded bed material. The erosion and deposition discharge threshold between Simmesport and Melville is 600,000 cfs.

Figure 70. Material 2 WY2012 Base Run time versus sediment volume change/Simmesport discharge.



WY2012 material 2 Scenario 3 in Figure 71 produced 1.74 million cu yd of aggraded bed material.

WY2012 material 2 Scenario 8a in Figure 72 produced 1.19 million cu yd of aggraded bed material.

WY2012 material 2 Scenario 9 in Figure 73 produced 2.88 million cu yd of aggraded bed material.

Figure 71. Material 2 WY2012 Scenario 3 time versus sediment volume change/Simmesport discharge.

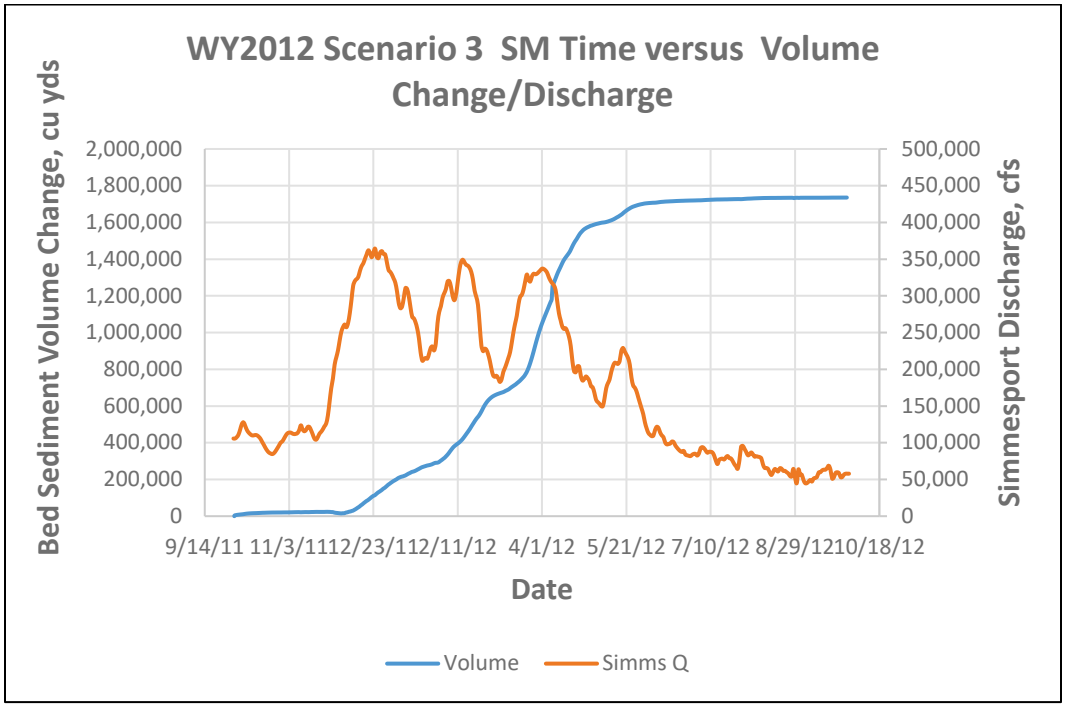


Figure 72. Material 2 WY2012 Scenario 8a time versus sediment volume change/Simmesport discharge.

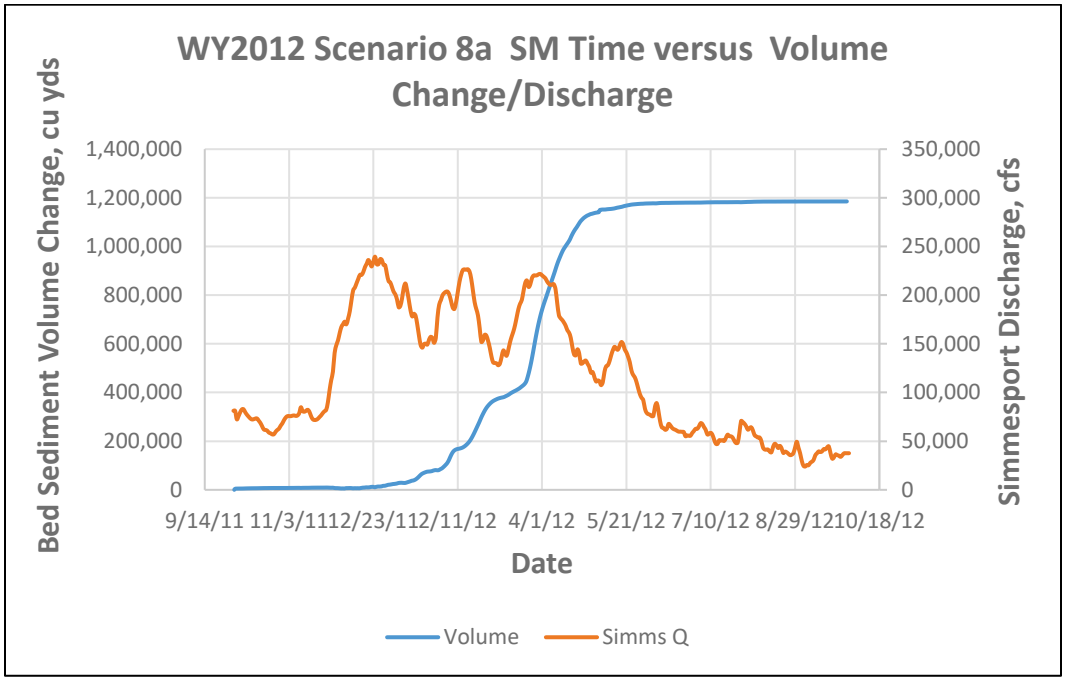


Figure 73. Material 2 WY2012 Scenario 9 time versus sediment volume change/Simmesport discharge.

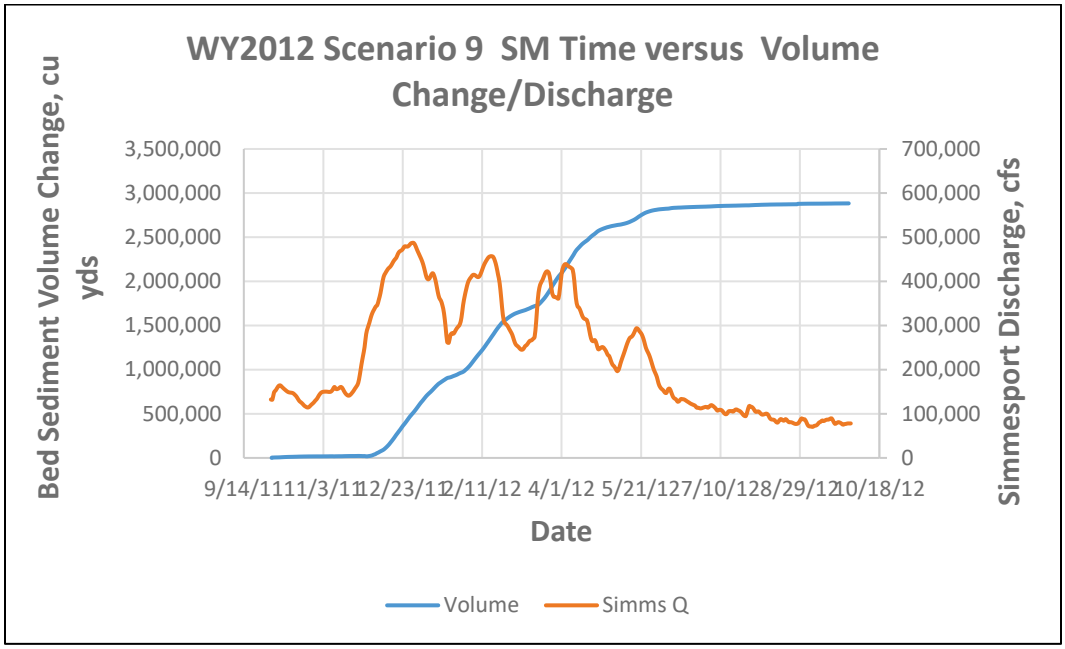
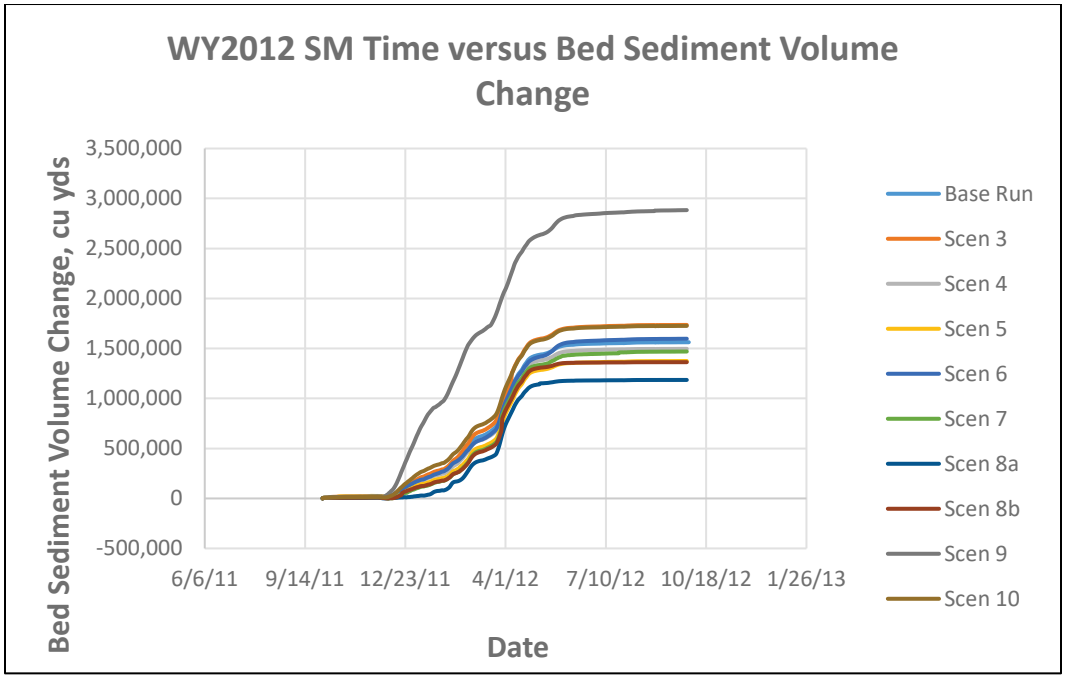


Figure 74 presents the time history of BSVC Base Run and Scenarios 3–10. All scenarios aggraded. All plots of BSVC can be located in Appendix E: WY 2012 BSVC–Material 2 Base Run and Scenarios 3–10, Plates E.14–E.23.

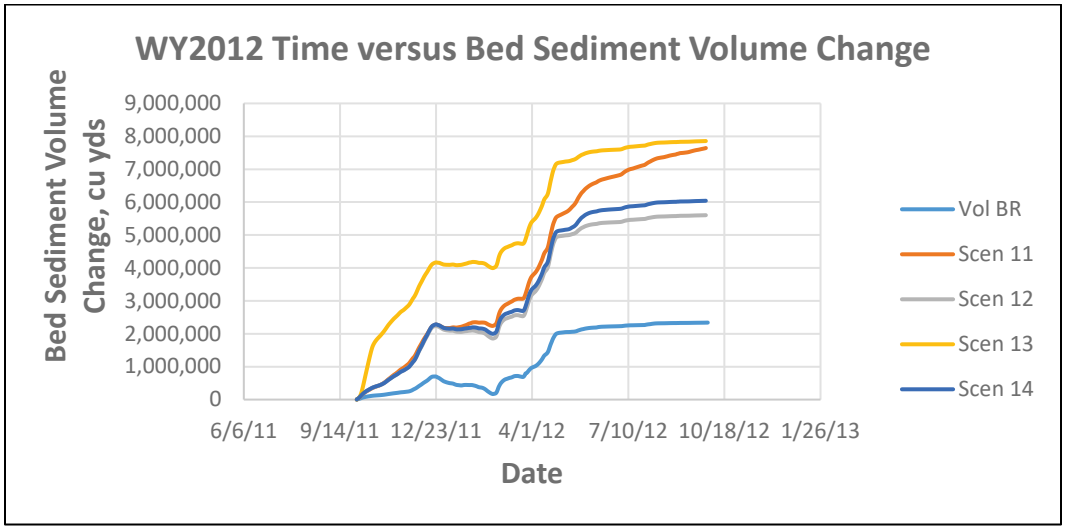
Figure 74. Material 2 WY2012 Base Run and Scenarios 3–10 time versus sediment volume change.



4.7.2 Material 1 BSVC Dredge Placement Scenarios 11–14

Time series plots of the BSVC and Simmesport discharge for Material 1 Scenarios 11–14 are located in Appendix E Plates E.26–29. Figure 75 presents a summary plot of the dredge placement scenarios BSVC. The location and rate of dredge material release (Figure 25) are the difference in the amount of deposition and erosion. Scenario 13 dredge material was sporadically released as shown in Figure 25 and results in the most deposition (7.85 million cu yds). In Scenario 11, dredge material was continuously released at the same location with 7.64 million cu yd In Scenario 12 and 14, dredge material was continuously released downstream of the Low Sill and Hydropower structures respectfully (Figure 25). In Scenario 12, due to the two-dimensional effect of the model having no vertical component of velocity, sediment deposits in the scour hole downstream of the Low Sill Structure. The release point of the dredge material is upstream of the boundary for material 1 (Figure 34) for both Scenario 12 and 14. Therefore, any deposition upstream of the USGS gage in the Outflow Channel may not be transported to the area of material 1. Scenario 12 accounts for 5.6 million cu yd Scenario 14 release point is downstream of the Hydropower Unit. Scenario 14 deposits sediment in the hydropower outfall channel that is not transported to the USGS gage in the Outflow Channel and not accounted in the material 1 area (Appendix: A, Plate A.117). Scenario 14 deposited 6.04 million cu yds.

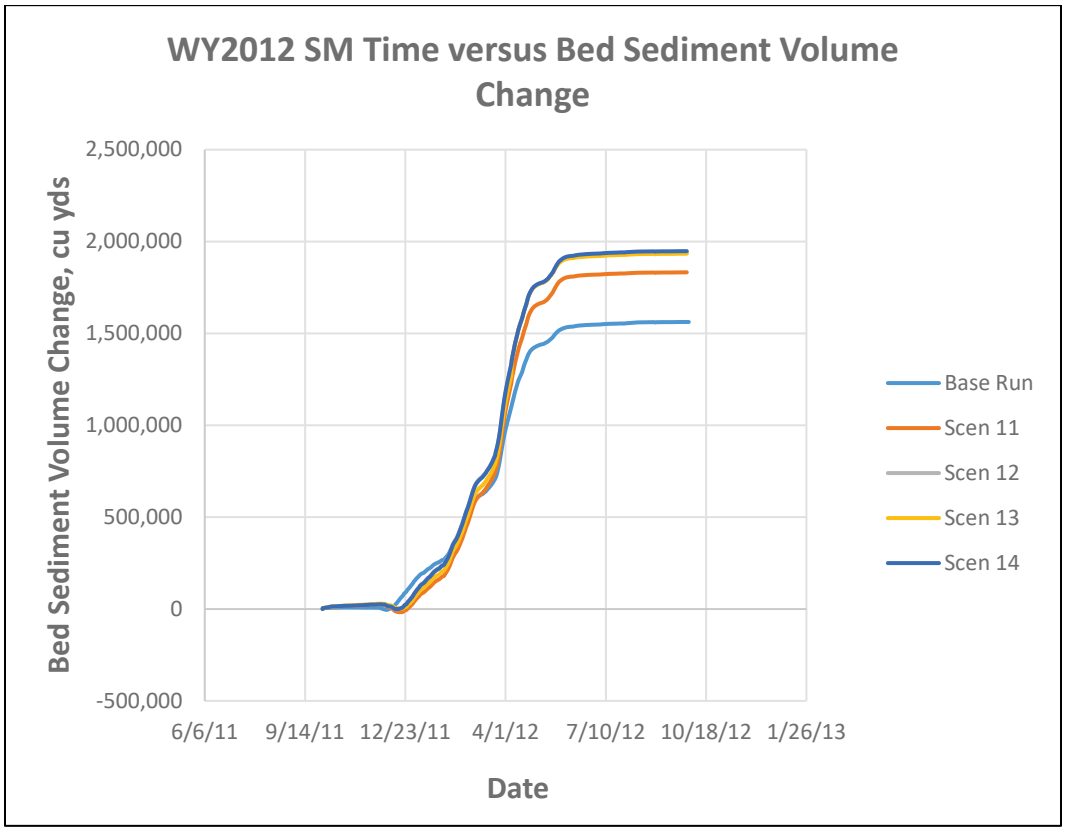
Figure 75. Material 1 WY2012 Base Run and Scenarios 11–14 time versus sediment volume change.



4.7.3 Material 2 BSVC Dredge Placement Scenarios 11–14

Time series plots of the BSVC and Simmesport discharge for Material 2 Scenarios 11–14 are located in Appendix: E Plates E.32–35. Figure 76 is a summary Material 2 BSVC plot of the Base Run and Scenarios 11–14. All scenarios deposit more sediment than the Base Run in material area 2.

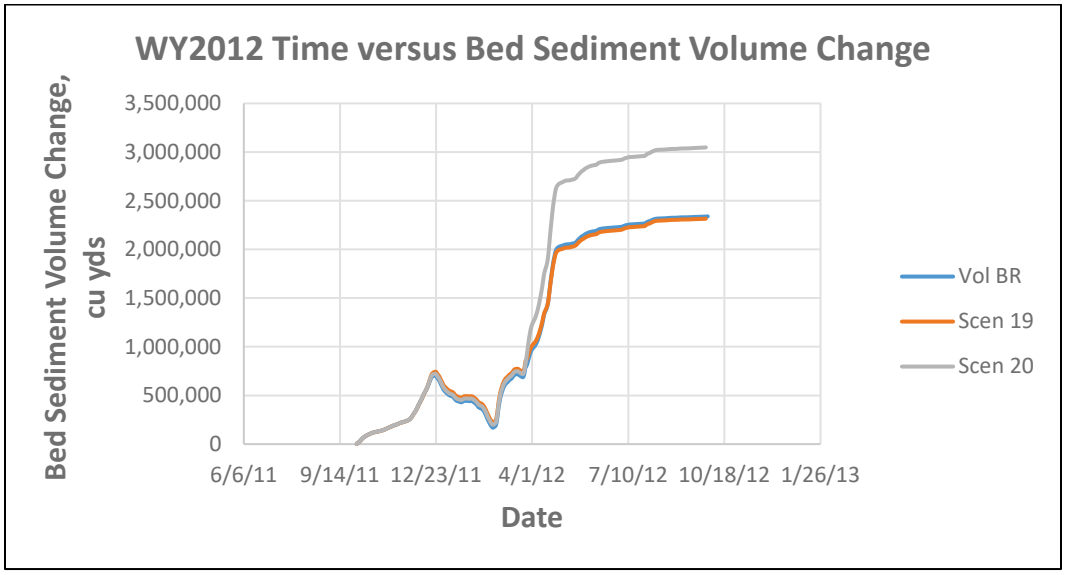
Figure 76. Material 2 WY2012 Base Run and Scenarios 11–14 time versus sediment volume change.



4.7.4 Material 1 BSVC Structure Options Scenarios 19 and 20

Both Structure Options are located upstream of the beginning of material area 1 (USGS gage) in the Outflow Channel. Scenario 19 dike configuration and location are shown in Figure 30. Figure 77 presents the summary of the material 1 for BSVC Base Run, Scenarios 19 and 20. Scenario 19 is the same as the Base Run 2.31 million cu yd Scenario 20 deposits 3.05 million cu yd. Time series plots of the BSVC and Simmesport discharge for Material 1 Scenarios 19–20 are located in Appendix E, Plates E.38–39.

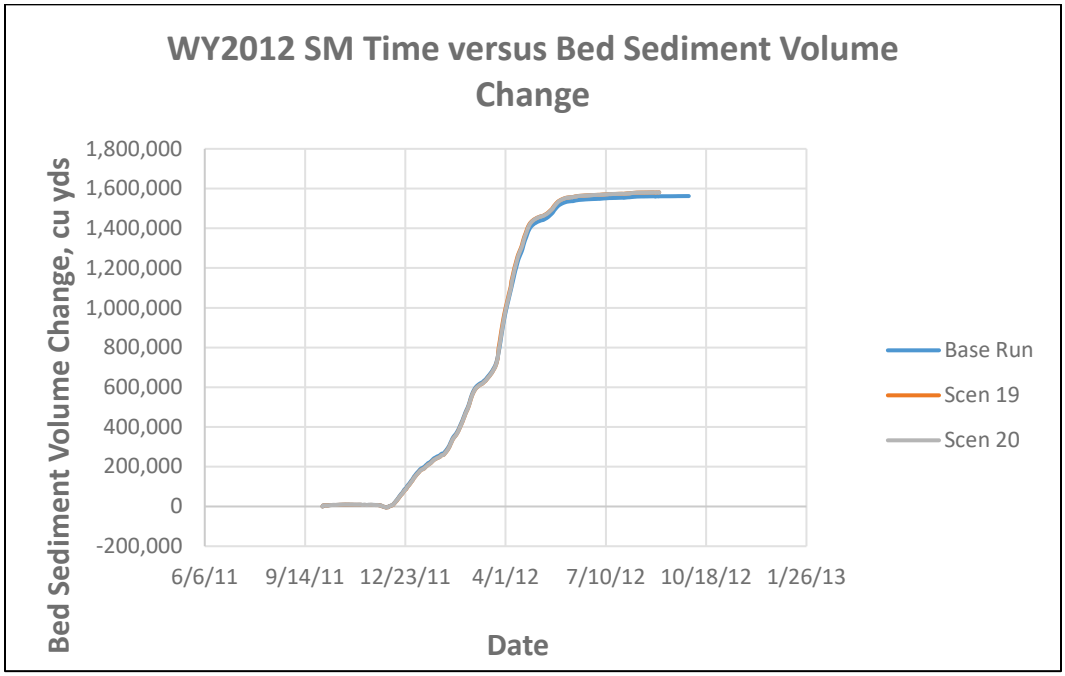
Figure 77. Material 1 WY2012 Base Run, Scenario 19 and 20 time versus sediment volume change.



4.7.5 Material 2 BSVC Structure Options Scenarios 19 and 20

Time series plots of the BSVC and Simmesport discharge for Material 2 Scenarios 19–20 are located in Appendix E Plates E.42–43. There is no change of BSVC from the Base Run between Simmesport and Melville (Figure 78).

Figure 78. Material 2 WY2012 Base Run, Scenario 19 and 20 time versus sediment volume change.

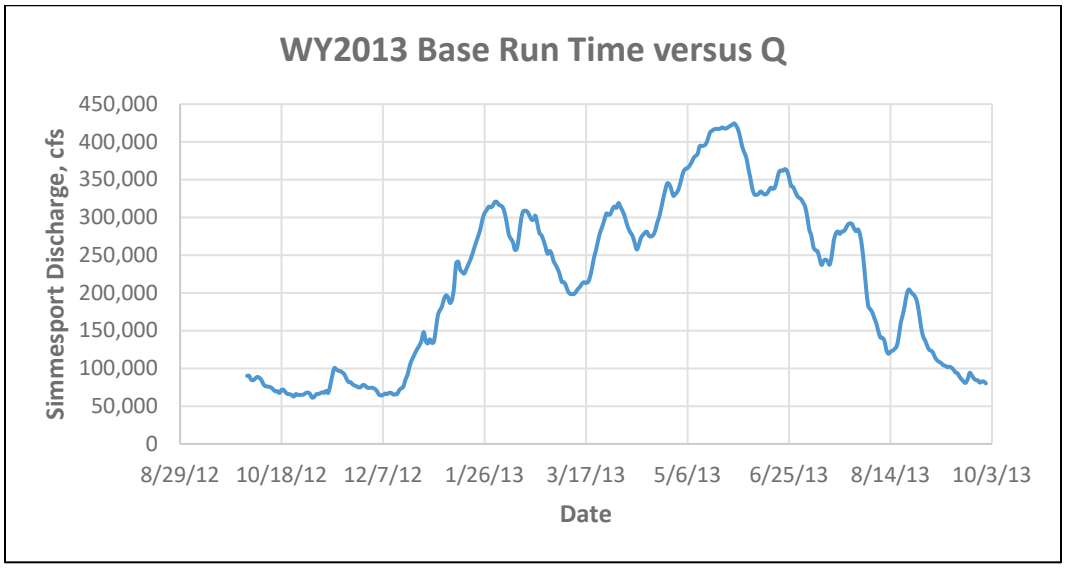


5 WY2013

5.1 Base Run BDD

The Base Run included a simulation of the actual historic data for WY2013. WY2013 was a water year with 415,640 cfs passing Simmesport. Figure 79 is the WY2013 Base Run Hydrograph. Base Run sediment transport trends are used to compare against the scenarios listed in Table 4. The scenario discharges were adjusted from the WY2012 discharges.

Figure 79. WY2013 Base Run hydrograph.



The BDD calculated during the WY2013 Base Run and all scenario simulations is located in Appendix F: WY2013 Bed Displacement Data. The BDD in Figure 80 presents a screen capture of the SMS software used to visualize the bed transformation for the last time step of WY2013. Figure 80 shows RR RM 15 to RR RM 10 and Outflow Channel. The legend is in meters and is color coded to visualize the sediment transport trends over the whole water year. For the Base Run, a screen capture for every 5 mi of river channel was recorded and located in Appendix F: WY2013 Base Run.

Figure 80. WY2013 Base Run BDD RR RM 15–RR RM 10 and the Outflow Channel.

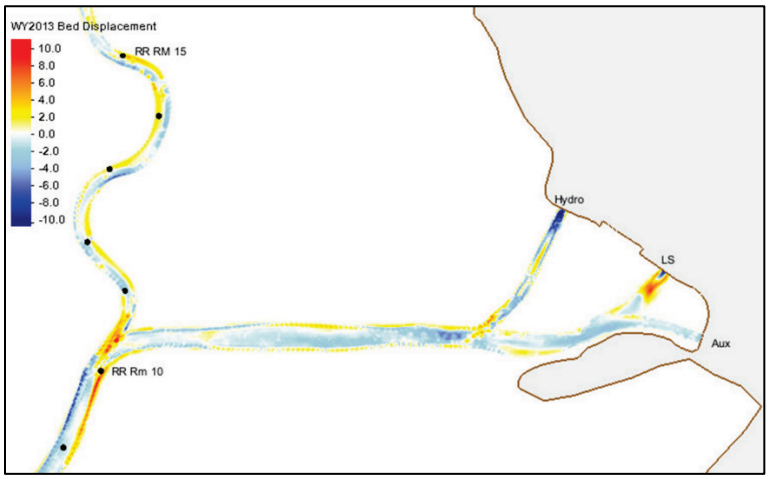
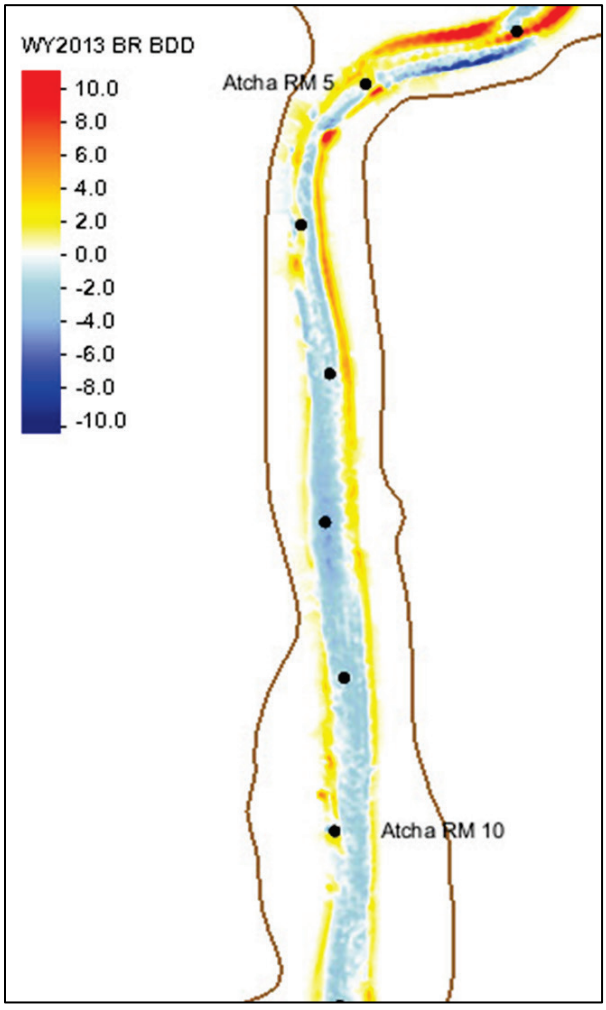


Figure 81 present the WY2013 Base Run BDD between Atcha RM 5 and Atcha RM 10.

Figure 81. WY2013 Base Run BDD Atcha RM 5-Atcha RM 10.



5.2 Scenario 3 BDD

Scenario 3 consists of the flow conditions for WY2013 adjusted to Ratio 1 with no Hydropower flows. Figure 82 is the BDD for RR RM 15 to RR RM 10 and the Outflow Channel. Sediment deposition is significantly greater than the Base Run downstream of the confluence of the Outflow Channel and Hydropower outfall channel. Increased flow through the Low Sill and Auxiliary Structure increases the erosion of the Outflow Channel upstream of the Outflow Channel and Hydropower outfall channel confluence compared to the Base Run, Figure 80. The upper reaches of the Red River are fairly constant as only flows passing the structure influence the sediment transport. This area is outside the backwater influence of the operation of the ORCC.

Figure 82. WY2013 Scenario 3 BDD RR RM 15–RR RM 10 and Outflow Channel.

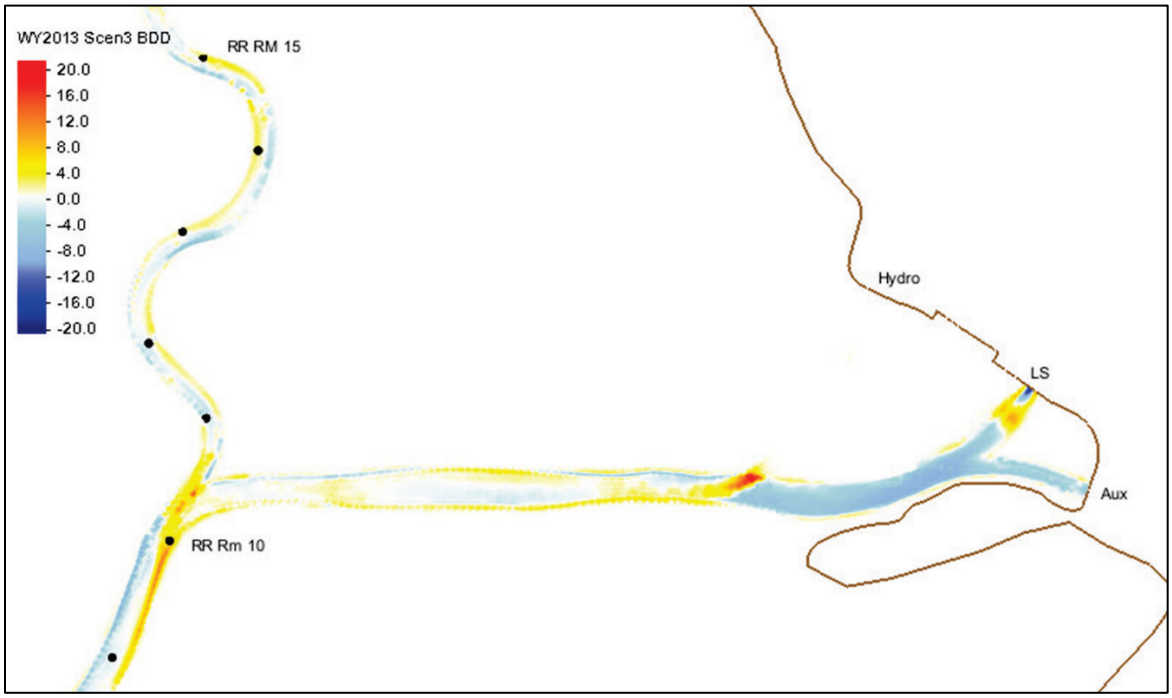
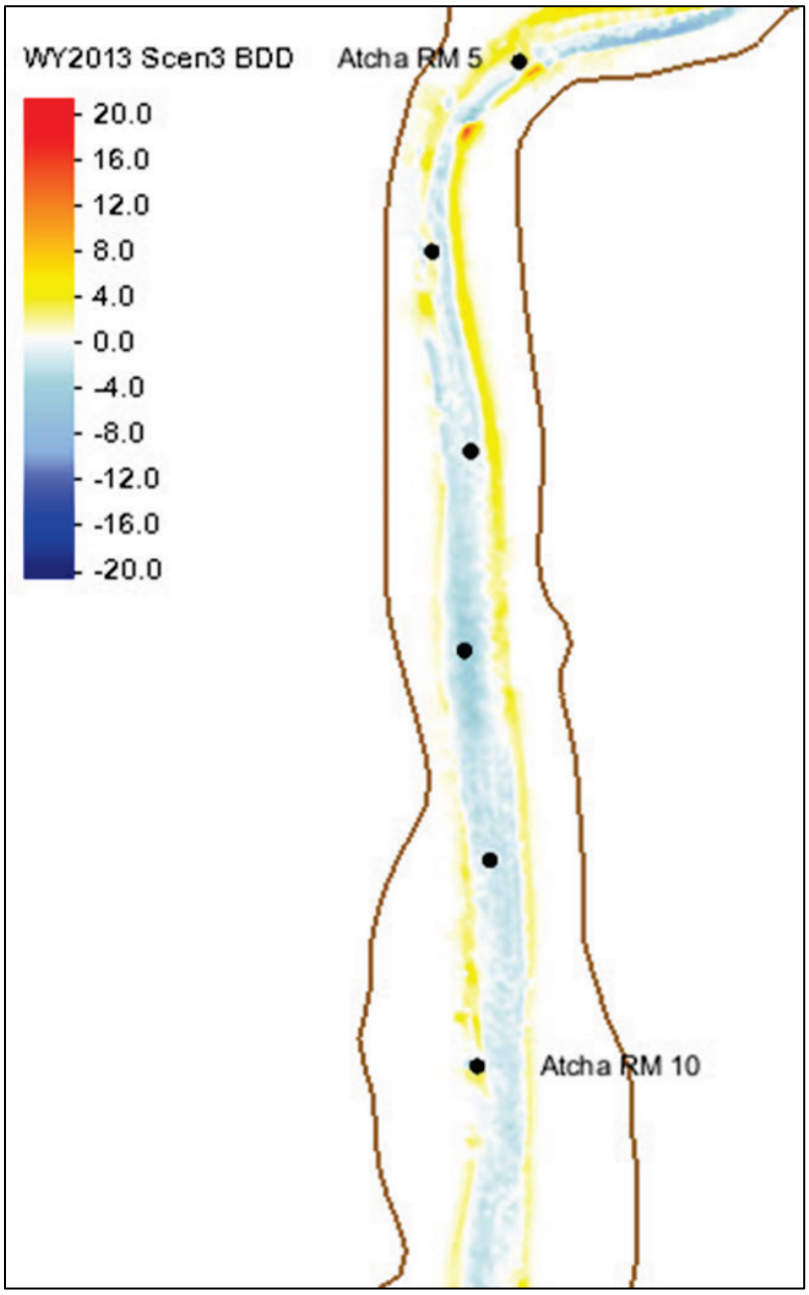


Figure 83 shows less deposition and less erosion than the Base Run (Figure 81). This is the sediment transport trend on all reaches on the Atchafalaya River to Atcha RM 29. For Scenario 3, a screen capture for every 10 mi of river channel was recorded and located in Appendix F: WY2013 Scenario 3.

Figure 83. WY2013 Base Scenario 3 displacement data Atcha RM 5-Atcha RM 10.



5.3 Scenario 8a BDD

Scenario 8a is an 80/20 split with no constraints and is one of the lower-flow scenarios. For the upper reach on the Red River, there is no change to the sediment trends. In the Outflow Channel (Figure 84), there is slightly less deposition and less erosion as there is less energy to transport sediment than Base Run (Figure 80).

Figure 84. WY2013 Scenario 8a BDD Outflow Channel.

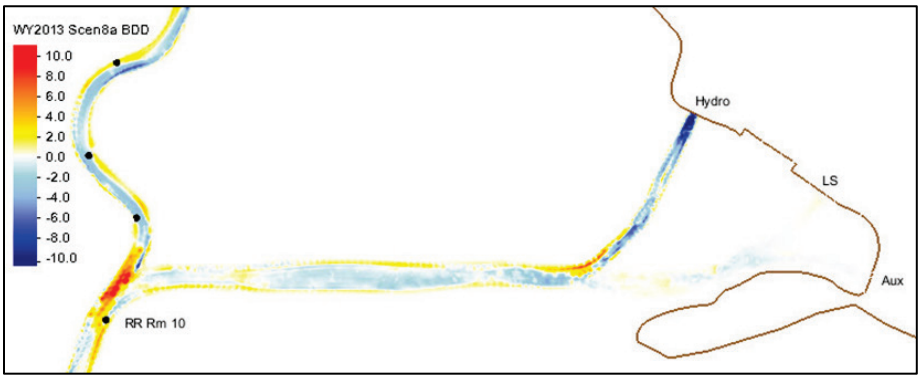
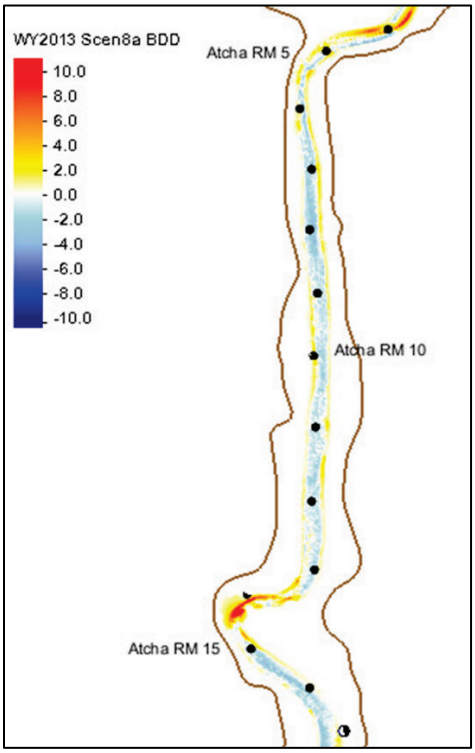


Figure 85 (Scenario 8a) presents less deposition and erosion than Figure 81 (Base Run). This trend is present throughout the Atchafalaya River to Atcha RM 29. For Scenario 8a, a screen capture for every 10 mi of river channel was recorded and located in Appendix F: WY2013, Scenario 8a.

Figure 85. WY2013 Scenario 8a BDD Atcha RM 5-Atcha RM 15.



5.4 Scenario 9 BDD

Scenario 9 consists of a 60/40 split, which are the highest flow rates simulated for the Red and Atchafalaya Rivers side of the ORCC. The reach of the Red River resulted in the same sediment transport trends as the

base condition upstream of the confluence with the Outflow Channel. Figure 86 shows change as the Outflow Channel did not have as much deposition and more erosion than Figure 80 Base Run.

Figure 86. WY2013 Scenario 9 BDD Outflow Channel.

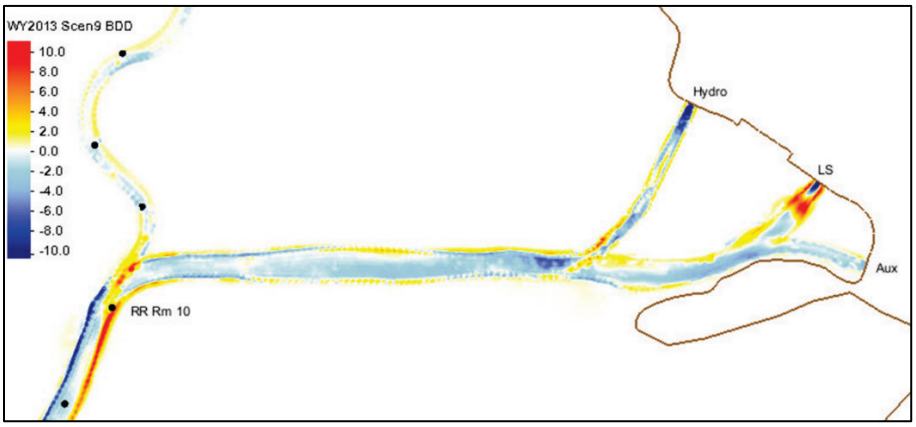
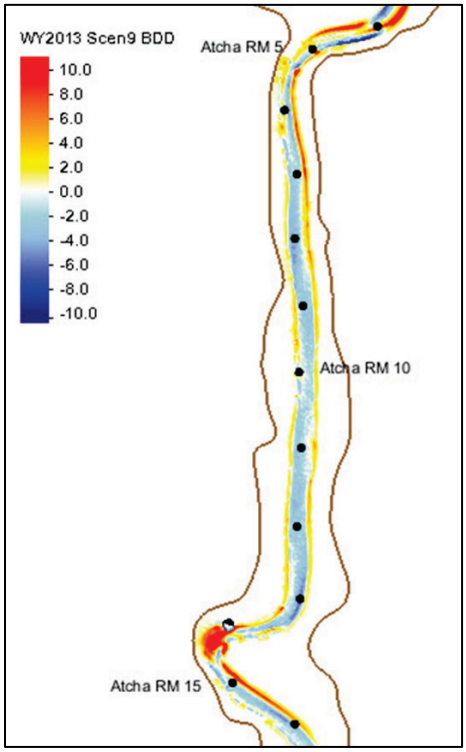


Figure 87 shows more deposition and erosion than the Base Run in Figure 81. These are the conditions for the lower Red River downstream of the confluence with the Outflow Channel and the Atchafalaya River to the end of the modeled area. For Scenario 9 a screen capture for every 10 mi of river channel was recorded and located in Appendix F: WY2013 Scenario 9.

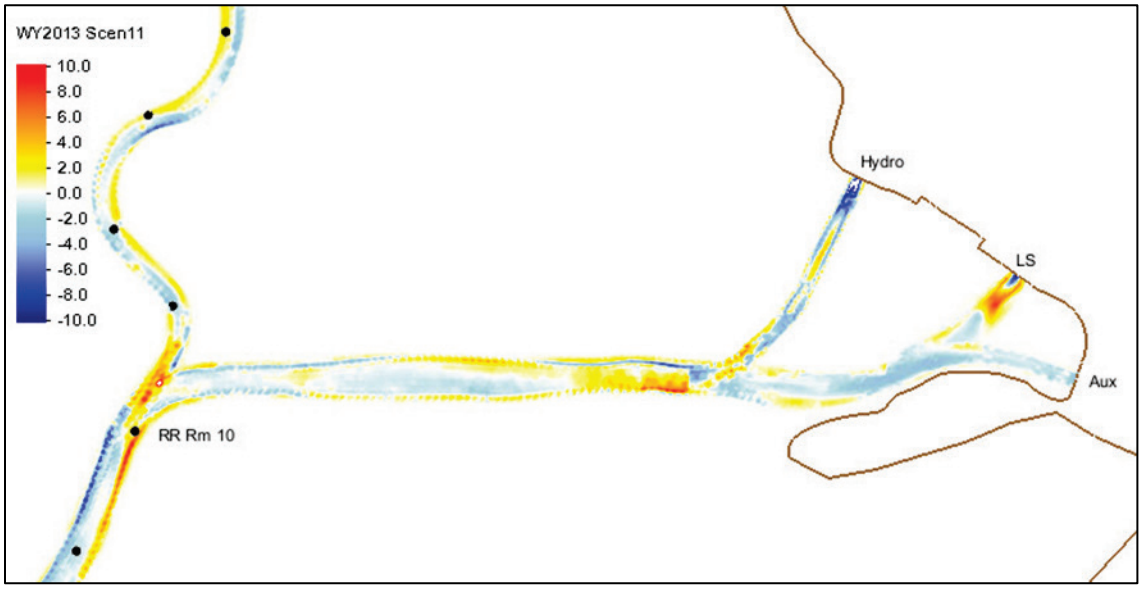
Figure 87. WY2013 Scenario 9 BDD Atcha RM 5-Atcha RM 15.



5.5 Dredge Placement Scenarios 11–14 BDD

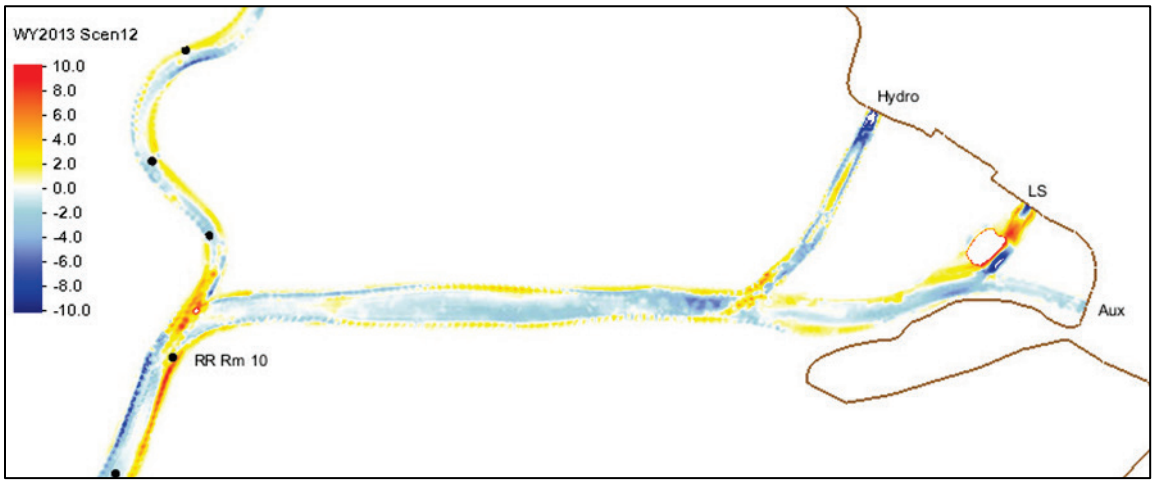
Dredging operations on the Mississippi River at various locations were investigated in a separate report. The result of that effort was to place the dredged material at a rate of 4.75 million tons/yr at four different locations downstream of the ORCC. Scenarios 11–14 are the dredge placement operations simulated and are depicted in Figure 25 and Table 5. Table 6 lists the sediment gradation for each scenario. Scenario 14 is different due to being dredged from a different location in the Mississippi River. All reaches of the model limits BDD can be reviewed in Appendix F: WY2013 Bed Displacement Data–Scenario 11–Scenario 14.

Figure 88. WY2013 Scenario 11 BDD Outflow Channel.



BDD is presented in Figure 88 for Scenario 11. The WY2013 Base Run flow conditions were simulated while continuously placing dredge material just downstream of the Outflow Channel and Hydropower outfall channel confluence. The Outflow Channel aggraded at the location of the dredge material release and immediately downstream of that point. Flow goes around the release point along the north bank line and shows erosion along this location. Downstream of the Outflow Channel and Red River confluence, the sediment trends are not affected, but there is slightly more deposition in areas that are aggrading.

Figure 89. WY2013 Scenario 12 BDD Outflow Channel.



Scenario 12 BDD (Figure 89) shows sediment depositing in the large scour hole just downstream of the Low Sill Structure at the release point of the dredge material. This is a result of the lack of vertical components of velocity in the two-dimensional model. Flow is diverted around the release point and erodes the blue area. The white area at the release point outlined in red is an indication that the deposition was greater than the scale in the legend. More sediment is deposited in the Outflow channel than the Base Run downstream to the confluence with the hydropower outfall channel. The releases from the Auxiliary Structure erode the Outflow Channel slightly more than the Base Run. There is no change in the sediment trends downstream.

Figure 90 presents Scenario 13 BDD sporadically releasing the dredge material. Flow erodes through the middle of the release point. Deposition occurs on either side and downstream along the bank lines. Downstream of the Outflow Channel and Red River confluence the sediment trends are not affected, but there is slightly more deposition in areas that are aggrading.

In Scenario 14 BDD (Figure 91), dredge material is continuously released downstream of the hydropower structure. The bulk of the material is deposited along the banks of the hydro channel with flow eroding through the center of the release point. More sediment is deposited in the hydropower outfall channel than the Base Run. The white areas at the release point outlined in red indicate that the deposition was greater than the scale in the legend. Downstream sediment trends are the same with slightly more sediment deposited than the Base Run.

Figure 90. WY2013 Scenario 13 BDD Outflow Channel.

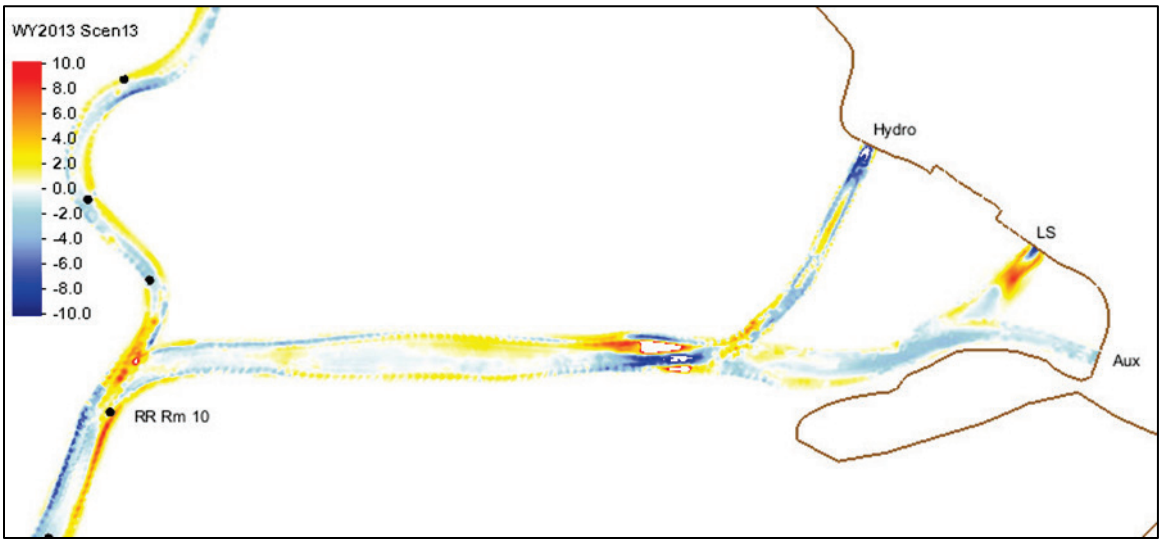
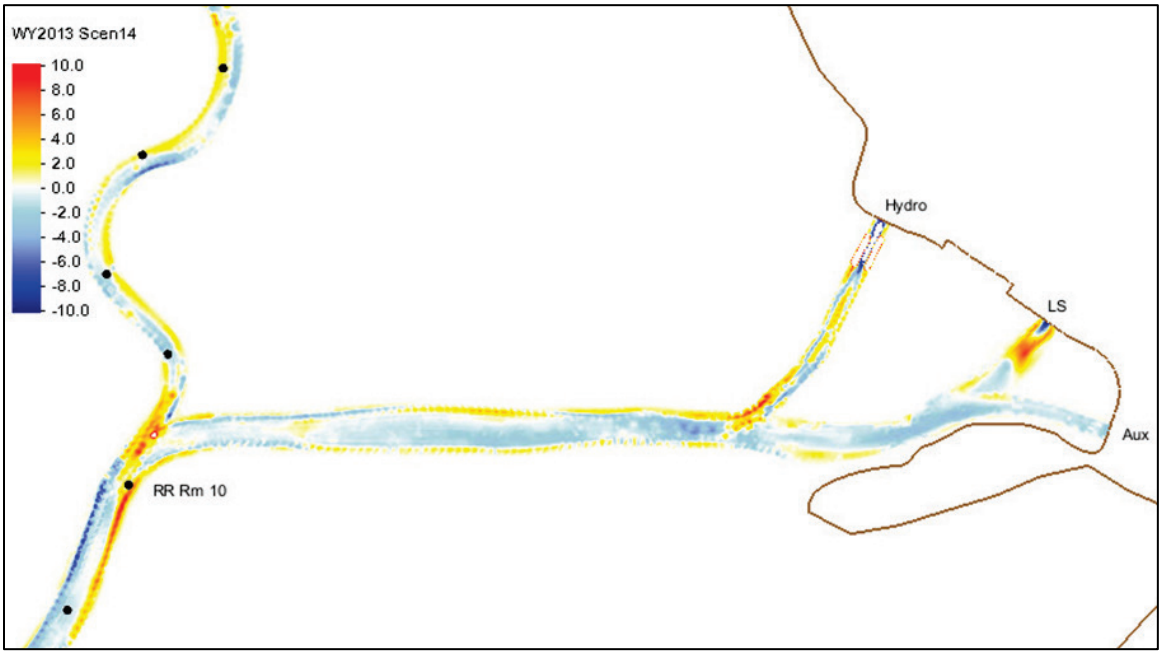


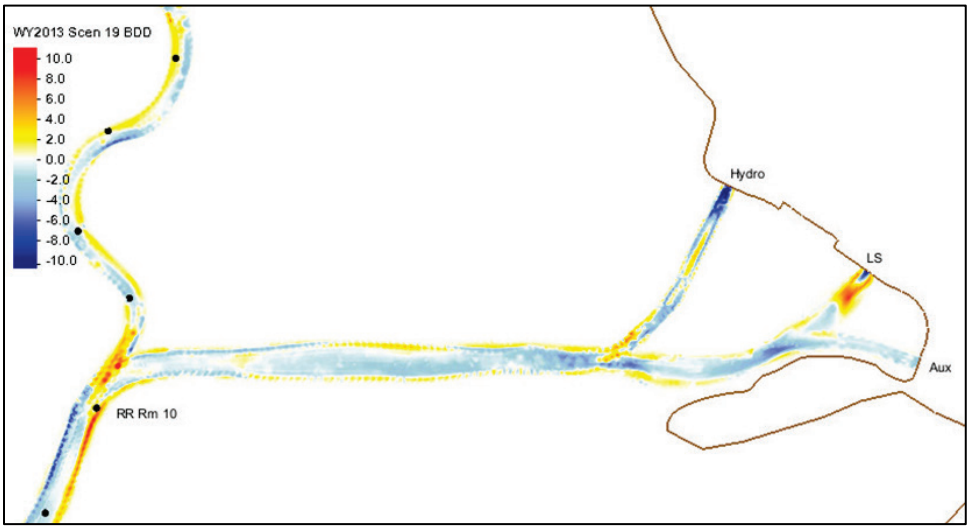
Figure 91. WY2013 Scenario 14 BDD Outflow Channel.



5.6 Structure Options Scenario 19 and 20

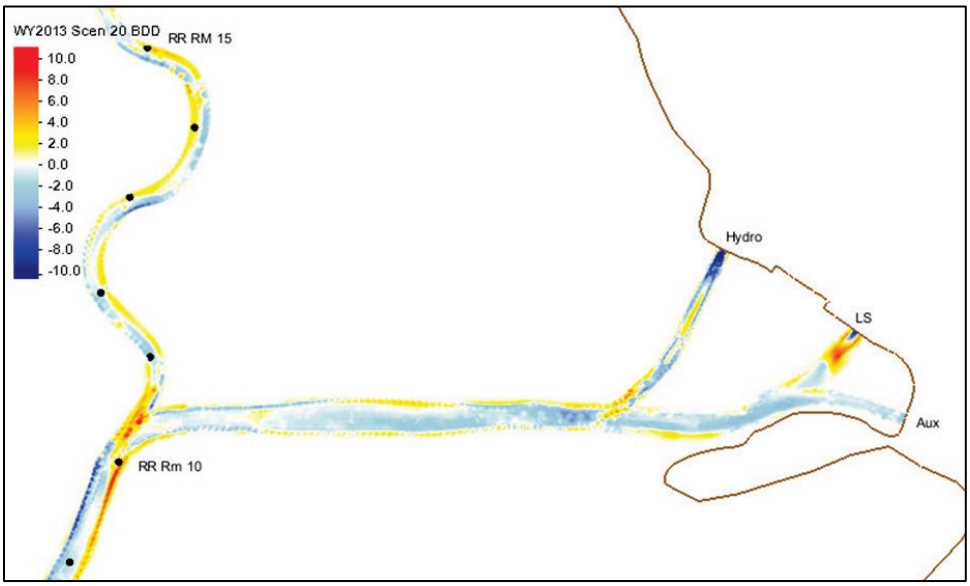
Layout of the dike configuration for Scenarios 19 and 20 are shown in Figure 30 and Figure 32, respectively.

Figure 92. WY2013 Scenario 19 BDD Outflow Channel.



BDD in Figure 92 shows scour downstream of the most easterly two dike fields and deposition along the south bank above the top of bank. In the center of the Outflow Channel, scour is more prominent downstream past the confluence of the Outflow Channel and Hydropower outfall channel than the Base Run.

Figure 93. WY2013 Scenario 20 BDD Outflow Channel.

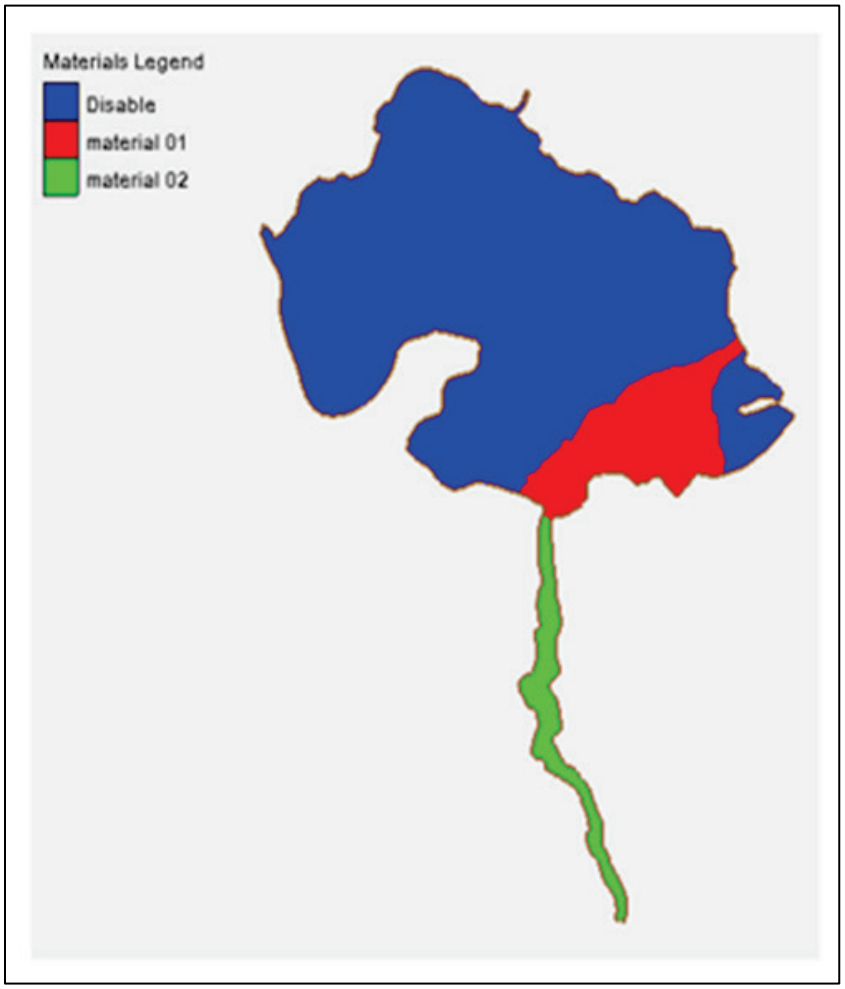


Deposition occurred throughout the dike field, and the center of the Outflow Channel eroded deeper than the Base Run. There was no appreciable change of sediment trends from the Base Run downstream of Scenario 20 dike field (Figure 93).

5.7 WY2013 BSVC

The BSVC was calculated in each simulation by material. Figure 94 is the material legend for the material areas. Material 1 is designated by the red area, and Material 2 by the green area (Simmesport to Melville). Appendix G: WY2013 BSVC contain the BSVC plots of Materials 1 and 2 for Base Run, Scenarios 3–10, Dredge Placement Scenarios 11–14, and Structures Options Scenarios 19 and 20.

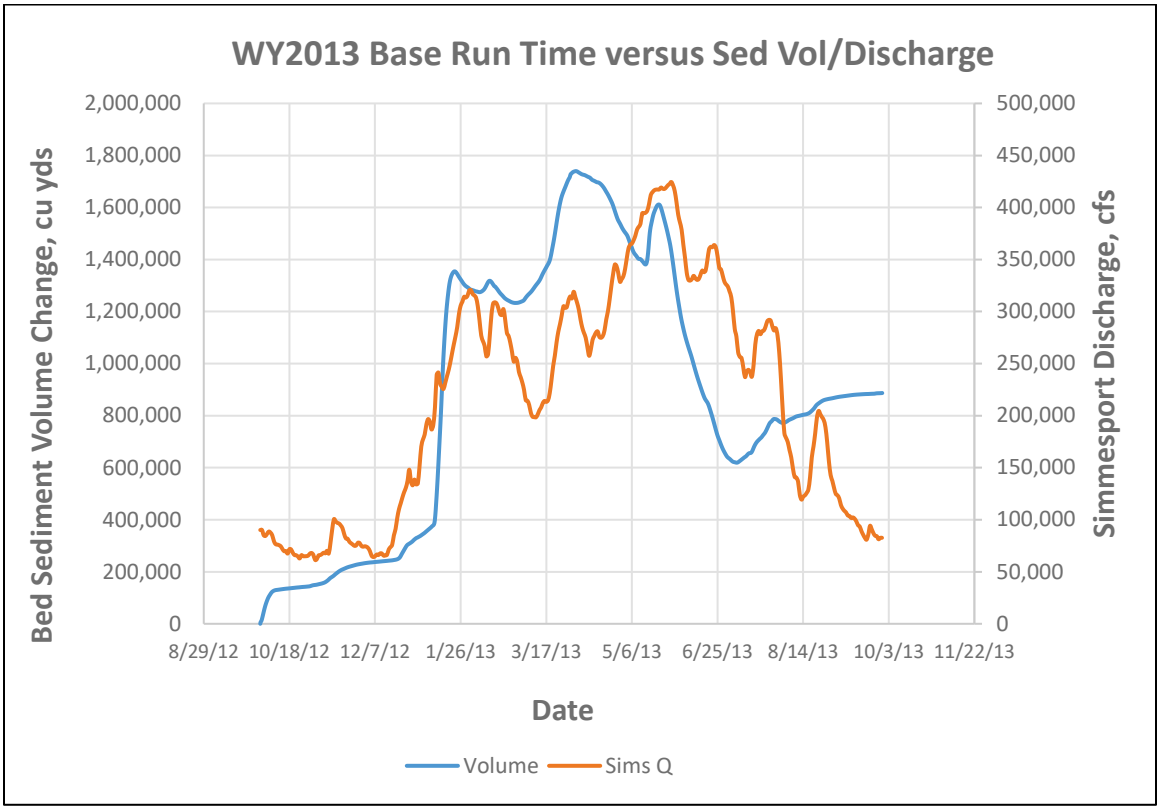
Figure 94. BSVC material legend.



5.7.1 Material 1 Base Run and Scenarios 3–10

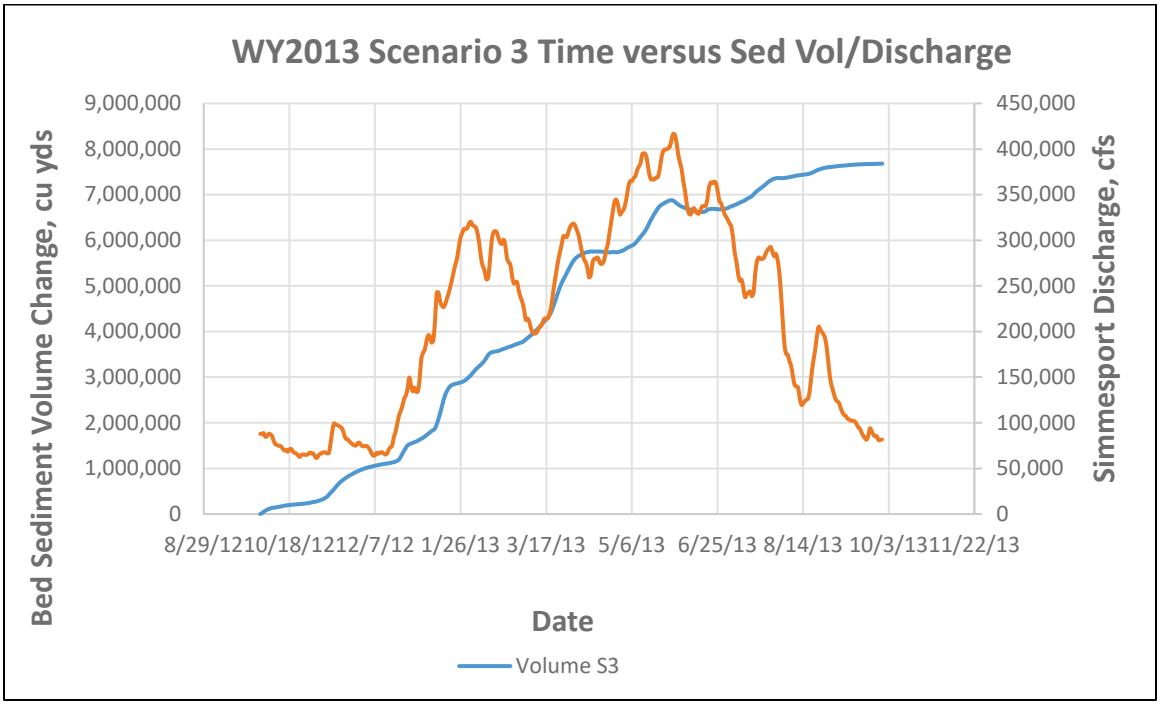
WY2013 Base Run time history plot verses Material 1 BSVC and Simmesport discharge (Figure 95) produced 886,000 cu yd of bed material deposition. Maximum Simmesport discharge is 421,000 cfs.

Figure 95. Material 1 WY2013 Base Run time versus sediment volume change/Simmesport discharge.



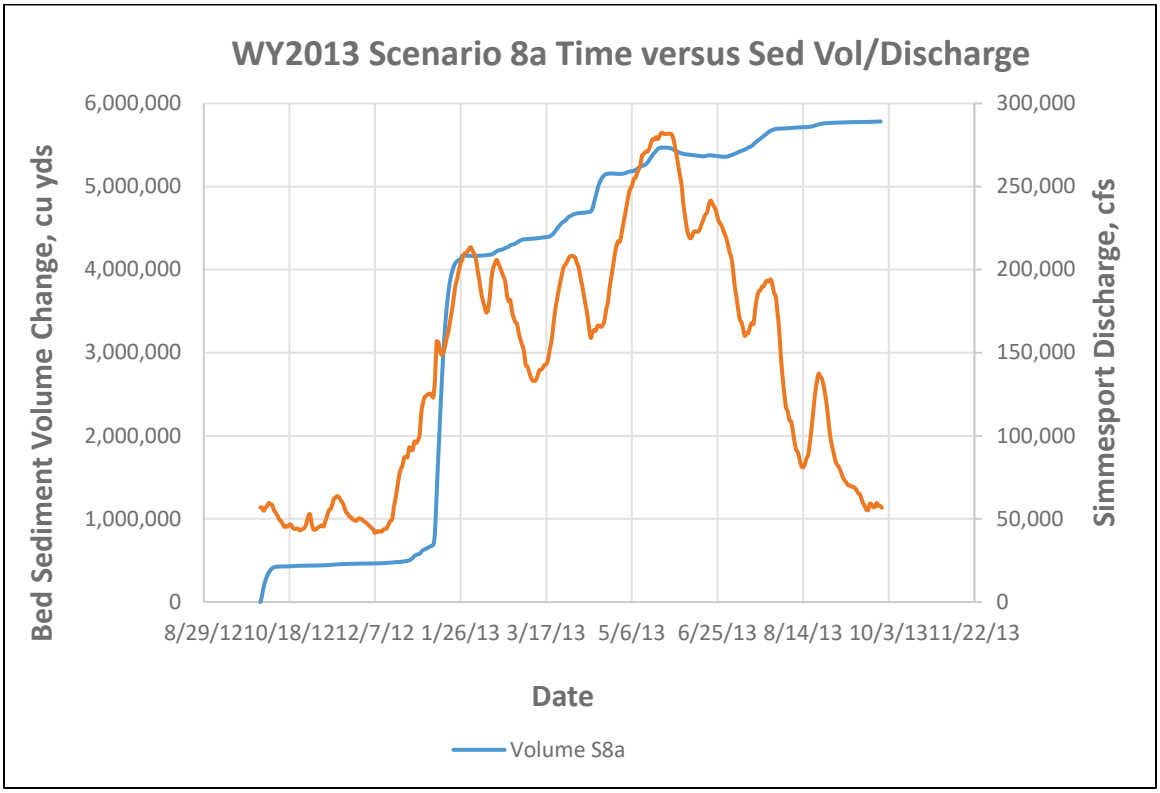
WY2013 Scenario 3 BSVC (Figure 96) has aggradation of 7.68 million cu yd. Maximum discharge is 416,000 cfs.

Figure 96. Material 1 WY2013 Scenario 3 time versus sediment volume change/Simmesport discharge.



WY2013 Scenario 8a BSVC (Figure 97) has aggradation of 578,000 cu yd. Maximum discharge is 281,500 cfs.

Figure 97. Material 1 WY2013 Scenario 8a time versus sediment volume change/Simmesport discharge.



WY2013 Scenario 9 BSVC (Figure 98) has degradation of 2.71 million cu yd. Maximum discharge is 550,000 cfs.

Figure 98. Material 1 WY2013 Scenario 9 time versus sediment volume change/Simmesport discharge.

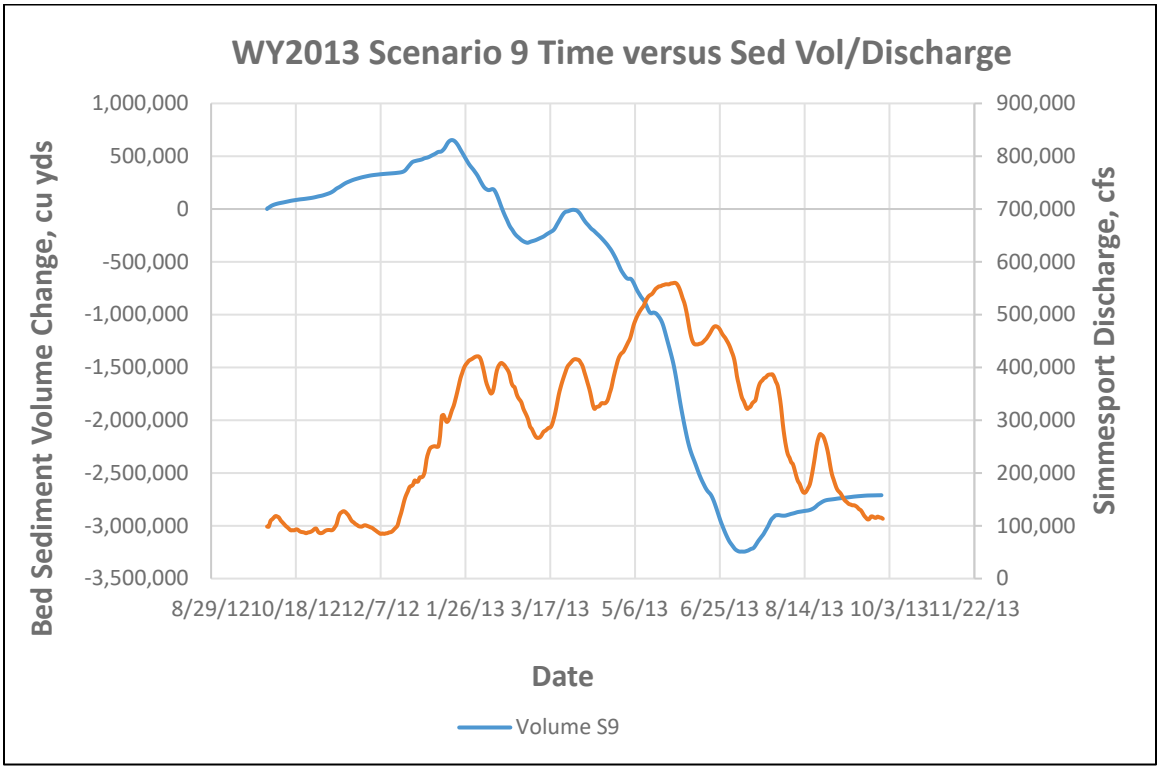
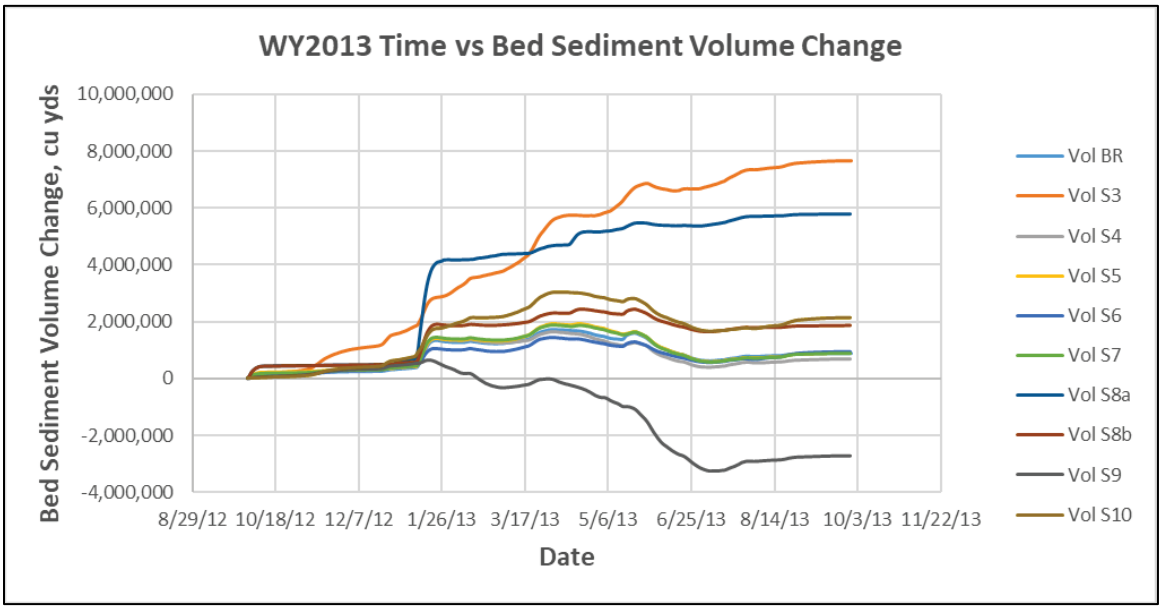


Figure 99 presents the time history of BSVC Base Run and Scenarios 3–10. All scenarios aggraded except Scenario 9, which degraded. All plots of BSVC can be located in Appendix G: WY 2012 BSVC–Material 1 Base Run and Scenarios 3–10, Plates G.2–G.11.

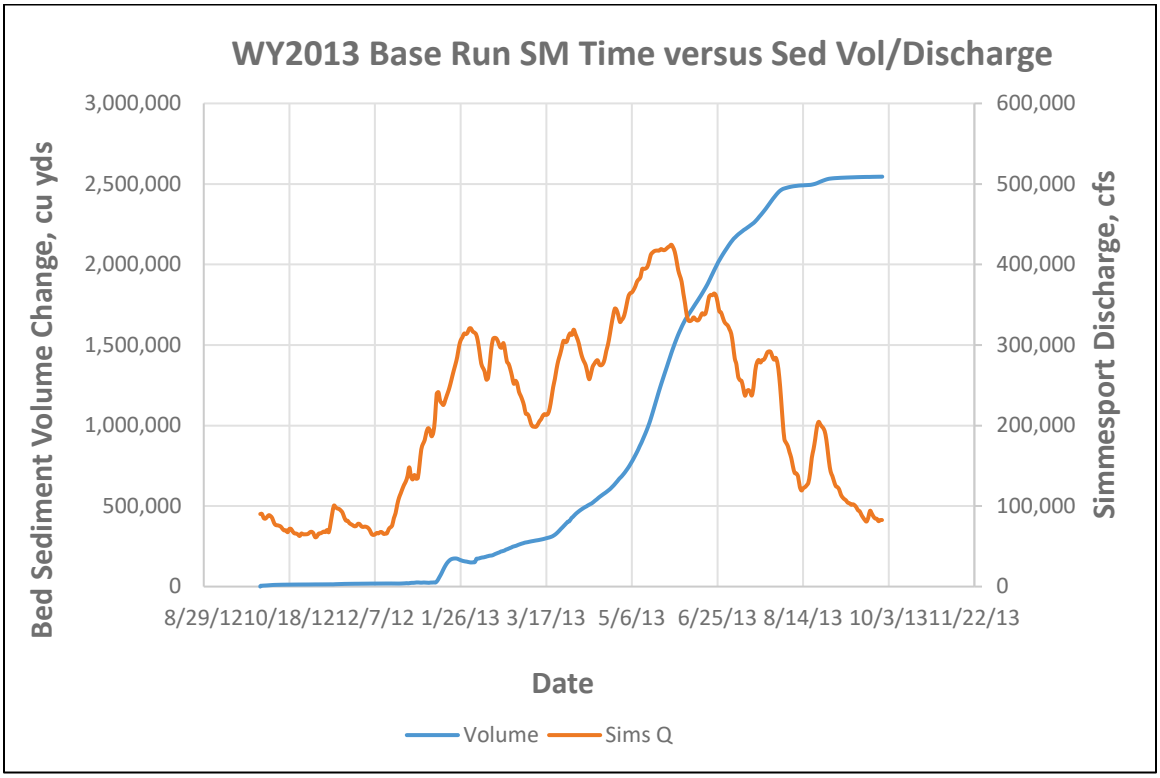
Figure 99. Material 1 WY2013 Base Run and Scenarios 3–10 time versus sediment volume change.



5.7.2 Material 2 Base Run and Scenarios 3–10

WY2013 material 2 Base Run in Figure 100 produced 2.54 million cu yd of aggraded bed material. The erosion and deposition discharge threshold between Simmesport and Melville is 600,000 cfs.

Figure 100. Material 2 WY2013 Base Run time versus sediment volume change/Simmesport discharge.



WY2013 material 2 Scenario 3 in Figure 101 produced 2.7 million cu yd of aggraded bed material.

WY2013 material 2 Scenario 8a in Figure 102 produced 889,800 cu yd of aggraded bed material.

WY2013 material 2 Scenario 9 in Figure 103 produced 4.69 million cu yd of aggraded bed material.

Figure 101. Material 2 WY2013 Scenario 3 time versus sediment volume change/Simmesport discharge.

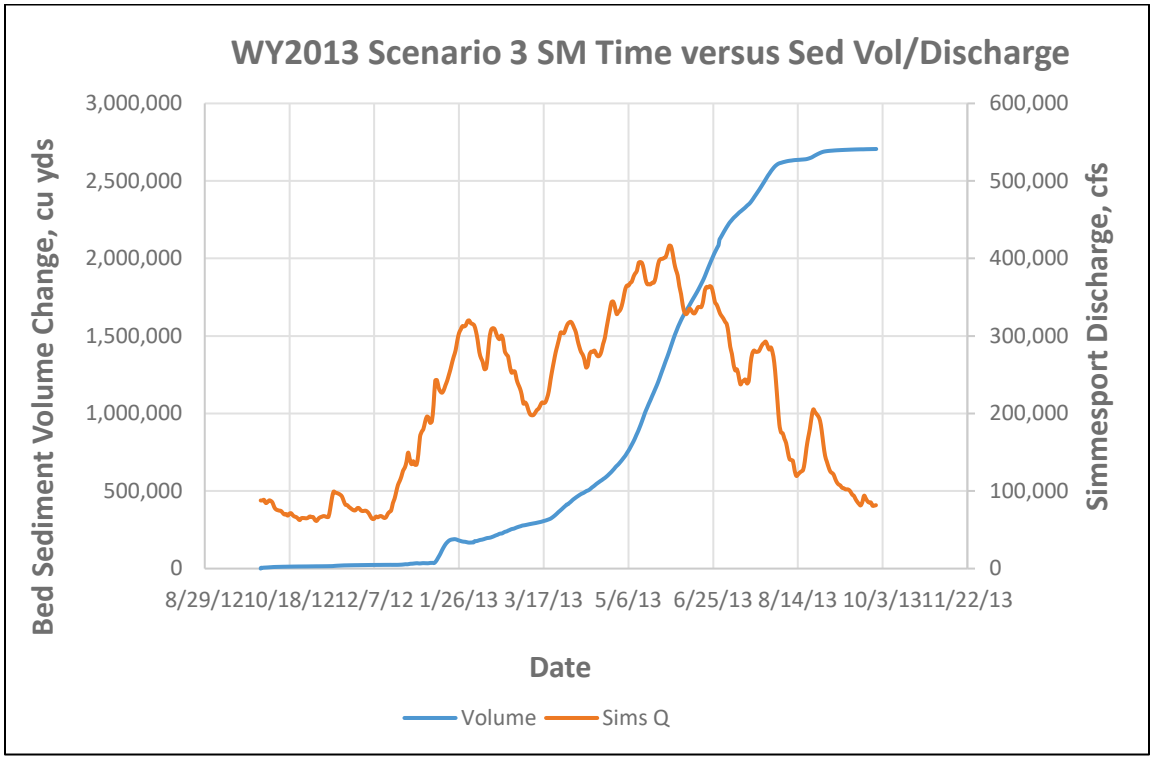


Figure 102. Material 2 WY2013 Scenario 8a time versus sediment volume change/Simmesport discharge.

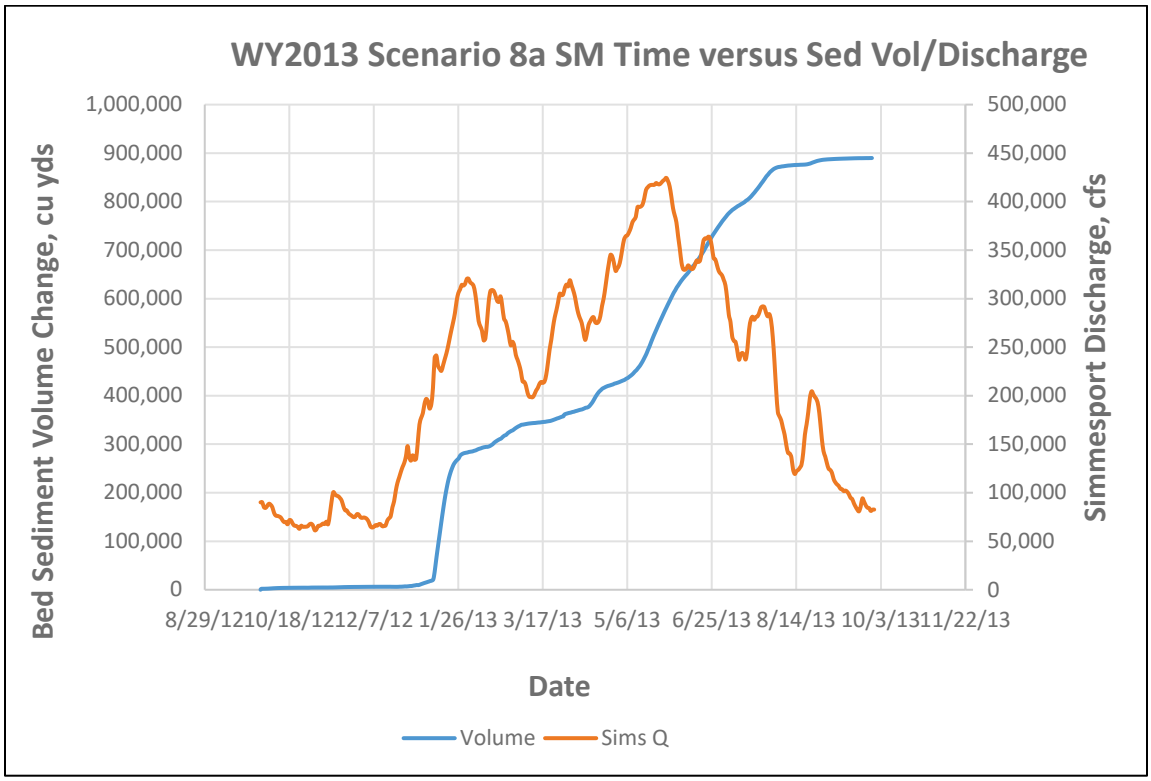


Figure 104 presents the time history of BSVC Base Run and Scenarios 3–10. All scenarios aggraded. All plots of BSVC can be located in Appendix G: WY 2013 BSVC–Material 2 Base Run and Scenarios 3–10, Plates G.14–G.23.

Figure 103. Material 2 WY2013 Scenario 9 time versus sediment volume change/Simmesport discharge.

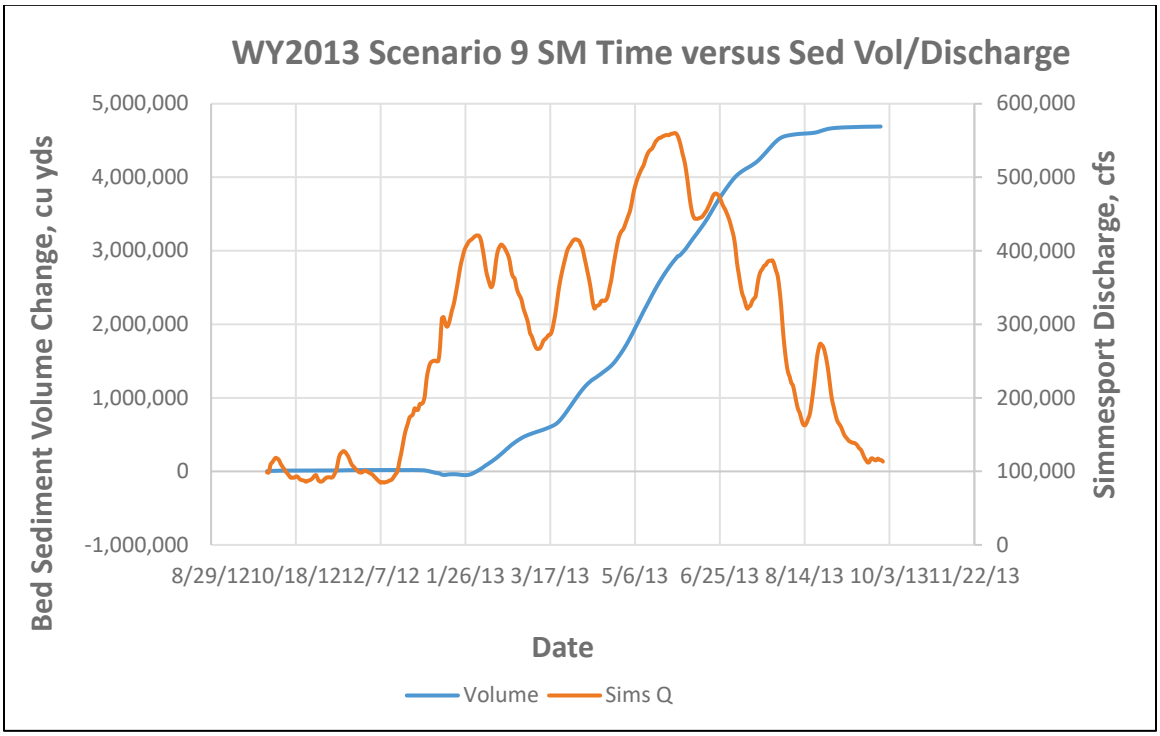
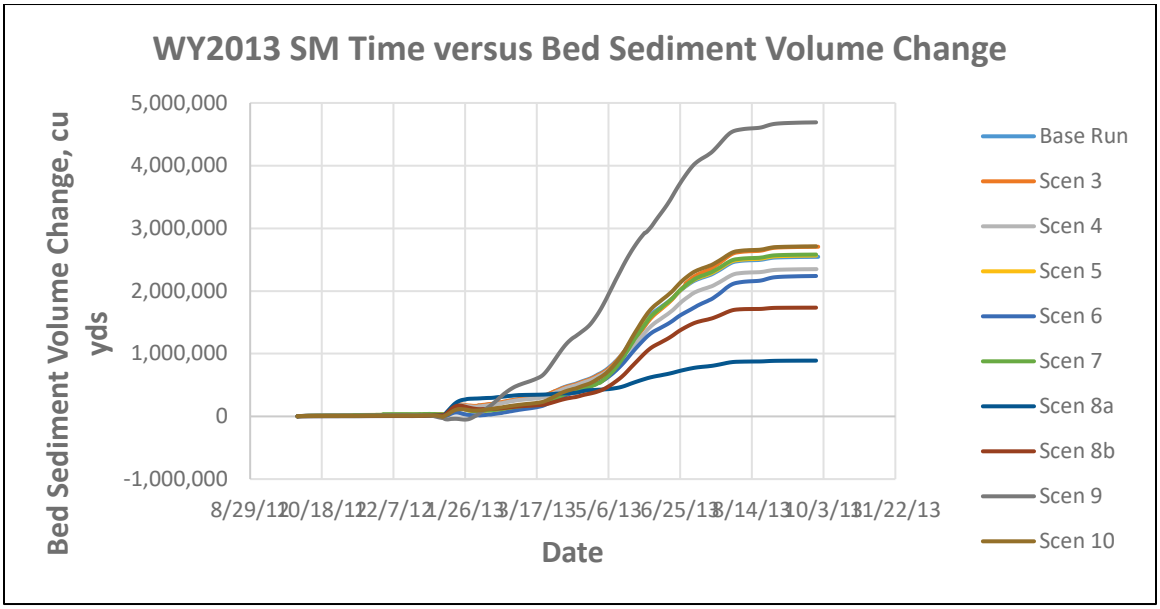


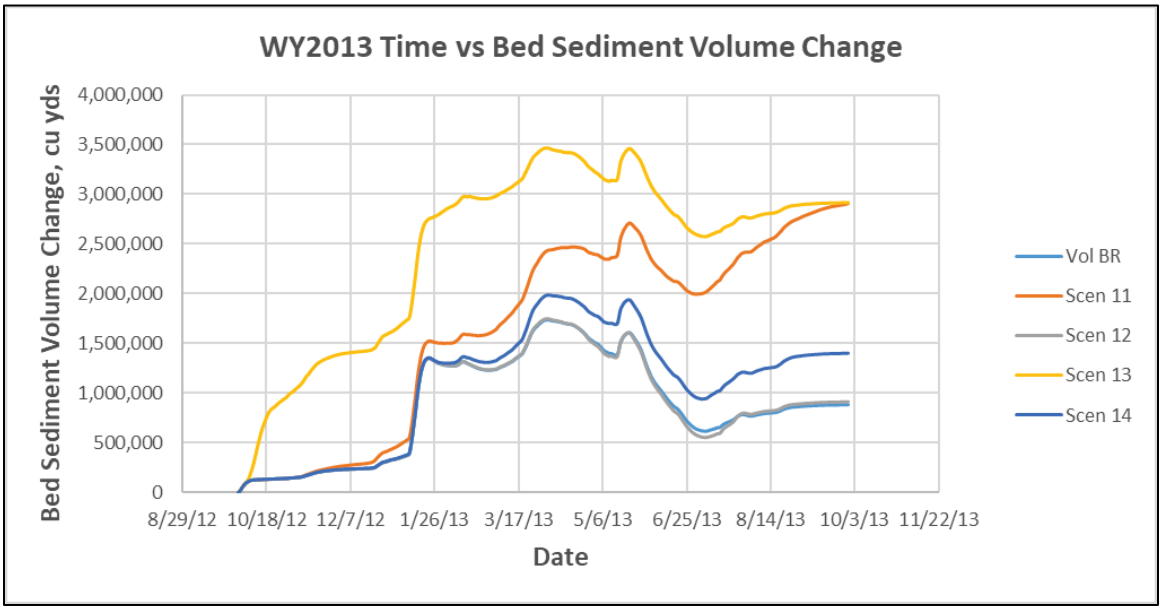
Figure 104. Material 2 WY2013 Base Run and Scenarios 3–10 time versus sediment volume change.



5.7.3 Material 1 BSVC Dredge Placement Scenarios 11–14

Time series plots of the BSVC and Simmesport discharge for Material 1 Scenarios 11–14 are located in Appendix G: Plates G.26–29. Figure 105 presents a summary plot of the dredge placement scenarios BSVC. Location and rate of dredge material release (Figure 25) are the difference in the amount of deposition and erosion. Scenario 13 dredge material was sporadically released as shown in Figure 25 and results in deposition of 2.9 million cu yd. In Scenario 11, dredge material was continuously released at the same location with 2.9 million cu yd. In Scenario 12 and 14, dredge material was continuously released downstream of the Low Sill and Hydro structures, respectively (Figure 25). In Scenario 12, due to the two-dimensional effect of the model having no vertical component of velocity, there are deposits in the scour hole downstream of the Low Sill Structure. The release point of the dredge material is upstream of the boundary for Material 1 (Figure 34) for both Scenario 12 and 14. Therefore, any deposition upstream of the USGS gage in the Outflow Channel may not be transported to the area of Material 1. Scenario 12 accounts for 916,000 cu yd. Scenario 14 release point is downstream of the Hydropower Unit. Scenario 14 deposits sediment in the hydropower outfall channel that is not transported to the USGS gage in the Outflow Channel and not accounted in the Material 1 area (Appendix A: Plate A.117). Scenario 14 deposits 1.4 million cu yds.

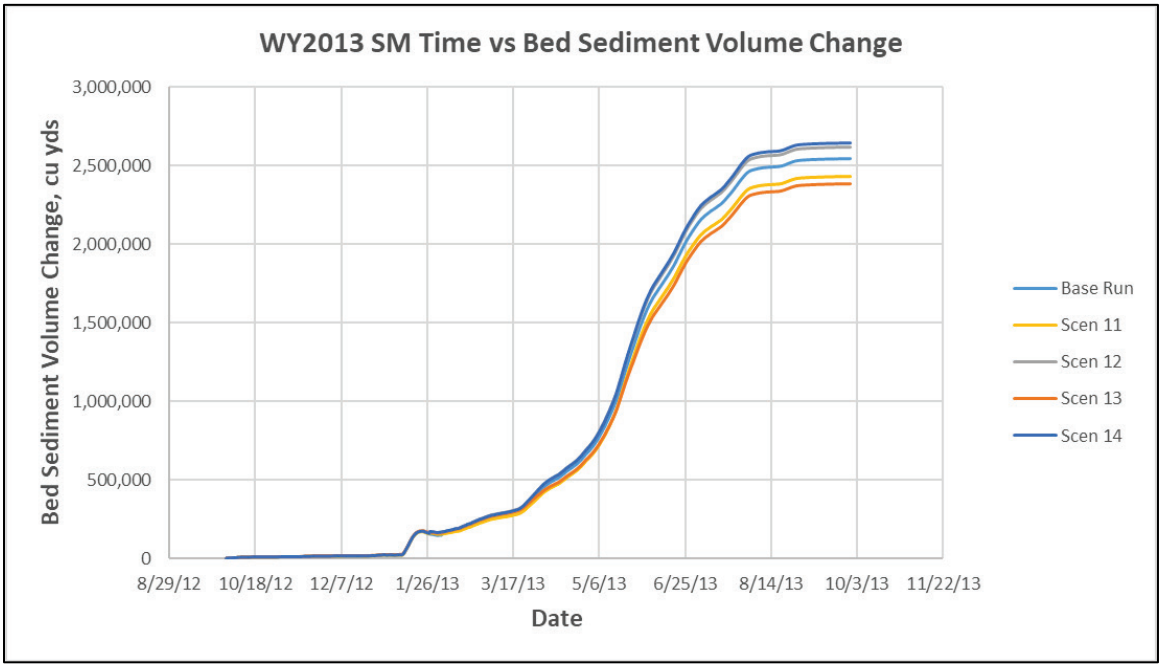
Figure 105. Material 1 WY2013 Base Run and Scenario 11–14 time versus sediment volume change.



5.7.4 Material 2 BSVC Dredge Placement Scenarios 11–14

Time series plots of the BSVC and Simmesport discharge for Material 2 Scenarios 11–14 are located in Appendix G: Plates G.32–35. Figure 106 is a summary Material 2 BSVC plot of the Base Run and Scenarios 11–14. Scenarios 12 and 14 deposit more sediment than the Base Run in Material Area 2. Scenarios 11 and 13 deposit less than the Base Run.

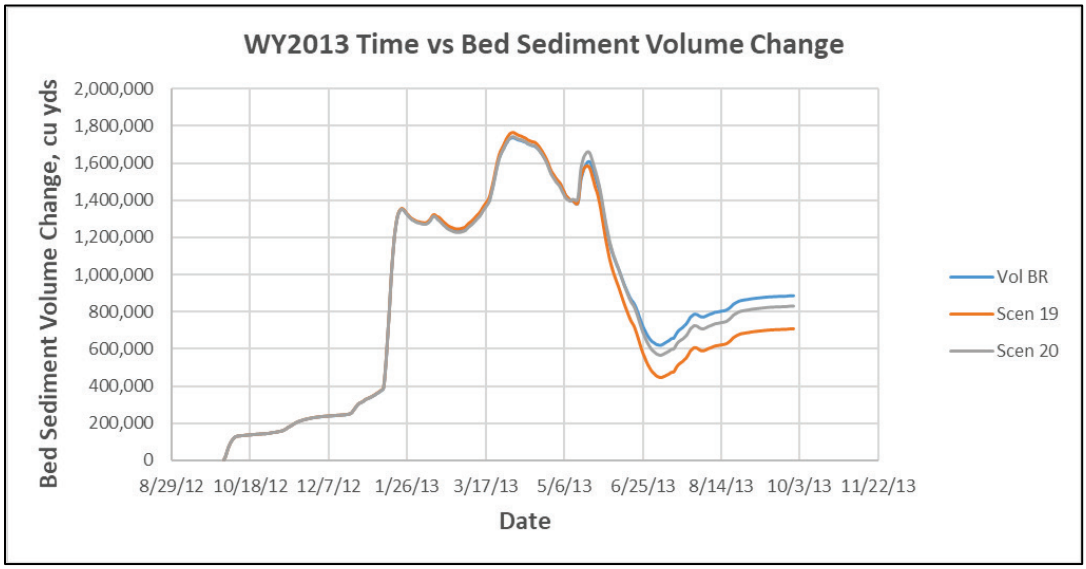
Figure 106. Material 2 WY2013 Base Run and Scenario 11–14 time versus sediment volume change.



5.7.5 Material 1 BSVC Structure Options Scenarios 19 and 20

Both structure options are located upstream of the beginning of Material Area 1 (USGS gage) in the Outflow Channel. Scenario 19 dike configuration and location are shown in Figure 30. Figure 107 presents the summary of the Material 1 for BSVC Base Run and Scenarios 19 and 20. Scenario 19 is the same as the Base Run 707,000 cu yd. Scenario 20 deposits 829,000 cu yd. The Base Run deposited 887,000 cu yd. Time series plots of the BSVC and Simmesport discharge for Material 1 Scenarios 19–20 are located in Appendix G: Plates G.38–39.

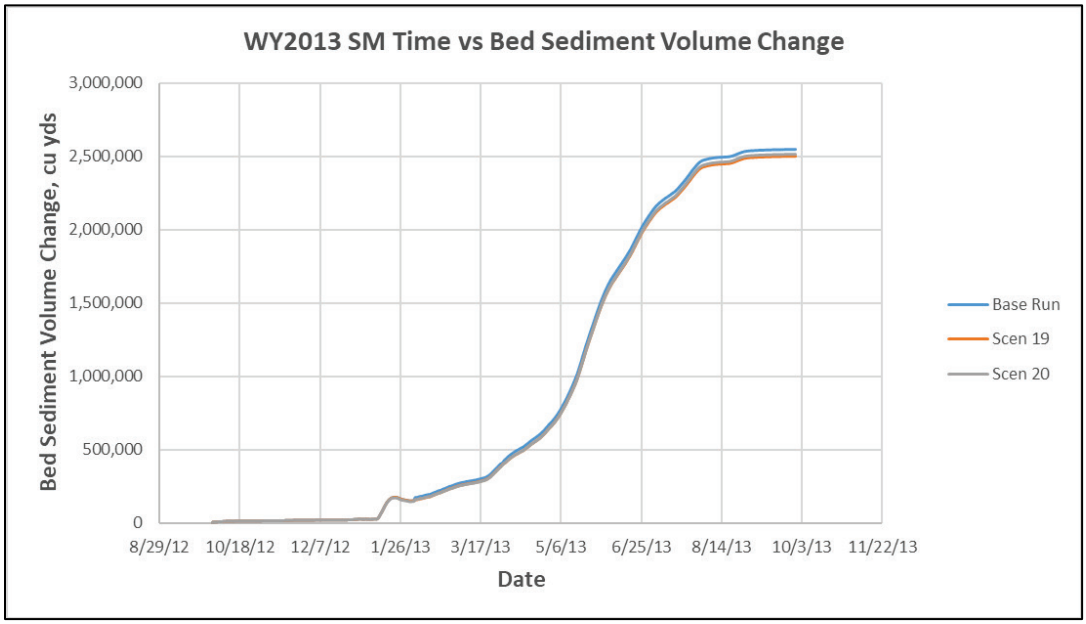
Figure 107. Material 1 WY2013 Base Run and Scenario 19 and 20 time versus sediment volume change.



5.7.6 Material 2 BSVC Structure Options Scenarios 19 and 20

Time series plots of the BSVC and Simmesport discharge for Material 2. Scenarios 19–20 are located in Appendix G: Plates G.42–43. There is no change of BSVC (Figure 108) from the Base Run between Simmesport and Melville (Figure 78).

Figure 108. Material 2 WY2013 Base Run and Scenario 19 and 20 time versus sediment volume change.



6 Results

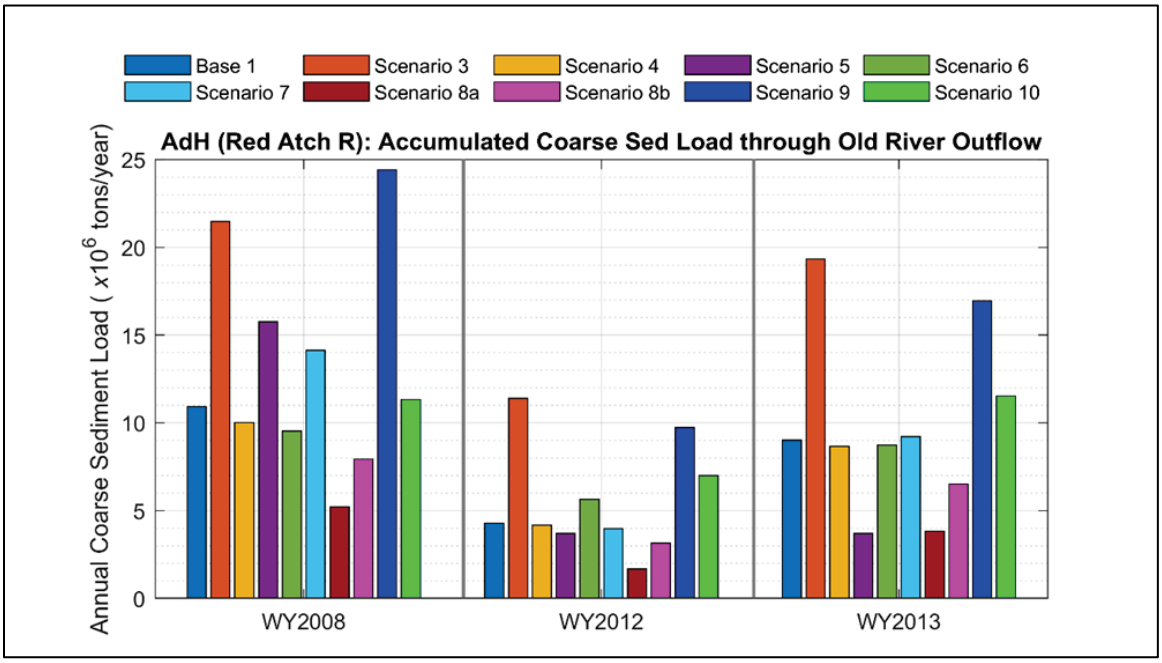
6.1 Base Run and Scenarios 3–10

Annual accumulated coarse sediment load measured through the USGS gages (Figure 109) in the Outflow Channel, Red River, and Simmesport are presented below.

Figure 109. USGS gage locations.

Bar charts of all three water years displaying the annual accumulated coarse sediment load through the Outflow Channel USGS 07381482 gage are shown in Figure 110. Scenarios 3, 5, 7, 9, and 10 pass more coarse sediment than the Base Run for WY2008. WY2012 (the low-flow water year) Scenarios 3, 6, 9, and 10 pass more sediment than the Base Run. WY2013 Scenarios 3, 7, 9, and 10 pass more coarse sediment than the Base Run. Comparisons of these data can be considered for the most efficient scenario transporting annual accumulated coarse sediment.

Figure 110. WY2008, WY2012 and WY2013 Scenarios 3–10 accumulated coarse sediment load through Outflow Channel USGS gage location.



Bar charts of all three water years displaying the annual accumulated coarse sediment load through the Red River USGS 07355690 gage are shown in Figure 111. Scenarios 5, 7, 8a, and 8b pass more coarse sediment than the Base Run for WY2008. WY2012 (the low-flow water year) all scenarios with the exception of Scenario 9 pass more sediment than the Base Run. WY2013 Scenarios 5, 8a, and 8b pass more coarse sediment than the Base Run. Comparisons of these data can be considered for the most efficient scenario transporting annual accumulated coarse sediment at the three different locations.

Bar charts of all three water years displaying the annual accumulated coarse sediment load through the Simmesport USGS 07381490 gage are shown in Figure 112. Scenarios 5, 7, and 9 pass more coarse sediment than the Base Run for WY2008. WY2012 (the low-flow water year) Scenarios 3, 6, 9, and 10 pass more sediment than the Base Run. WY2013 Scenarios 3, 7, 9, and 10 pass more coarse sediment than the Base Run. Comparisons of these data can be considered for the most efficient scenario transporting annual accumulated coarse sediment at the three different locations.

Figure 111. WY2008, WY2012 and WY2013 Scenarios 3–10 accumulated coarse sediment load through Red River USGS gage location.

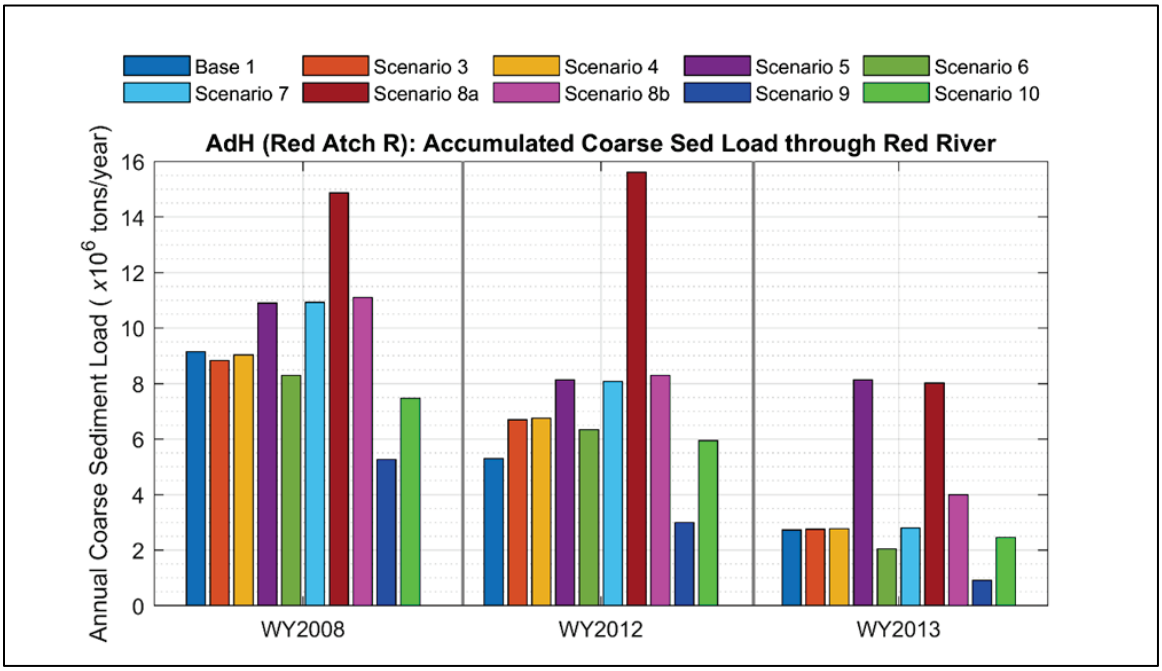
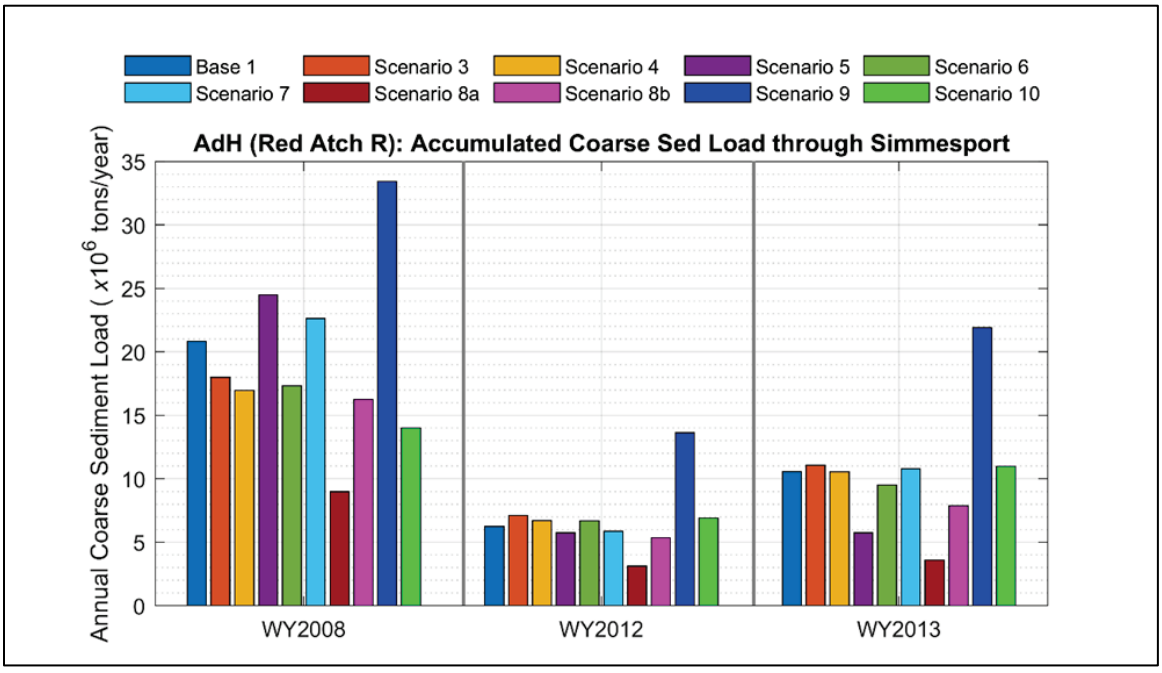


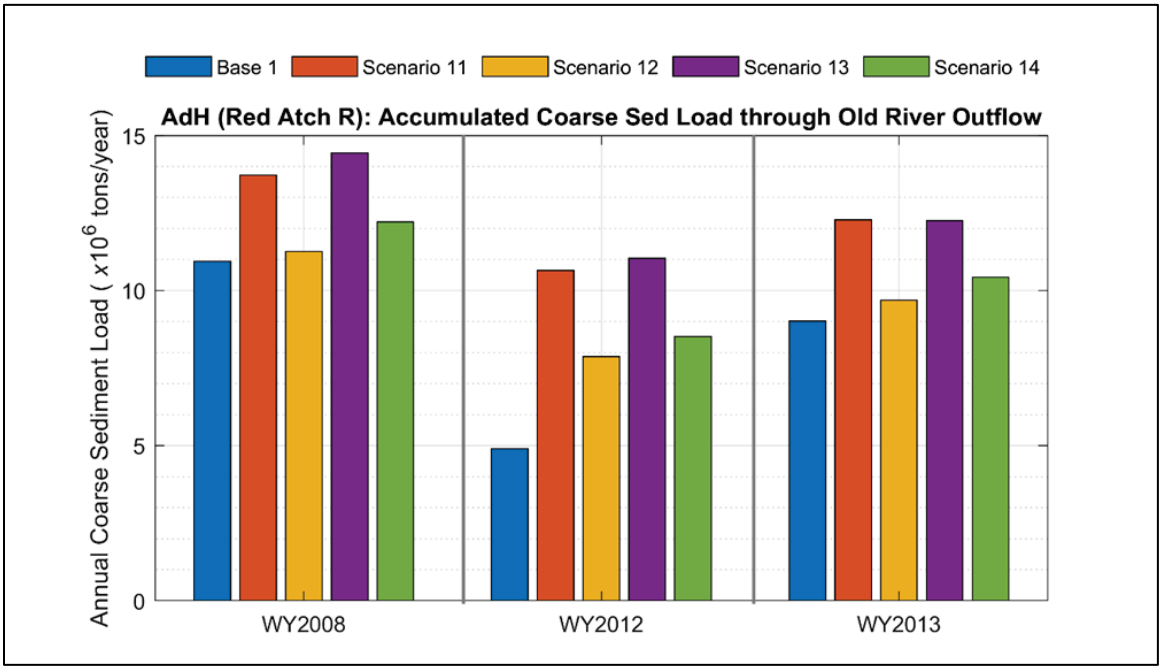
Figure 112. WY2008, WY2012 and WY2013 Scenario 3–10 accumulated coarse sediment load through Simmesport USGS gage location.



6.2 Dredge Placement Scenarios 11–14

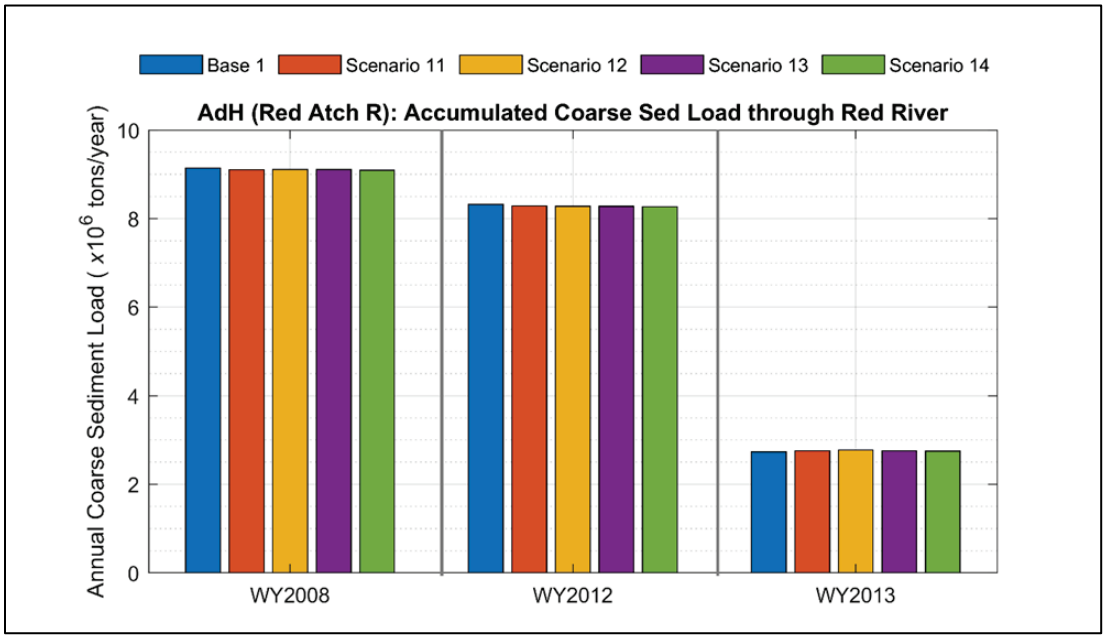
Bar charts of all three water years displaying the annual accumulated coarse sediment load for dredge placement Base Run and Scenarios 11–14 through the Outflow Channel USGS 07381482 gage are shown in Figure 113. All scenarios pass more annual accumulated coarse sediment load than the Base Run.

Figure 113. WY2008, WY2012 and WY2013 Dredge Displacement Scenarios 11–14 accumulated coarse sediment load through Outflow Channel USGS gage location.



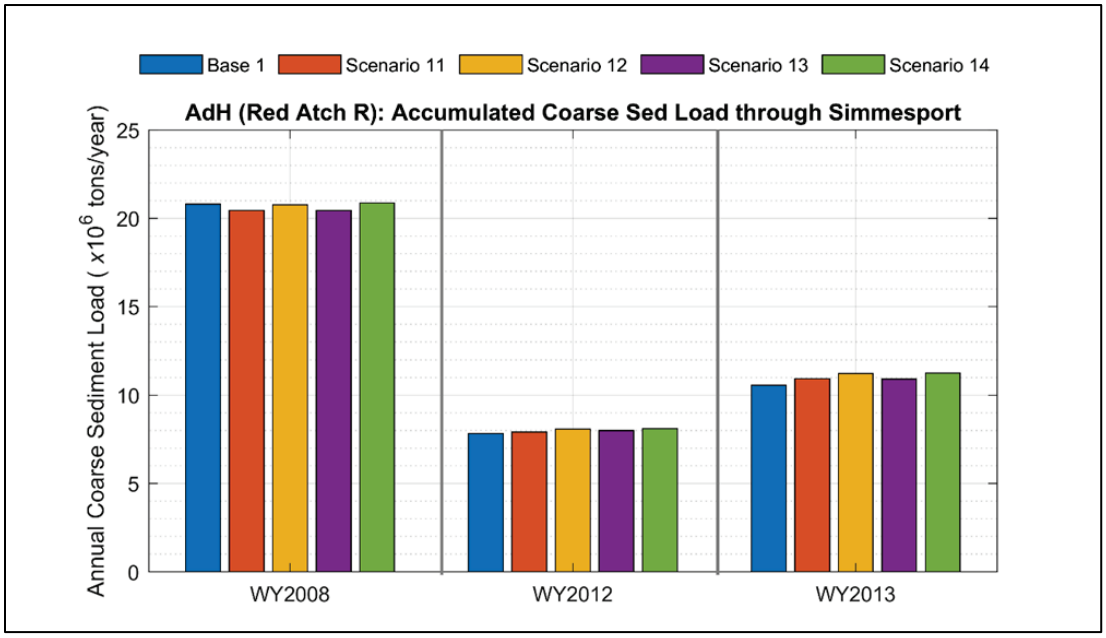
Bar charts of all three water years displaying the annual accumulated coarse sediment load for dredge placement Base Run and Scenarios 11–14 through the Red River USGS 07355690 gage are shown in Figure 114. This gage is located upstream of the Outflow Channel confluence, and dredge placement in the Outflow Channel does not affect the annual accumulated coarse sediment load.

Figure 114. WY2008, WY2012 and WY2013 Dredge Displacement Scenarios 11–14 accumulated coarse sediment load through Red River USGS gage location.



Bar charts of all three water years displaying the annual accumulated coarse sediment load through the Simmesport USGS 07381490 gage are shown in Figure 115. Dredge placement scenarios have minimal affect at Simmesport.

Figure 115. WY2008, WY2012 and WY2013 Dredge Displacement Scenarios 11–14 accumulated coarse sediment load through Simmesport USGS gage location.



6.3 Structures Options Scenarios 19 and 20

Bar charts of all three water years displaying the annual accumulated coarse sediment load for the structures options Base Run and Scenarios 19–20 through the Outflow Channel USGS 07381482 gage are shown in Figure 116. WY2008 and WY2013 all scenarios pass more annual accumulated coarse sediment load than the Base Run. Sediment in the Outflow Channel is eroded in the upper reach of the Outflow Channel and deposited in the mid and lower reach of the Outflow Channel. WY2012 slightly less material is eroded due to sediment being deposited between the individual dikes during the low-flow year.

Bar charts of all three water years displaying the annual accumulated coarse sediment load for the structures options Base Run and Scenarios 19–20 through the Red River USGS 07355690 gage are shown in Figure 117. WY2012 Scenario 20 is slightly higher than the Base Run.

Figure 116. WY2008, WY2012 and WY2013 Structures Options Scenarios 19 and 20 accumulated coarse sediment load through Outflow Channel USGS gage location.

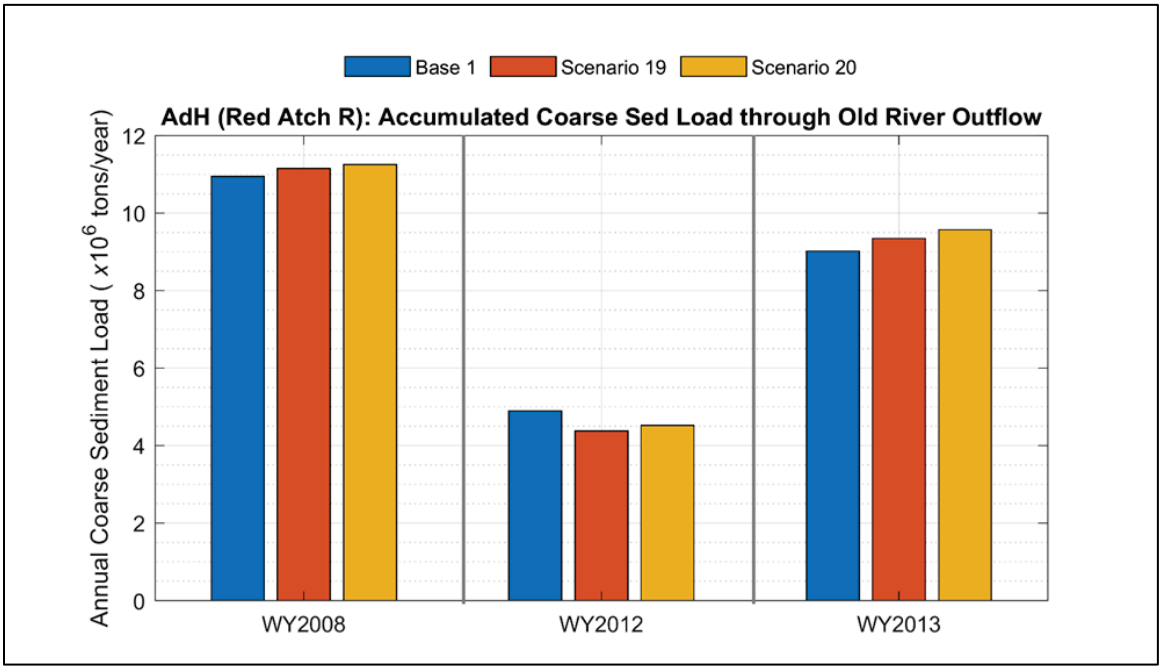
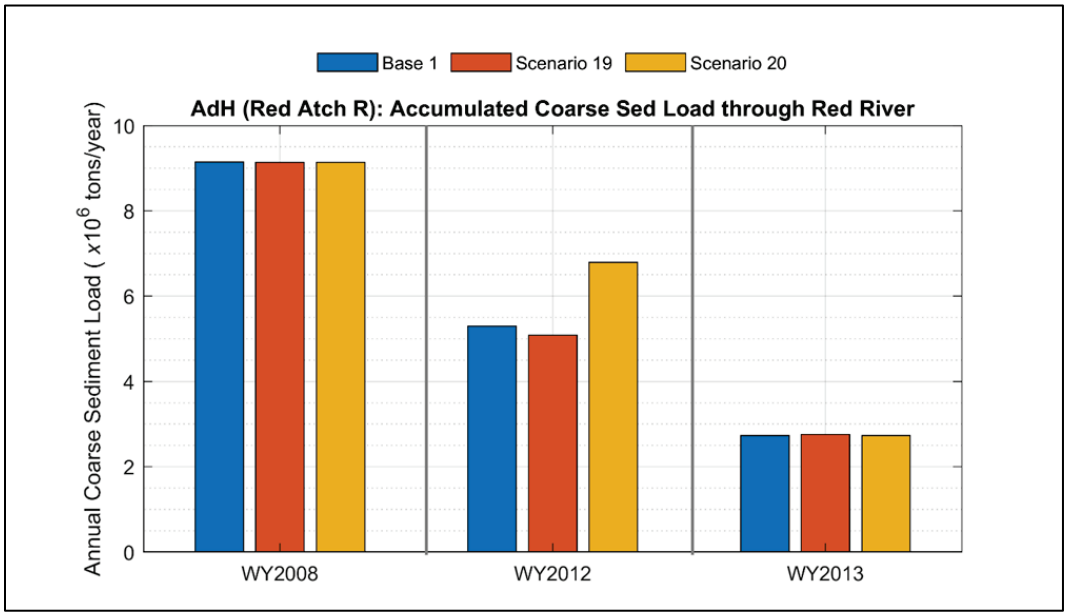
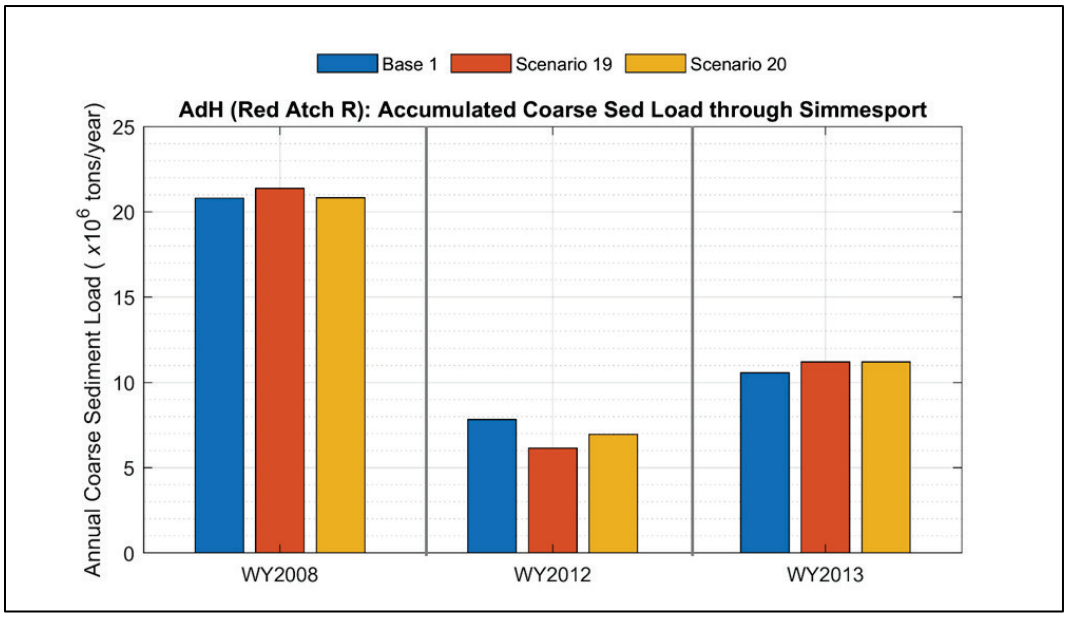


Figure 117. WY2008, WY2012 and WY2013 Structures Options Scenarios 19 and 20 accumulated coarse sediment load through Red River USGS gage location.



Bar charts of all three water years displaying the annual accumulated coarse sediment load through the Simmesport USGS 07381490 gage are shown in Figure 118. Structures options scenarios have minimal affect through Simmesport.

Figure 118. WY2008, WY2012 and WY2013 Structures Options Scenarios 19 and 20 accumulated coarse sediment load through Simmesport USGS gage location.



7 Conclusions and Recommendations

The report details the results of a multidimensional model analysis of the hydrodynamic and geomorphological impacts caused by various proposed scenario analyses for the ORCC. The conclusions are confined to the Outflow Channel and the Atchafalaya River geomorphic responses.

7.1 Conclusions

The conclusions are cast in terms of responses to the Steering Committee charge questions that this task was designed to address. The questions are given below, followed by the responses.

7.1.1 How much sediment is being supplied by the Red River to the Atchafalaya?

This model analyzed the sediment diversion for three separate historic flow years: high flow (WY2008), low flow (WY2012), and typical flow (WY2013). The upper limits of the boundary are Red River Lock and Dam #1 and a 1 mi reach of the Black River at Acme. Sediment transport diminishes below Red River Lock and Dam #1. Most of the sediment is supplied by the Black River, and this area is influenced by the backwater affect generated by the operation of the ORCC. Section 6, Figure 111, Figure 114, and Figure 117 show the annual coarse sediment accumulated at the Red River USGS gage. These figures show that the coarse sediment supplied by the Red River is approximately 9, 5, and 3 million tons/yr for WY2008, WY2012, and WY2013 simulations, respectively.

How can water control operations be optimized to improve sediment transfer based on improved understanding of water flow and sediment transport in the system? Sections 3, 4, 5, and 6 of this report detail the effects of various potential changes in operations at the ORCC. An increase in the ORCC flow distribution from the 70/30 split to a 60/40 split significantly increases the sediment transfer through the ORCC. Conversely, a reduction of the ORCC flow distribution to an 80/20 split significantly decreases the sediment transfer through the ORCC. For all three water years, Scenario 3 brought more sediment through ORCC than the Base Run for the same amount of flow.

7.1.2 What is the sediment transport capacity of the ORCC combined outflow channel under a variety of potential operational schemes?

Sections 3, 4, and 5 of this report detail the effects of various potential changes in operations at the ORCC. An increase in the ORCC flow distribution from the 70/30 split to a 60/40 split significantly increases the sediment transport capacity to the upper Atchafalaya River but does not impact the lower Red River upstream of the Outflow Channel confluence whereas a reduction of the ORCC flow distribution to an 80/20 split significantly decreases the sediment transport capacity to the upper Atchafalaya River. The channel exhibited scour for the 60/40 scenario and exhibited deposition for the 80/20 scenario during the one year simulation. Scenario 3 brought more sediment through ORCC than the Base Run for the same amount of flow, and it exhibited more channel deposition than the base scenario. This additional deposition could be problematic during relatively dry years, such as 2012. Sections 3.7, 4.7, and 5.7 BSVC illustrate the erosion and deposition potential for specific scenarios.

7.1.3 Are there potential structural solutions on either side of ORCC that could facilitate sediment transport through the system?

This investigation evaluated two structural scenarios (Scenarios 19 and 20) on the downstream side of ORCC, as described in Sections 3.6, 4.6, 5.6, and 6. These scenarios affected only the Outflow Channel. In general, the structures caused some sediment to be eroded in the upper reach of the Outflow Channel and deposited in the mid and lower reach of the Outflow Channel. There was no significant change downstream of the Outflow Channel and Red River confluence to Melville.

7.2 Recommendations

The scenario analyses presented in this report are to identify large trends and to make large scale assessments of the potential impacts of various proposed operational changes to the ORCC.

However, if any of these scenarios were to be analyzed for possible implementation at the ORCC, significant additional modeling would need to be conducted to inform this decision. Additional modeling should be simulated for 10 years at minimum. This modeling should include one-dimensional modeling for long-term and large-scale impacts, multidimensional modeling for local impacts, and should assess project performance.

References

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Appendix A: WY2008 Bed Displacement Data (BDD)

The BDD in Plate A.1. presents a screen capture of the Surface Modeling System (SMS) software used to visualize the bed transformation for the last time step of WY2008. Plate A.1. shows Red River, River Mile (RR RM) 43.9 to RR RM 39. The legend is in meters and is color-coded to visualize the sediment transport trends over the whole water year. For the Base Run, a screen capture for every five miles of river channel was recorded.

A.1 Base Run

Plate A.1. WY2008 Base Run BDD RR RM 43–RR RM 39.

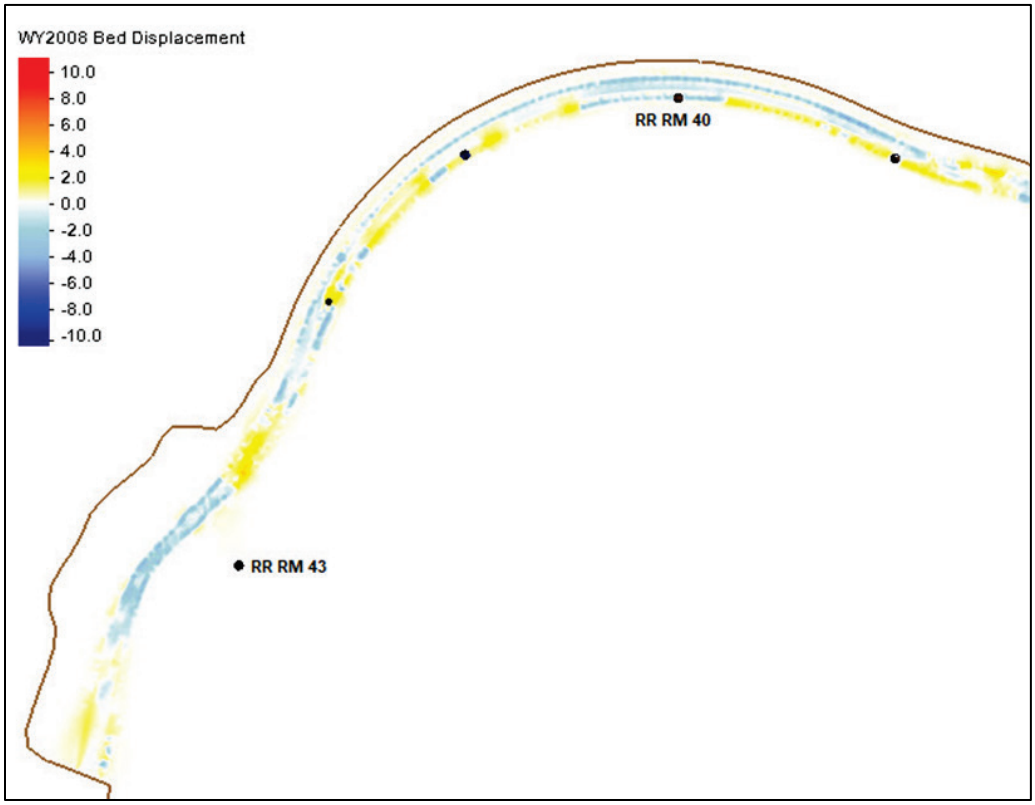


Plate A.2. WY2008 Base Run BDD RR RM 40–RR RM 35.

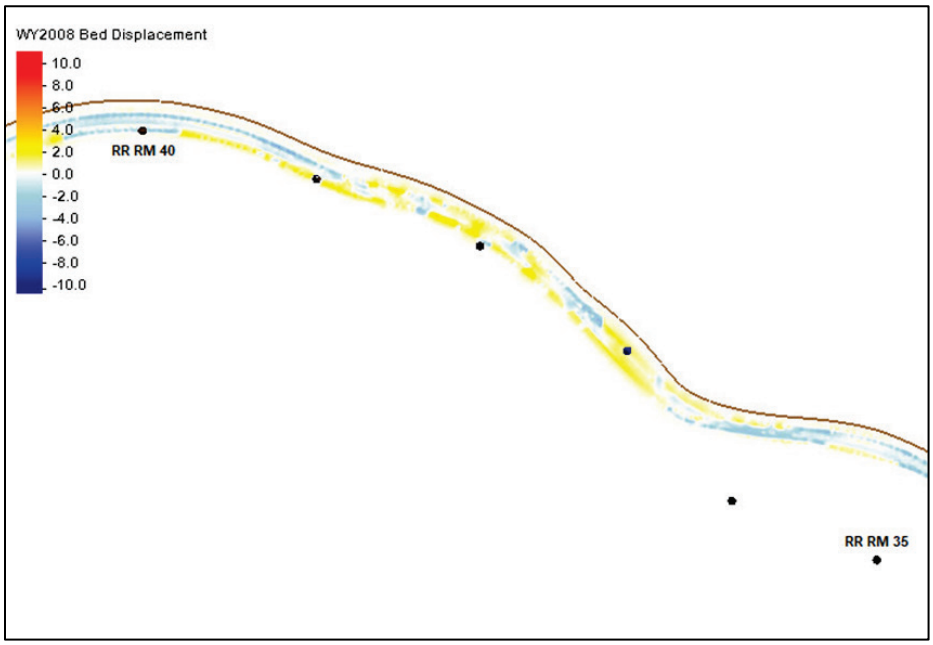


Plate A.3. WY2008 Base Run BDD RR RM 35–RR RM 30.

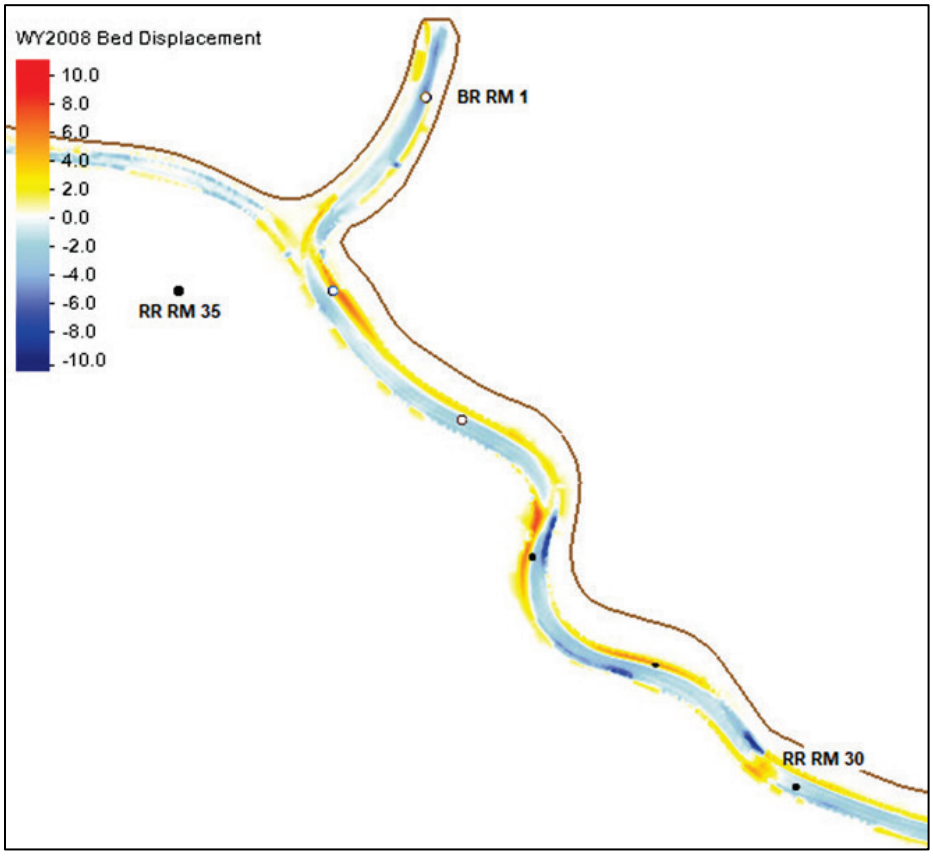


Plate A.4. WY2008 Base Run BDD RR RM 30–RR RM 25.

Plate A.5. WY2008 Base Run BDD RR RM 25–RR RM 18.

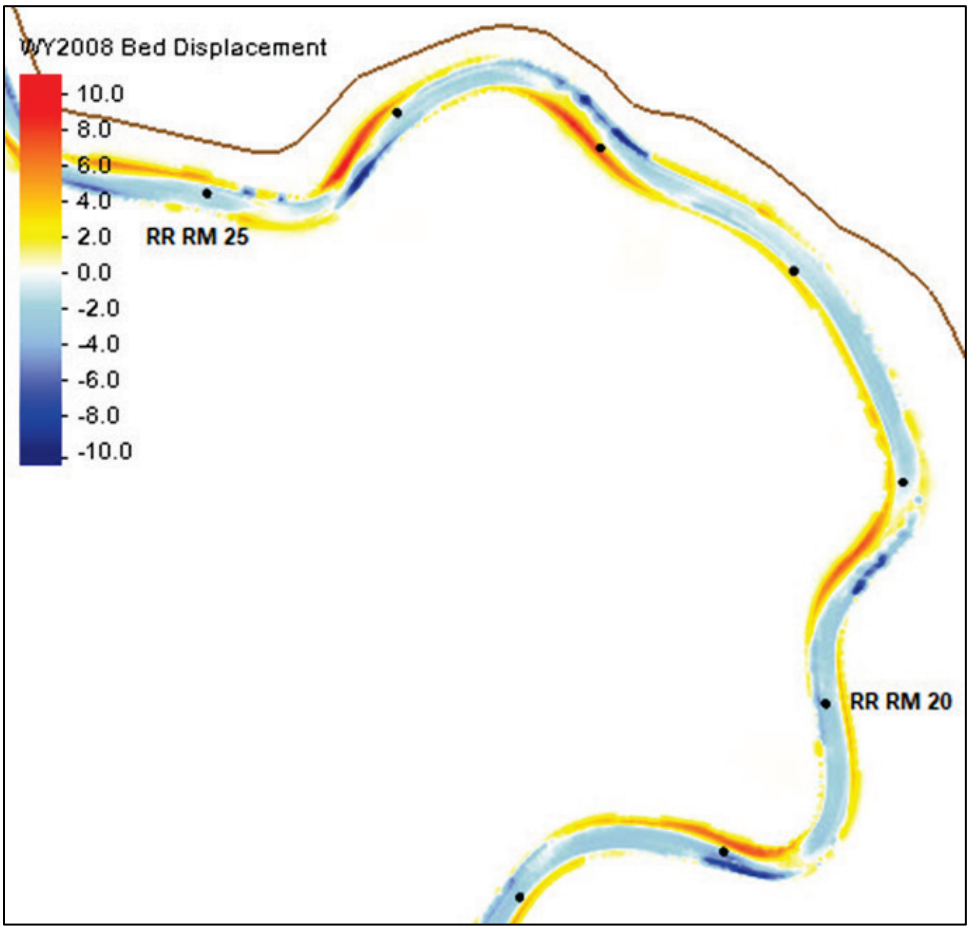


Plate A.6. WY2008 Base Run BDD RR RM 20–RR RM 14.

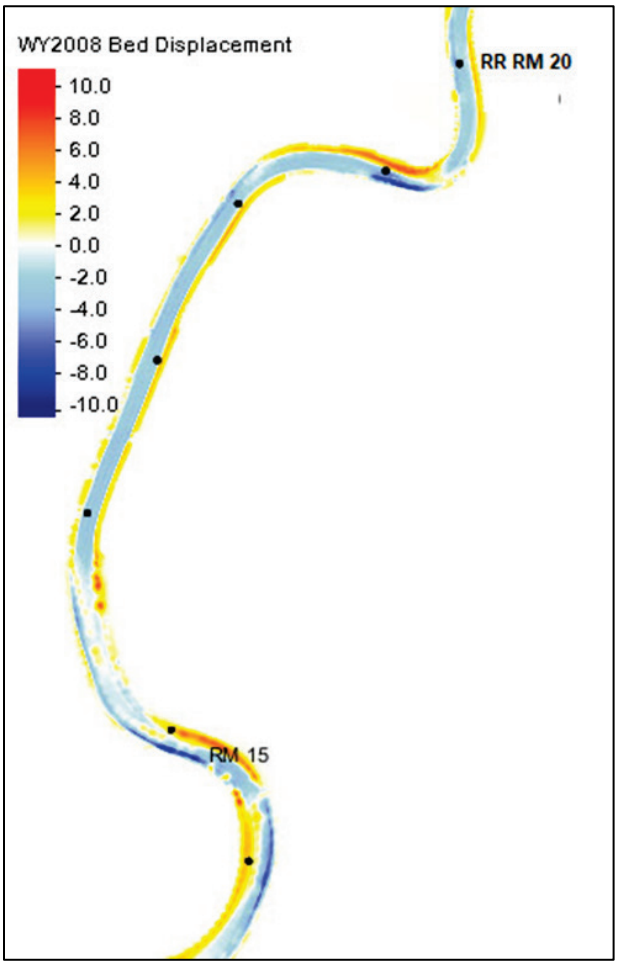


Plate A.7. WY2008 Base Run BDD RR RM 15–RR RM 10 and Outflow Channel.

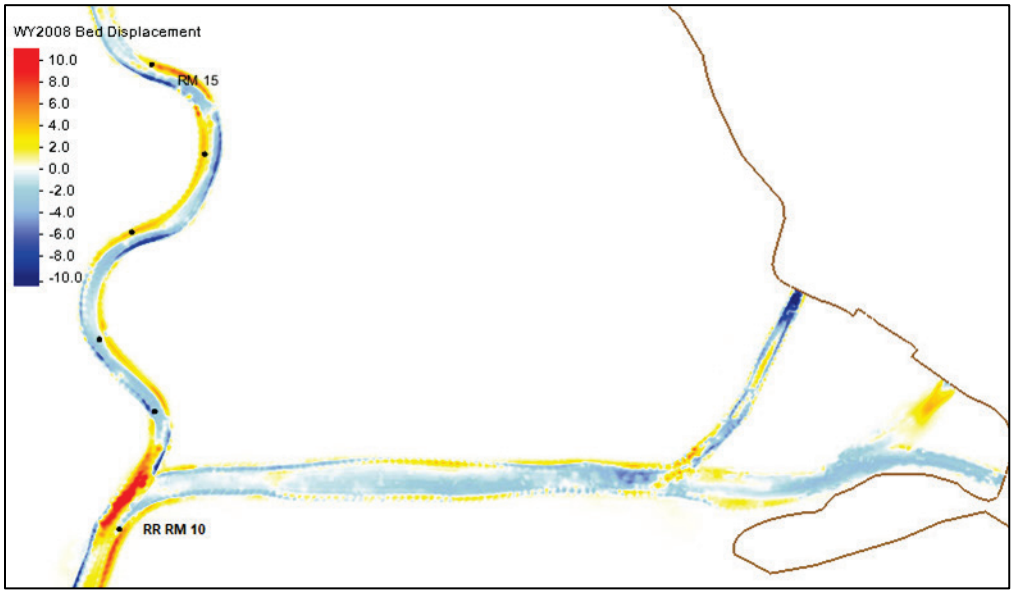


Plate A.8. WY2008 Base Run BDD RR RM 10–Atcha RM 3.

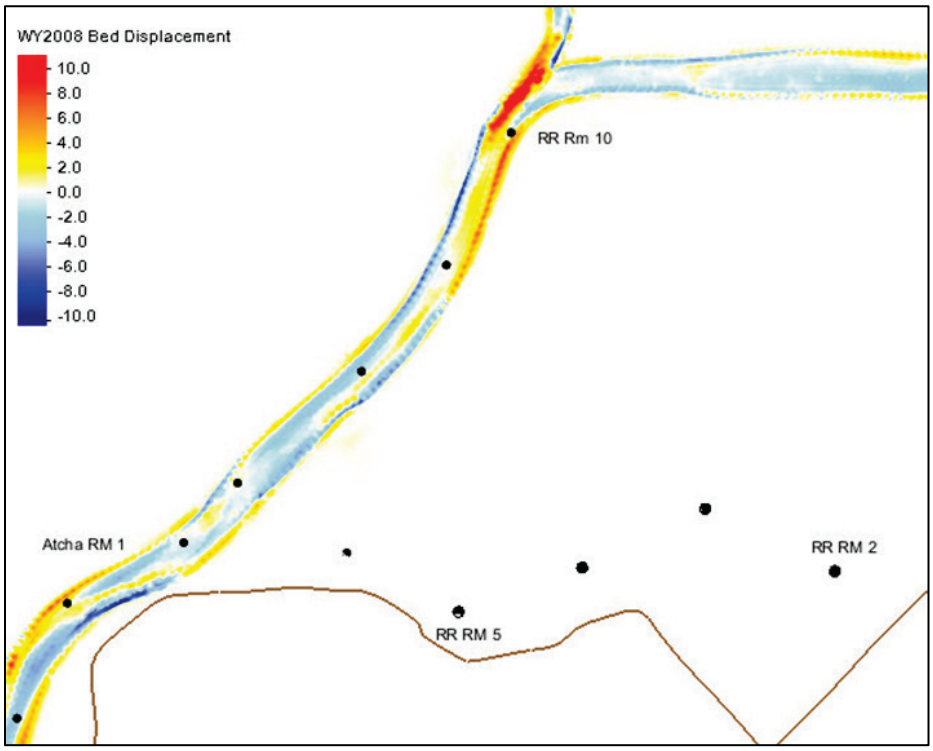


Plate A.9. WY2008 Base Run BDD Atcha RM 1–Atcha RM 5.

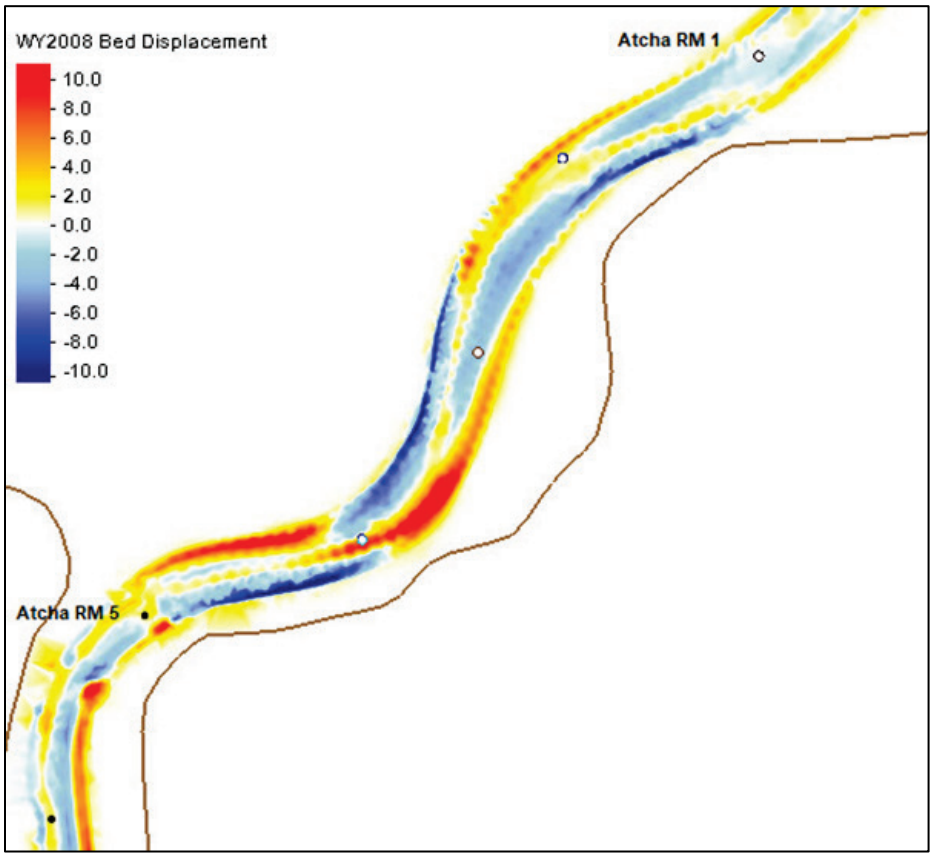


Plate A.10. WY2008 Base Run BDD Atcha RM 5–Atcha RM 10.

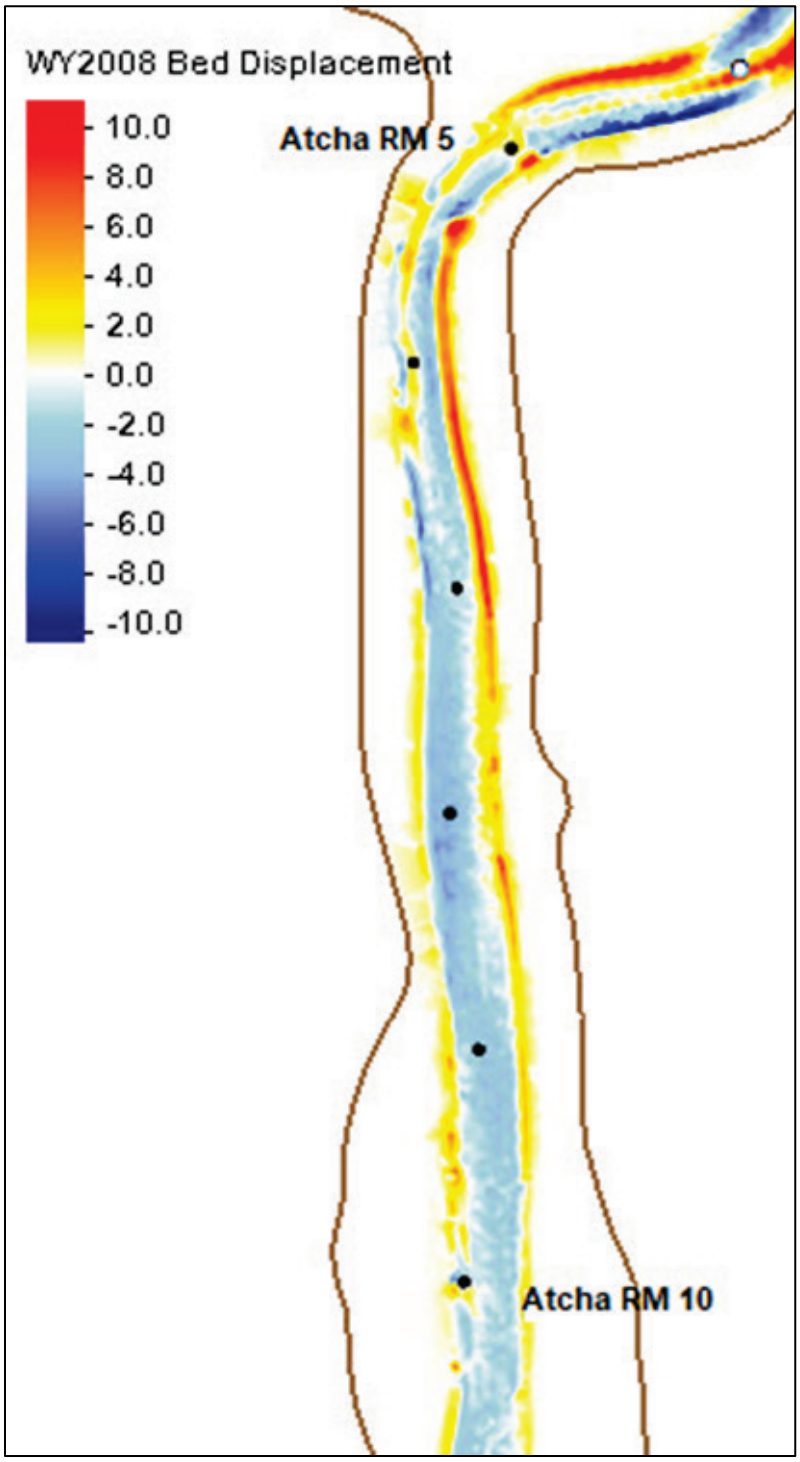


Plate A.11. WY2008 Base Run BDD Atcha RM 10–Atcha RM 15.

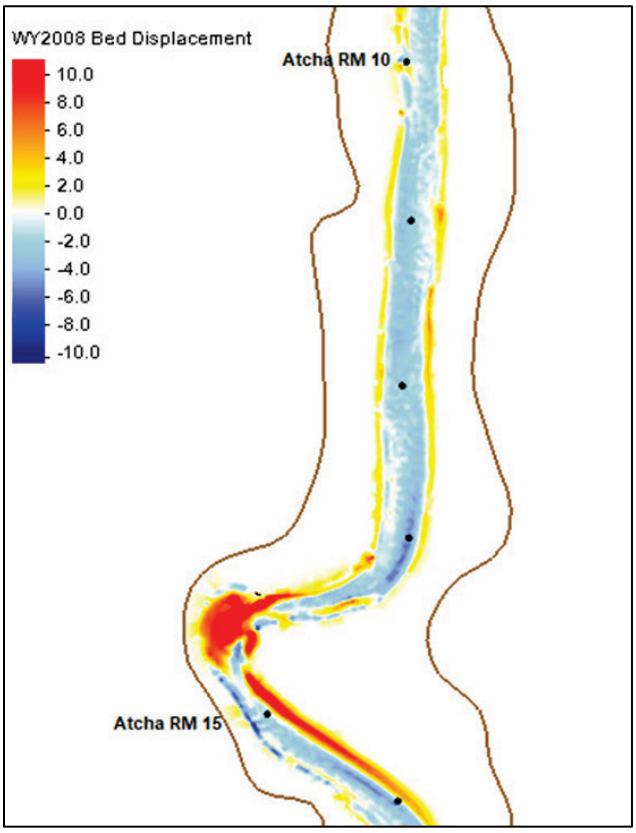


Plate A.12. WY2008 Base Run BDD Atcha RM 15–Atcha RM 20.

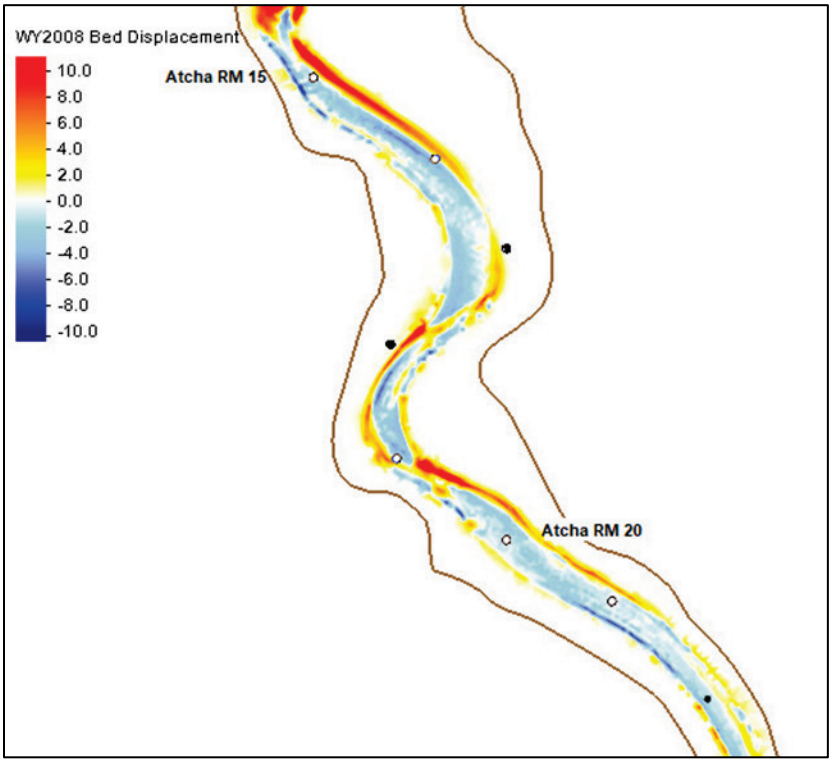


Plate A.13. WY2008 Base Run BDD Atcha RM 20–Atcha RM 25.

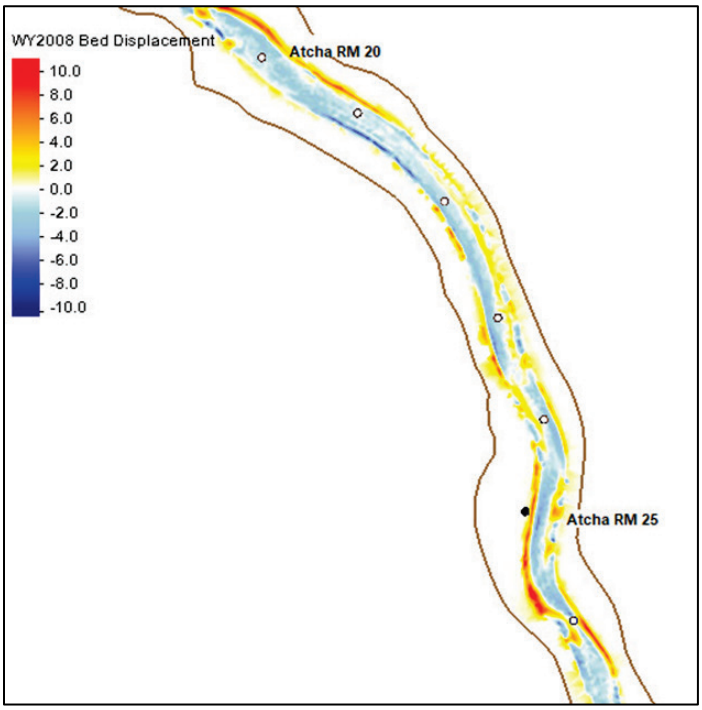
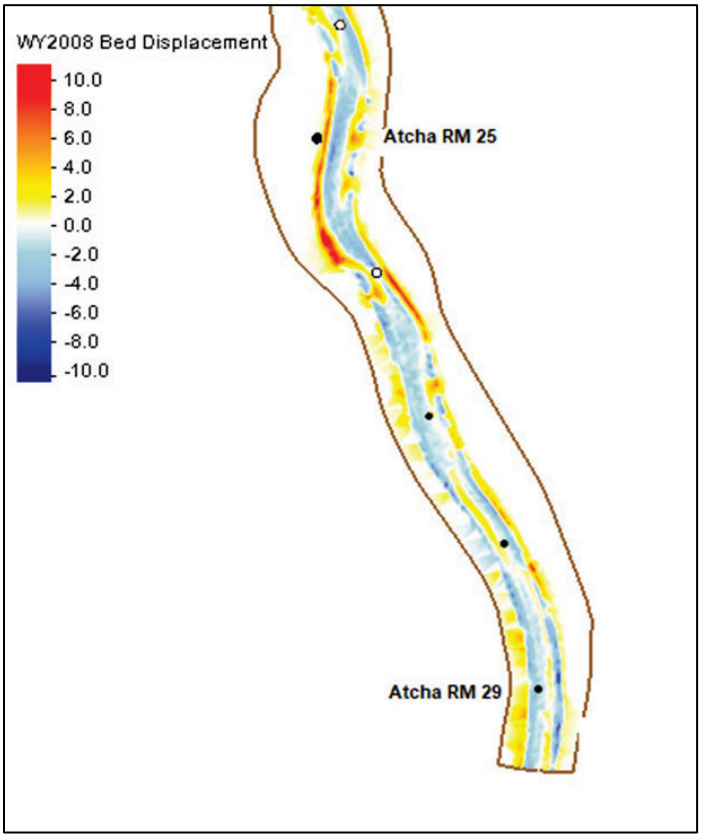


Plate A.14. WY2008 Base Run BDD Atcha RM 25–Atcha RM 29.



A.2 Scenario 3

Plate A.15. WY2008 Scenario 3 BDD RR RM 43–RR RM 40.

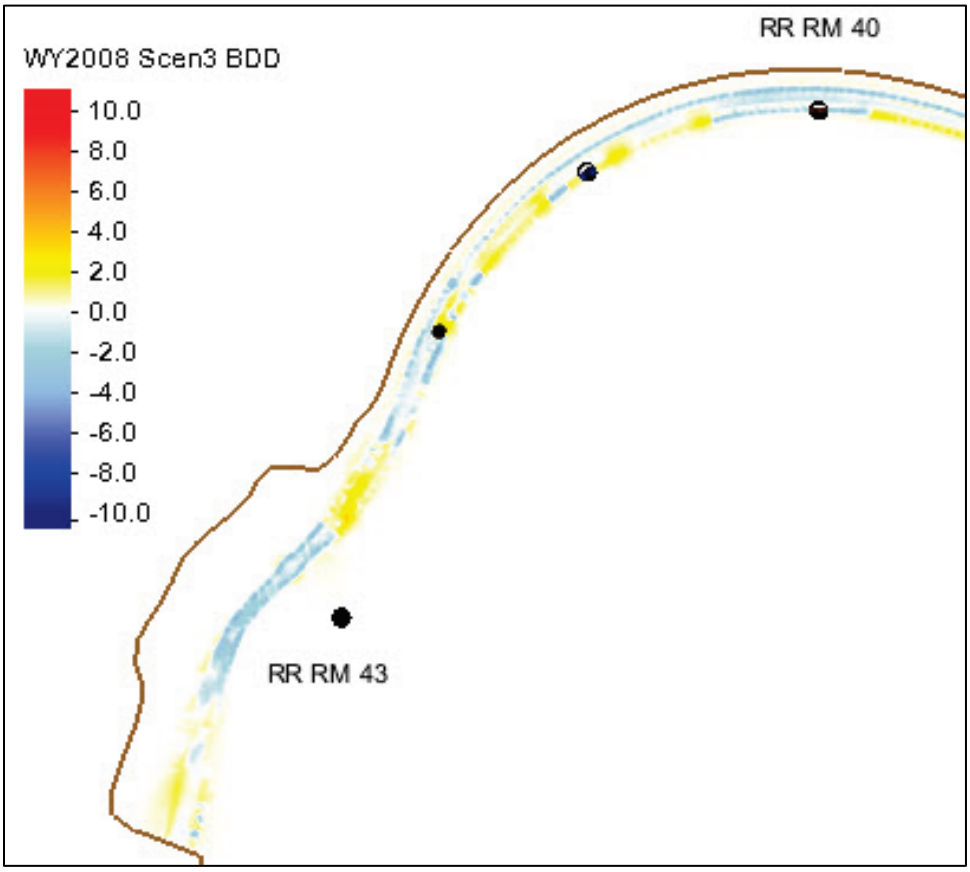


Plate A.16. WY2008 Scenario 3 BDD RR RM 40–RR RM 35.

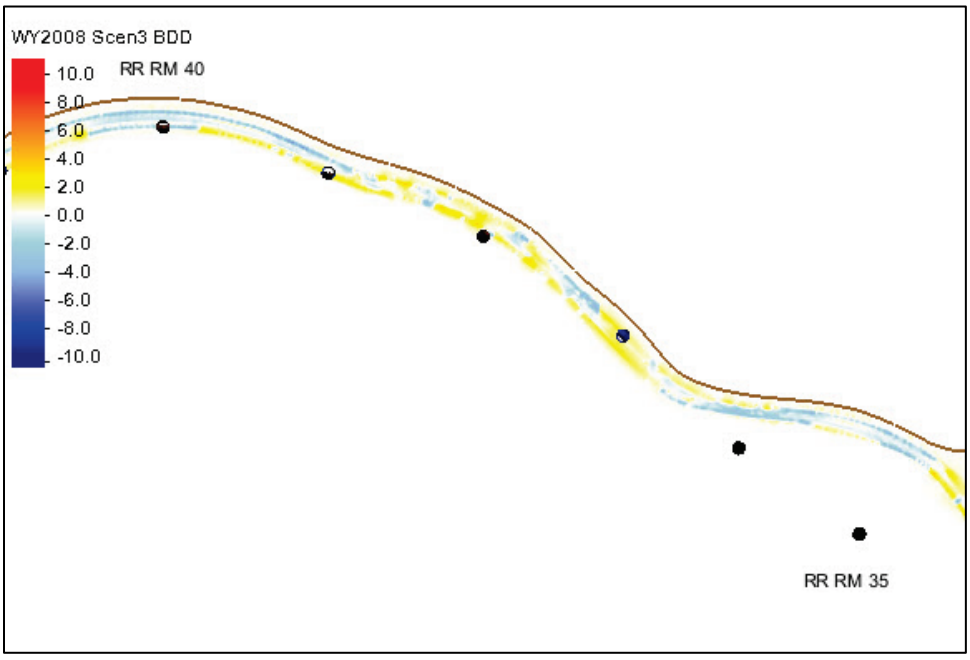


Plate A.17. WY2008 Scenario 3 BDD RR RM 35–RR RM 30.

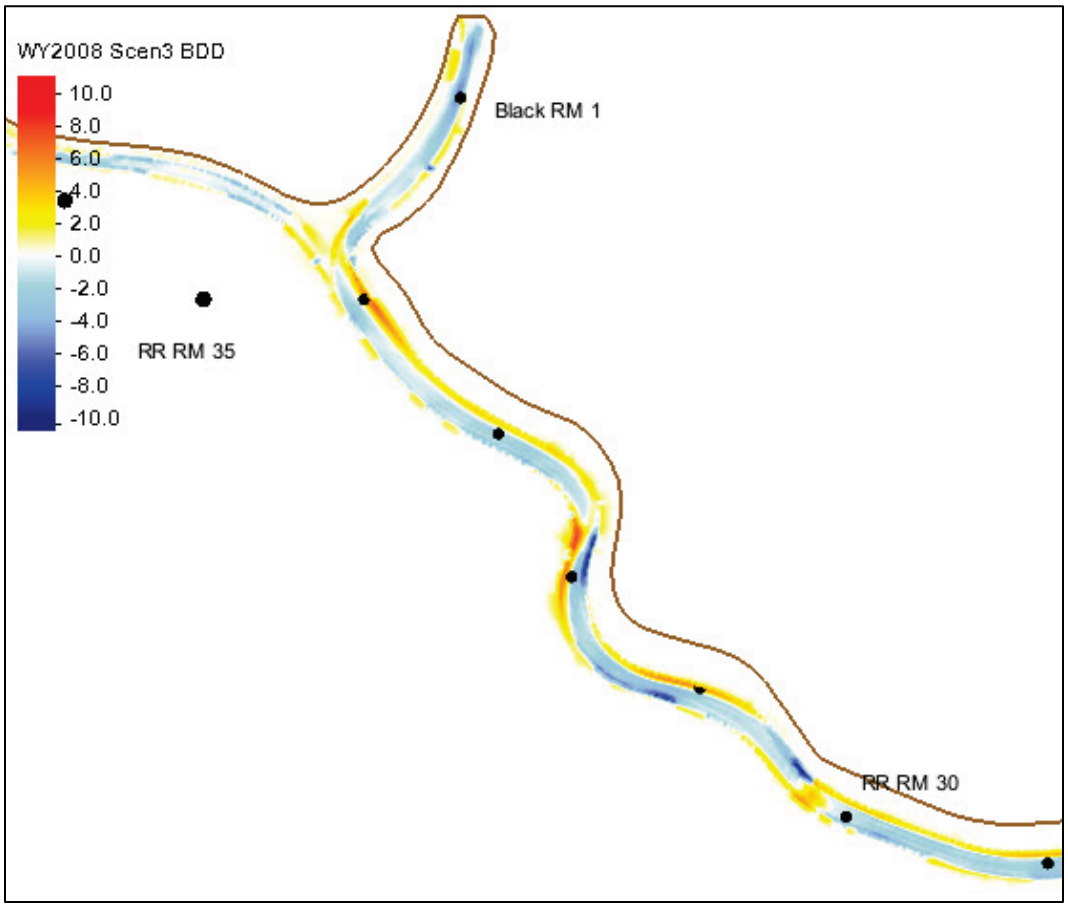


Plate A.18. WY2008 Scenario 3 BDD RR RM 30–RR RM 25.

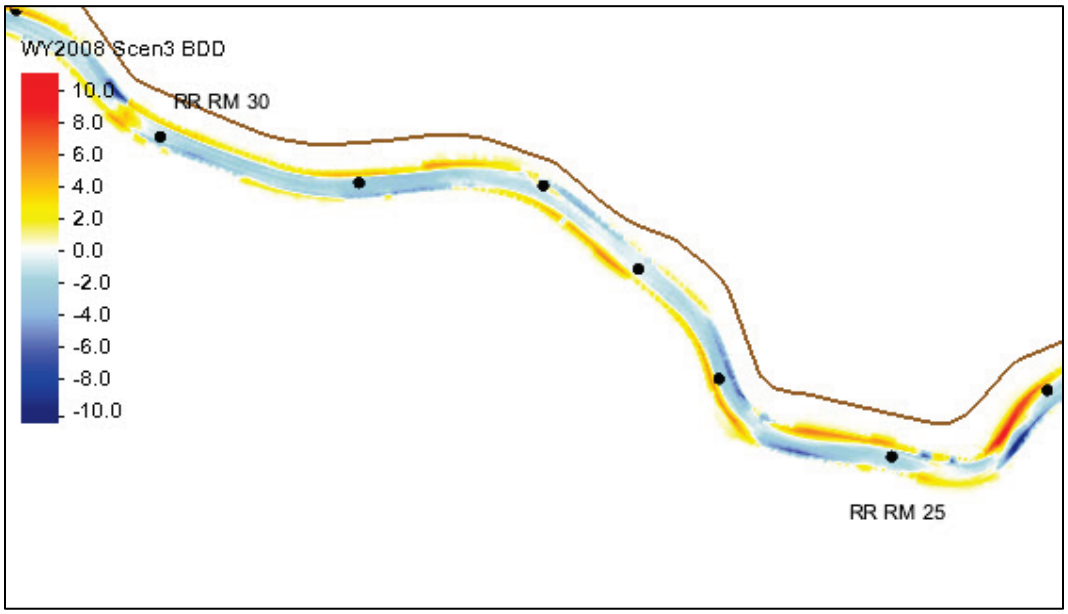


Plate A.19. WY2008 Scenario 3 BDD RR RM 25–RR RM 20.

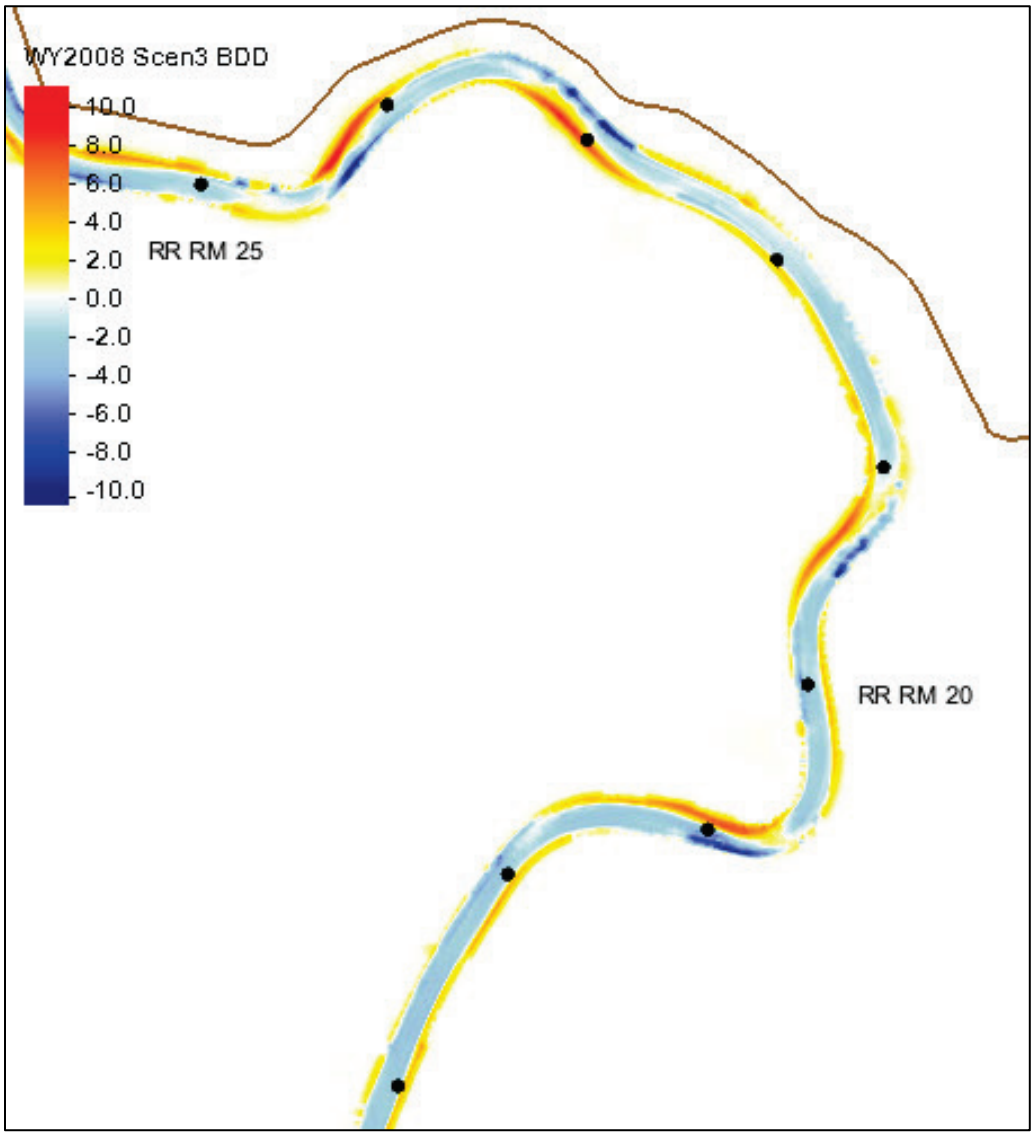


Plate A.20. WY2008 Scenario 3 BDD RR RM 20–RR RM 15.

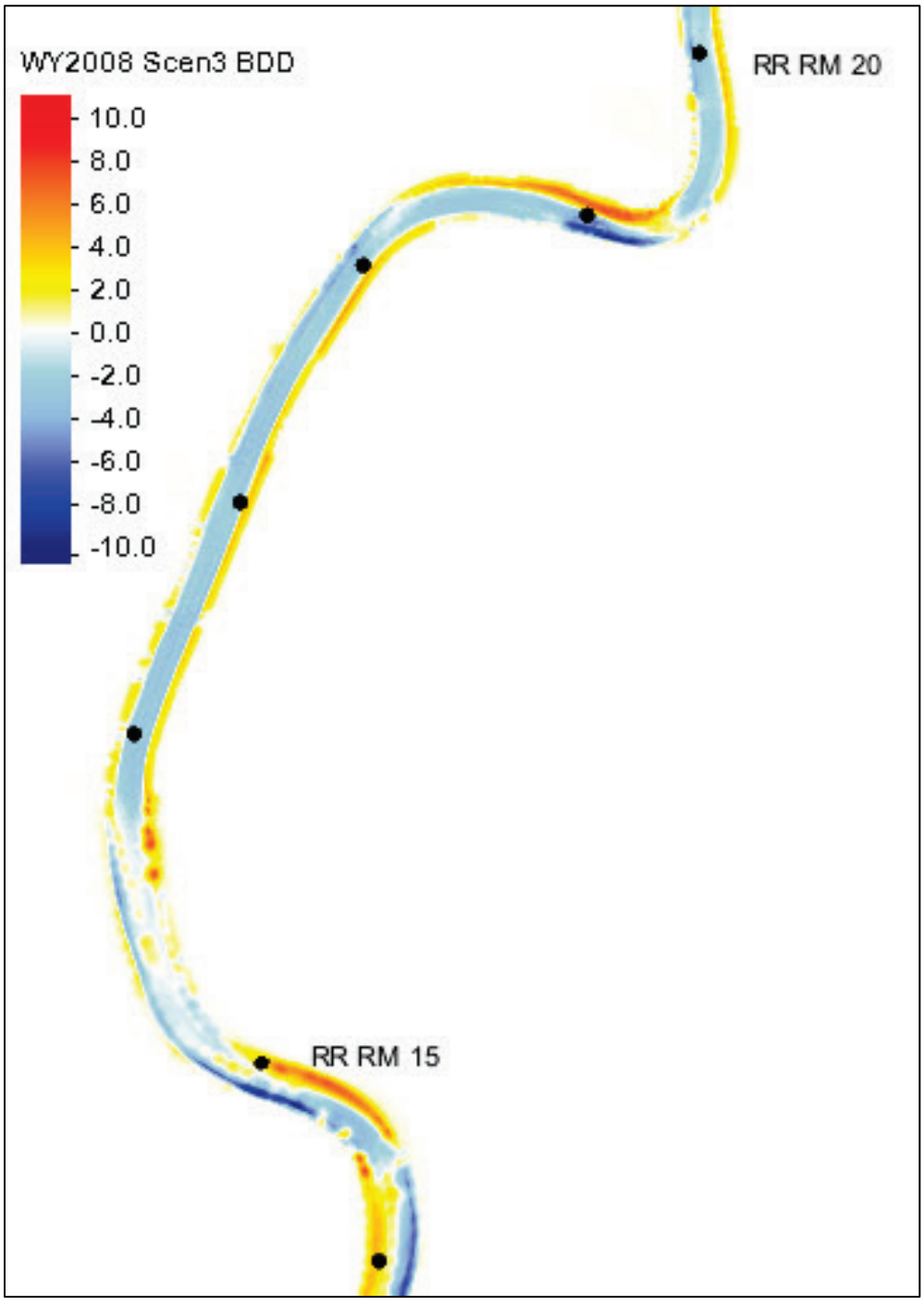


Plate A.21. WY2008 Scenario 3 BDD RR RM 15–RR RM 10 and Outflow Channel.

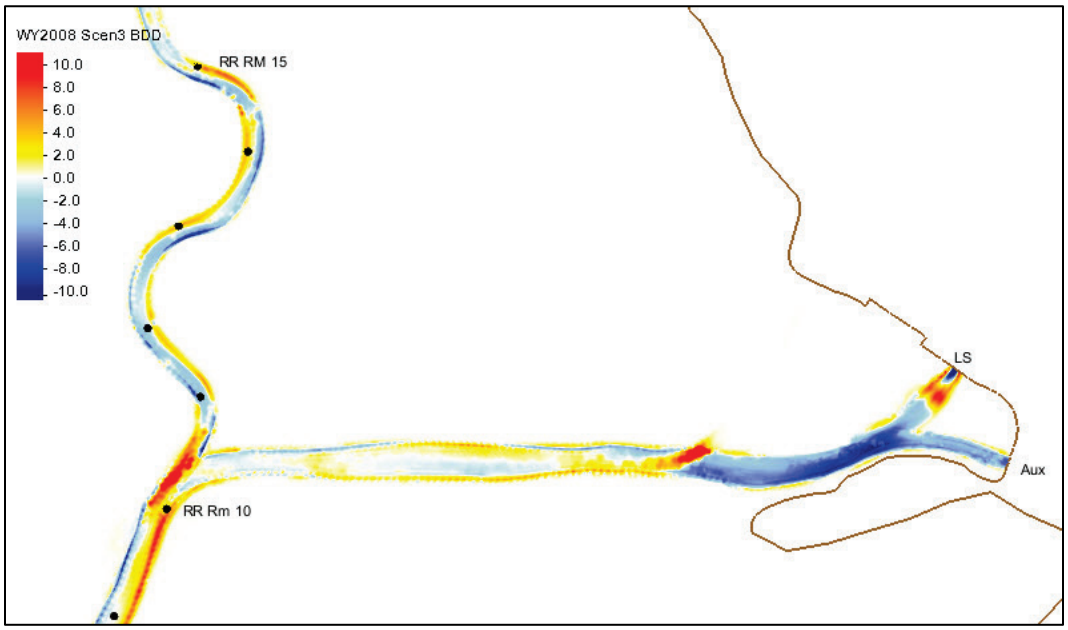


Plate A.22. WY2008 Scenario 3 BDD Outflow Channel.

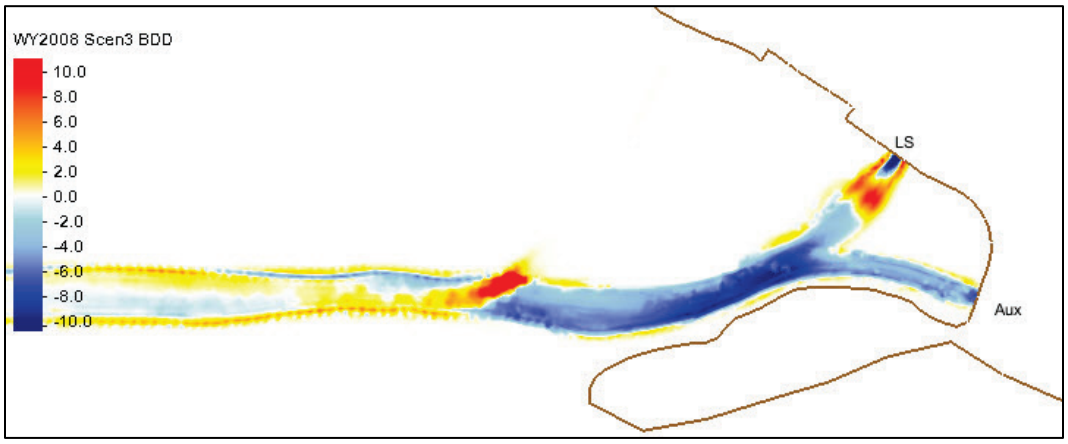


Plate A.23. WY2008 Scenario 3 BDD RR RM 10–Atcha RM 1.

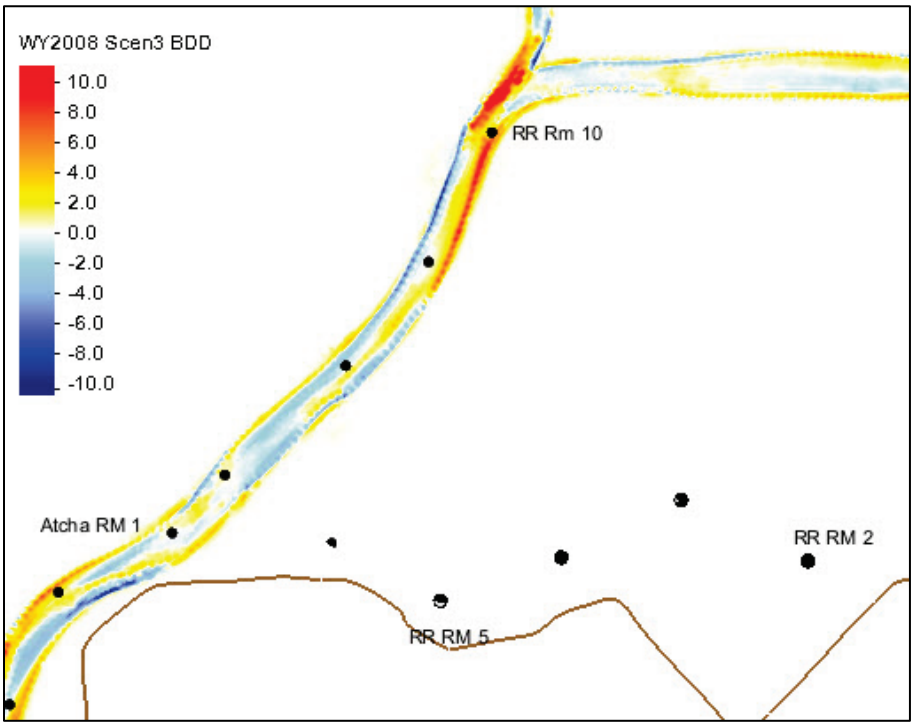


Plate A.24. WY2008 Scenario 3 BDD Atcha RM 1–Atcha RM 5.

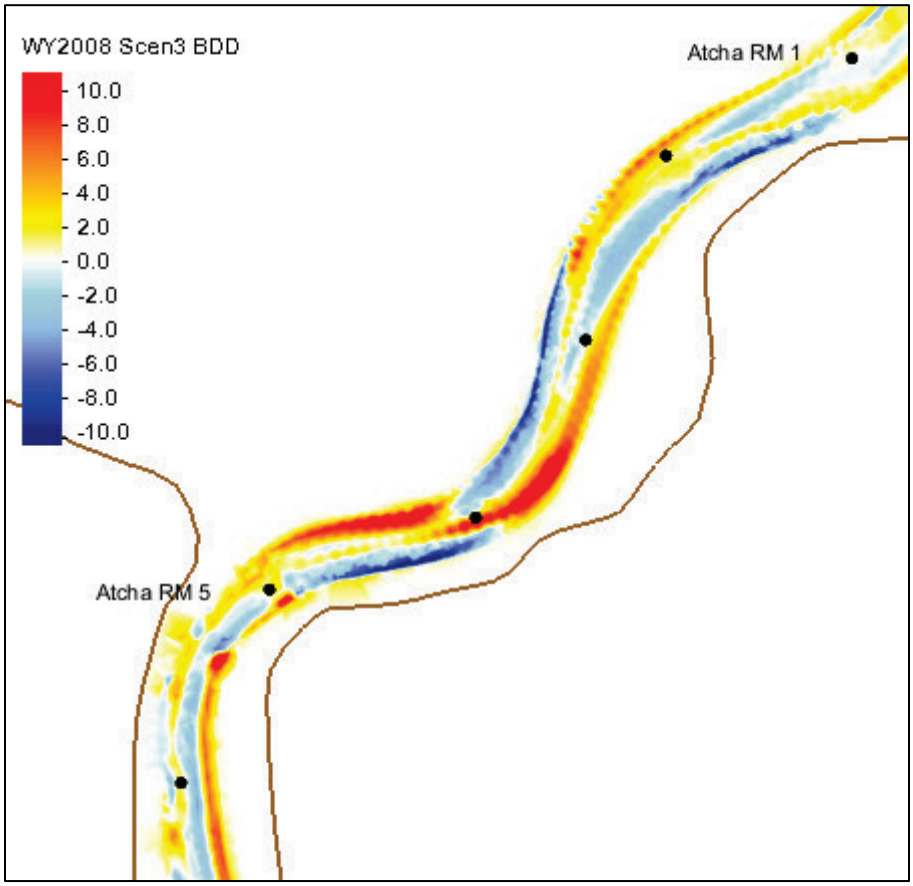


Plate A.25. WY2008 Scenario 3 BDD Atcha RM 5–Atcha RM 10.

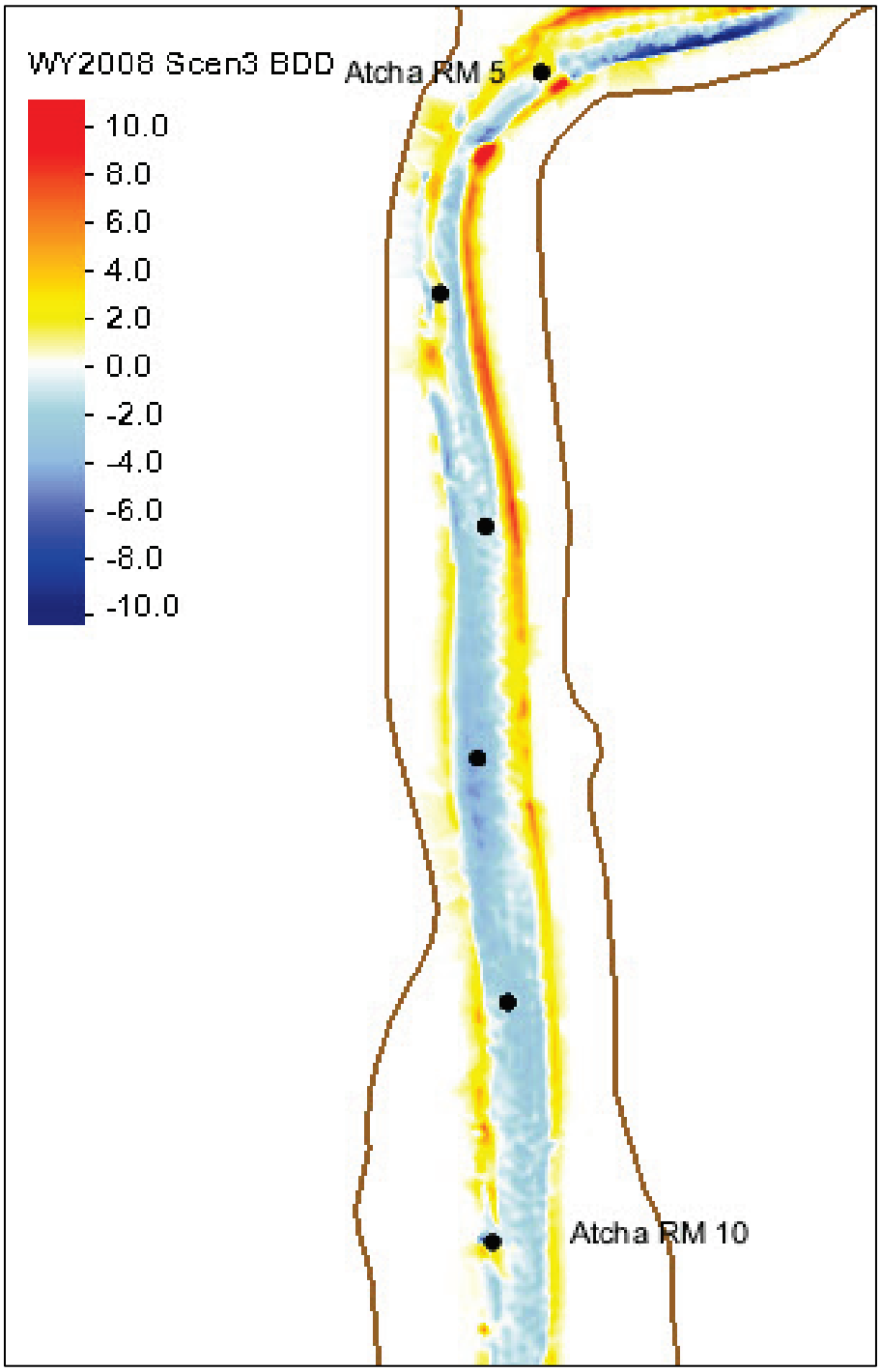


Plate A.26. WY2008 Scenario 3 BDD Atcha RM 10–Atcha RM 15.

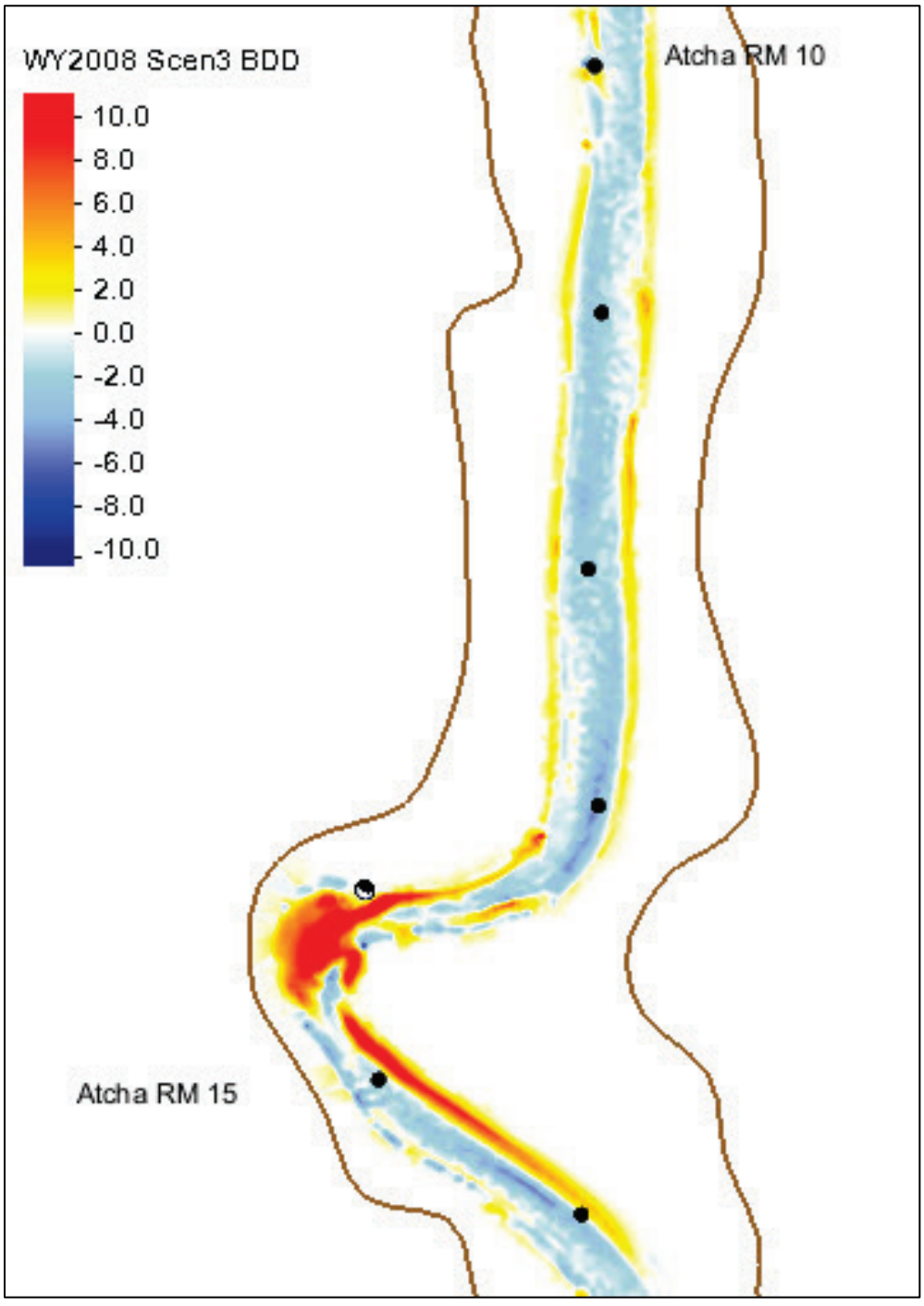


Plate A.27. WY2008 Scenario 3 BDD Atcha RM 15–Atcha RM 20.

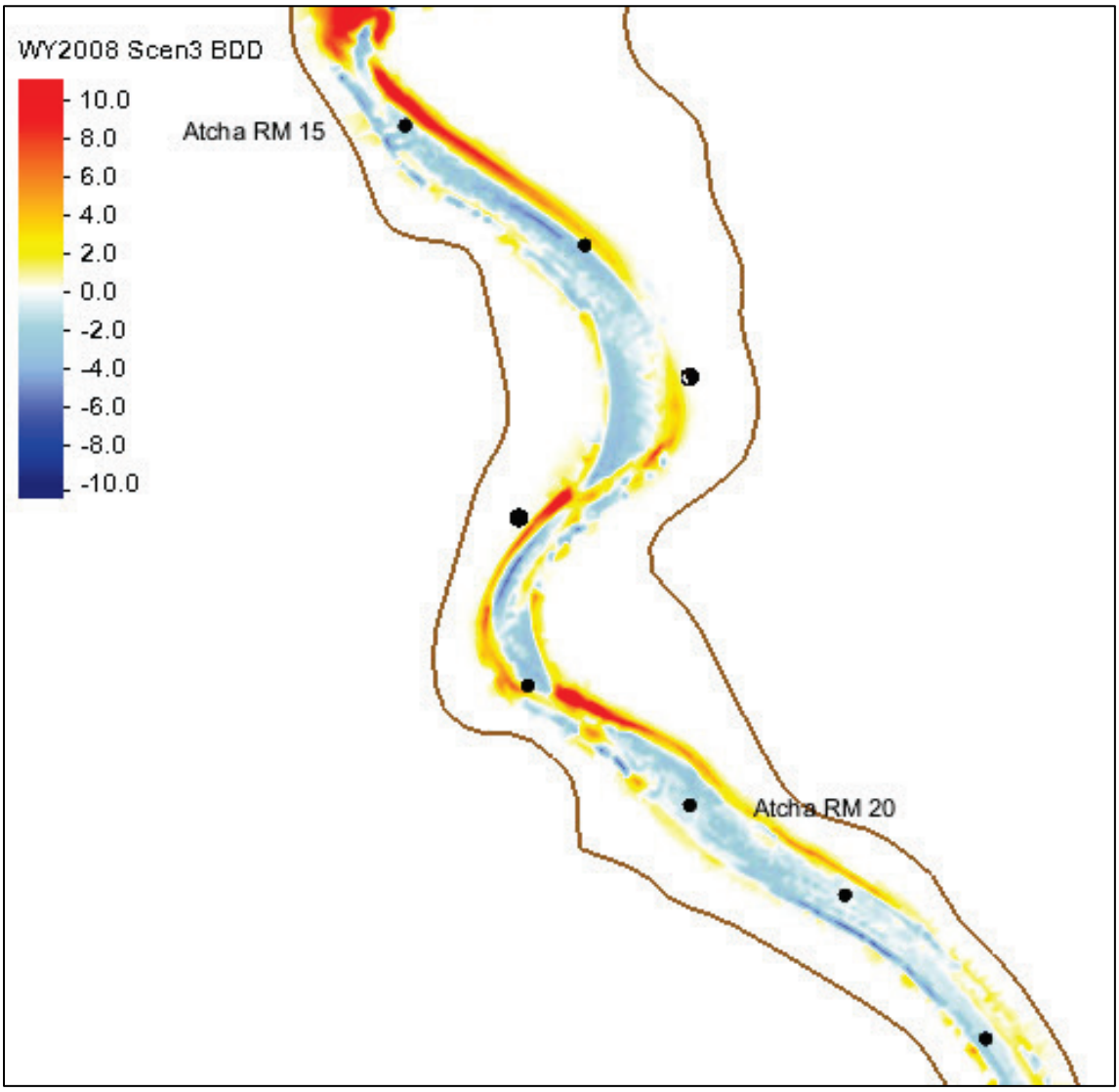


Plate A.28. WY2008 Scenario 3 BDD Atcha RM 20–Atcha RM 25.

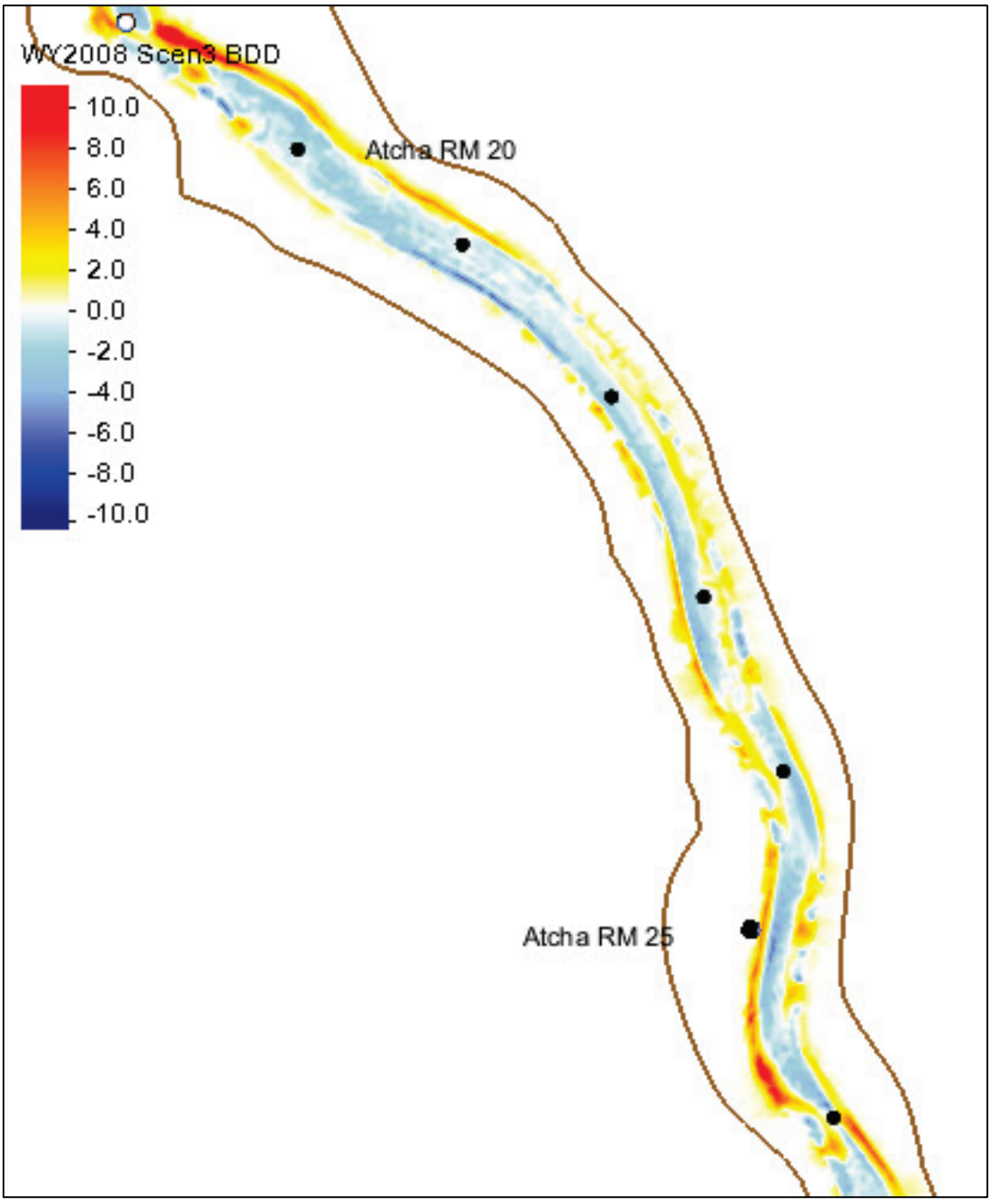
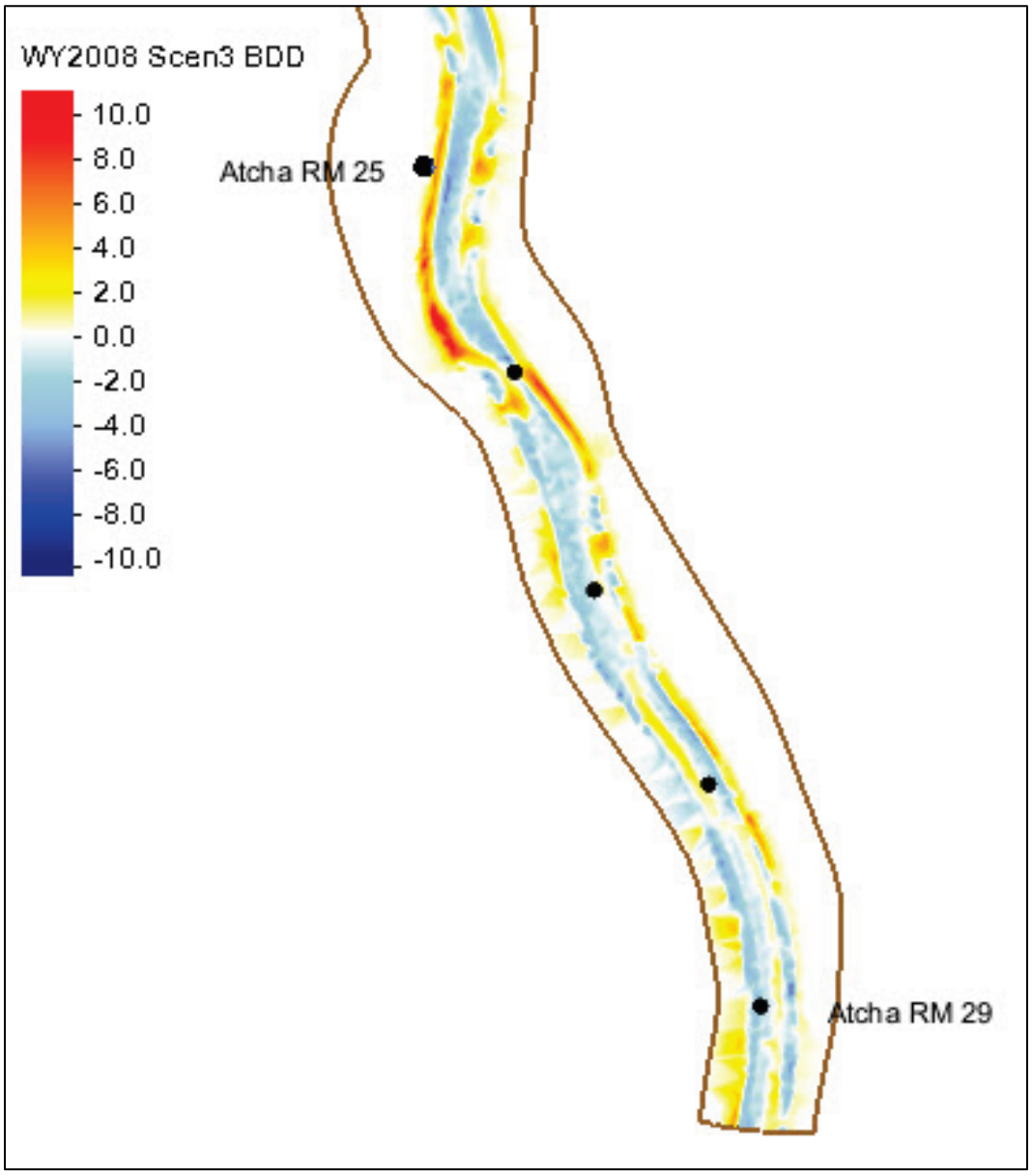


Plate A.29. WY2008 Scenario 3 BDD Atcha RM 25–Atcha RM 29.



A.3 Scenario 4

Plate A.30. WY2008 Scenario 4 BDD RR RM 43–RR RM 30.

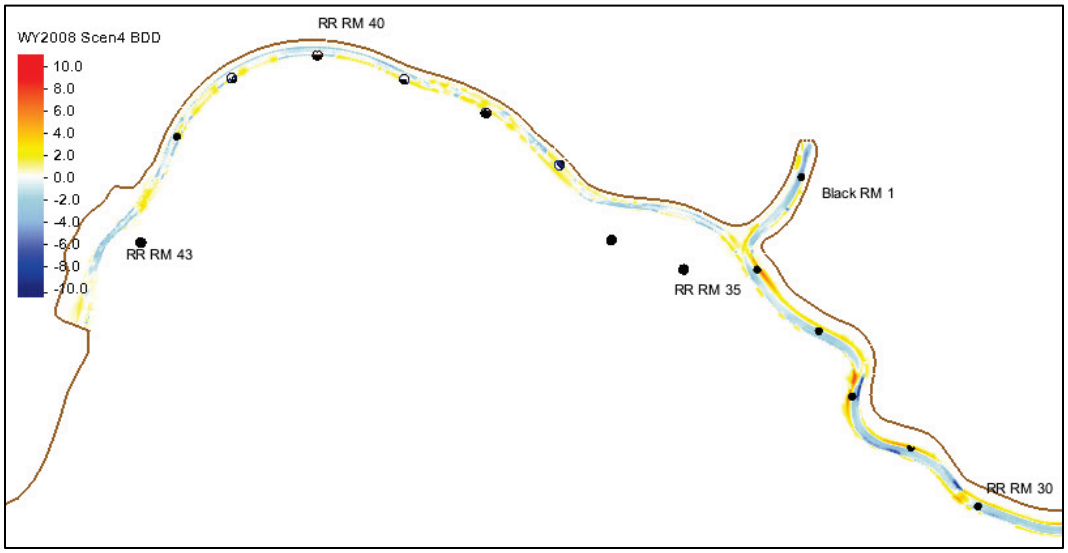


Plate A.31. WY2008 Scenario 4 BDD RR RM 30–RR RM 20.

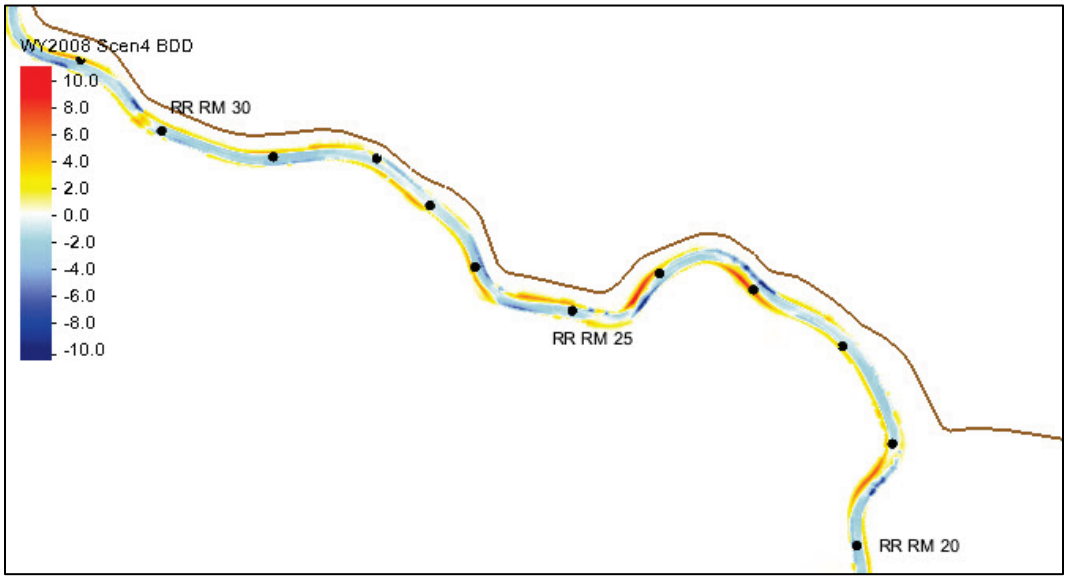


Plate A.32. WY2008 Scenario 4 BDD RR RM 20–RR RM 10.

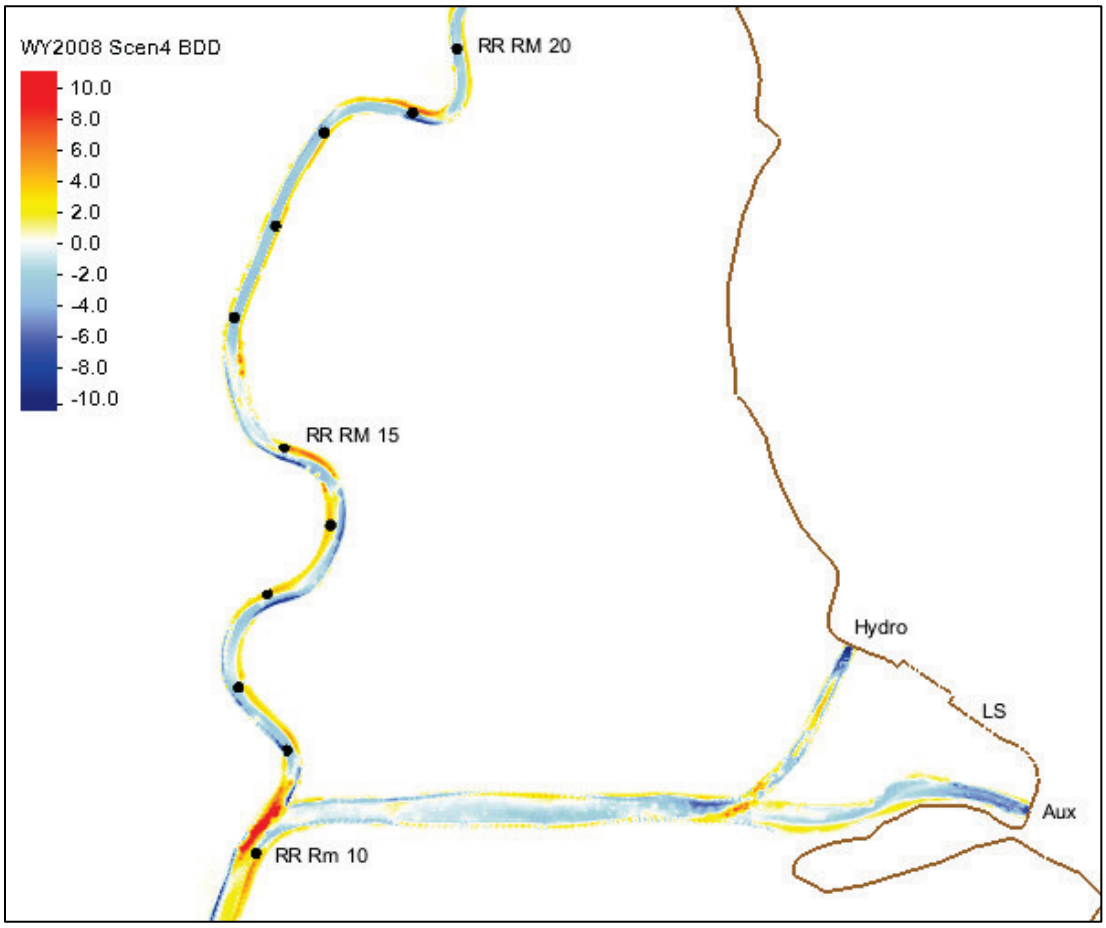


Plate A.33. WY2008 Scenario 4 BDD Outflow Channel

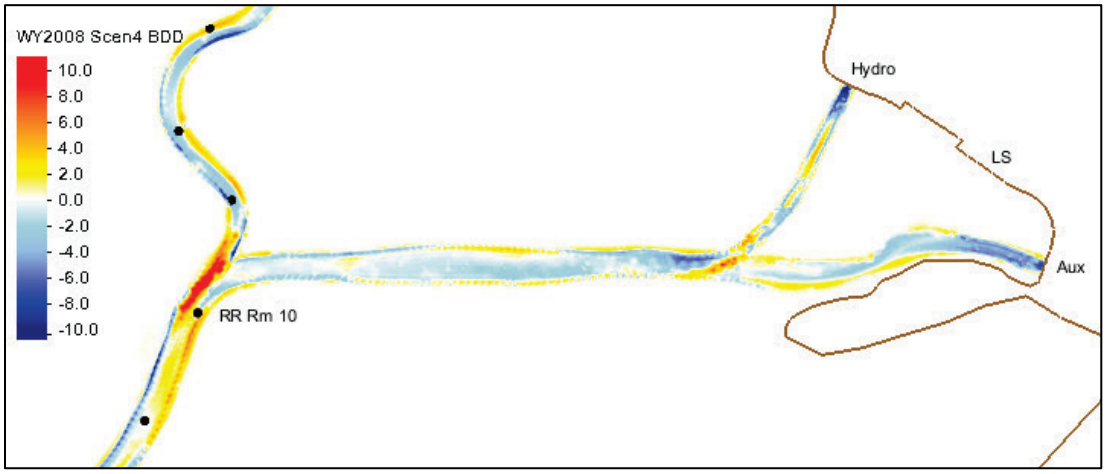


Plate A.34. WY2008 Scenario 4 BDD RR RM 10–Atcha RM 5.

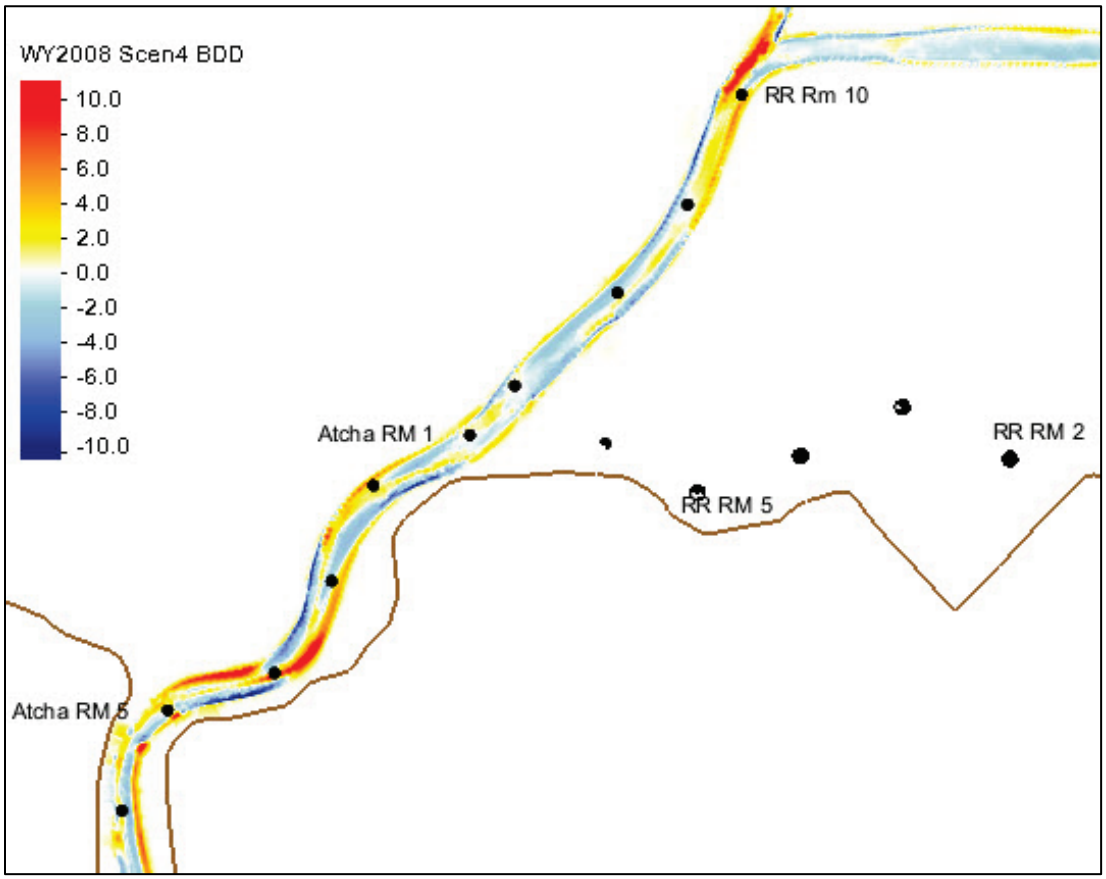


Plate A.35. WY2008 Scenario 4 BDD Atcha RM 5–Atcha RM 15.

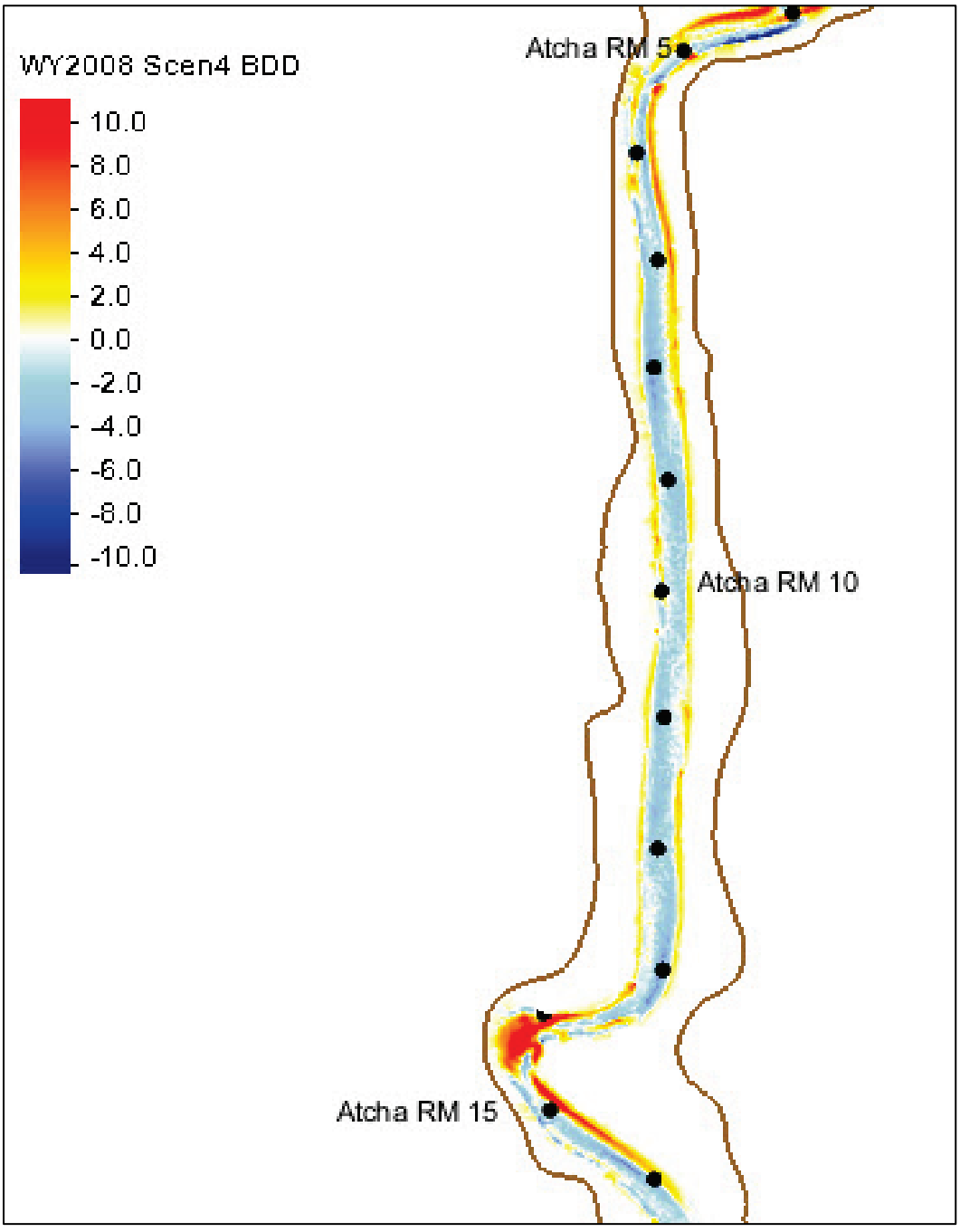
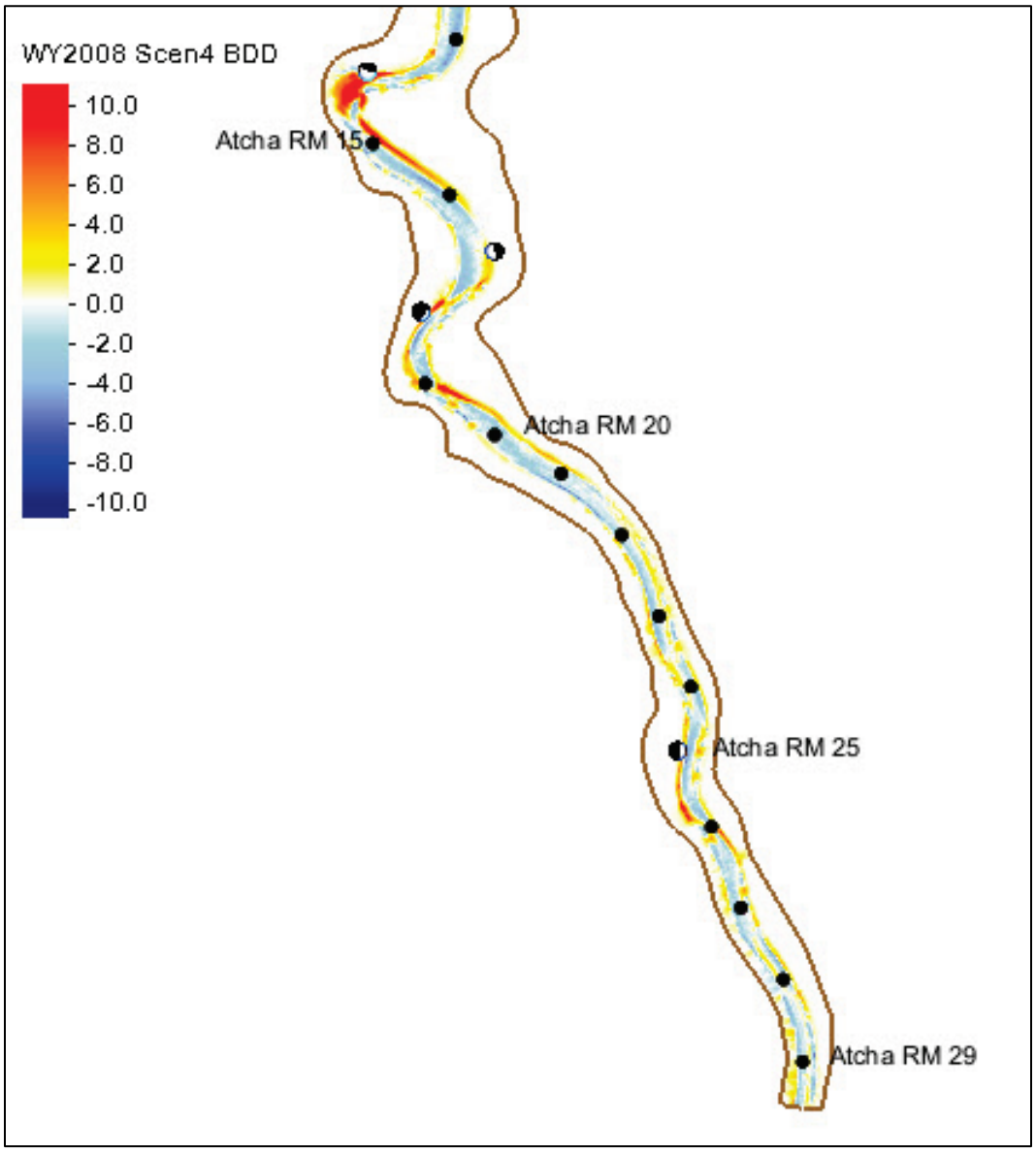


Plate A.36. WY2008 Scenario 4 BDD Atcha RM 15–Atcha RM 29.



A.4 Scenario 5

Plate A.37. WY2008 Scenario 5 BDD RR RM 43–RR RM 30.

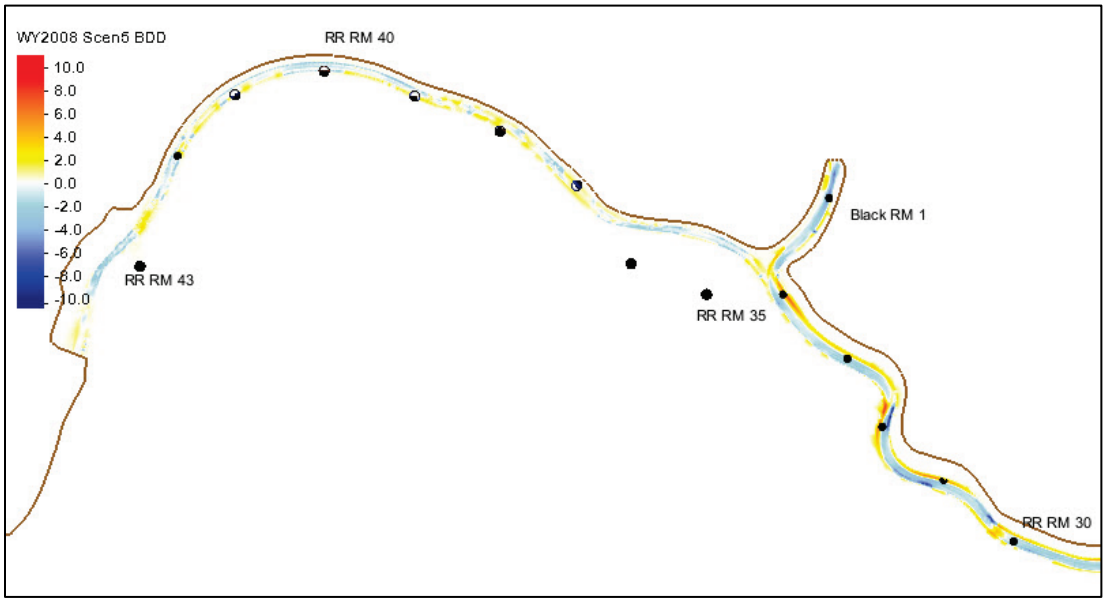


Plate A.38. WY2008 Scenario 5 BDD RR RM 30–RR RM 20.

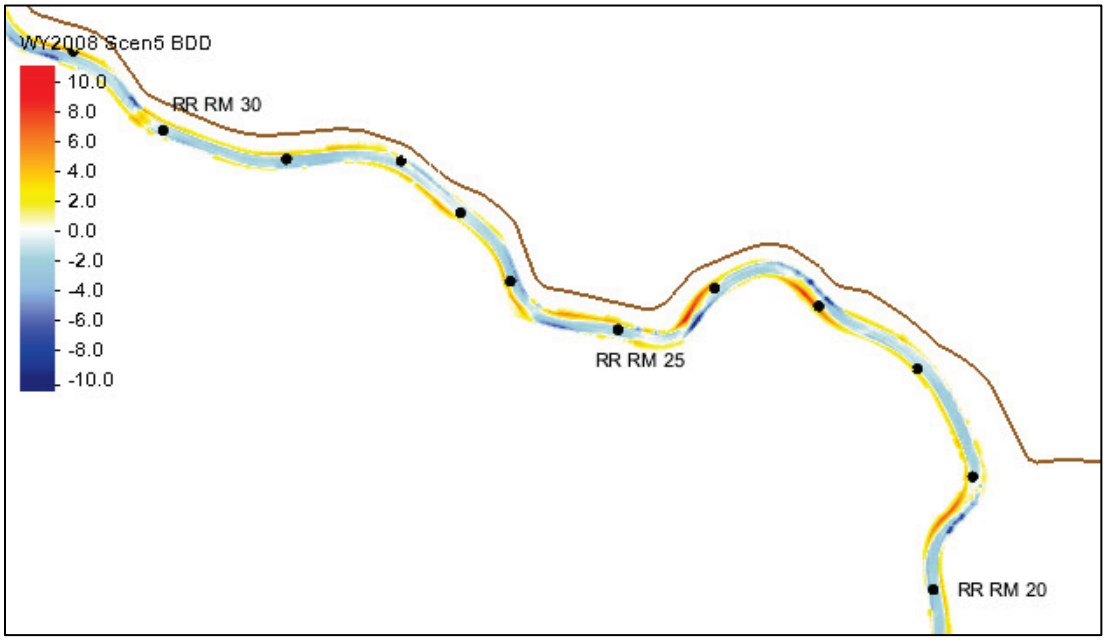


Plate A.39. WY2008 Scenario 5 BDD RR RM 20–RR RM 10.

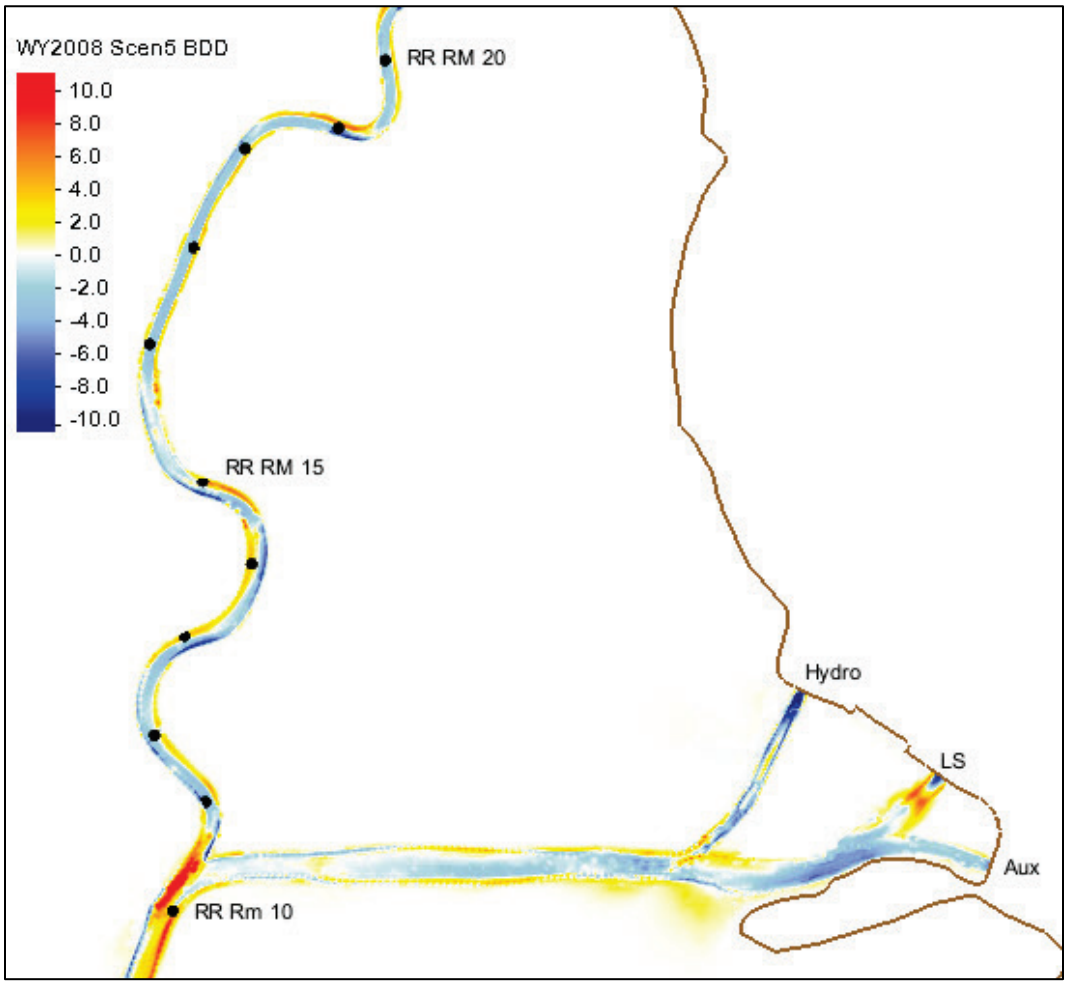


Plate A.40. WY2008 Scenario 5 BDD Outflow Channel

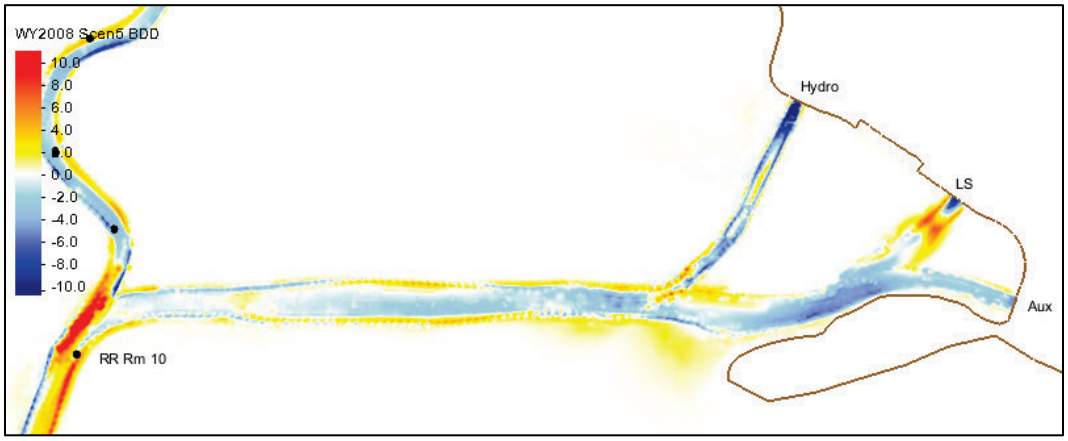


Plate A.41. WY2008 Scenario 5 BDD RR RM 10–Atcha RM 5.

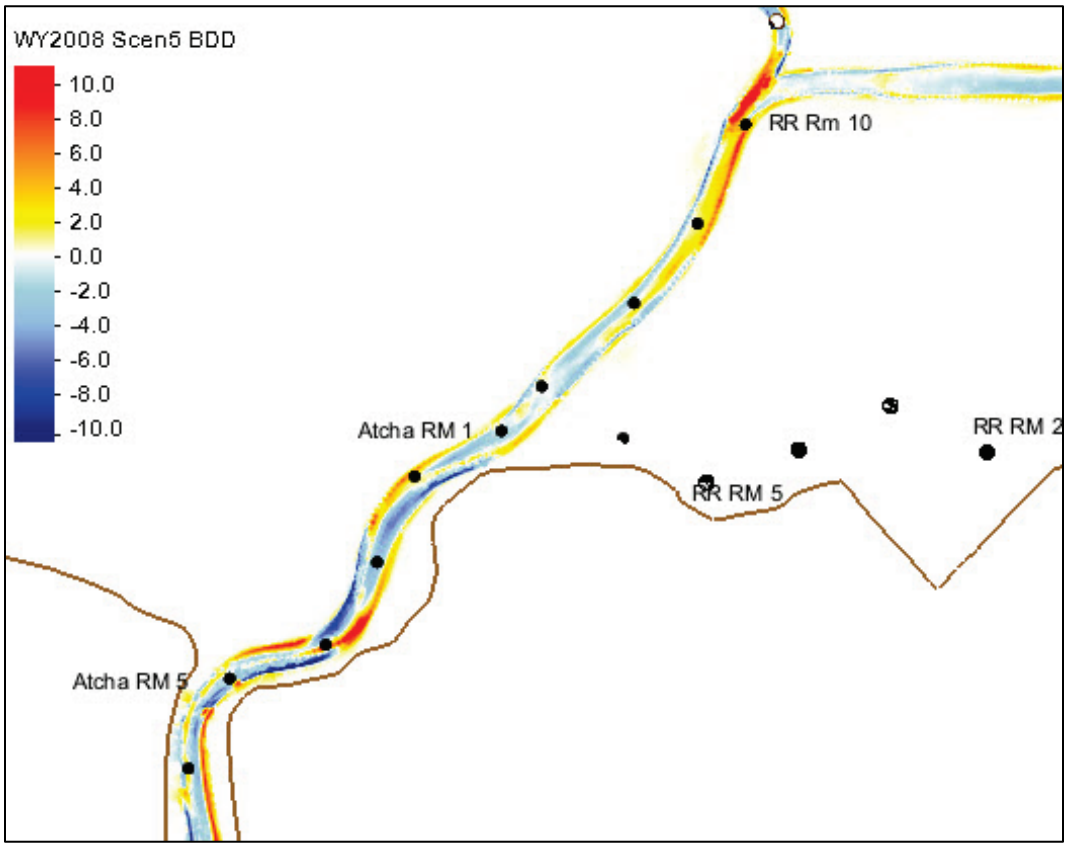


Plate A.42. WY2008 Scenario 5 BDD Atcha RM 5–Atcha RM 15.

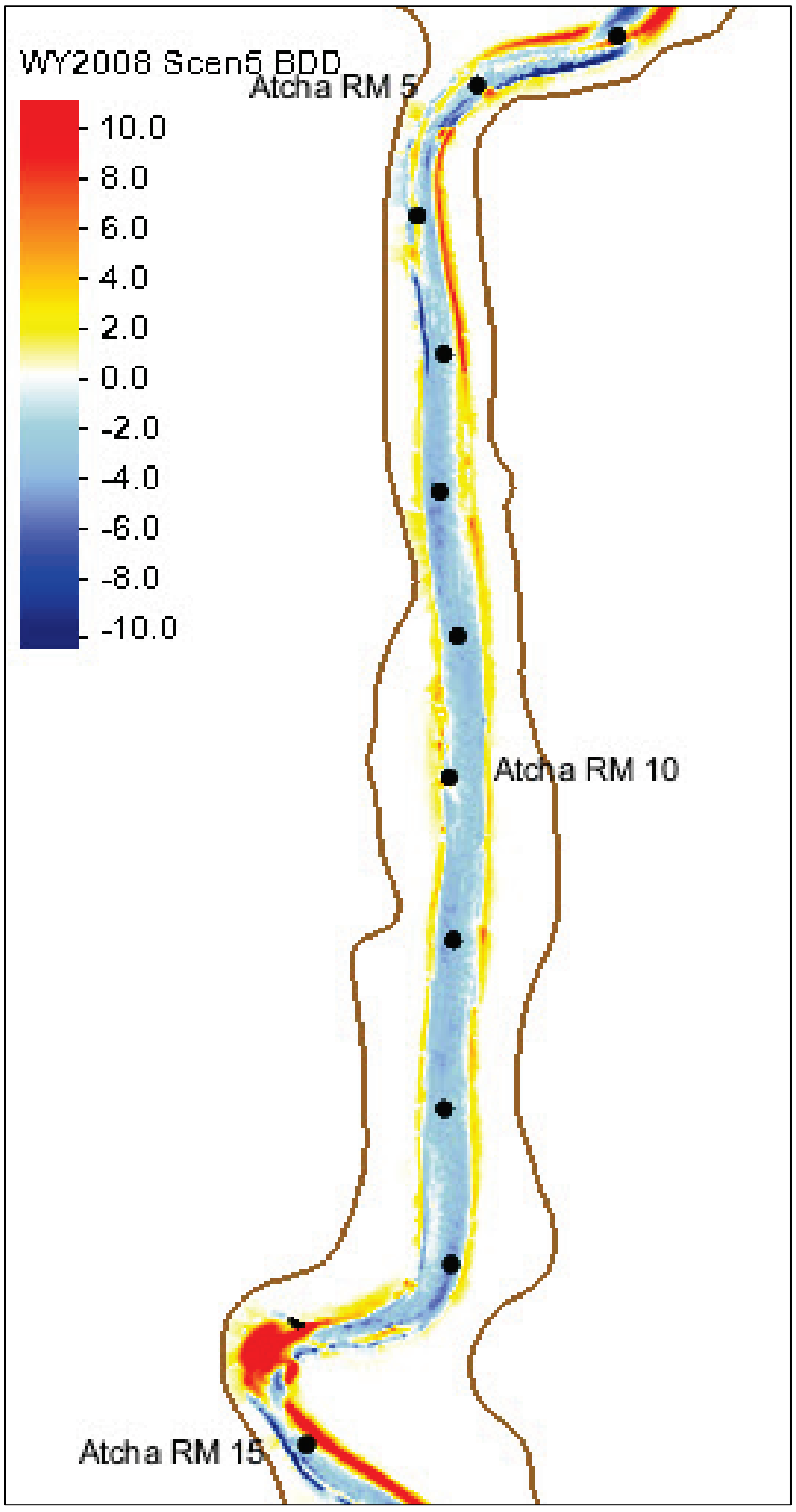
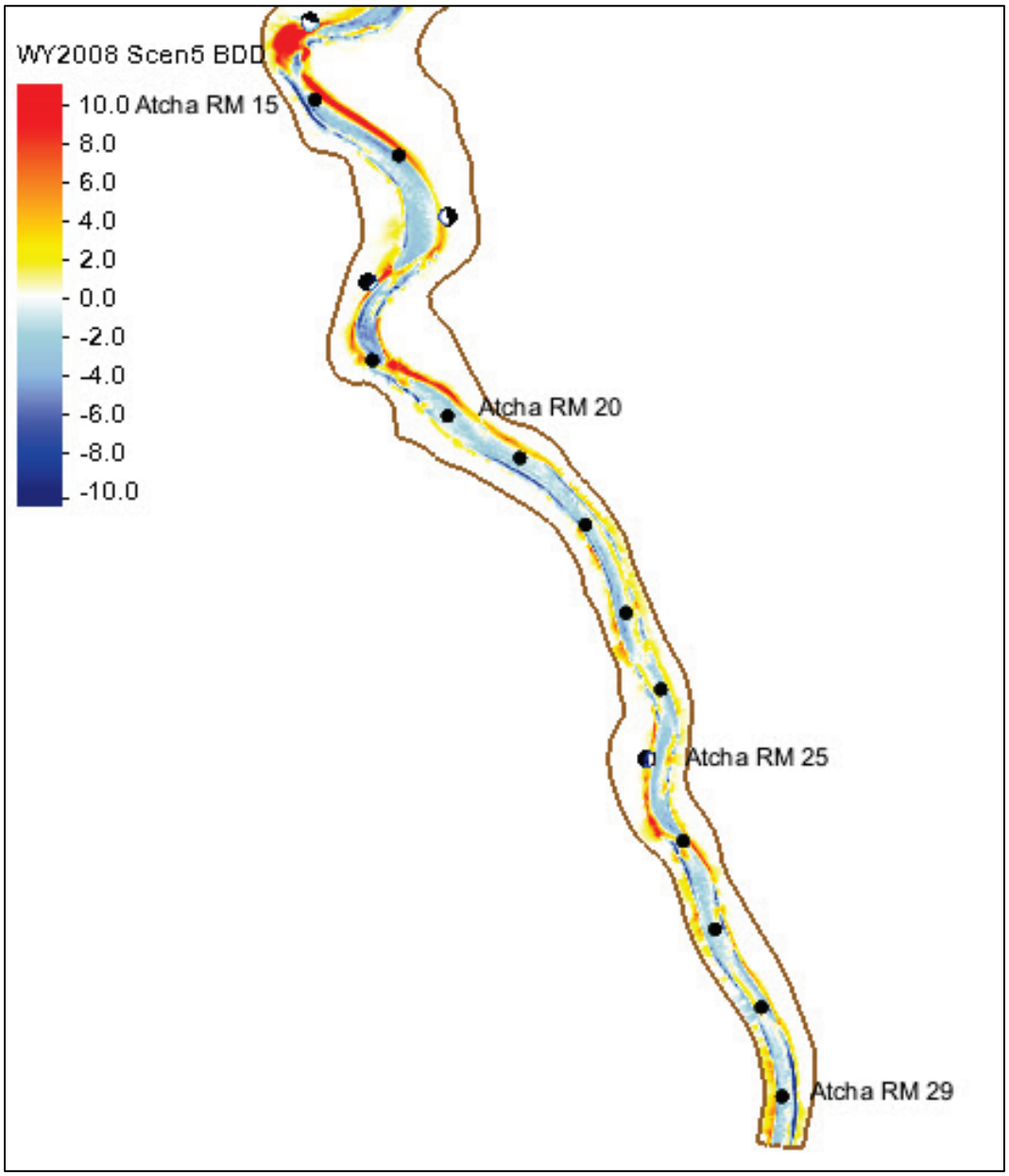


Plate A.43. WY2008 Scenario 5 BDD Atcha RM 15–Atcha RM 29.



A.5 Scenario 6

Plate A.44. WY2008 Scenario 6 BDD RR RM 43–RR RM 30.

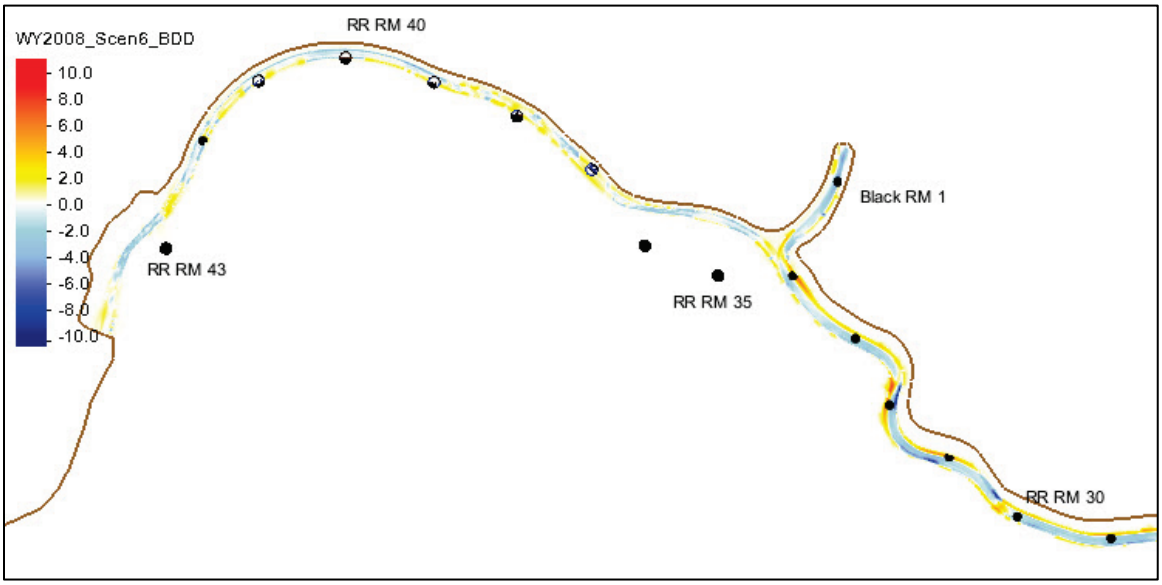


Plate A.45. WY2008 Scenario 6 BDD RR RM 30–RR RM 20.

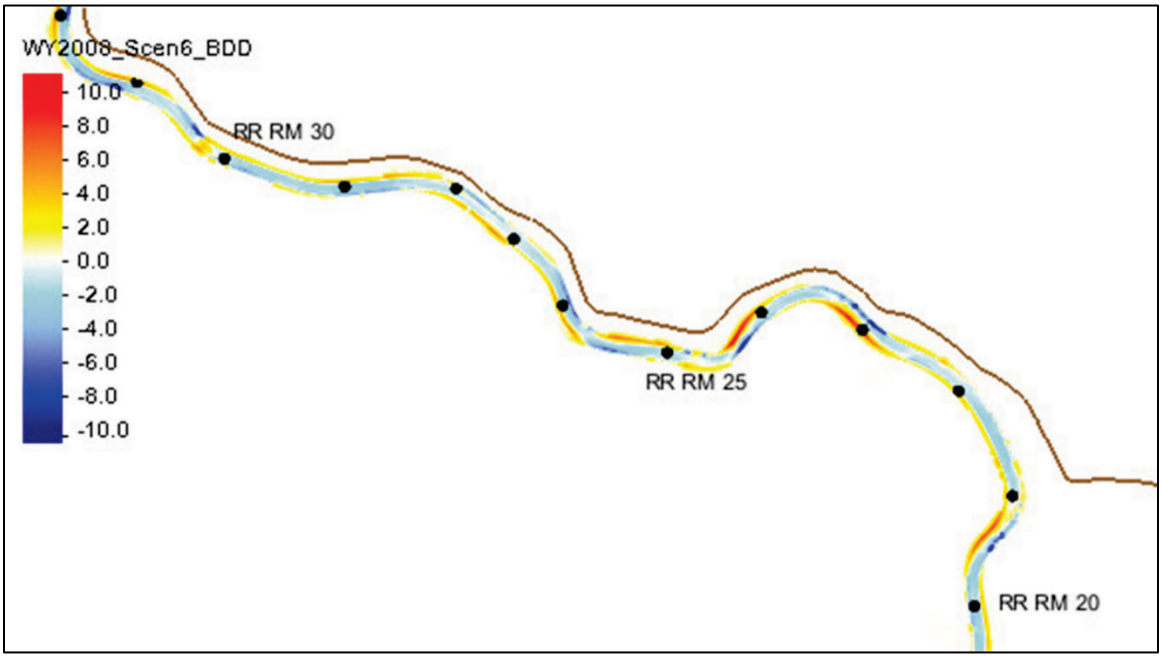


Plate A.46. WY2008 Scenario 6 BDD RR RM 20–RR RM 10.

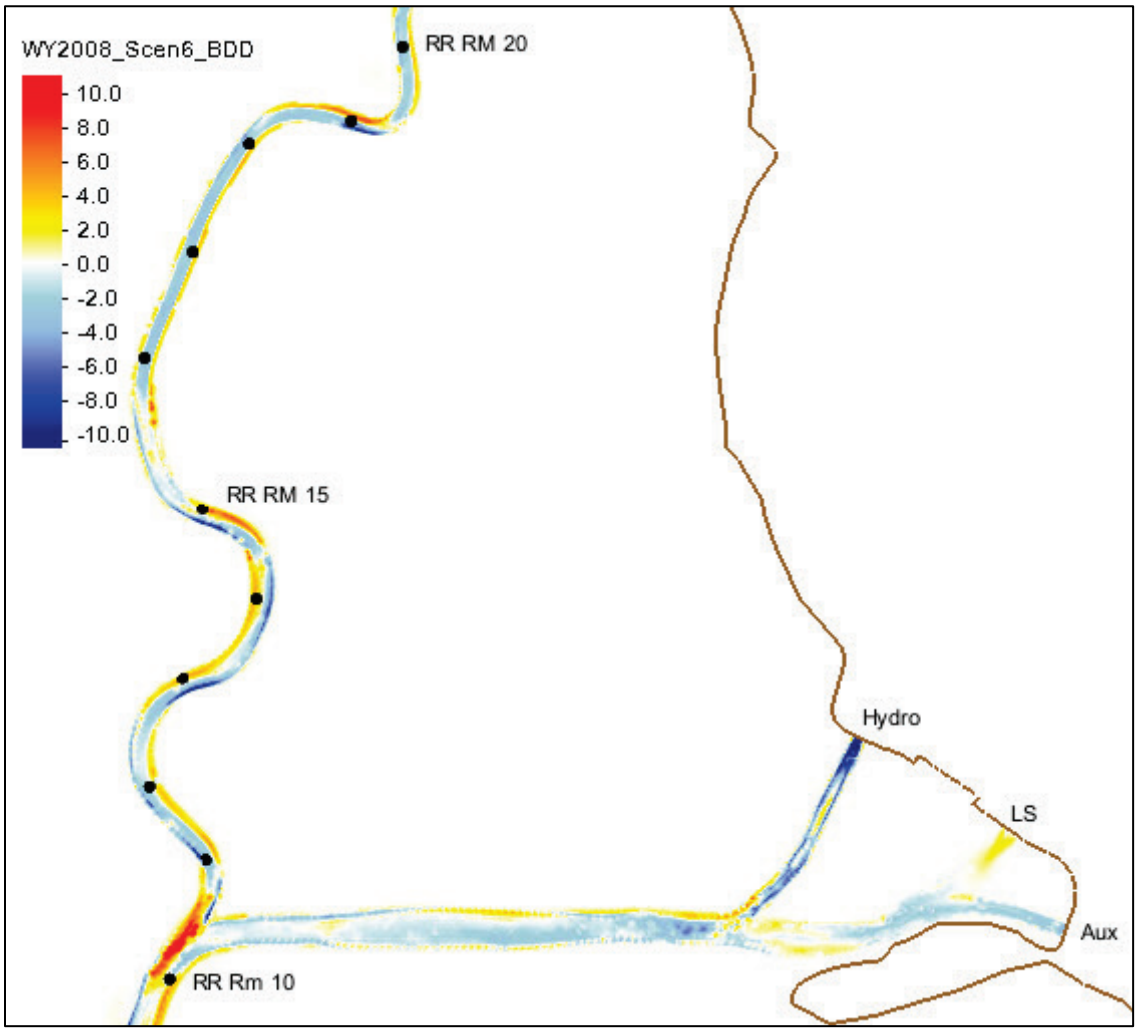


Plate A.47. WY2008 Scenario 6 BDD Outflow Channel.

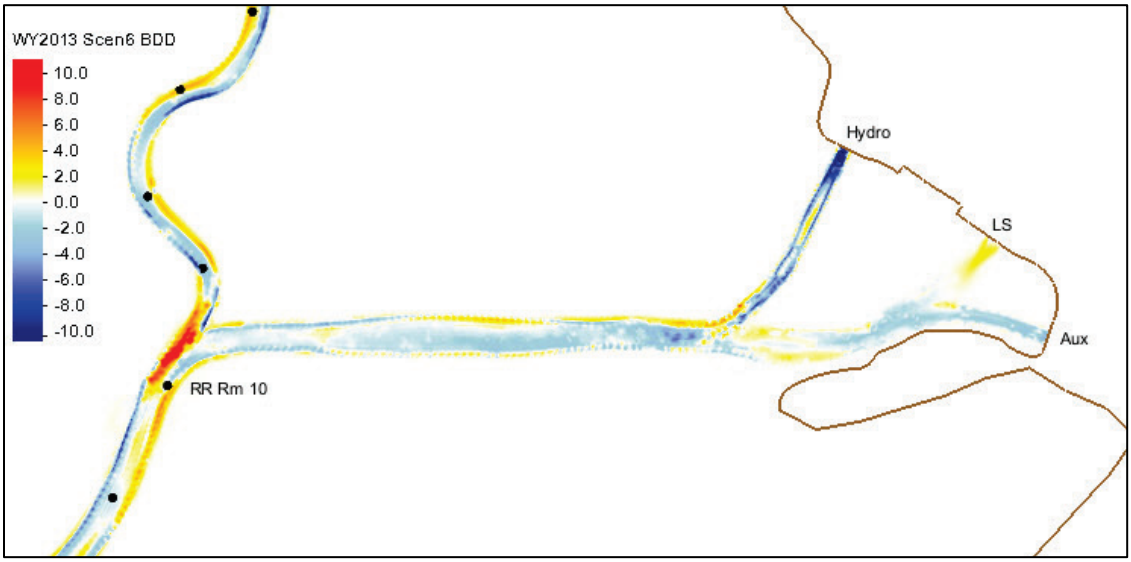


Plate A.48. WY2008 Scenario 6 BDD RR RM 10–Atcha RM 5.

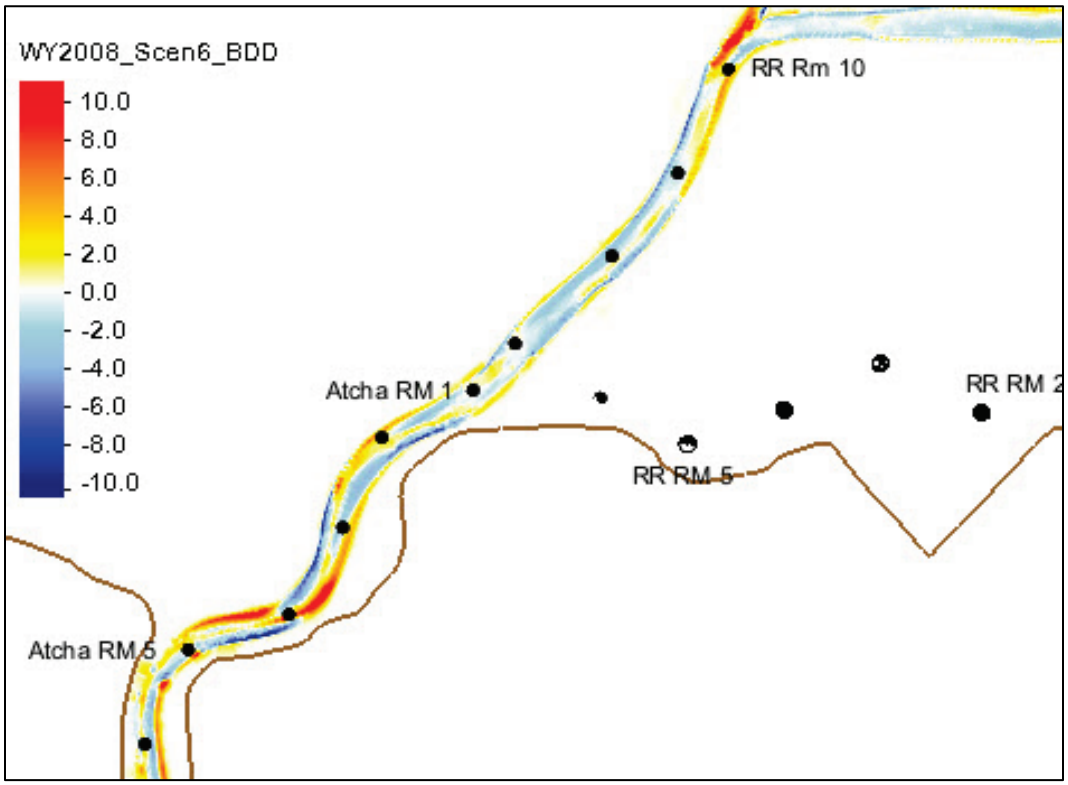


Plate A.49. WY2008 Scenario 6 BDD Atcha RM 5–Atcha RM 15.

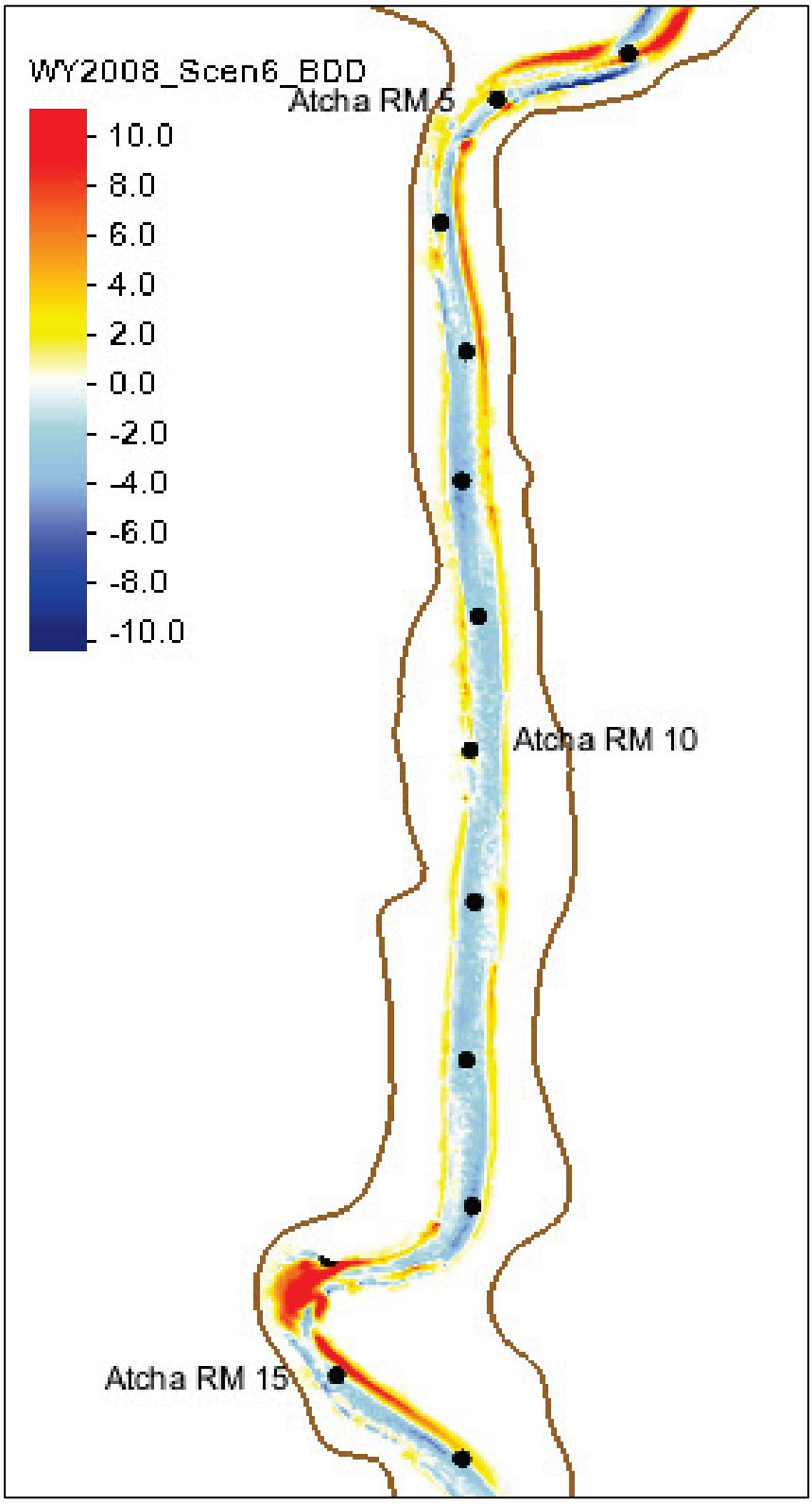
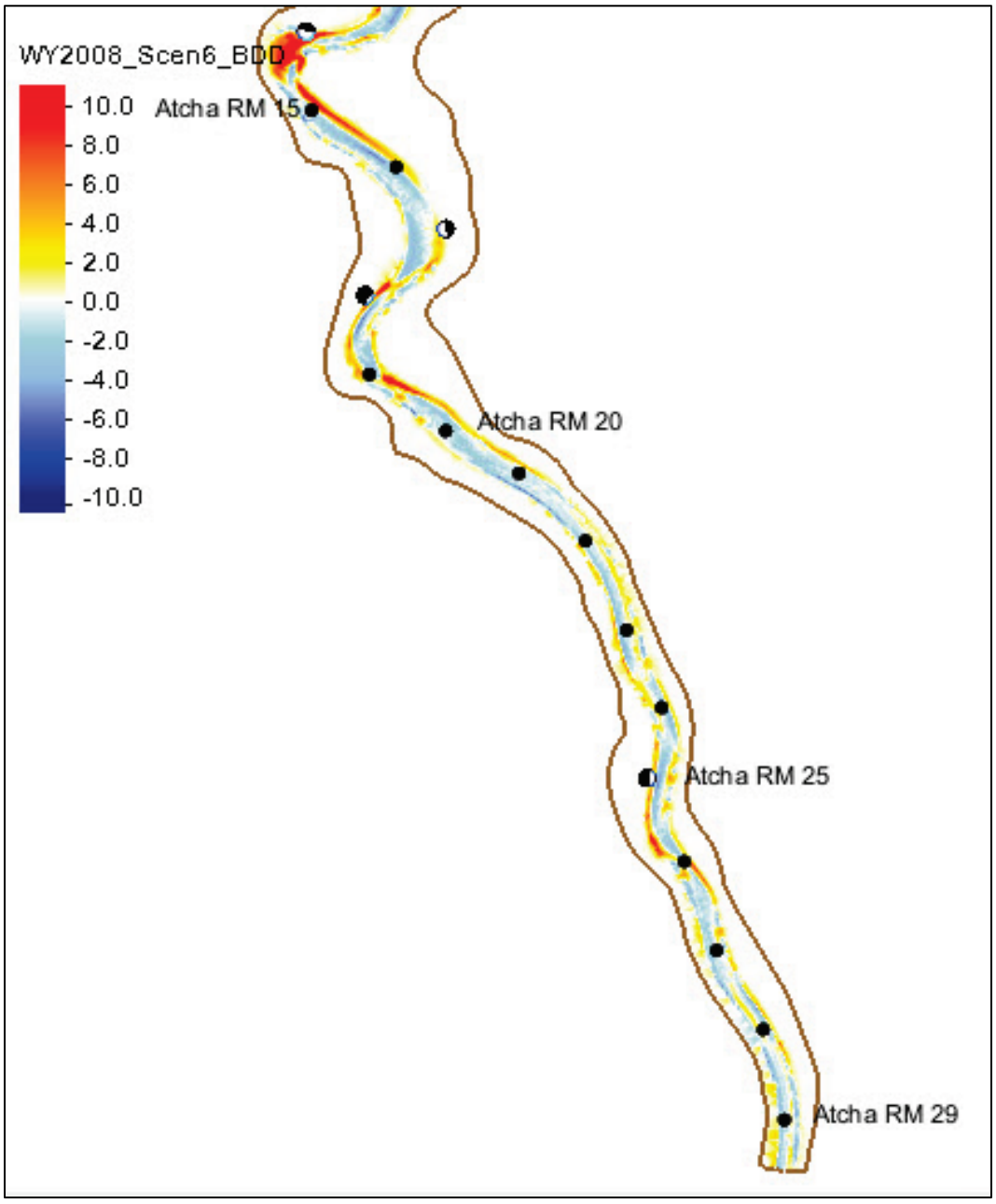


Plate A.50. WY2008 Scenario 6 BDD Atcha RM 15–Atcha RM 29.



A.6 Scenario 7

Plate A.51. WY2008 Scenario 7 BDD RR RM 43–RR RM 30.

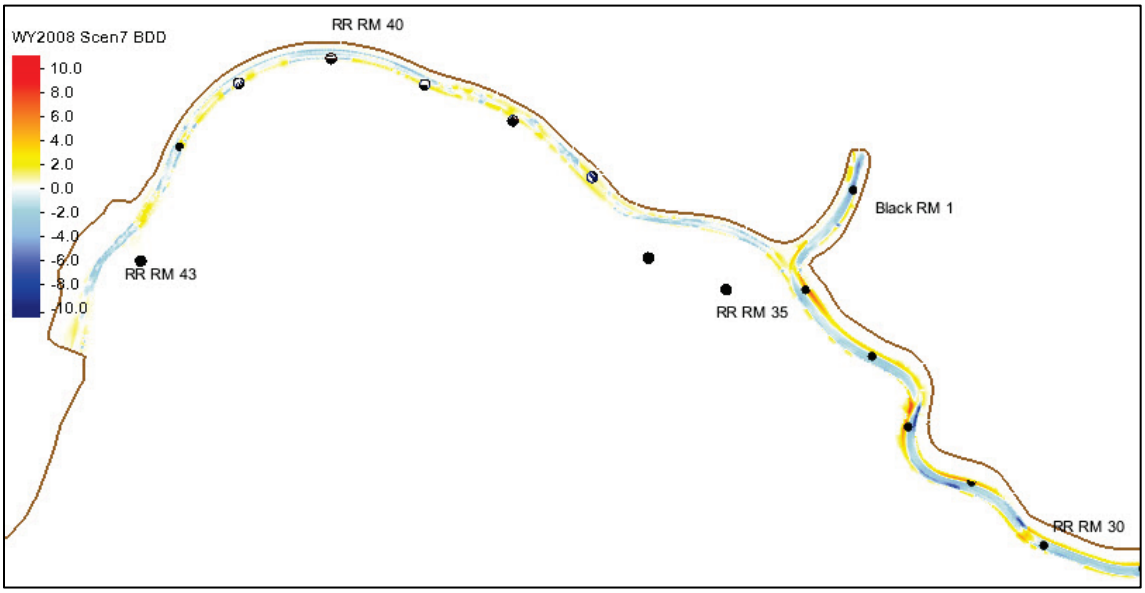


Plate A.52. WY2008 Scenario 7 BDD RR RM 30–RR RM 20.

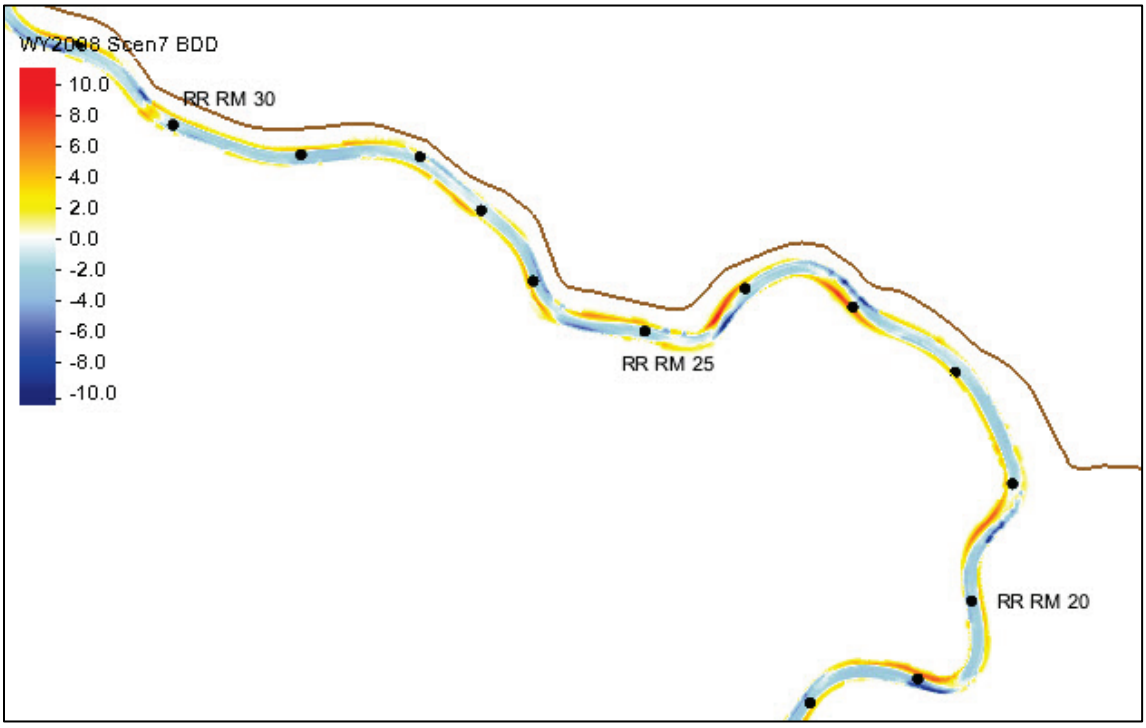


Plate A.53. WY2008 Scenario 7 BDD RR RM 20–RR RM 10.

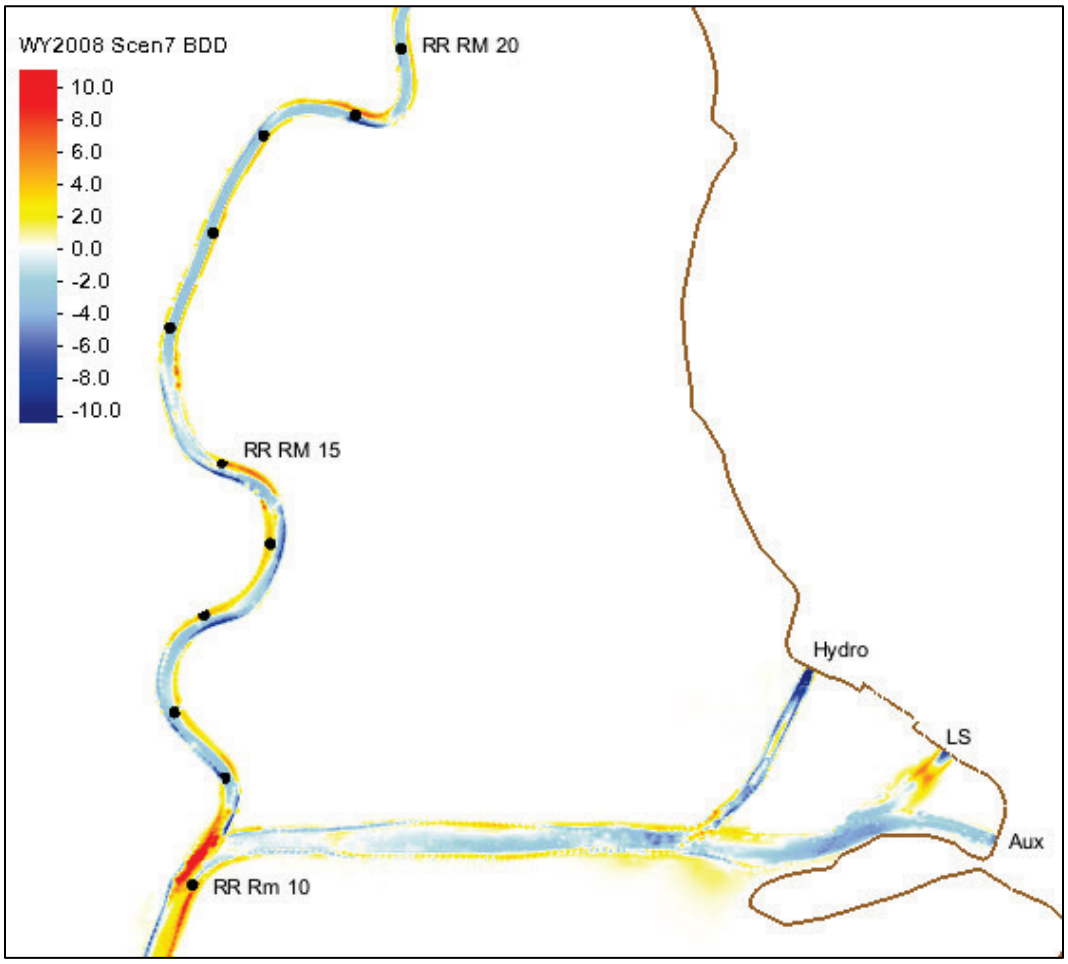


Plate A.54. WY2008 Scenario 7 BDD Outflow Channel.

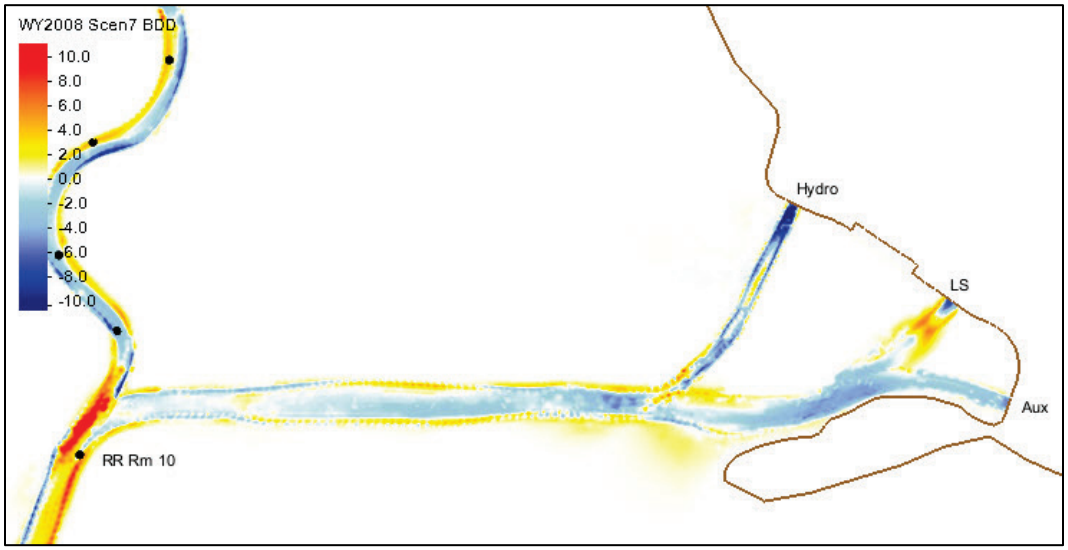


Plate A.55. WY2008 Scenario 7 BDD RR RM 10–Atcha RM 5.

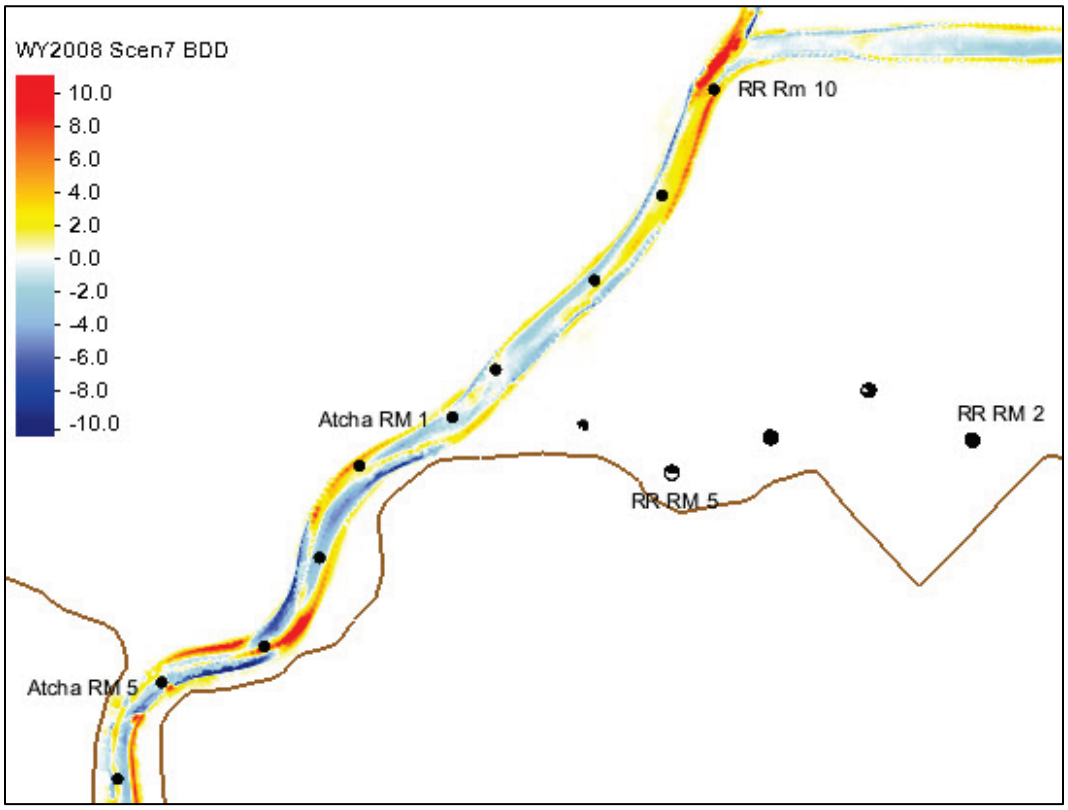


Plate A.56. WY2008 Scenario 7 BDD Atcha RM 5–Atcha RM 15.

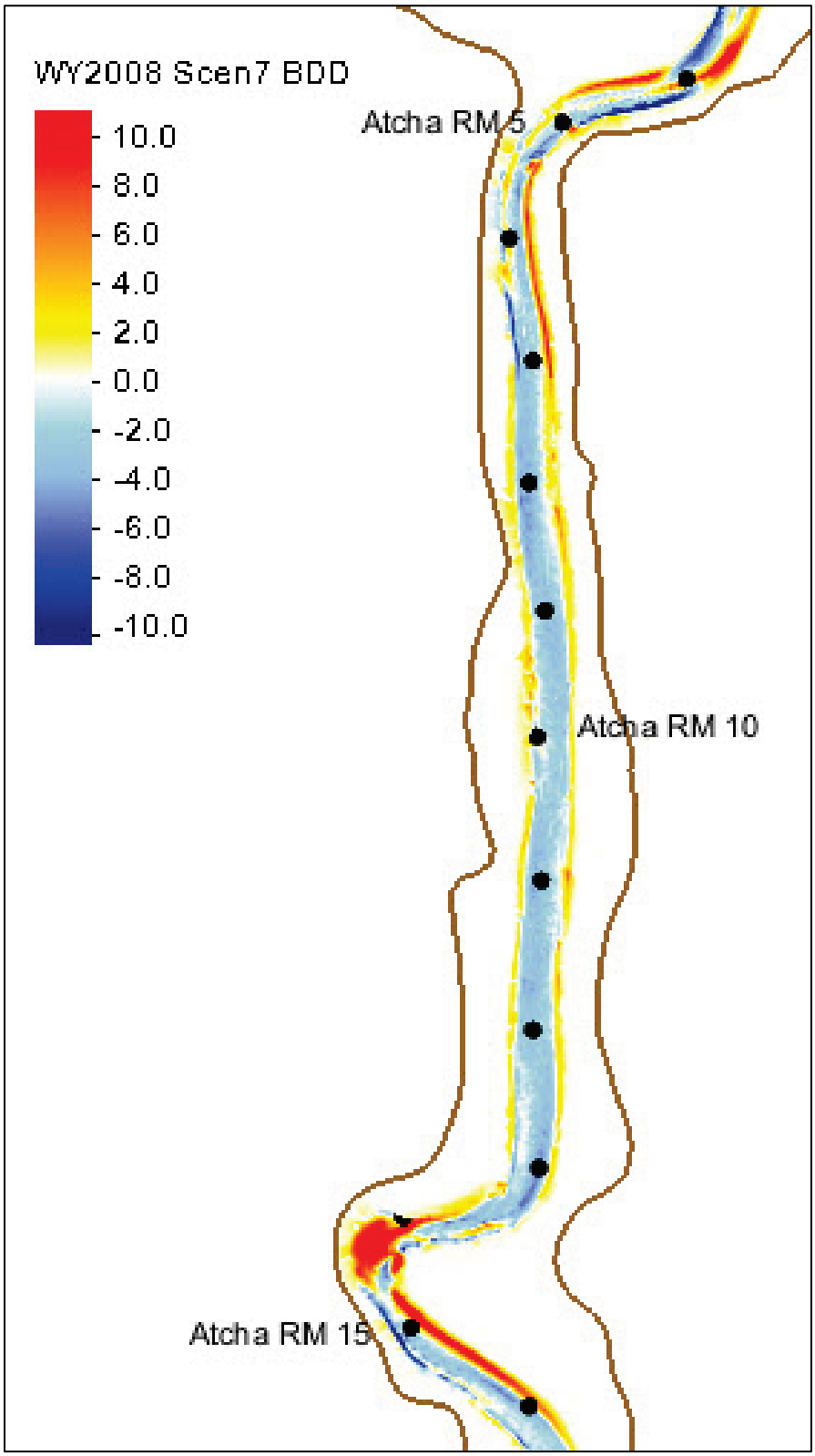
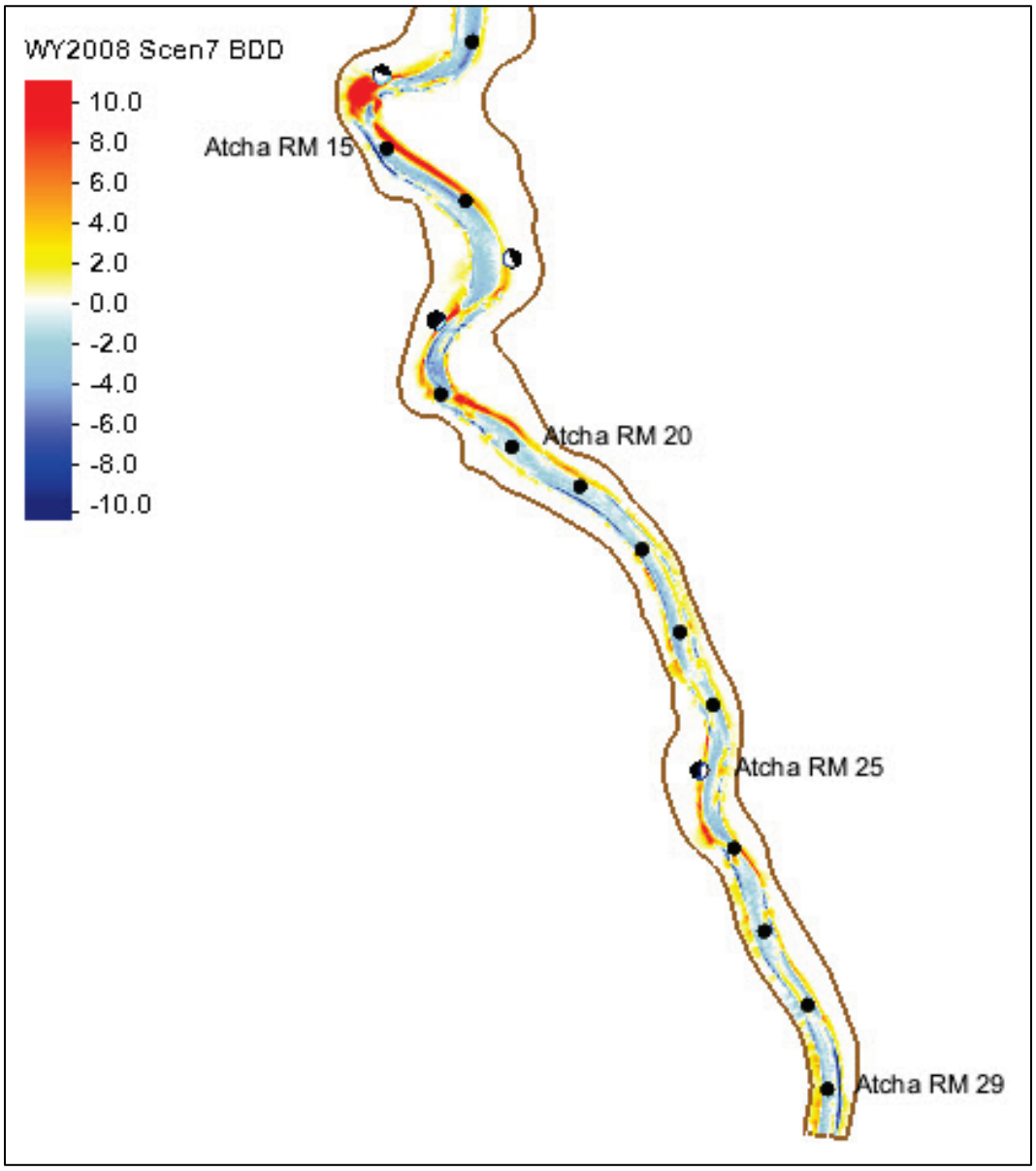


Plate A.57. WY2008 Scenario 7 BDD Atcha RM 15–Atcha RM 29.



A.7 Scenario 8a

Plate A.58. WY2008 Scenario 8a BDD RR RM 43–RR RM 30.

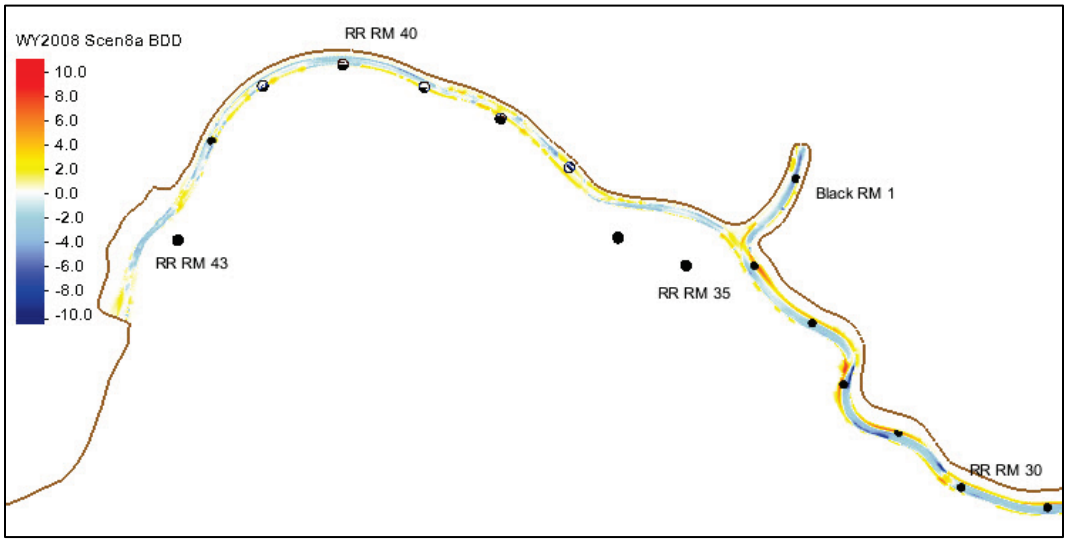


Plate A.59. WY2008 Scenario 8a BDD RR RM 30–RR RM 20.

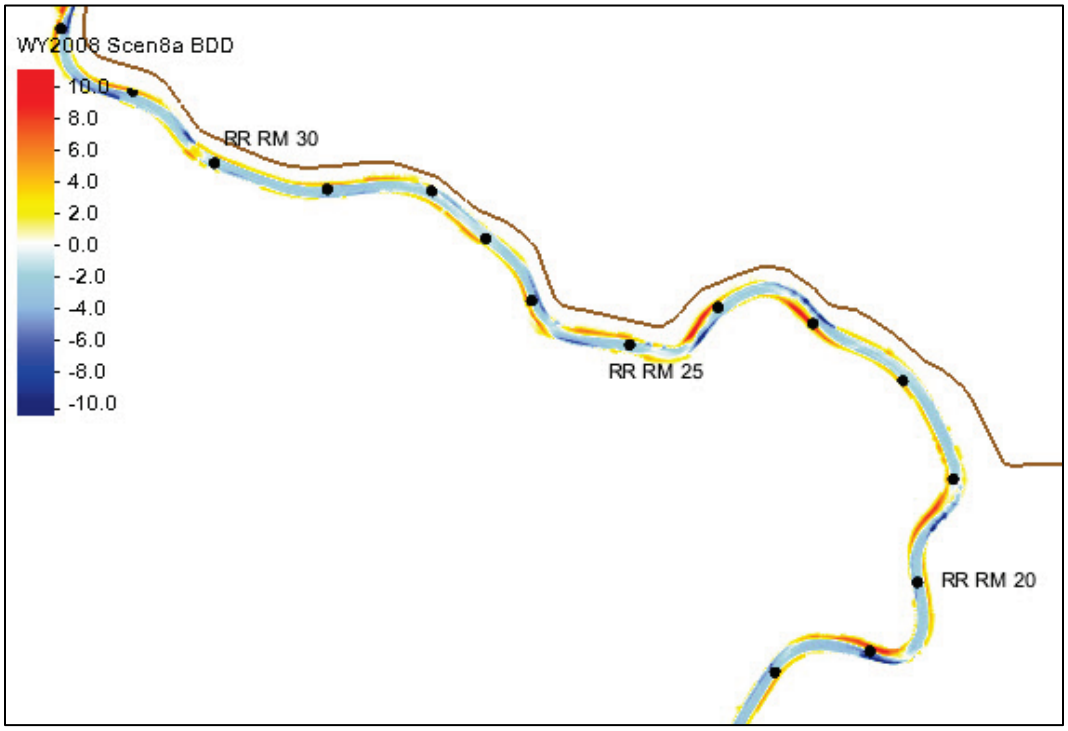


Plate A.60. WY2008 Scenario 8a BDD RR RM 20–RR RM 10.

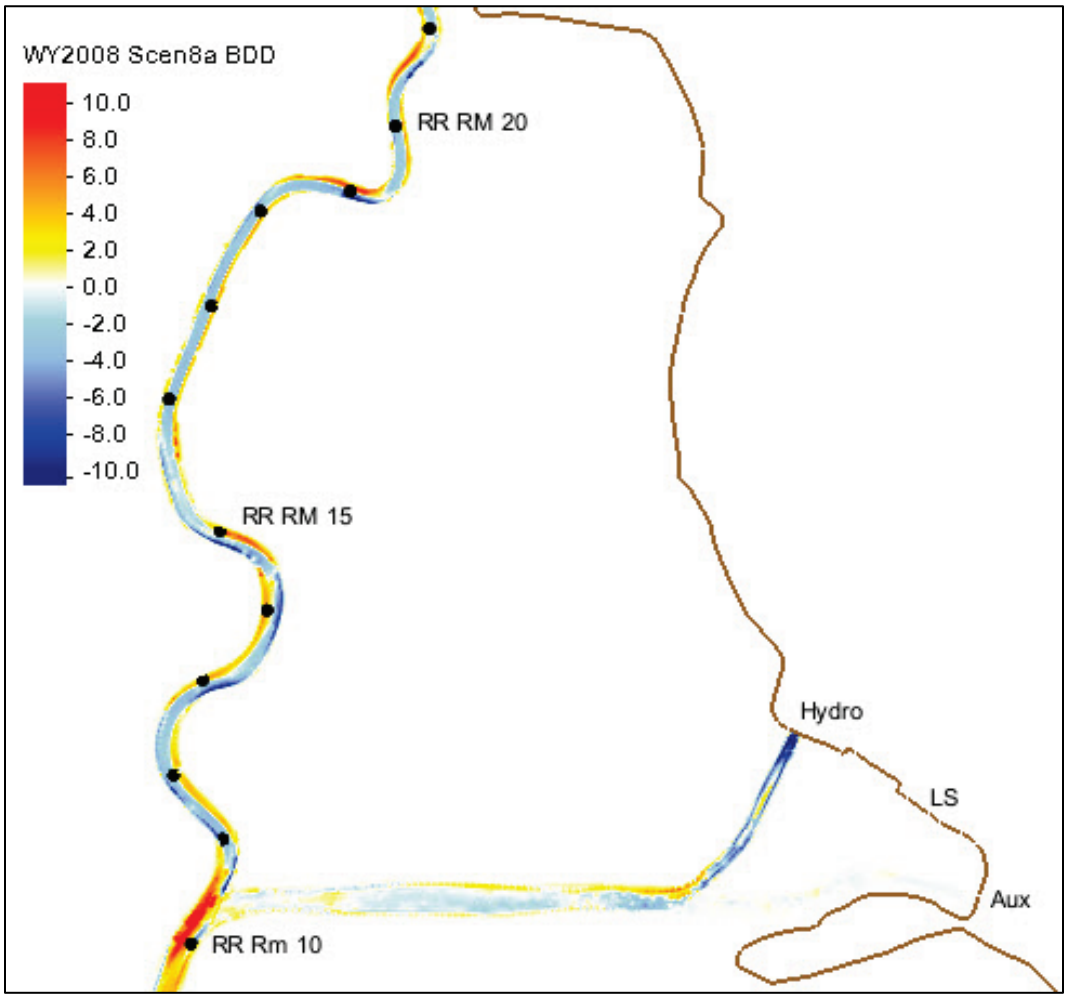


Plate A.61. WY2008 Scenario 8a BDD Outflow Channel

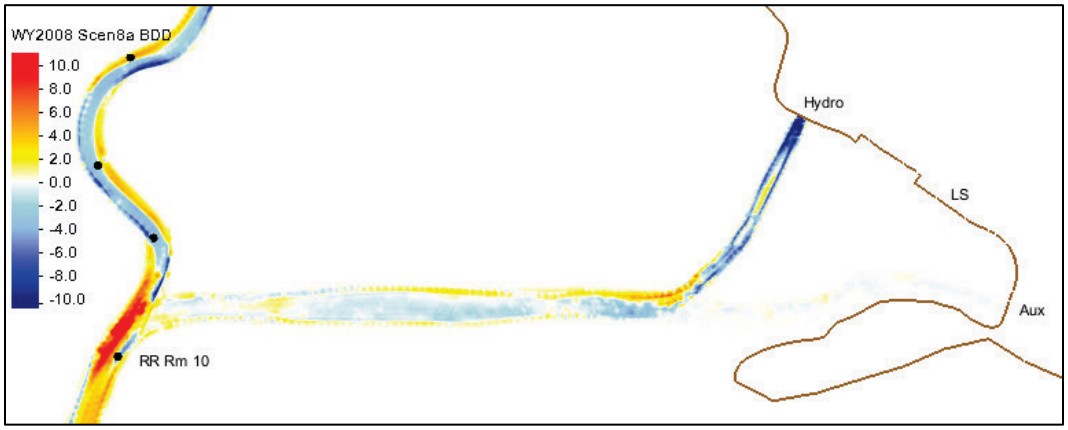


Plate A.62. WY2008 Scenario 8a BDD RR RM 10–Atcha RM 5.

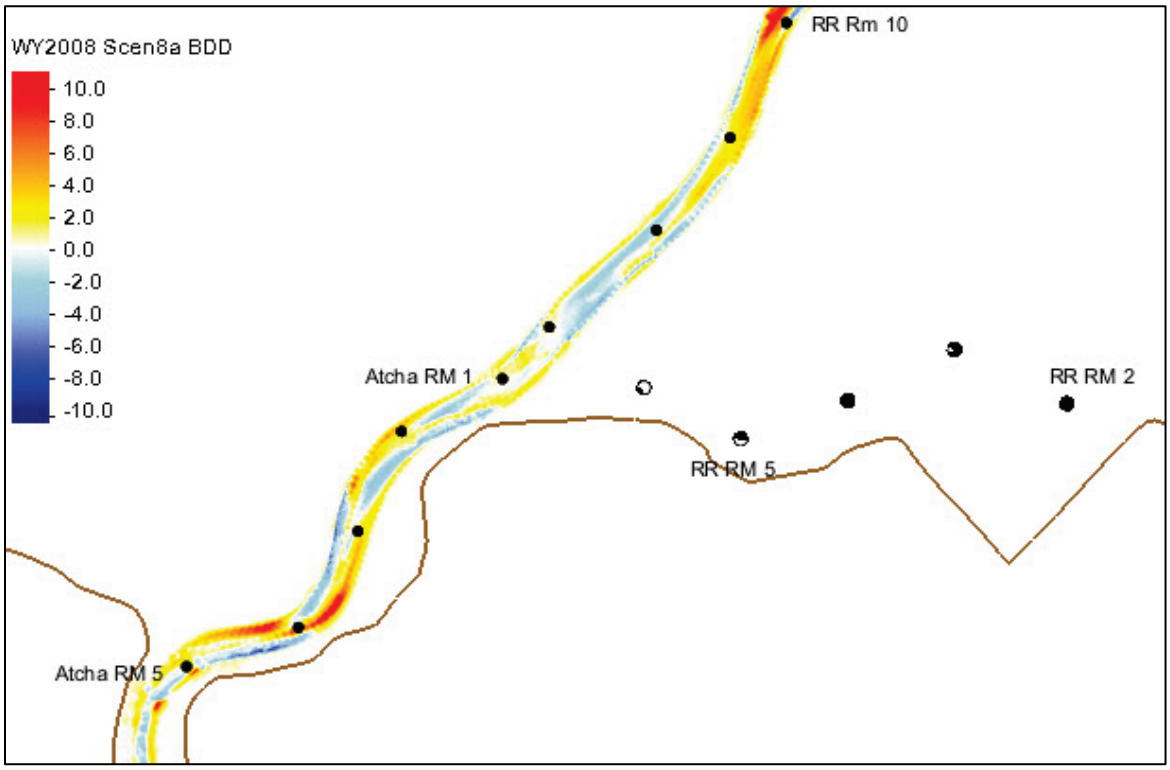


Plate A.63. WY2008 Scenario 8a BDD Atcha RM 5–Atcha RM 15.

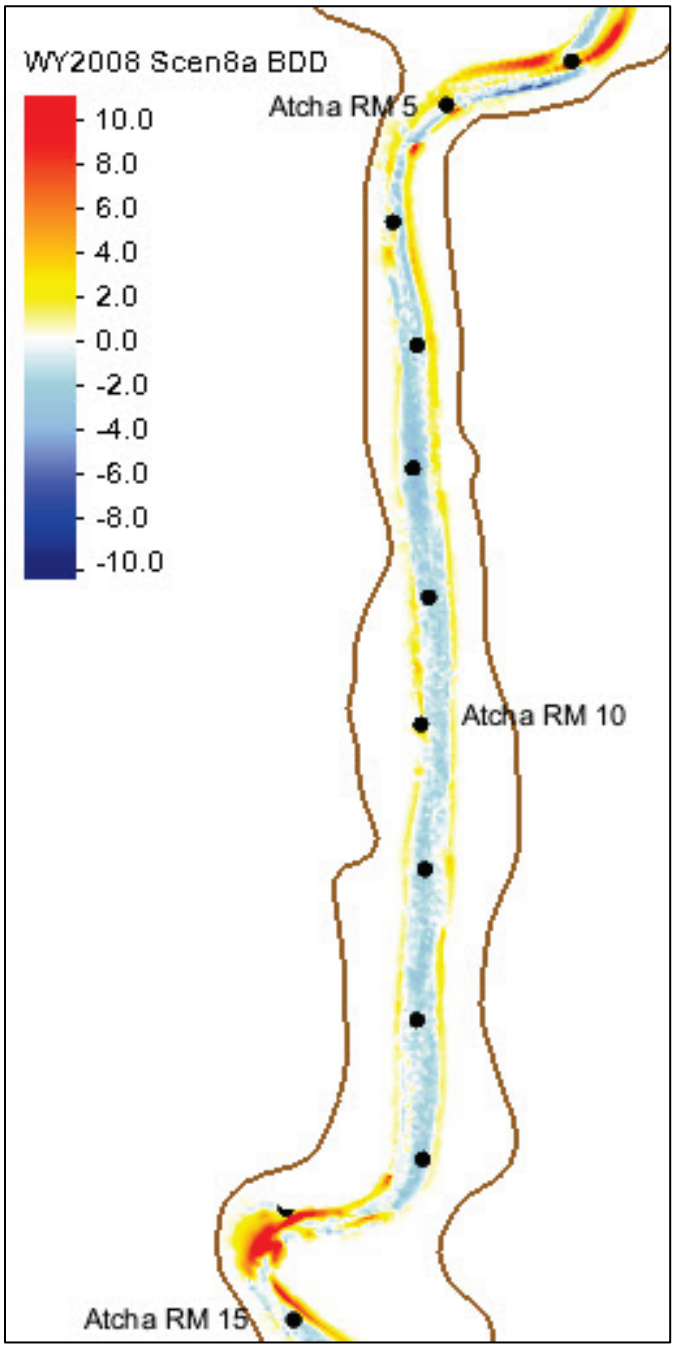
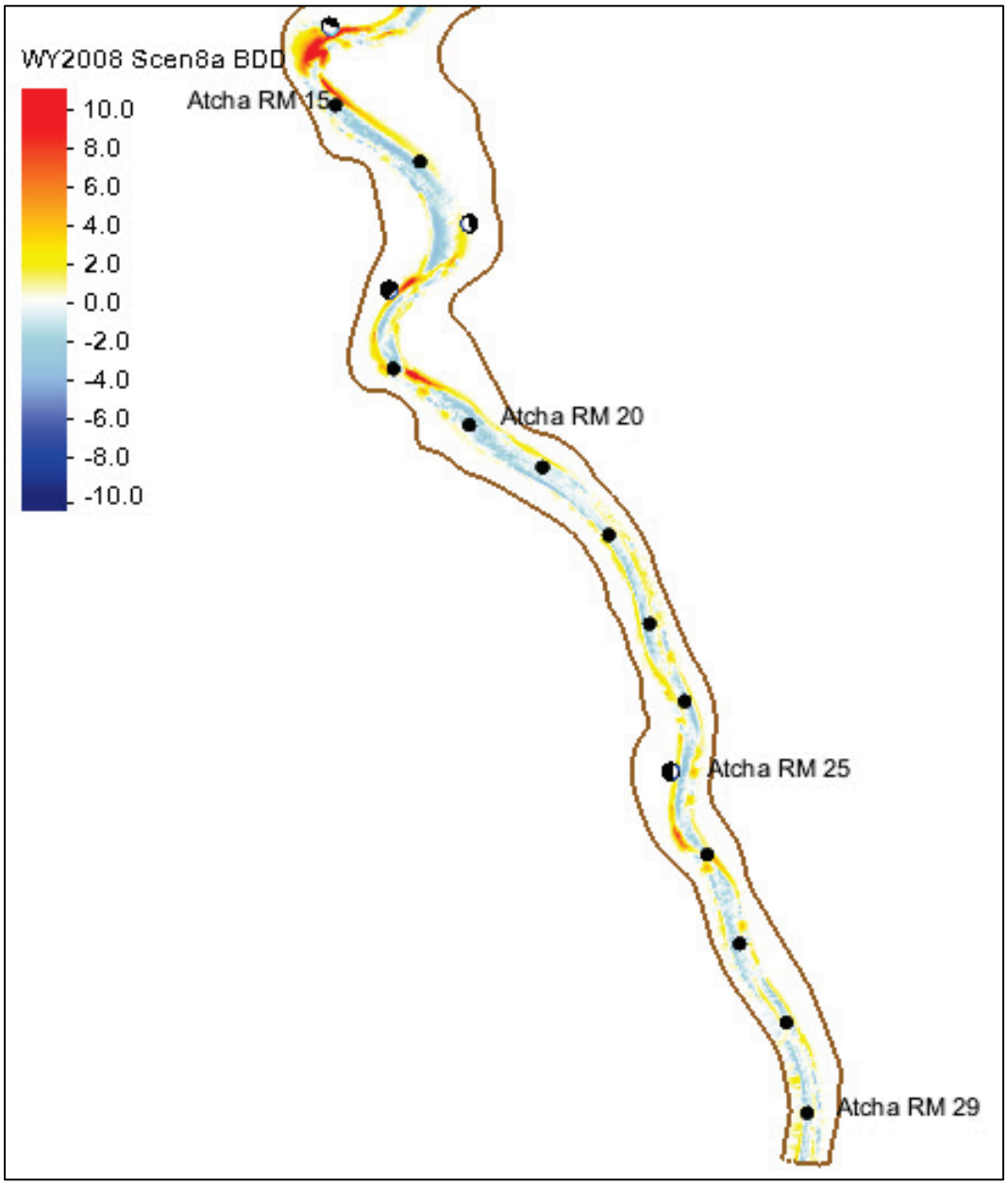


Plate A.64. WY2008 Scenario 8a BDD Atcha RM 15–Atcha RM 29.



A.8 Scenario 8b

Plate A.65. WY2008 Scenario 8b BDD RR RM 43–RR RM 30.

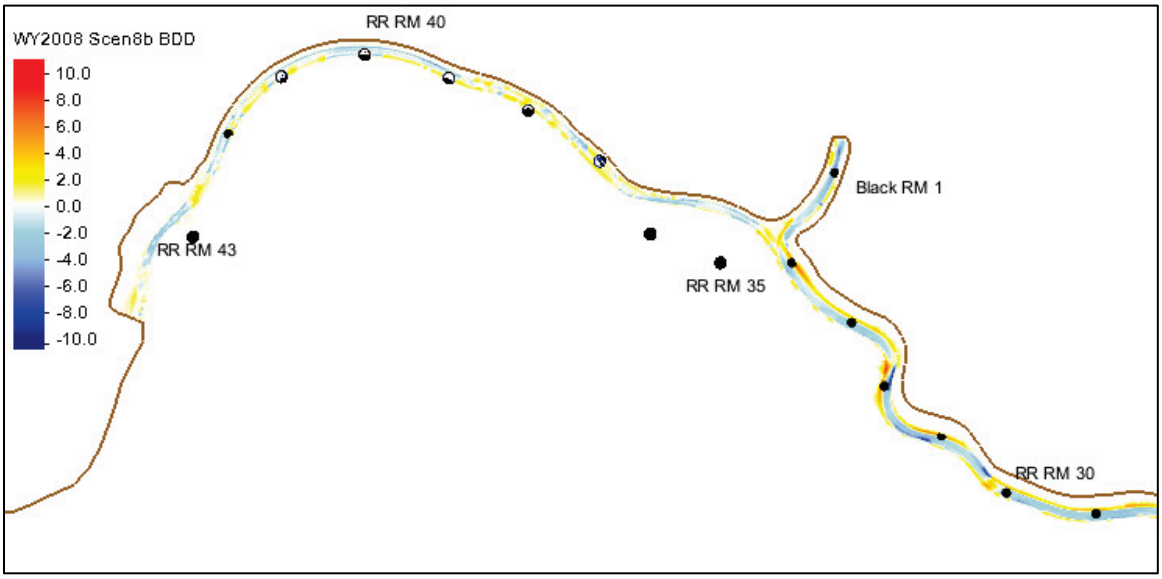


Plate A.66. WY2008 Scenario 8b BDD RR RM 30–RR RM 20.

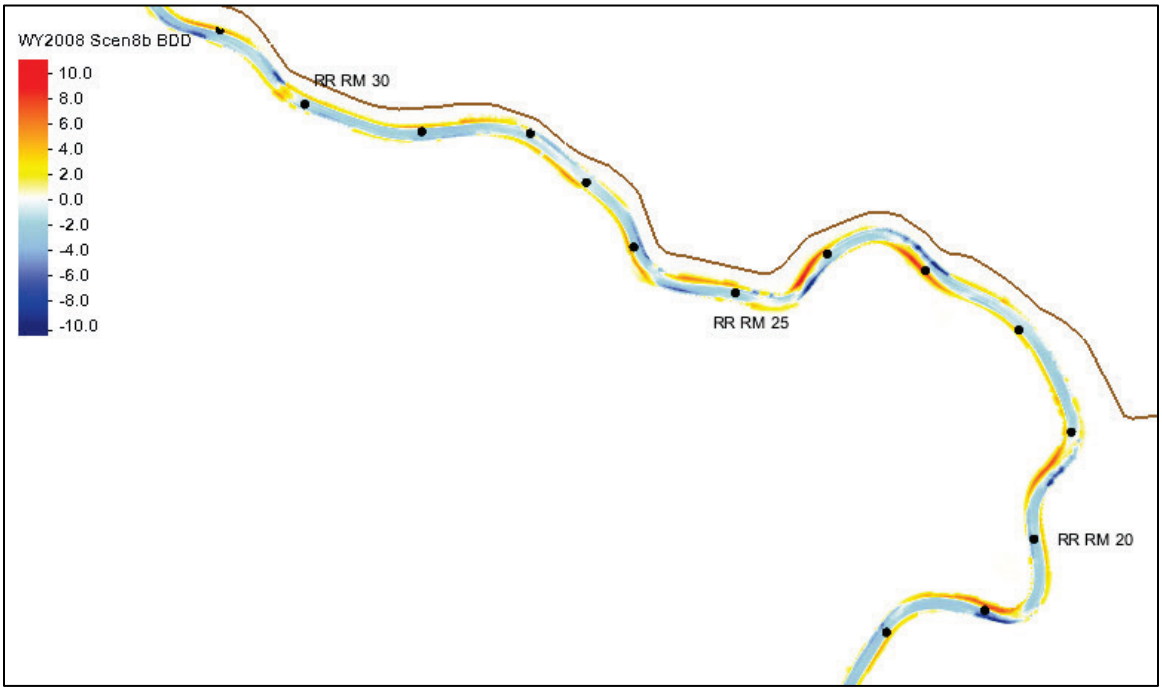


Plate A.67. WY2008 Scenario 8b BDD RR RM 20–RR RM 10.

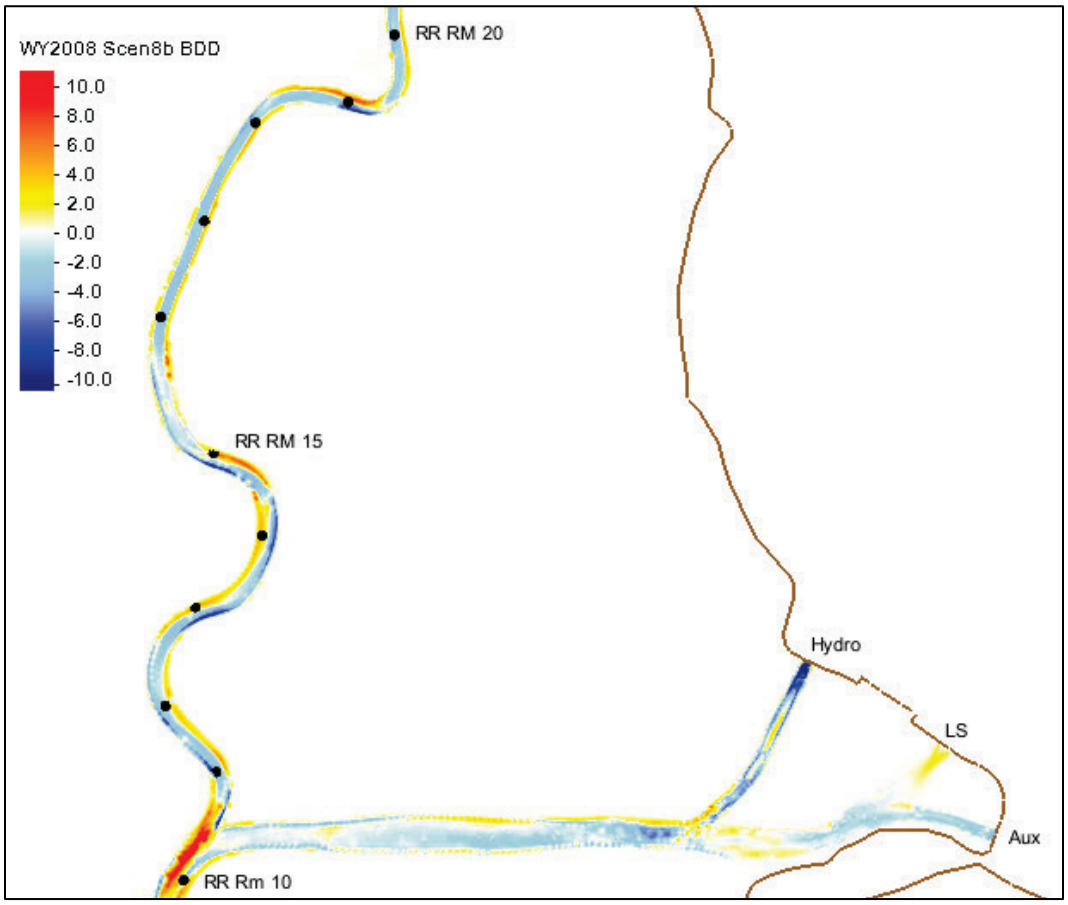


Plate A.68. WY2008 Scenario 8b BDD Outflow Channel.

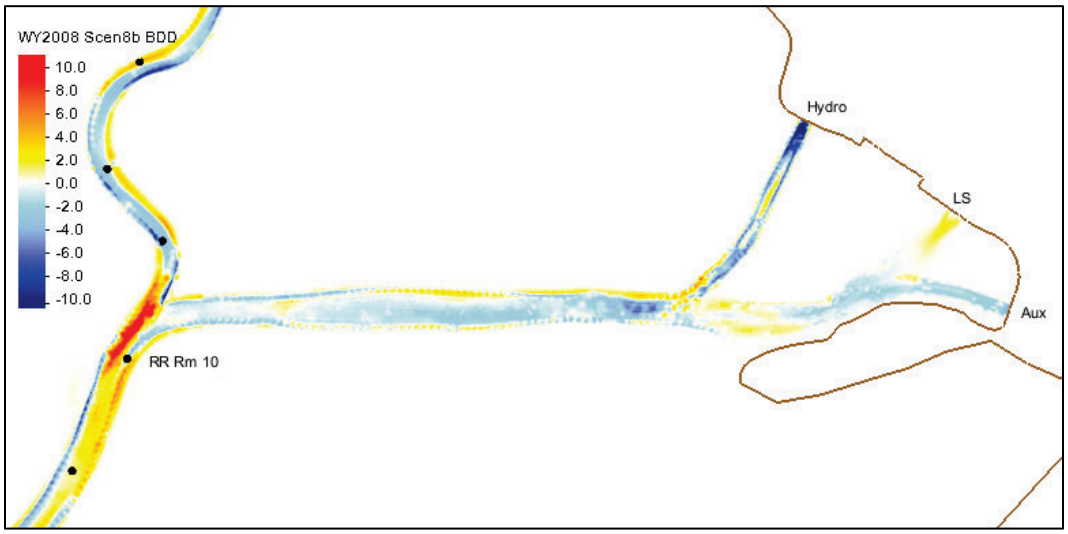


Plate A.69. WY2008 Scenario 8b BDD RR RM 10–Atcha RM 5.

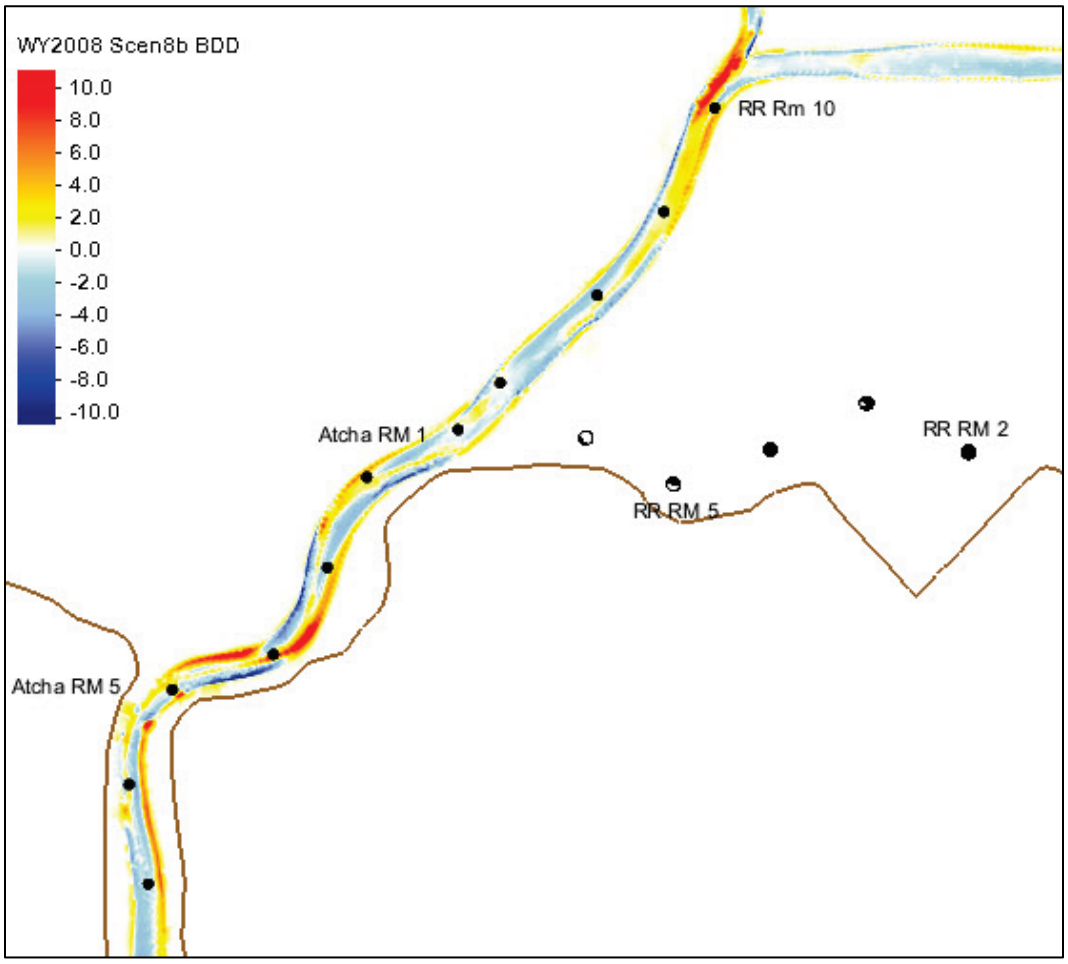


Plate A.70. WY2008 Scenario 8b BDD Atcha RM 5–Atcha RM 15.

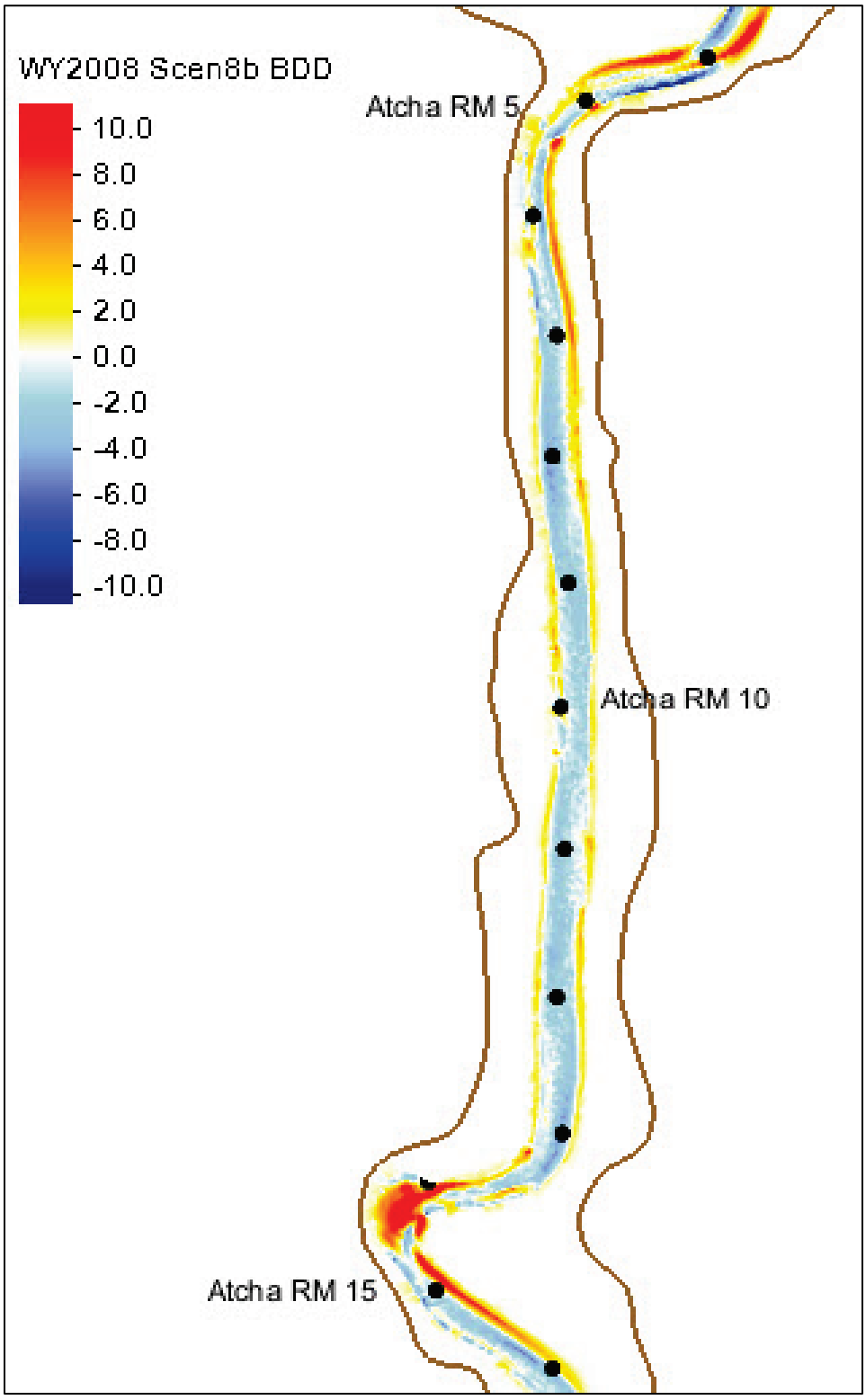
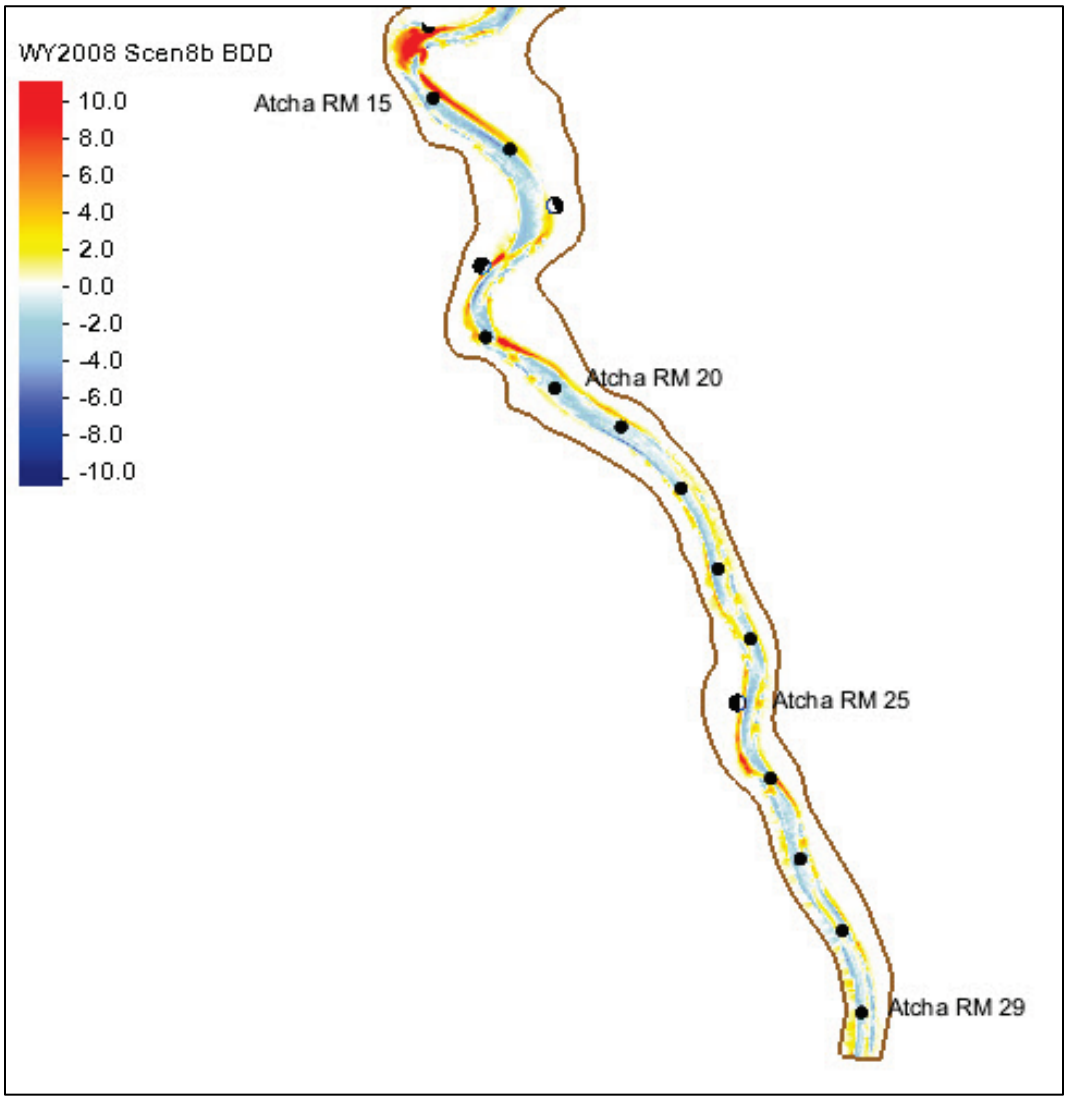


Plate A.71. WY2008 Scenario 8b BDD Atcha RM 15–Atcha RM 29.



A.9 Scenario 9

Plate A.72. WY2008 Scenario 9 BDD RR RM 43–RR RM 40.

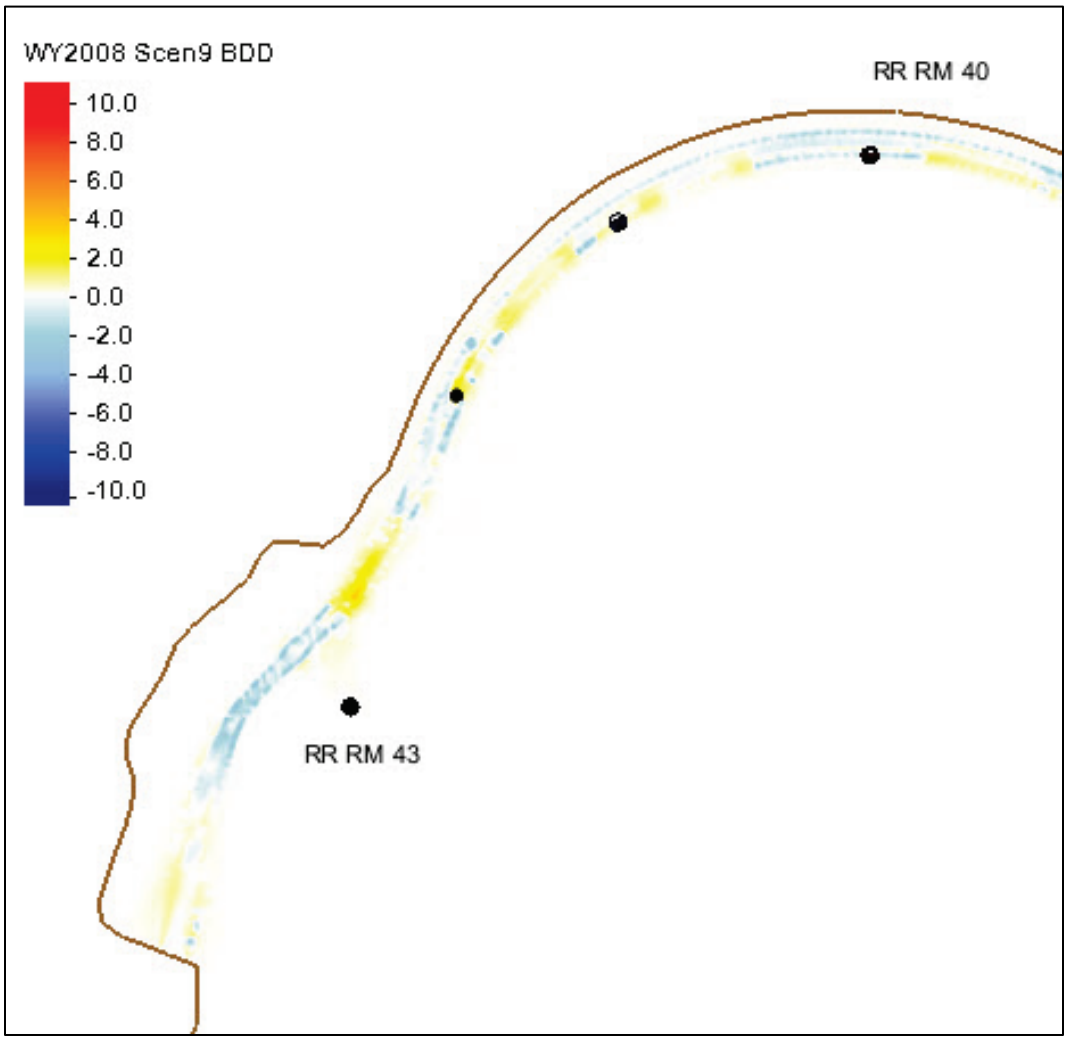


Plate A.73. WY2008 Scenario 9 BDD RR RM 35–RR RM 30.

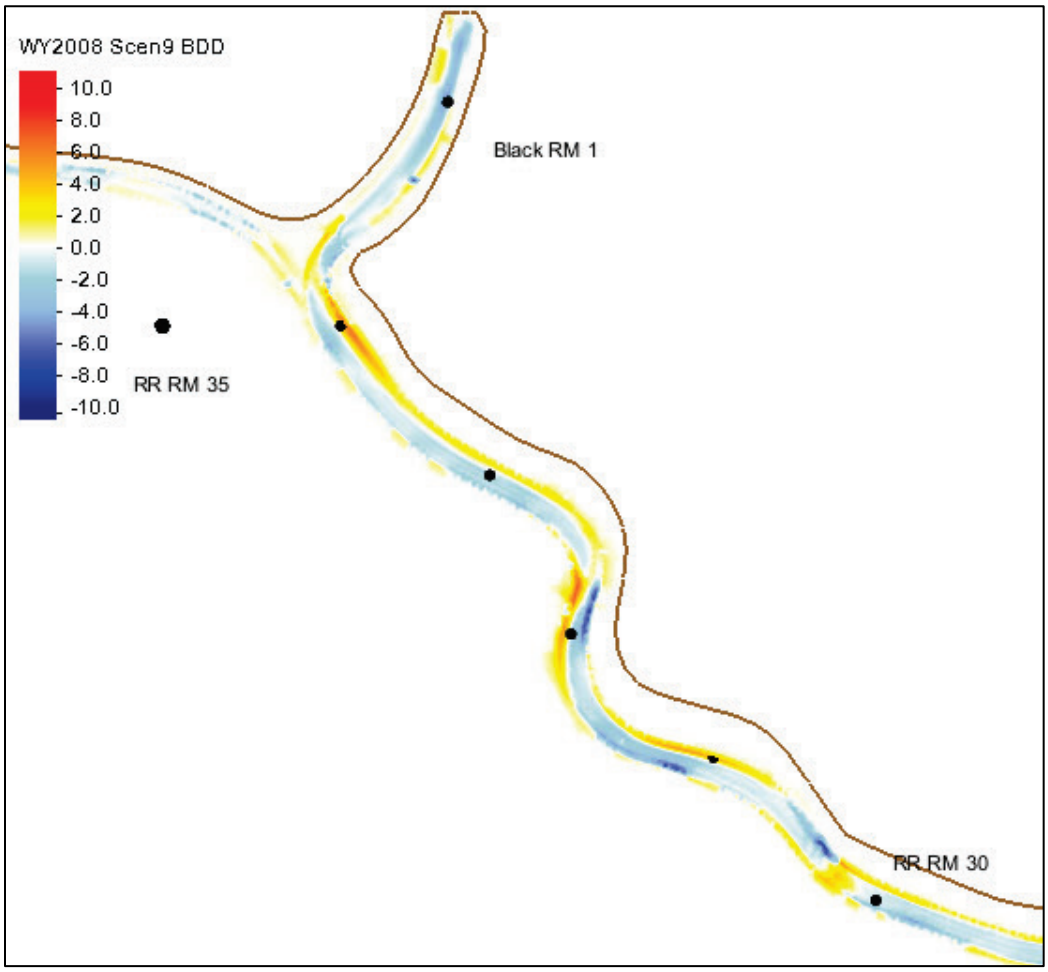


Plate A.74. WY2008 Scenario 9 BDD RR RM 30–RR RM 25.

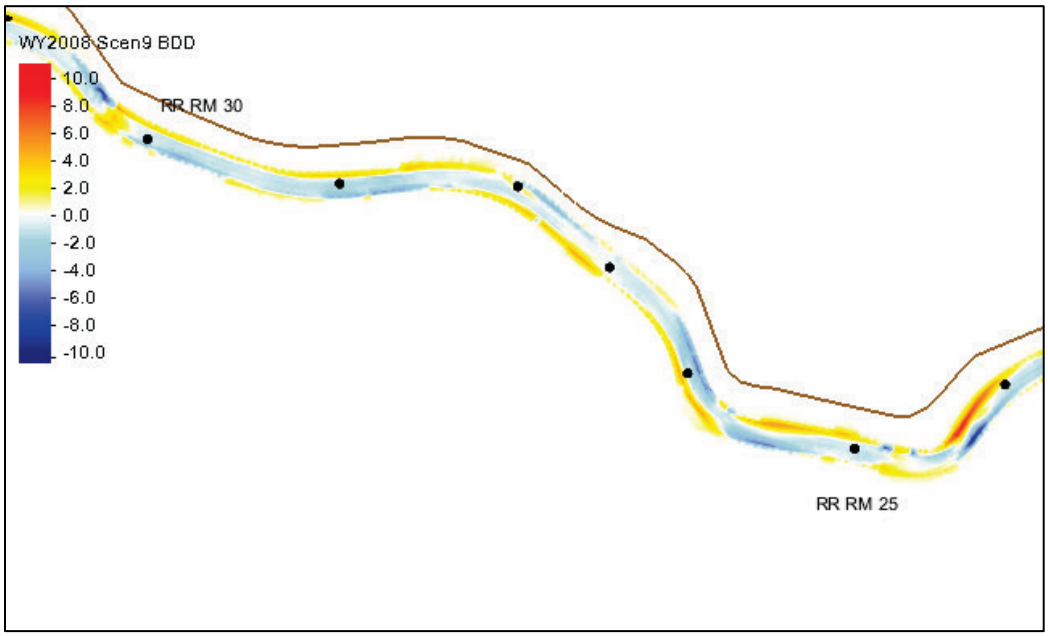


Plate A.75. WY2008 Scenario 9 BDD RR RM 25–RR RM 20.

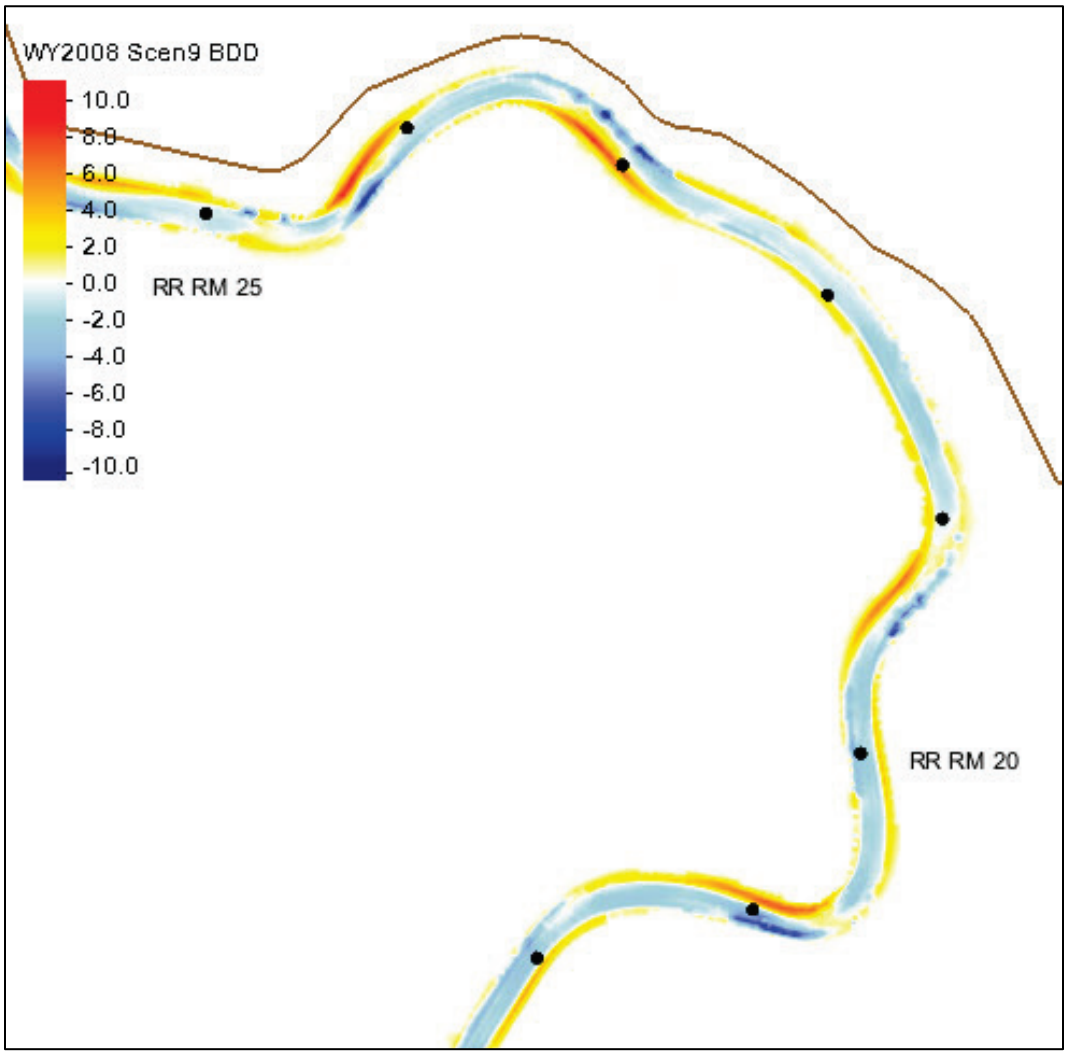


Plate A.76. WY2008 Scenario 9 BDD RR RM 20–RR RM 15.

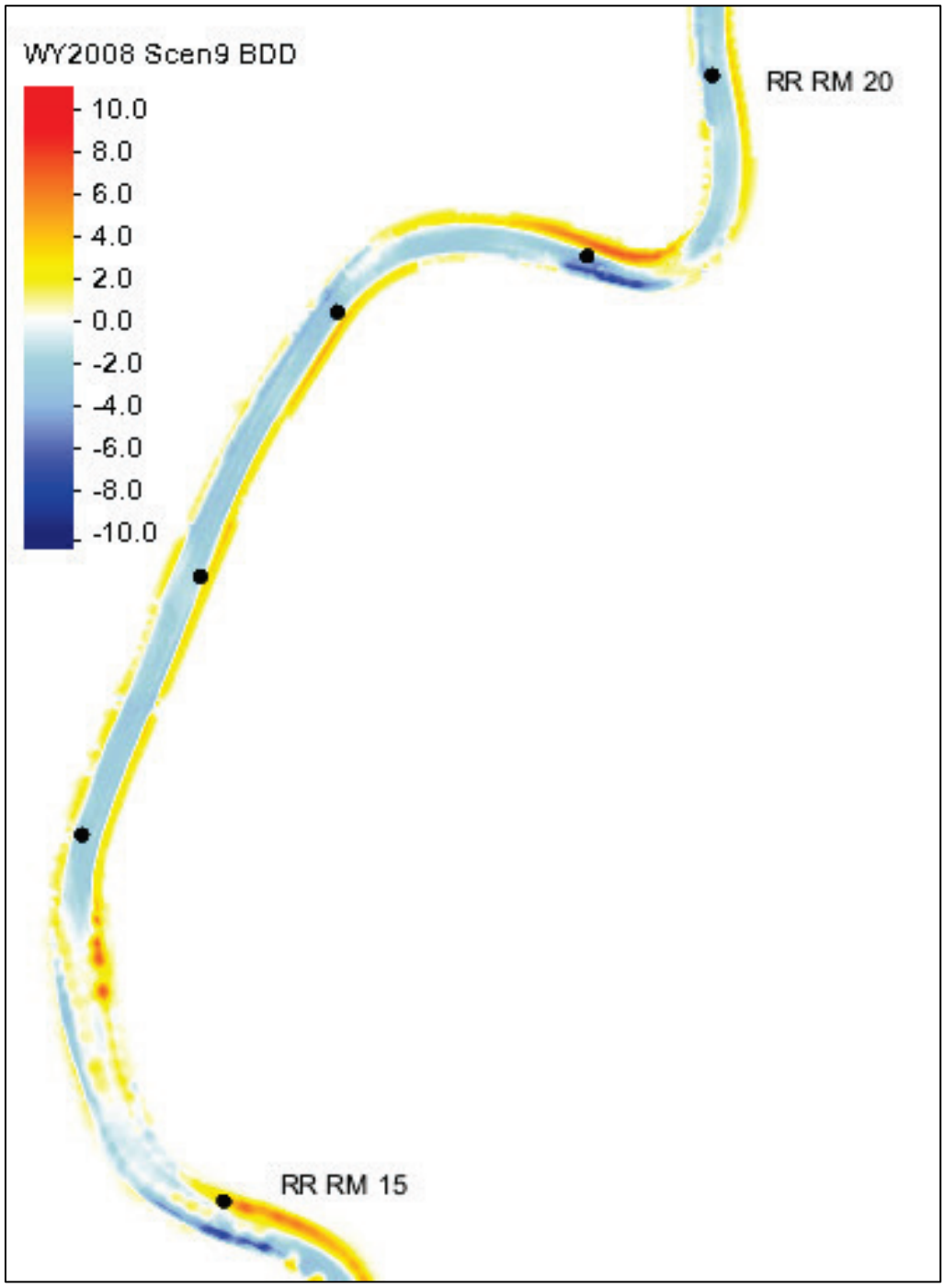


Plate A.77. WY2008 Scenario 9 BDD RR RM 15–RR RM 10.

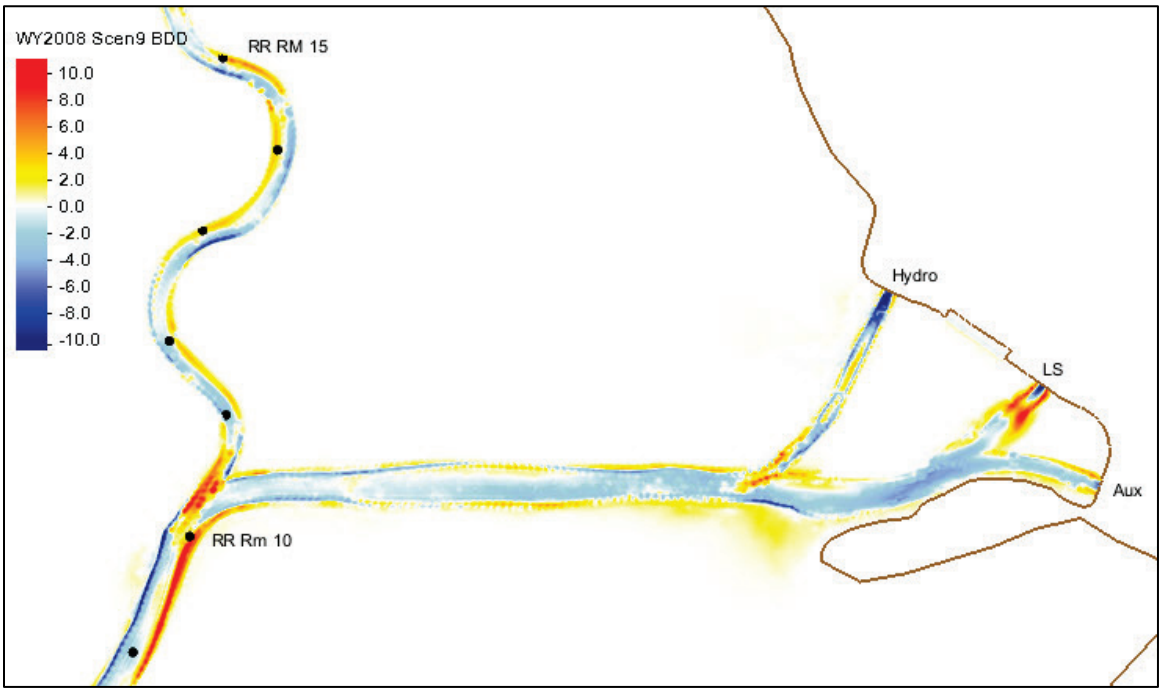


Plate A.78. WY2008 Scenario 9 BDD Outflow Channel.

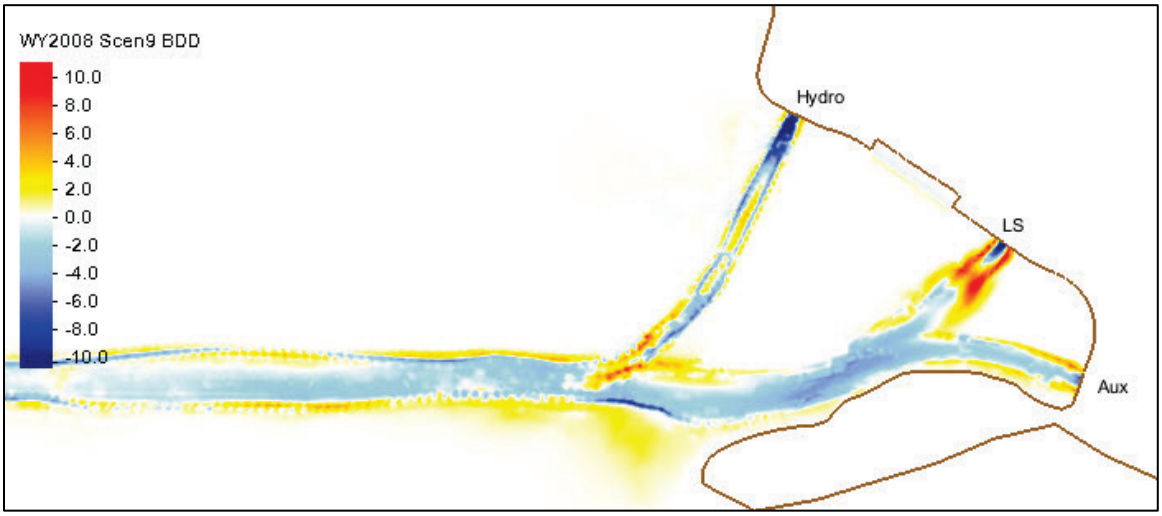


Plate A.79. WY2008 Scenario 9 BDD RR RM 10–Atcha RM 1.

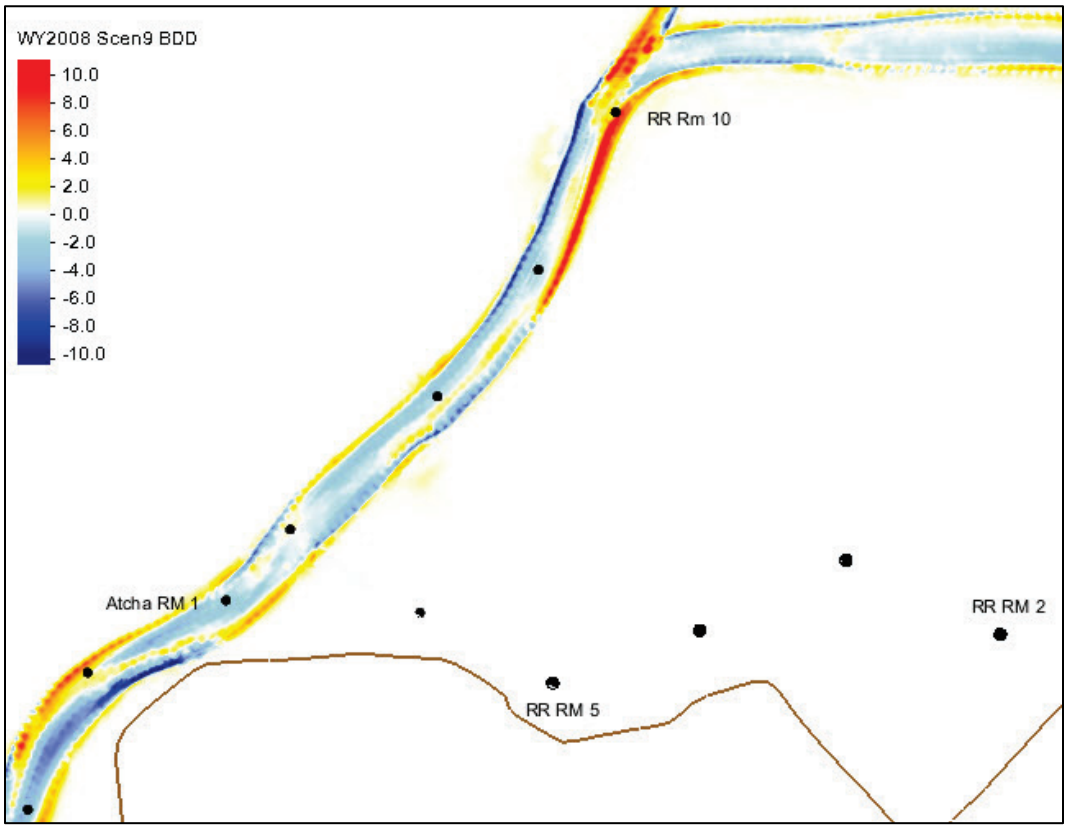


Plate A.80. WY2008 Scenario 9 BDD Atcha RM 1–Atcha RM 5.

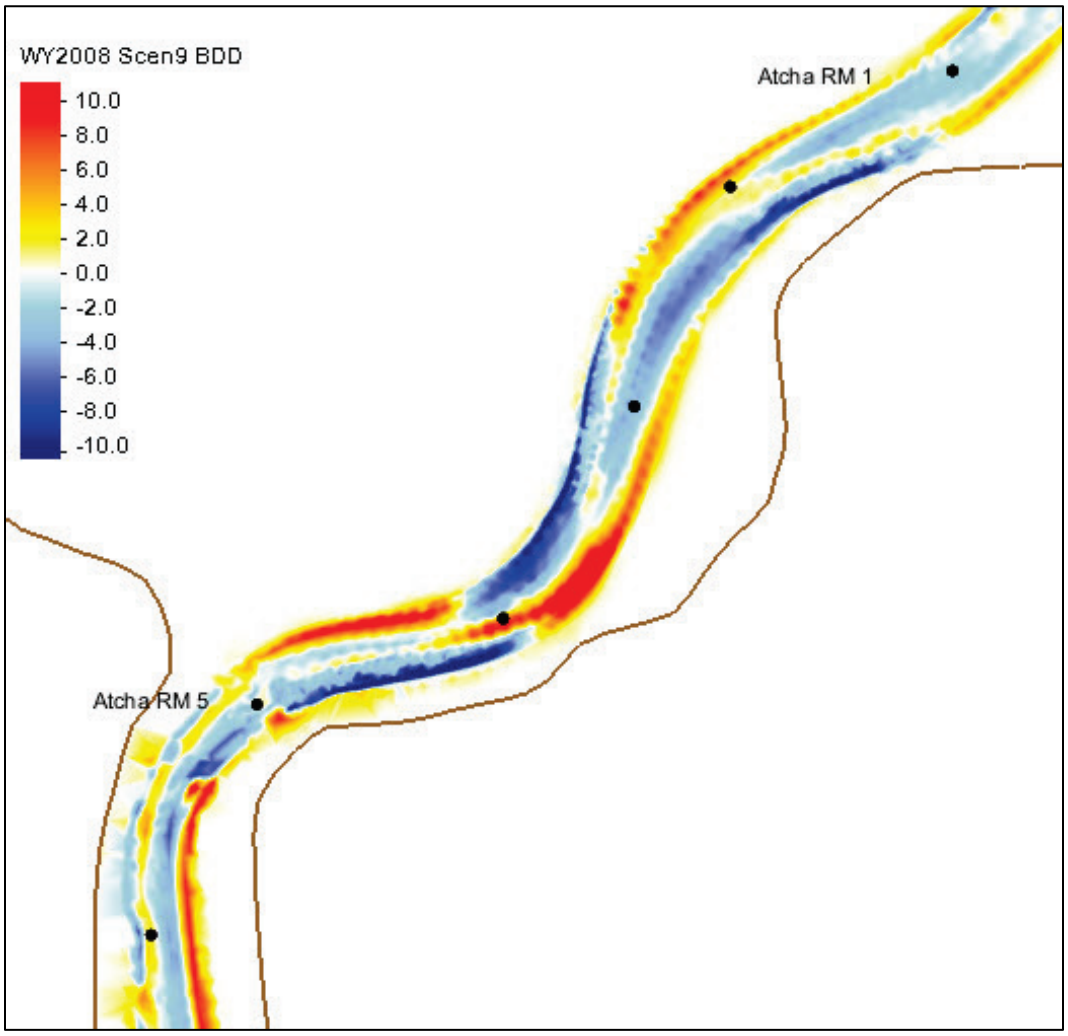


Plate A.81. WY2008 Scenario 9 BDD Atcha RM 5–Atcha RM 10.

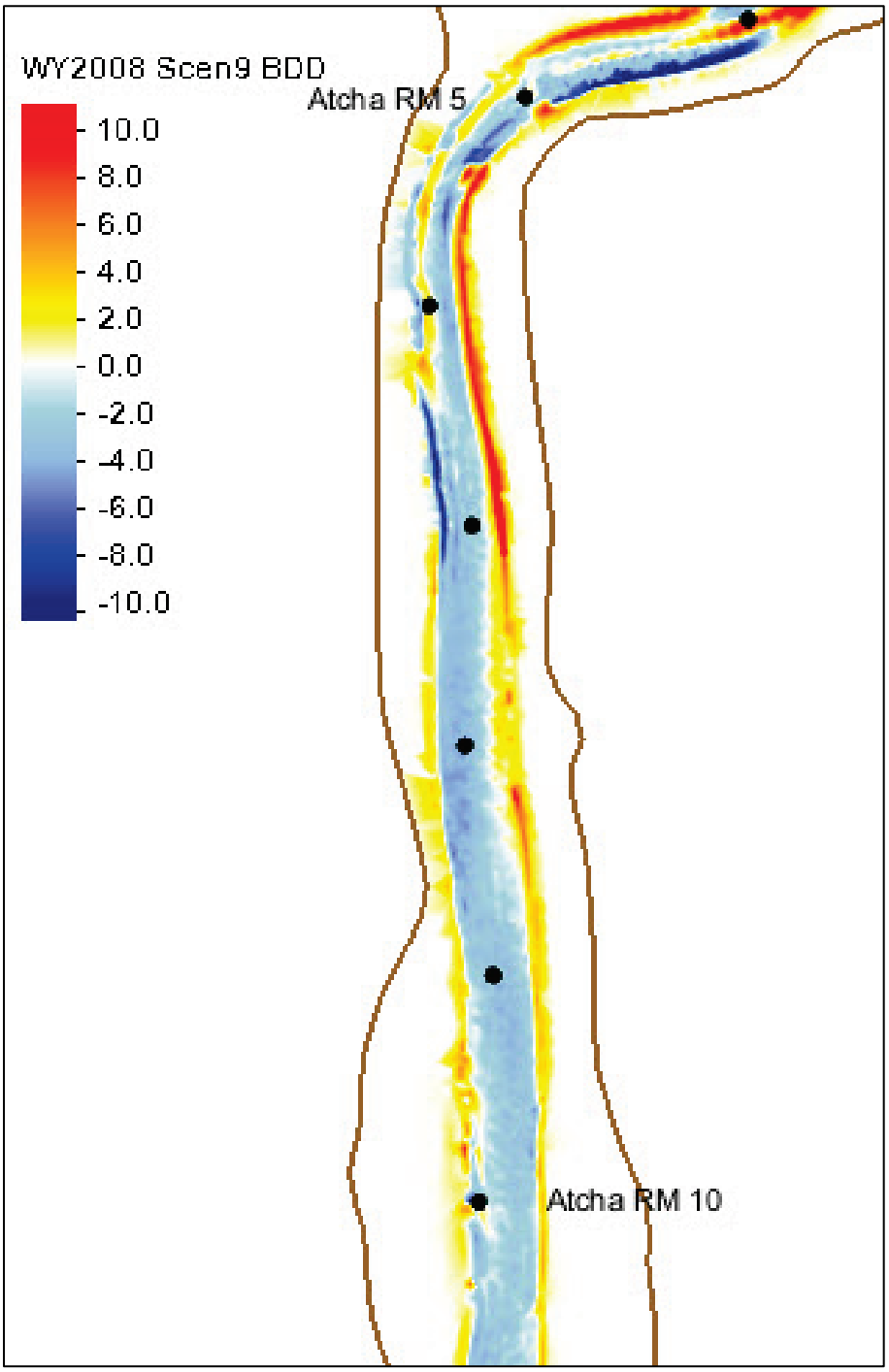


Plate A.82. WY2008 Scenario 9 BDD Atcha RM 10–Atcha RM 15.

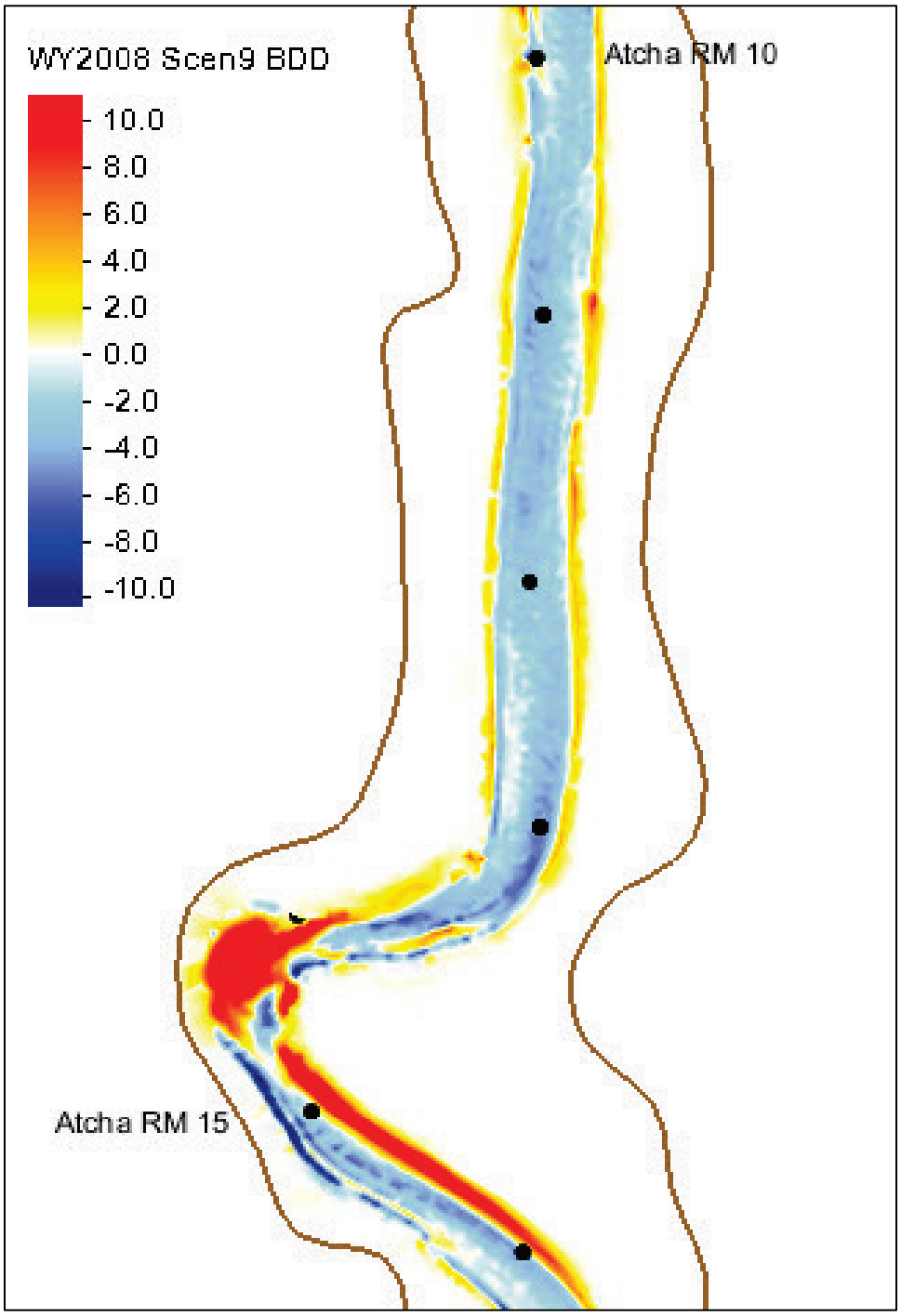


Plate A.83. WY2008 Scenario 9 BDD Atcha RM 15–Atcha RM 20.

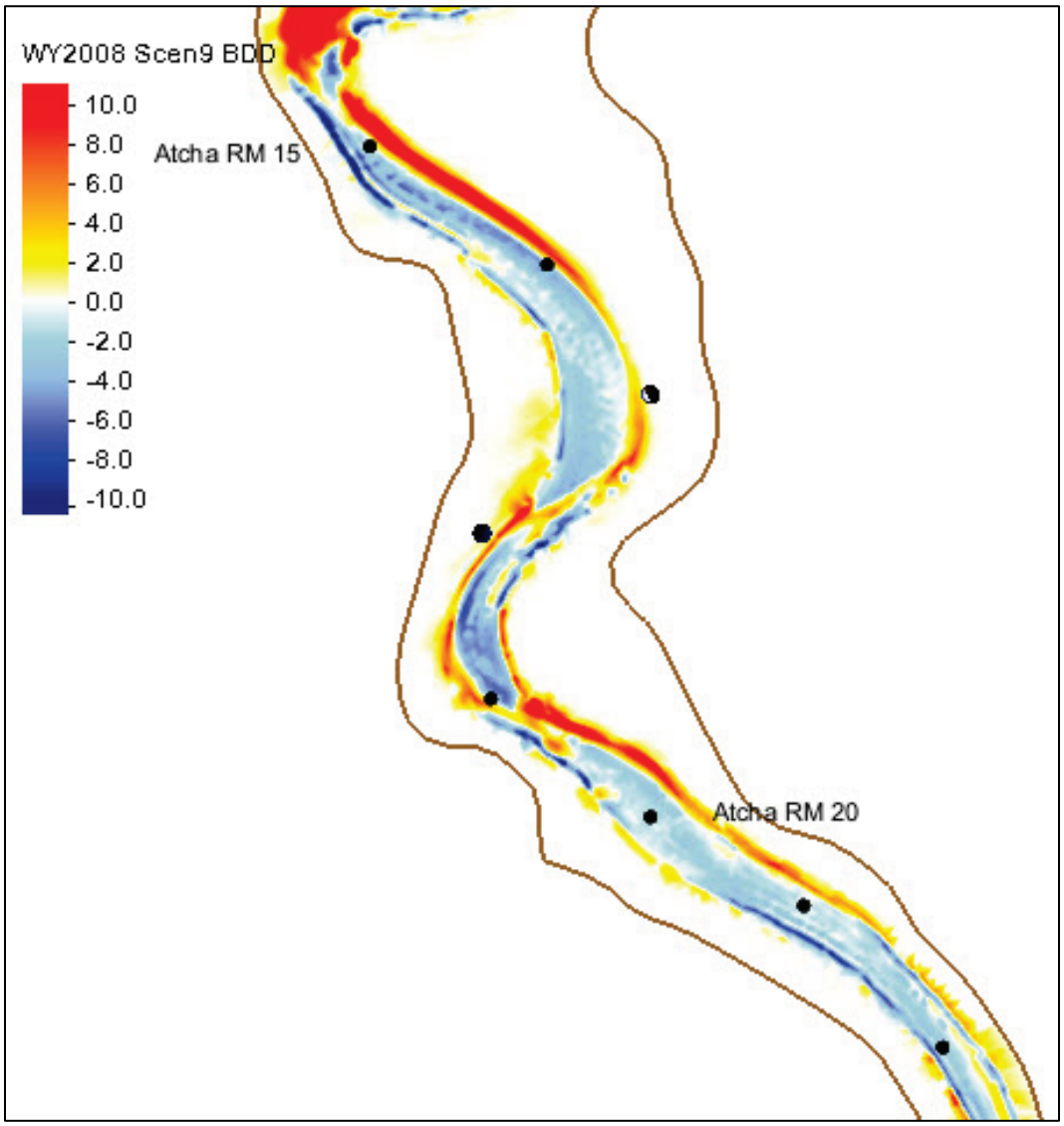


Plate A.84. WY2008 Scenario 9 BDD Atcha RM 20–Atcha RM 25.

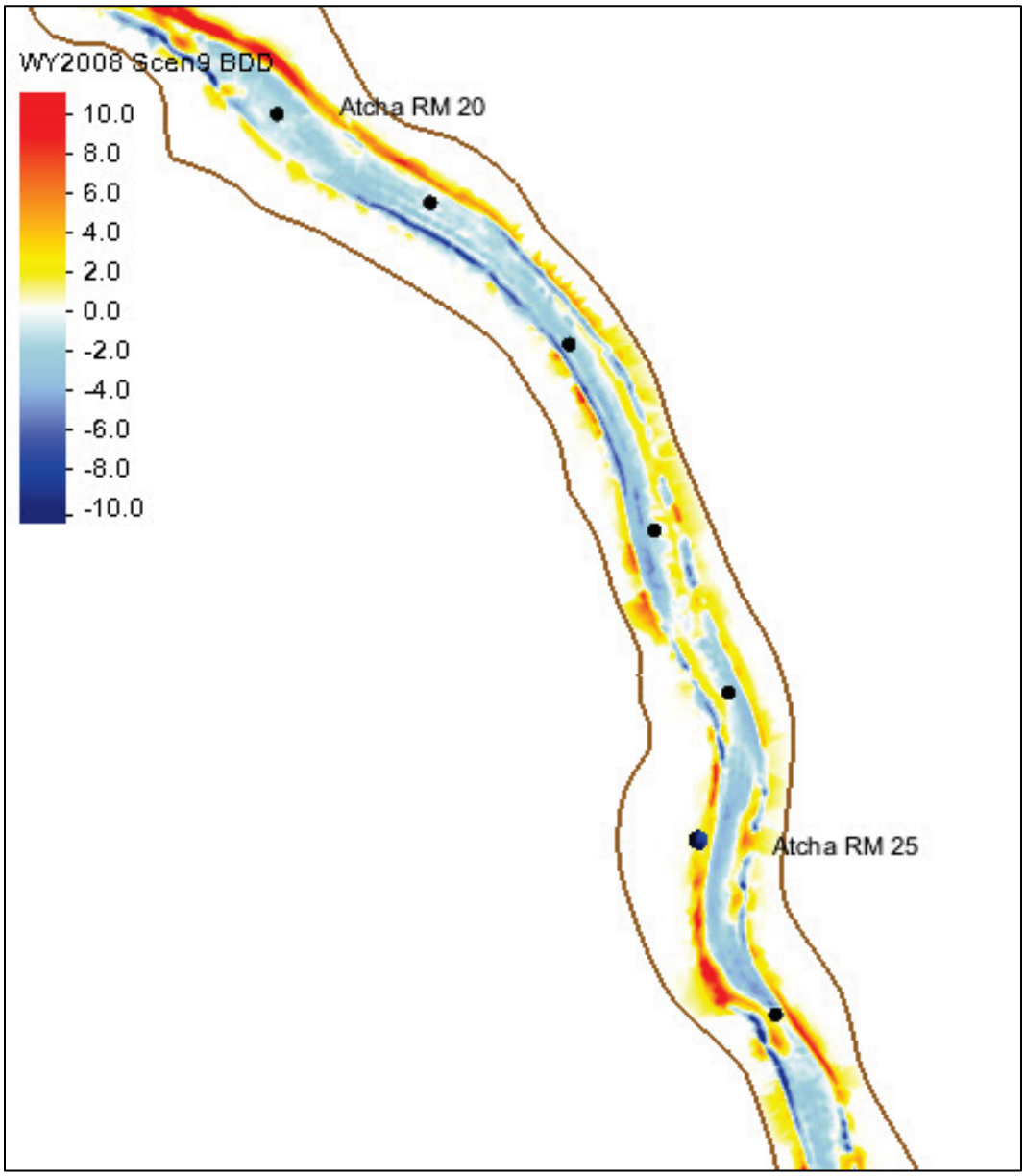
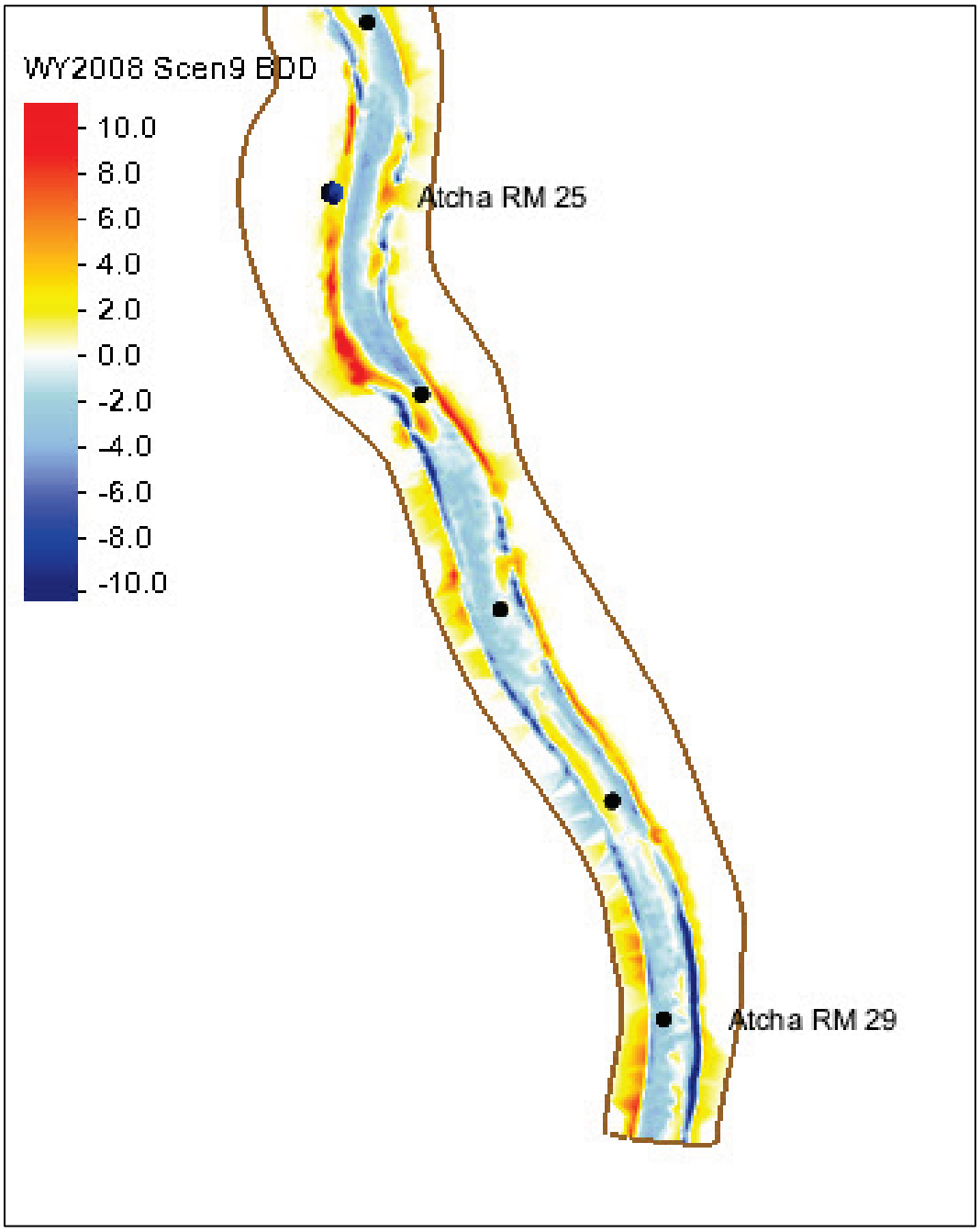


Plate A.85. WY2008 Scenario 9 BDD Atcha RM 25–Atcha RM 29.



A.10 Scenario 10

Plate A.86. WY2008 Scenario 10 BDD RR RM 43–RR RM 30.

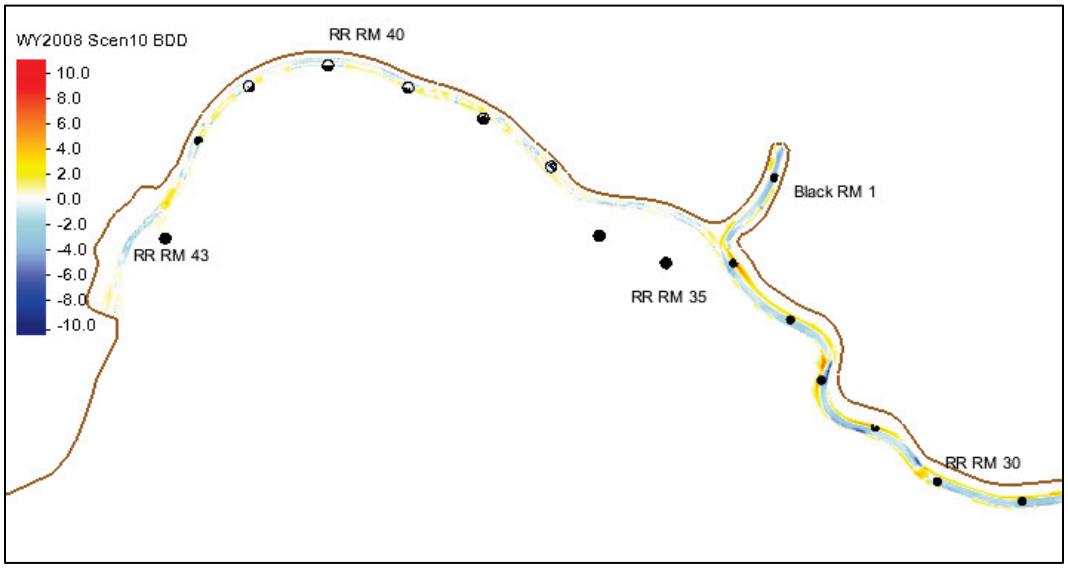


Plate A.87. WY2008 Scenario 10 BDD RR RM 30–RR RM 20.

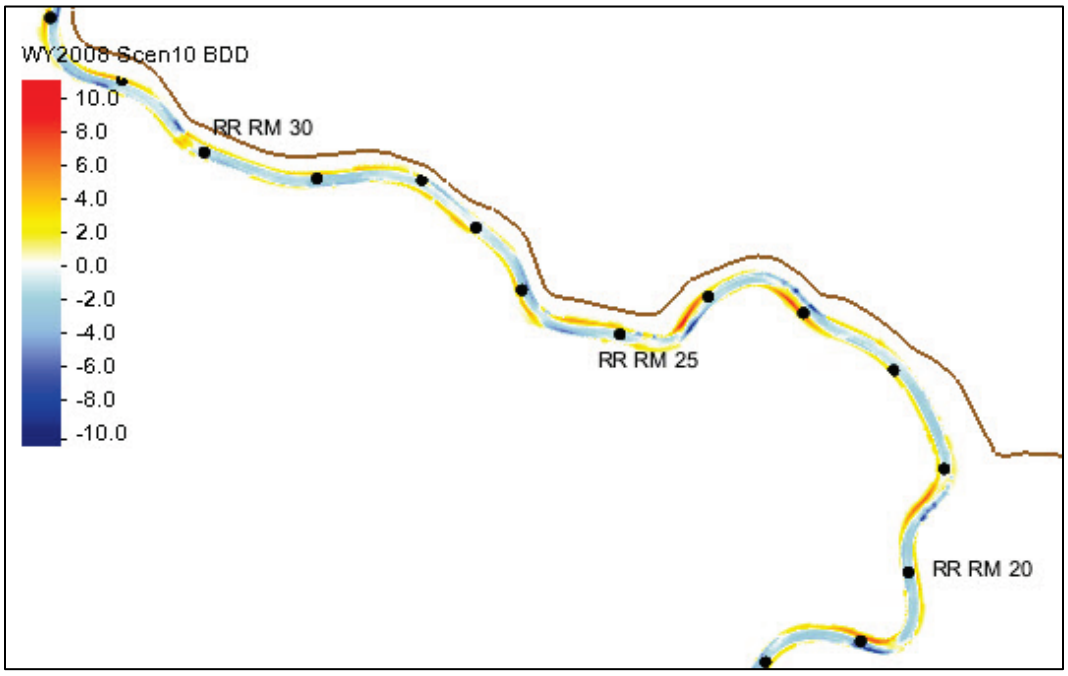


Plate A.88. WY2008 Scenario 10 BDD RR RM 20–RR RM 10.

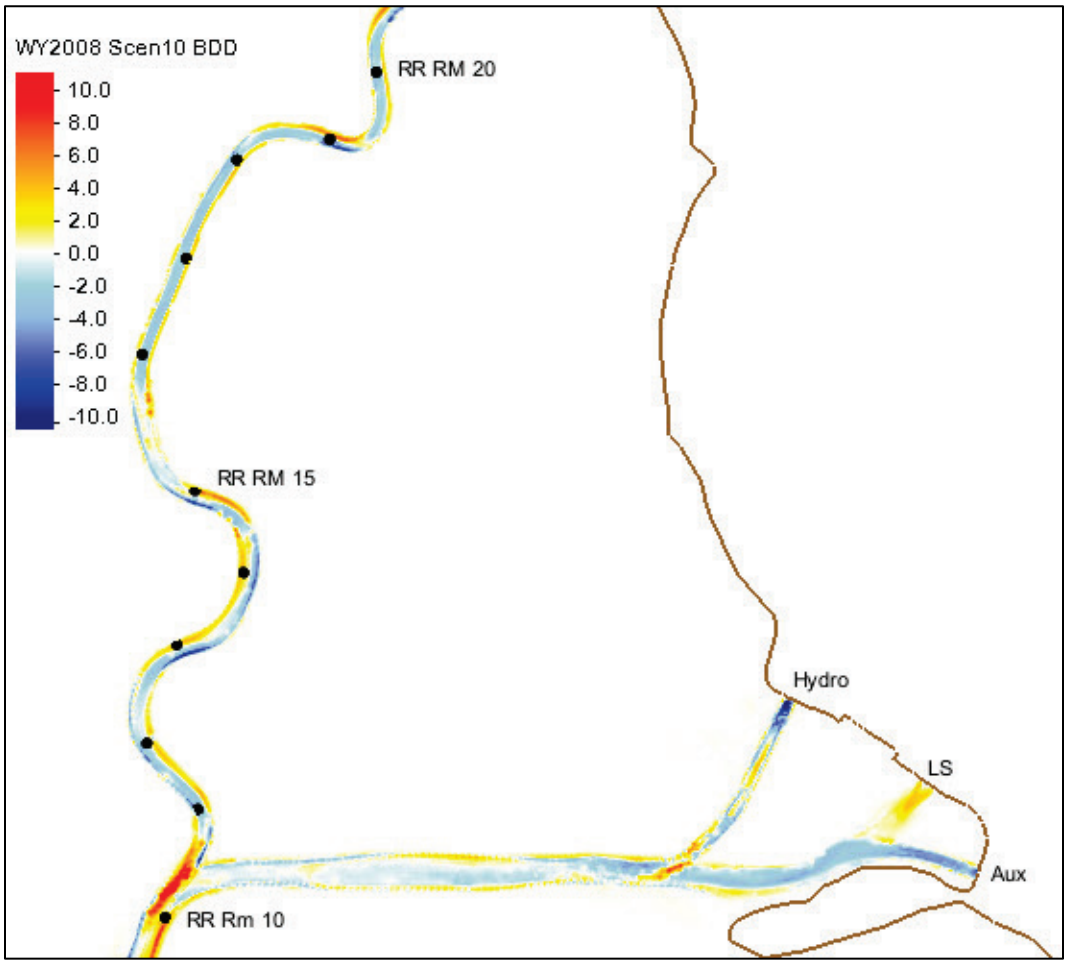


Plate A.89. WY2008 Scenario 10 BDD Outflow Channel.

Plate A.90. WY2008 Scenario 10 BDD RR RM 10–Atcha RM 5.

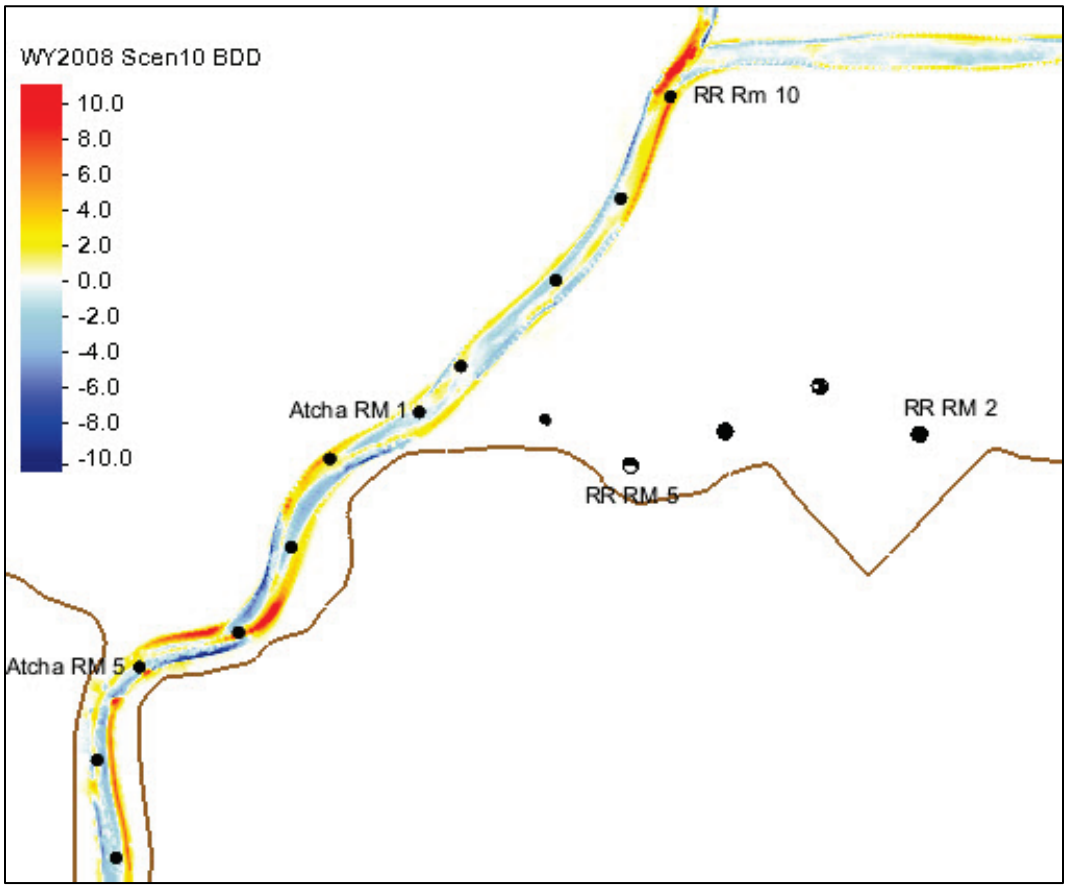


Plate A.91. WY2008 Scenario 10 BDD Atcha RM 5–Atcha RM 15.

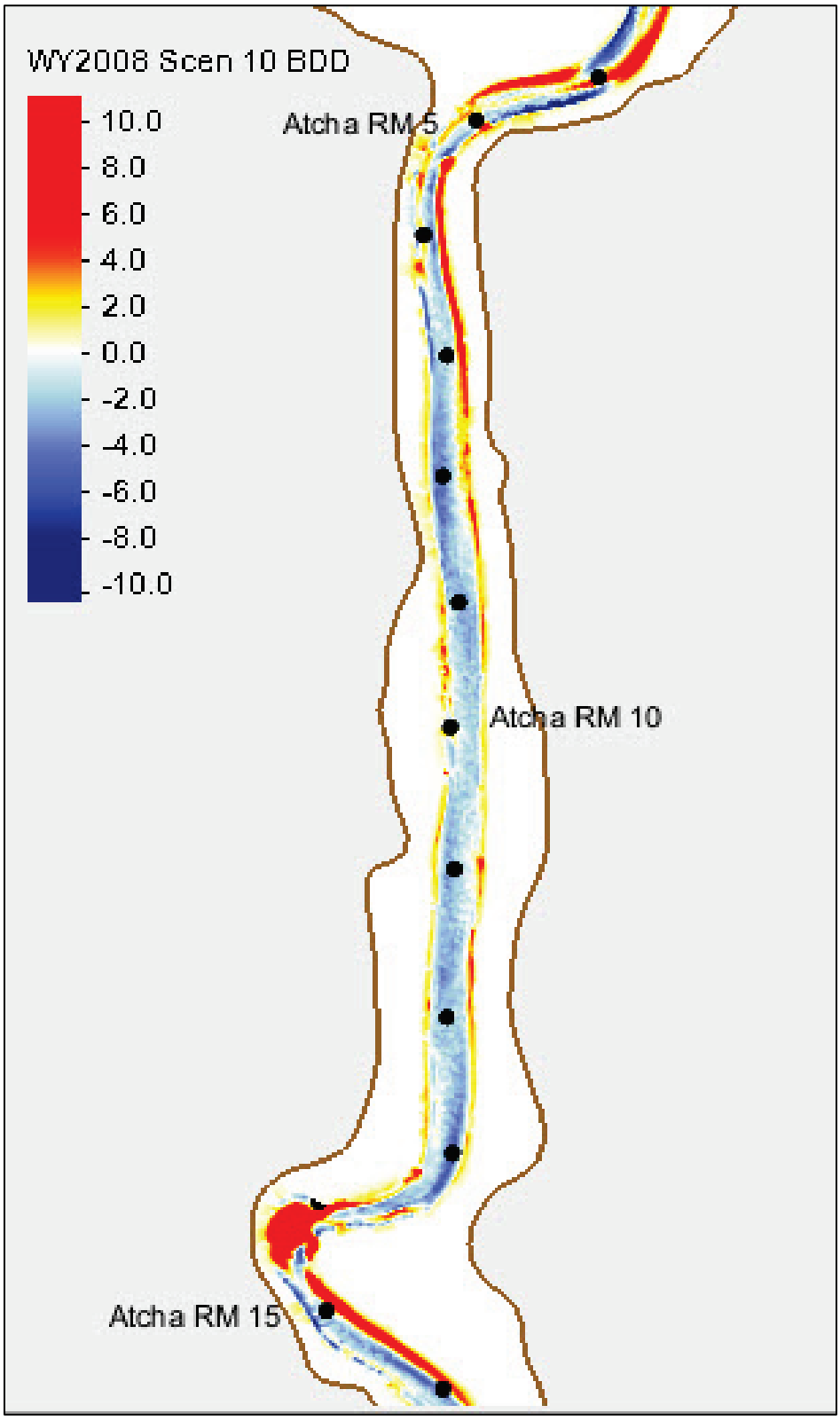
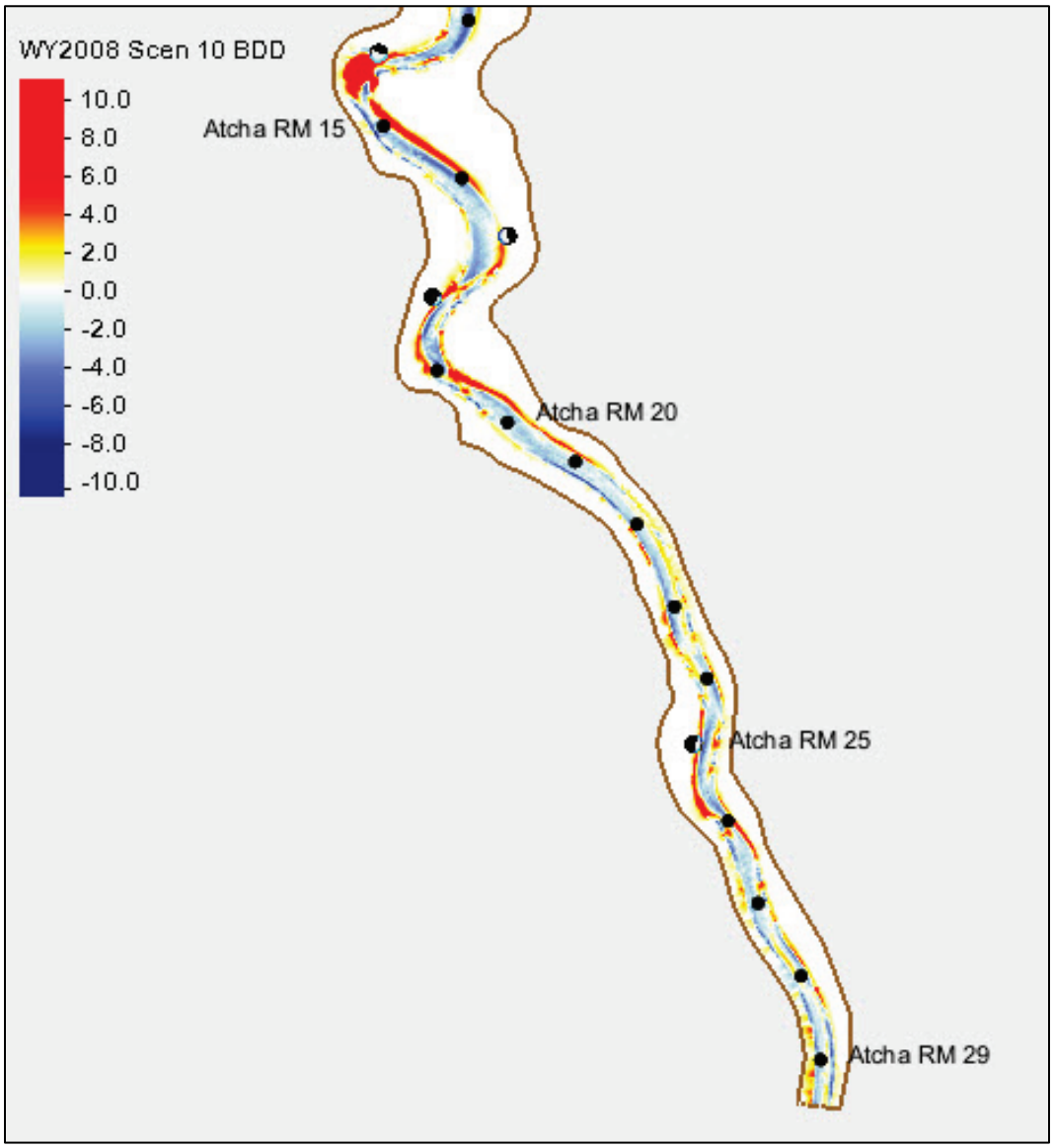


Plate A.92. WY2008 Scenario 10 BDD Atcha RM 15–Atcha RM 29.



A.11 Dredge Displacement Scenarios

A.11.1 Scenario 11

Plate A.93. WY2008 Scenario 11 BDD RR RM 43–RR RM 30.

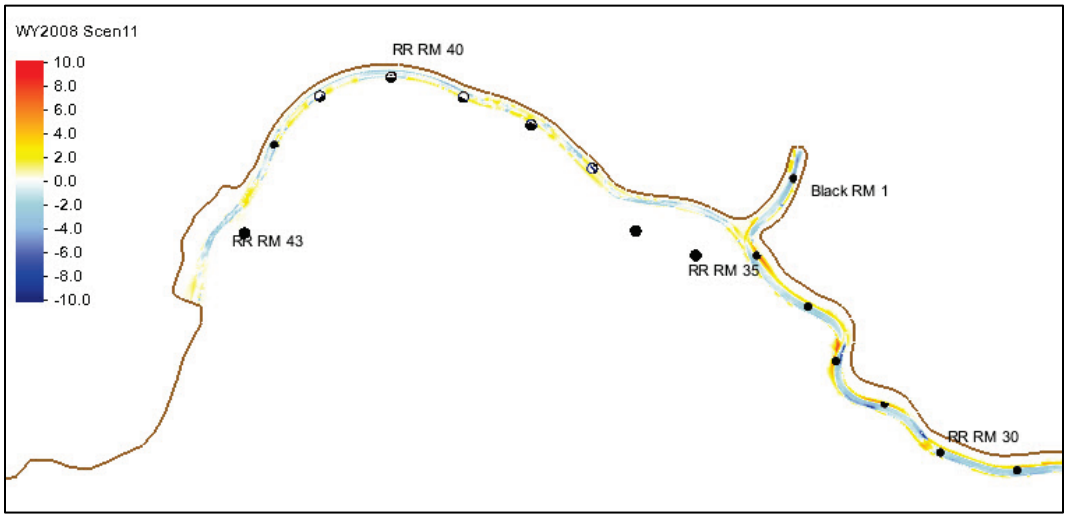


Plate A.94. WY2008 Scenario 11 BDD RR RM 30–RR RM 20.

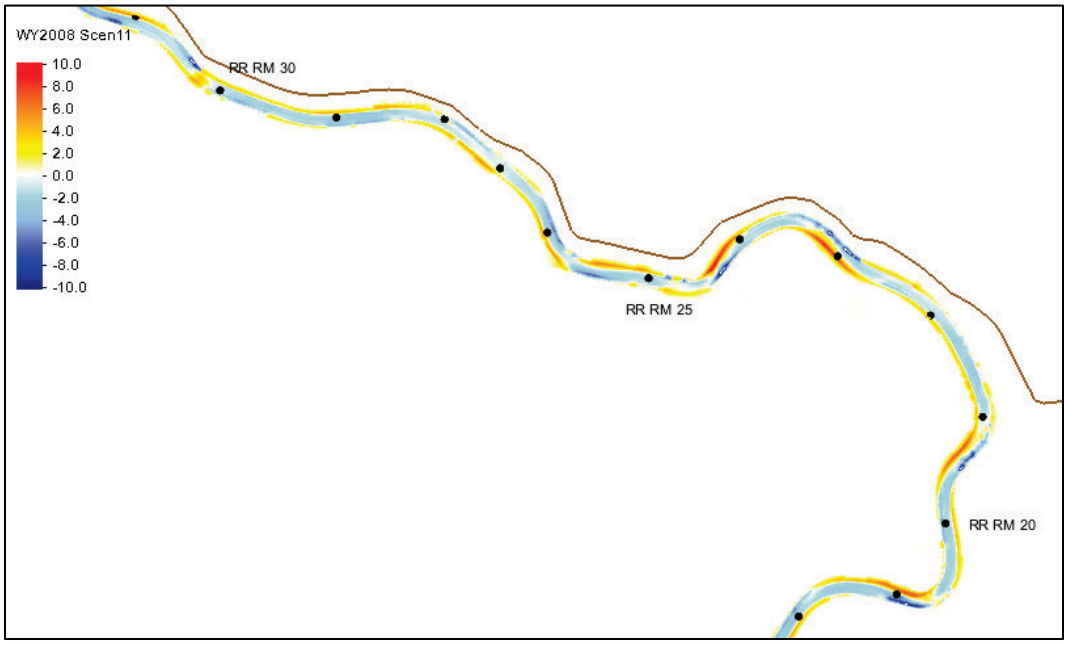


Plate A.95. WY2008 Scenario 11 BDD RR RM 20–RR RM 10.

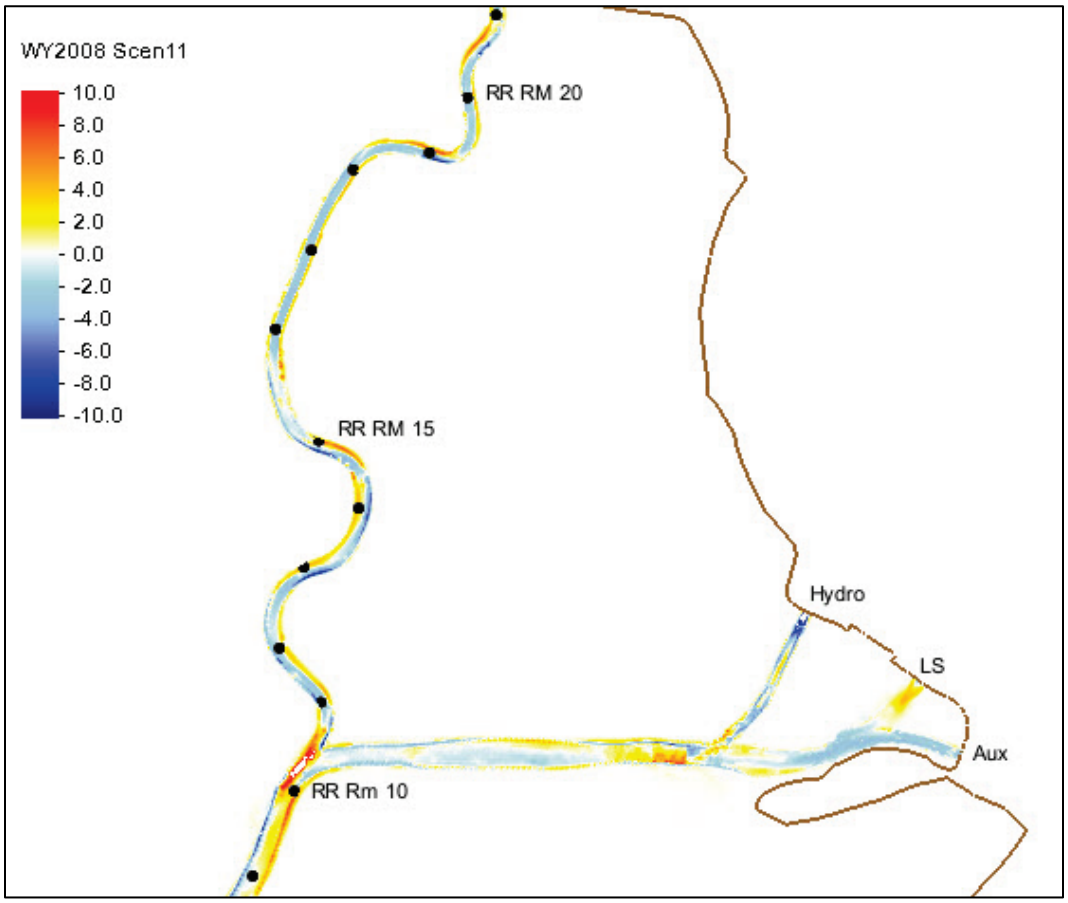


Plate A.96. WY2008 Scenario 11 BDD Outflow Channel.

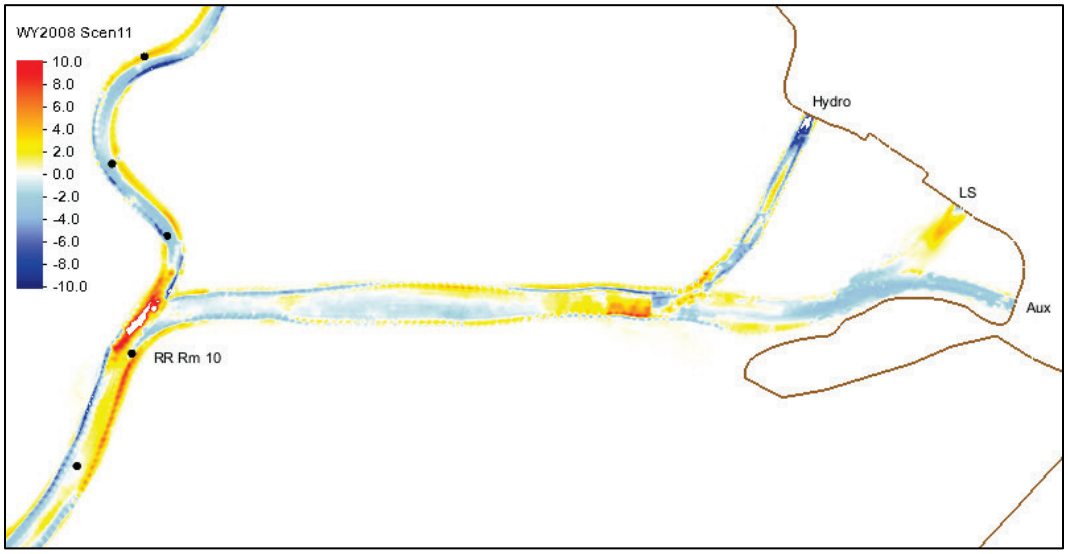


Plate A.97. WY2008 Scenario 11 BDD RR RM 10–Atcha RM 5.

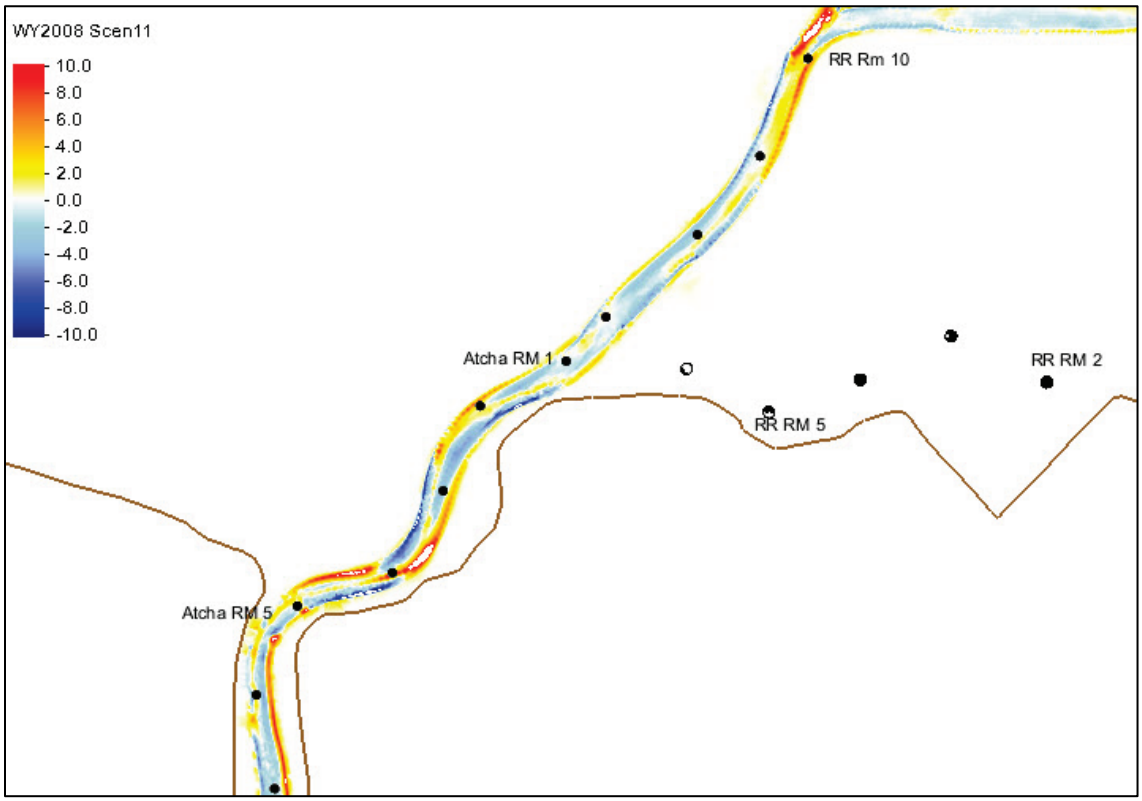


Plate A.98. WY2008 Scenario 11 BDD Atcha RM 5–Atcha RM 15.

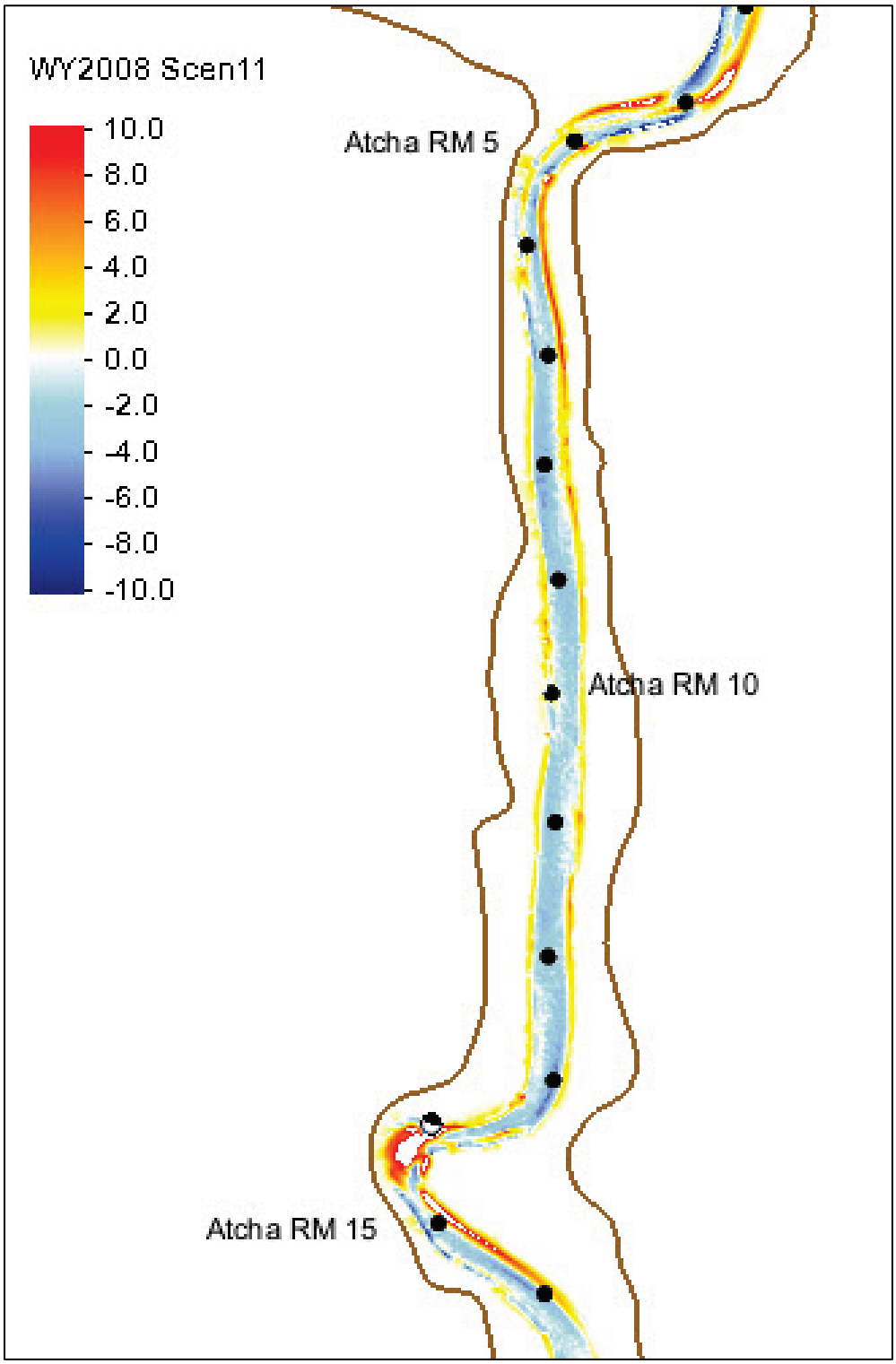
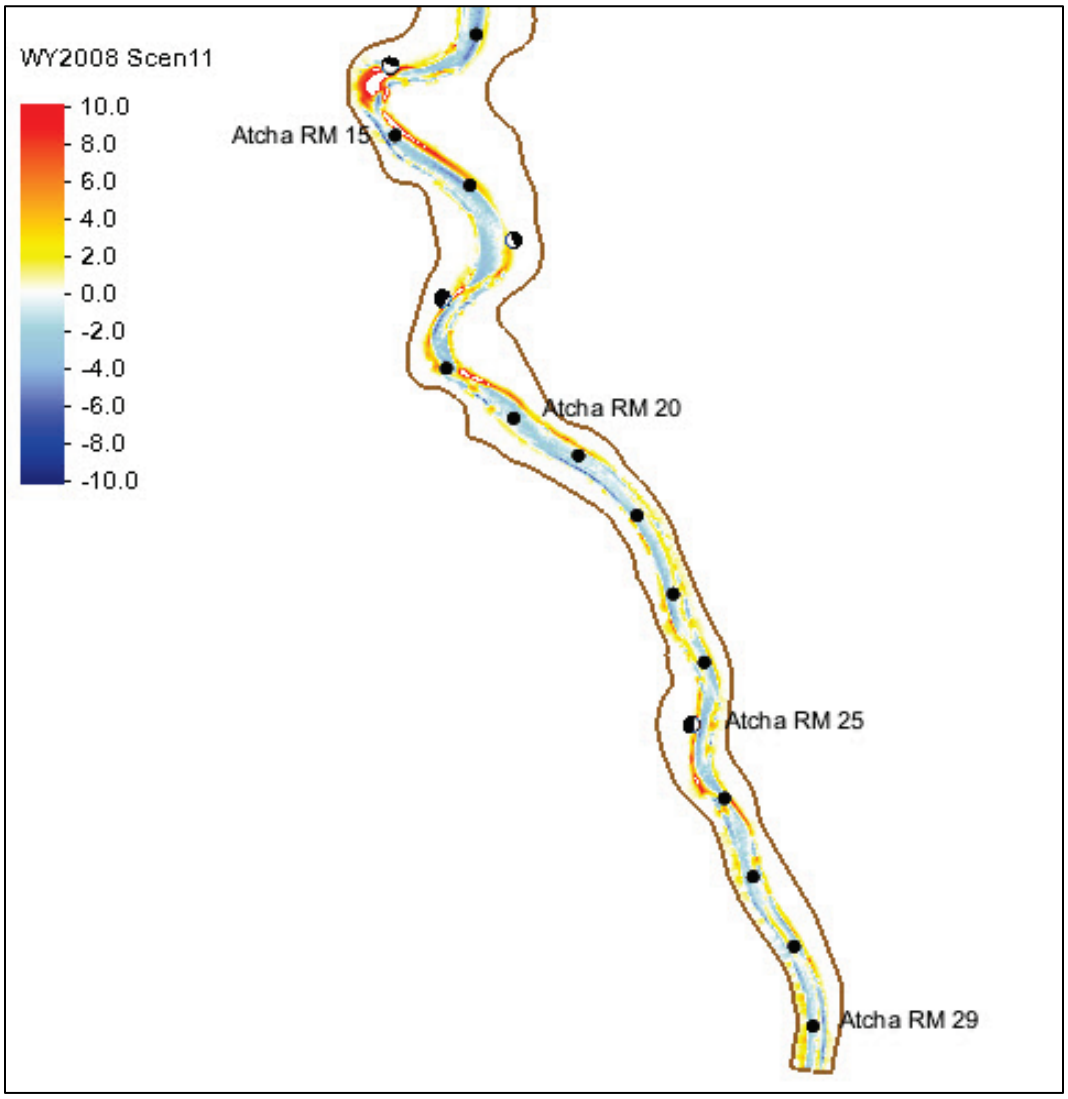


Plate A.99. WY2008 Scenario 11 BDD Atcha RM 15–Atcha RM 29.



A.11.2 Scenario 12

Plate A.100. WY2008 Scenario 12 BDD RR RM 43–RR RM 30.

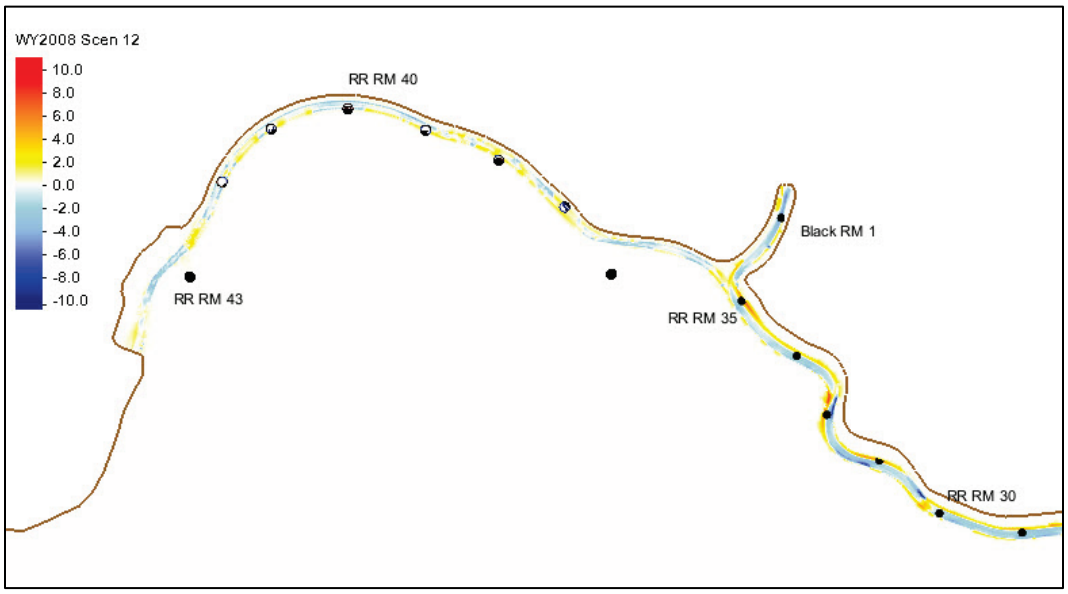


Plate A.101. WY2008 Scenario 12 BDD RR RM 30–RR RM 20.

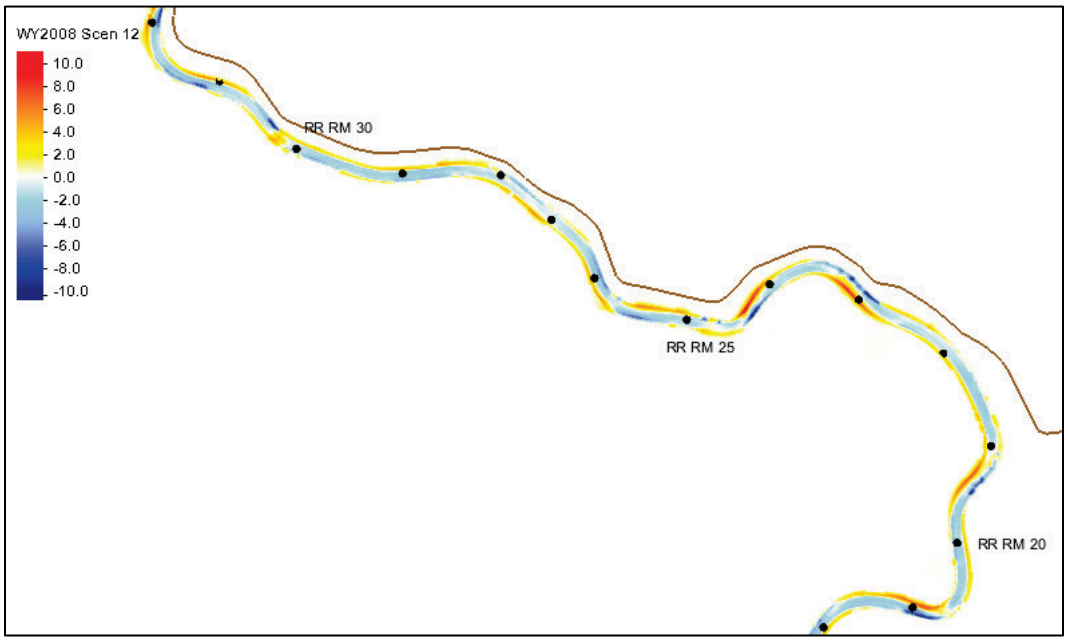


Plate A.102. WY2008 Scenario 12 BDD RR RM 20–RR RM 10.

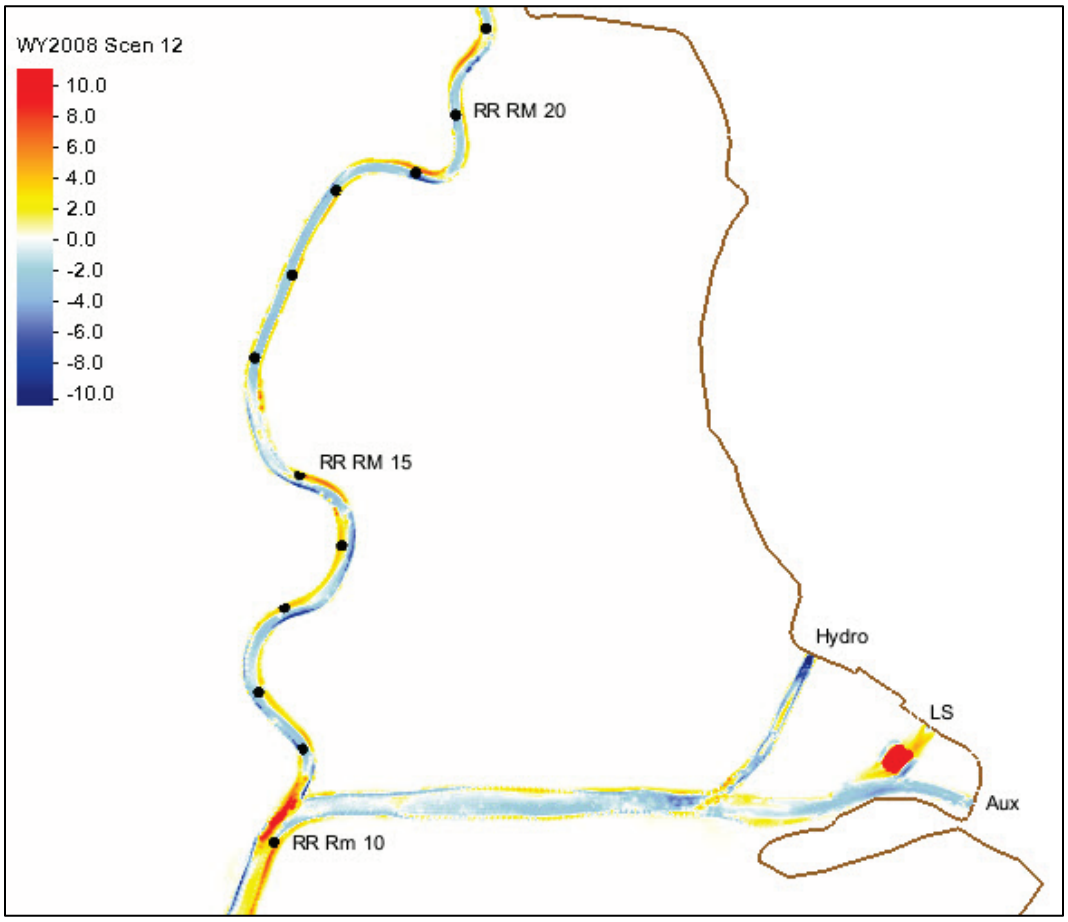


Plate A.103. WY2008 Scenario 12 BDD Outflow Channel.

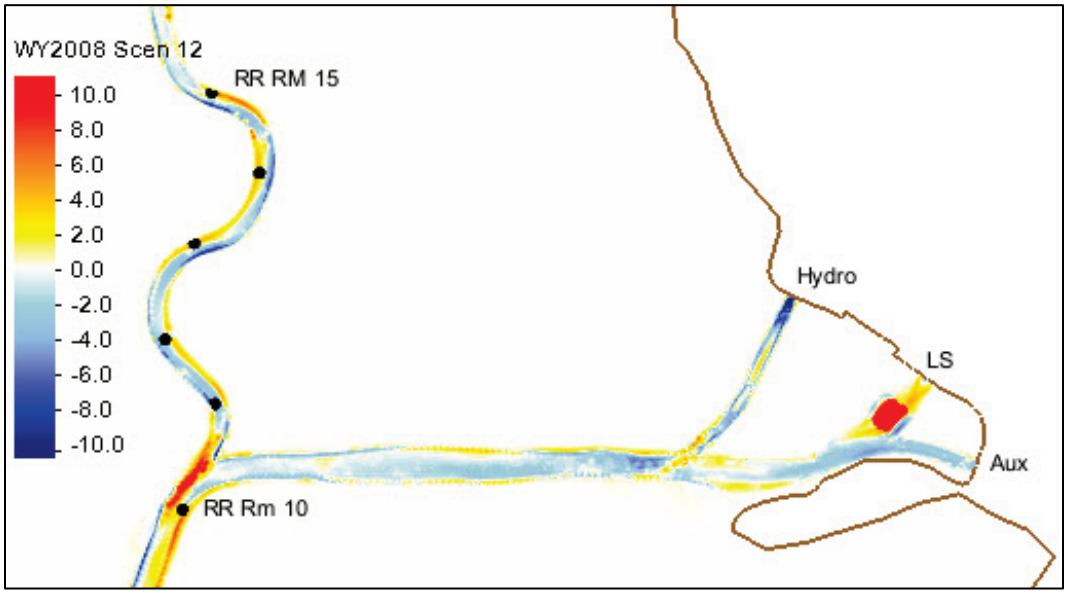


Plate A.104. WY2008 Scenario 12 BDD RR RM 10–Atcha RM 5.

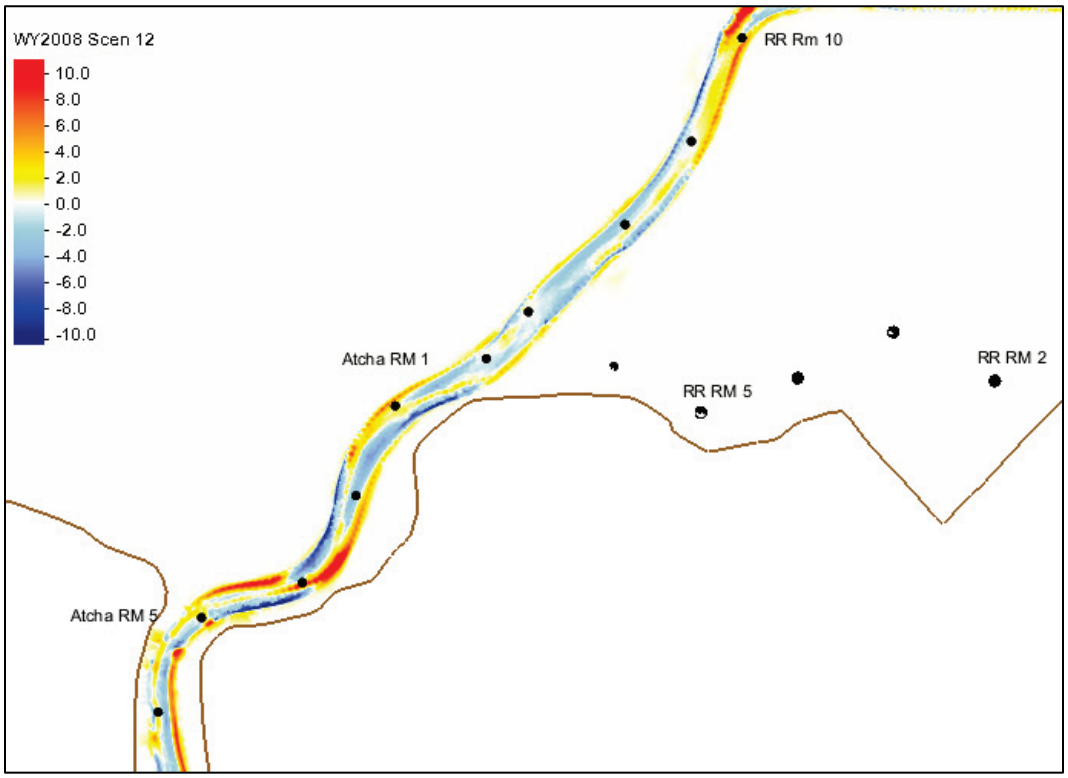


Plate A.105. WY2008 Scenario 12 BDD Atcha RM 5–Atcha RM 15.

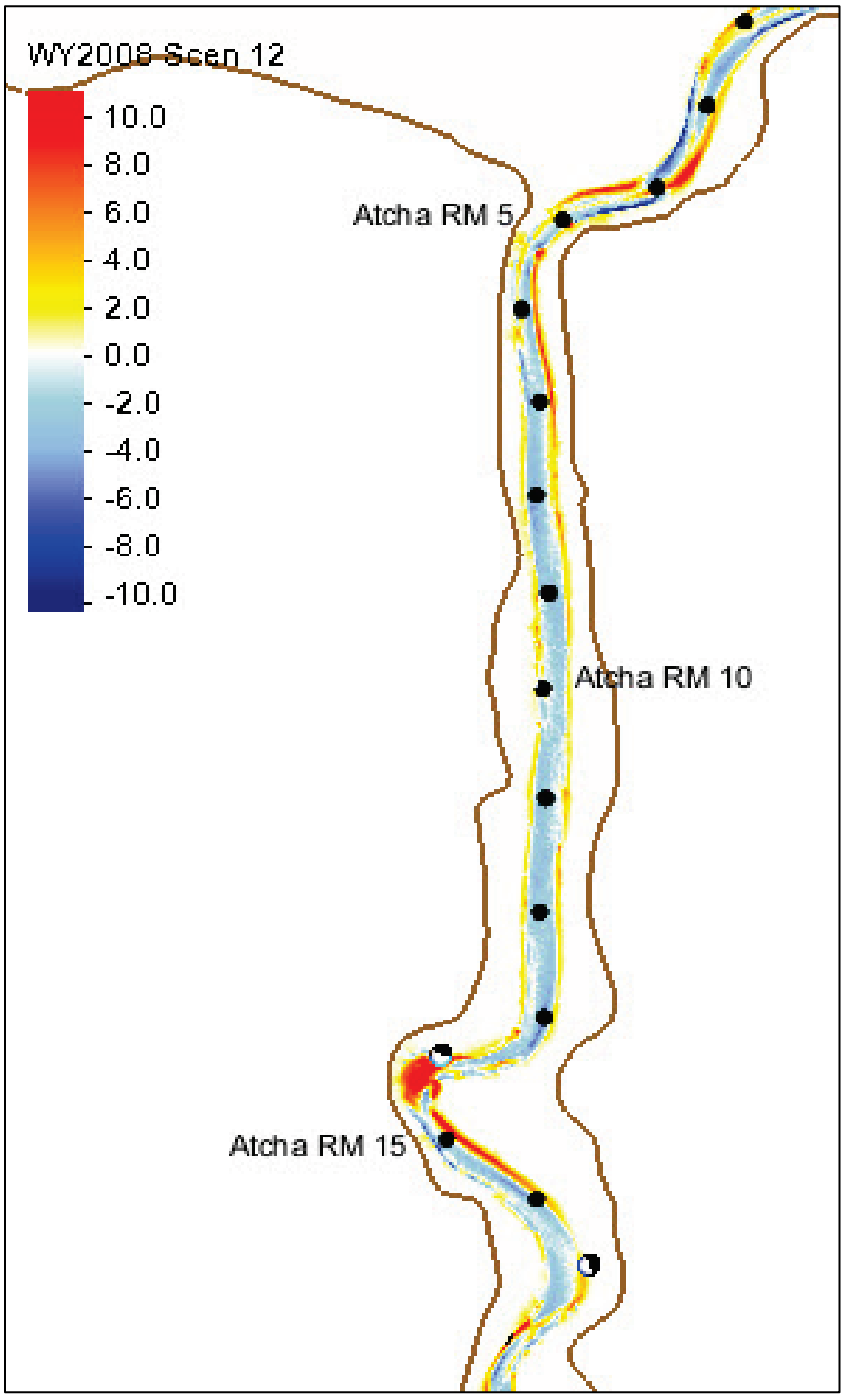
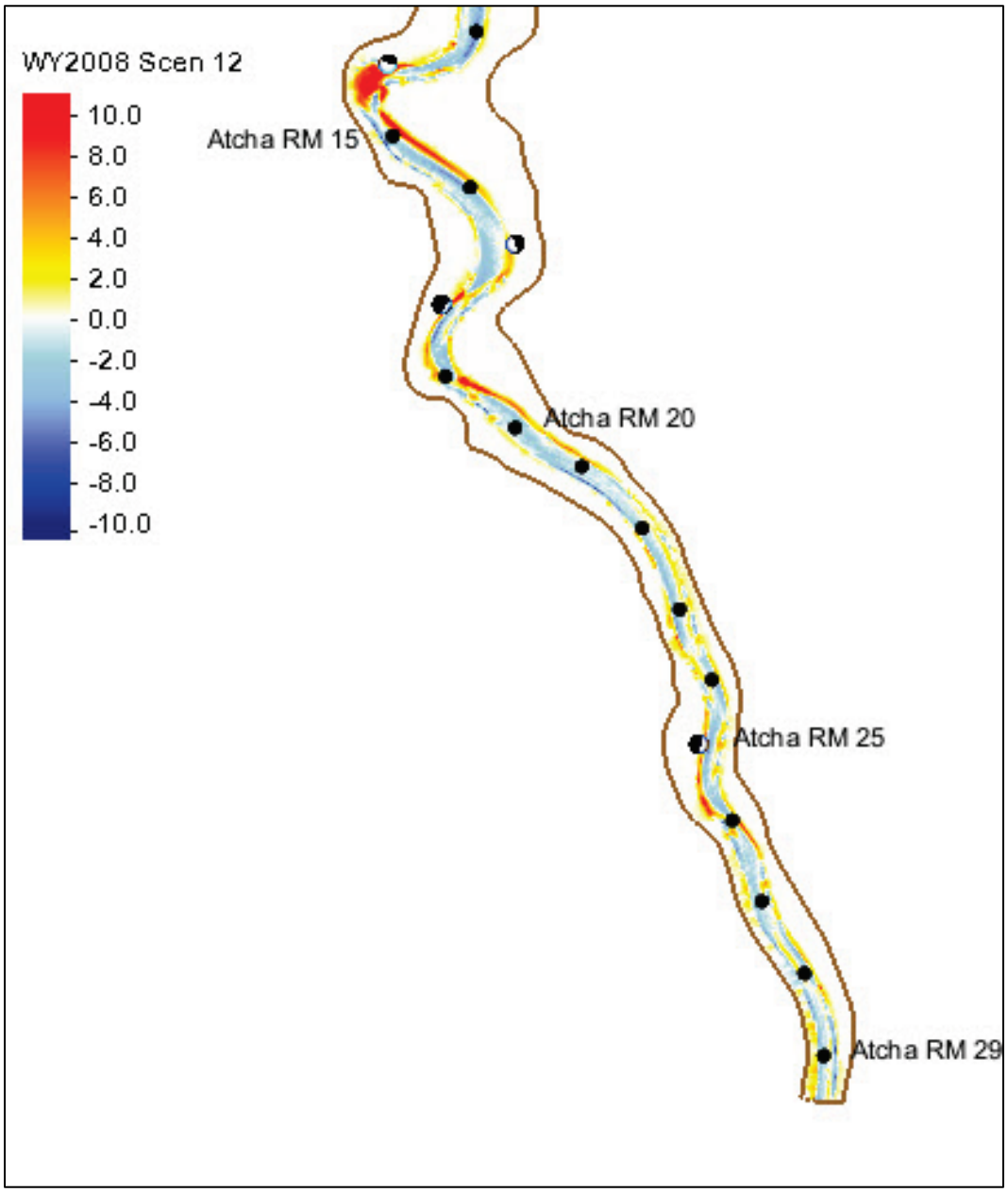


Plate A.106. WY2008 Scenario 12 BDD Atcha RM 15–Atcha RM 29.



A.11.3 Scenario 13

Plate A.107. WY2008 Scenario 13 BDD RR RM 43–RR RM 30.

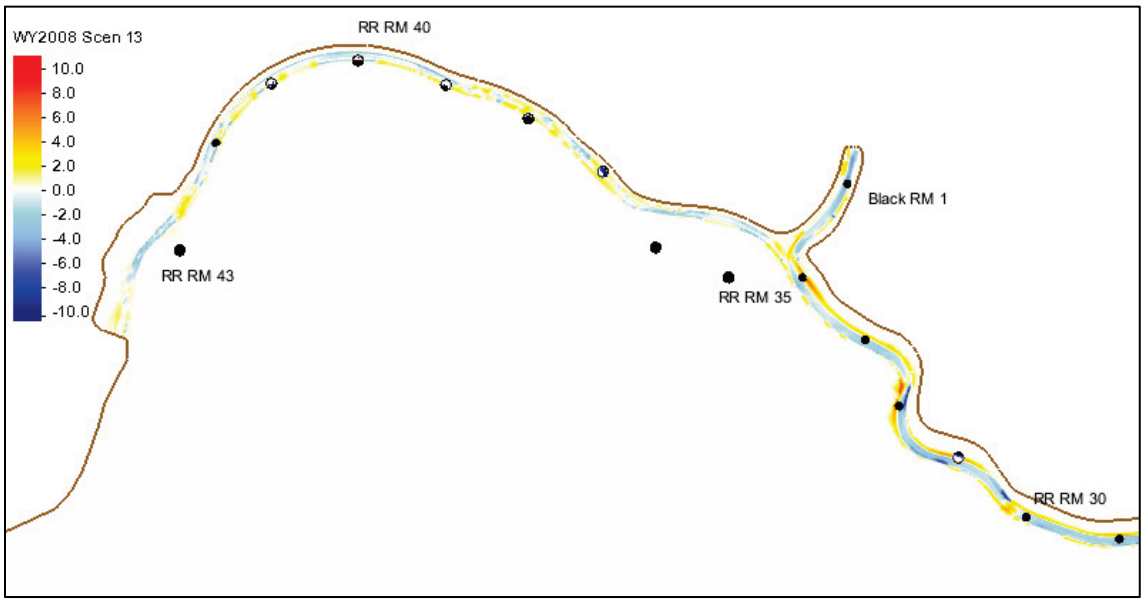


Plate A.108. WY2008 Scenario 13 BDD RR RM 30–RR RM 20.

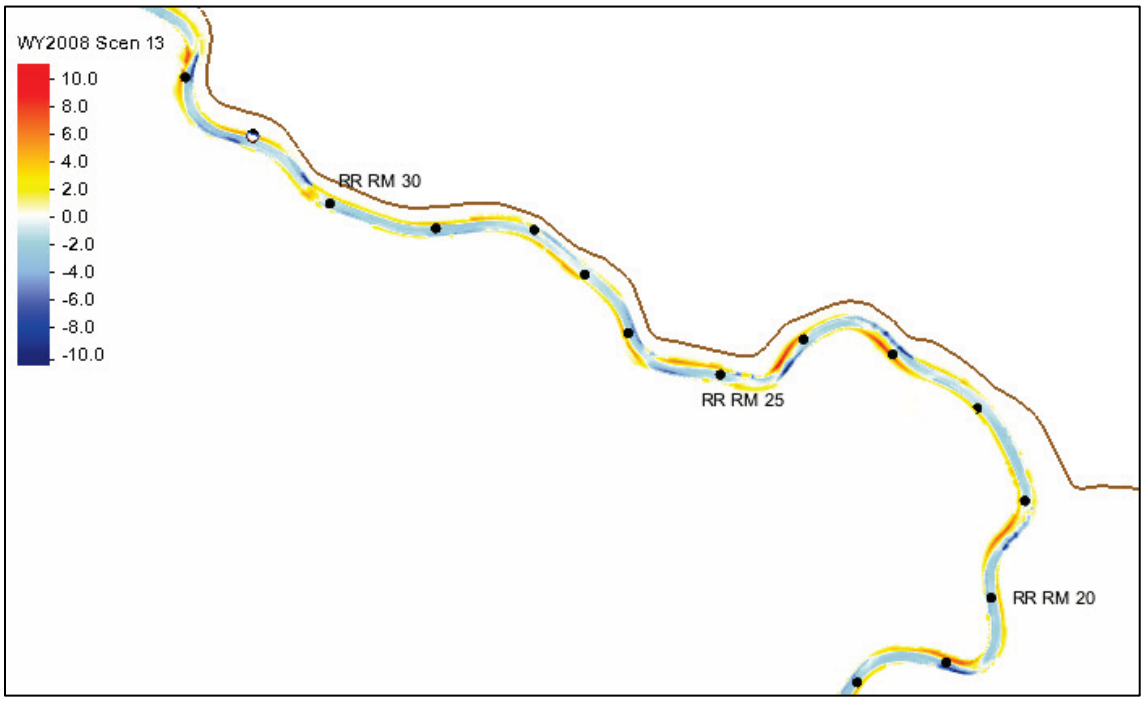


Plate A.109. WY2008 Scenario 13 BDD RR RM 20–RR RM 10.

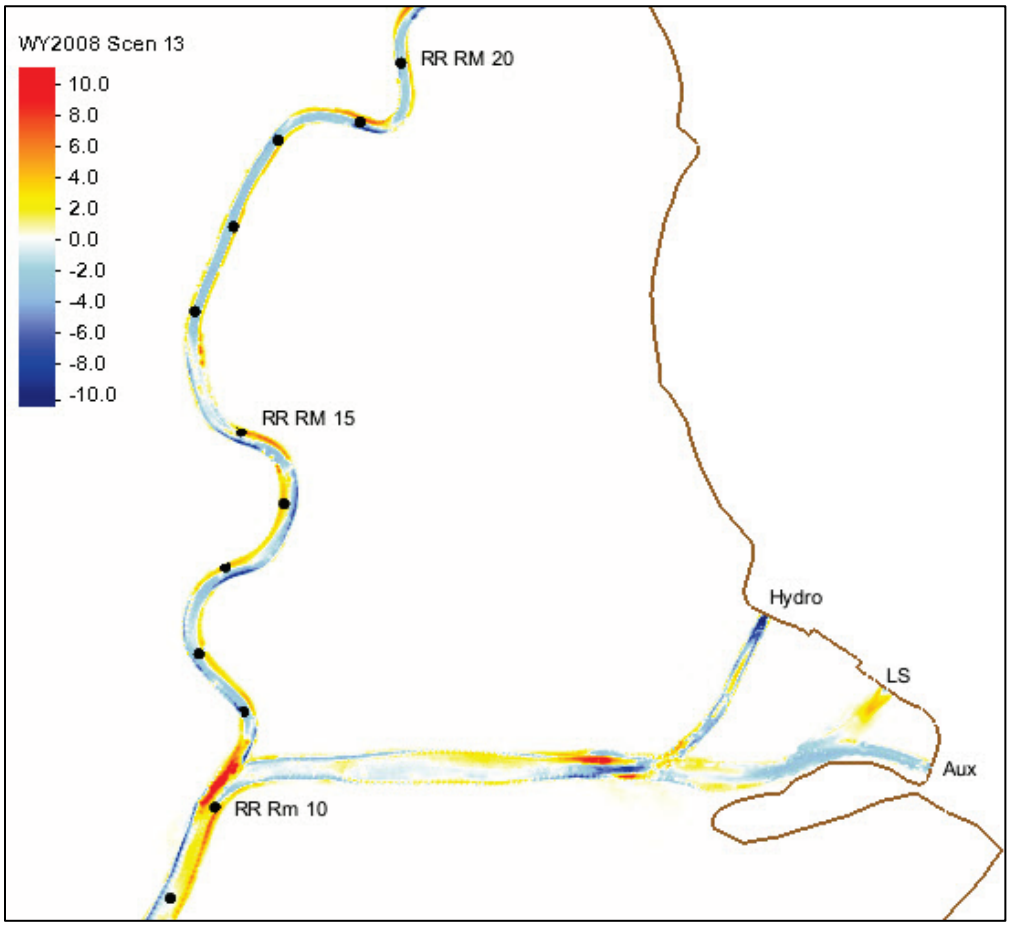


Plate A.110. WY2008 Scenario 13 Bed Displacement Outflow Channel.

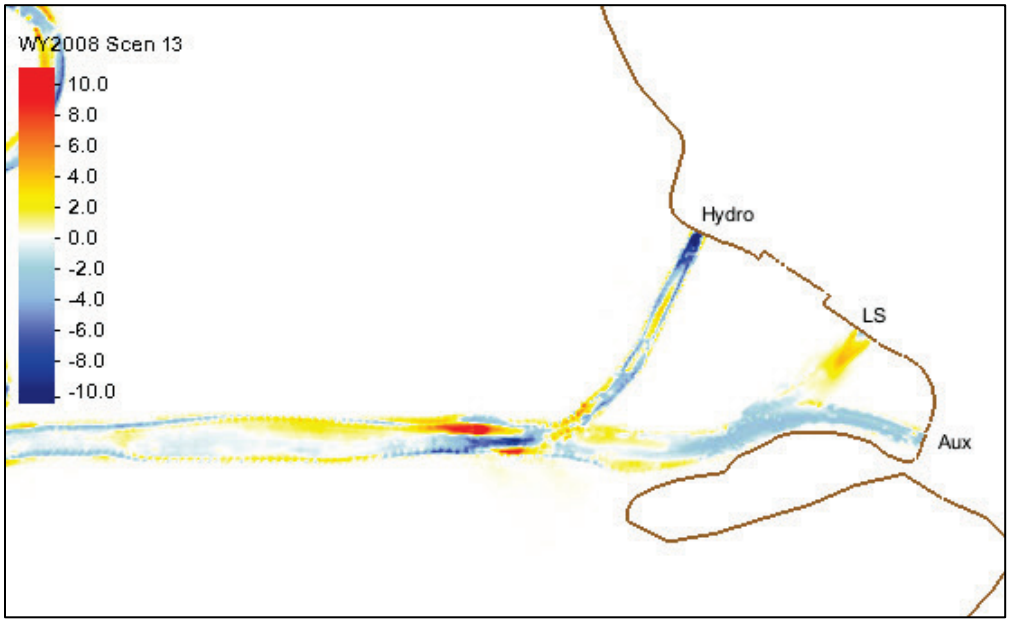


Plate A.111. WY2008 Scenario 13 BDD RR RM 10–Atcha RM 5.

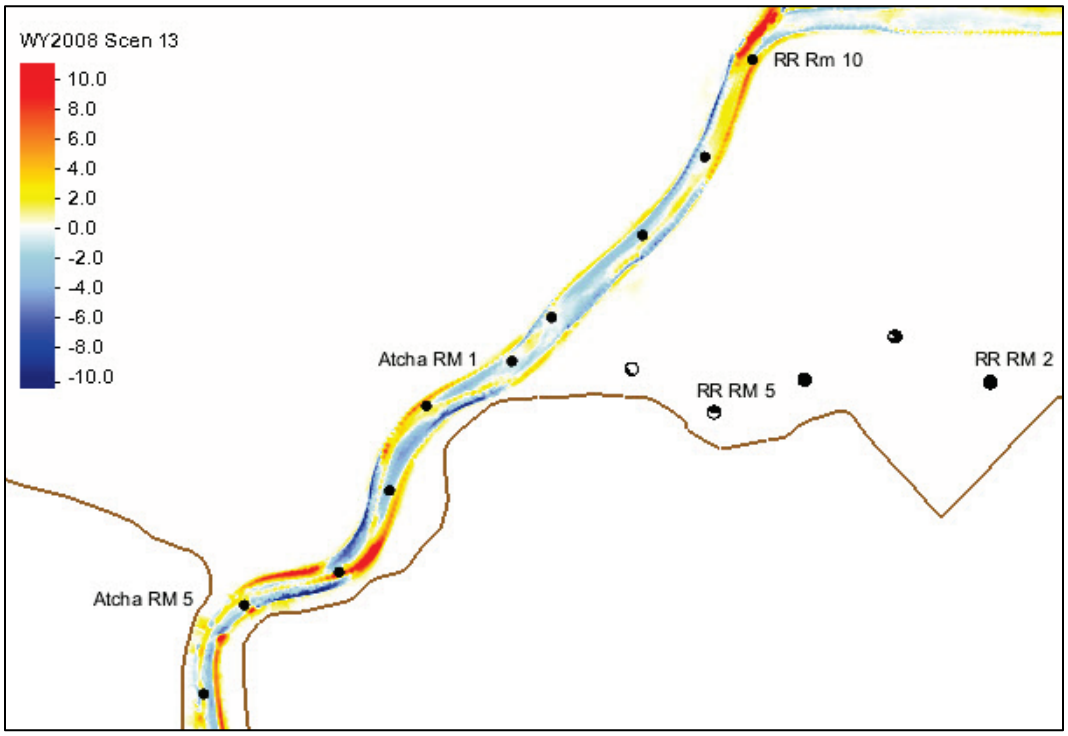


Plate A.112. WY2008 Scenario 13 BDD Atcha RM 5–Atcha RM 15.

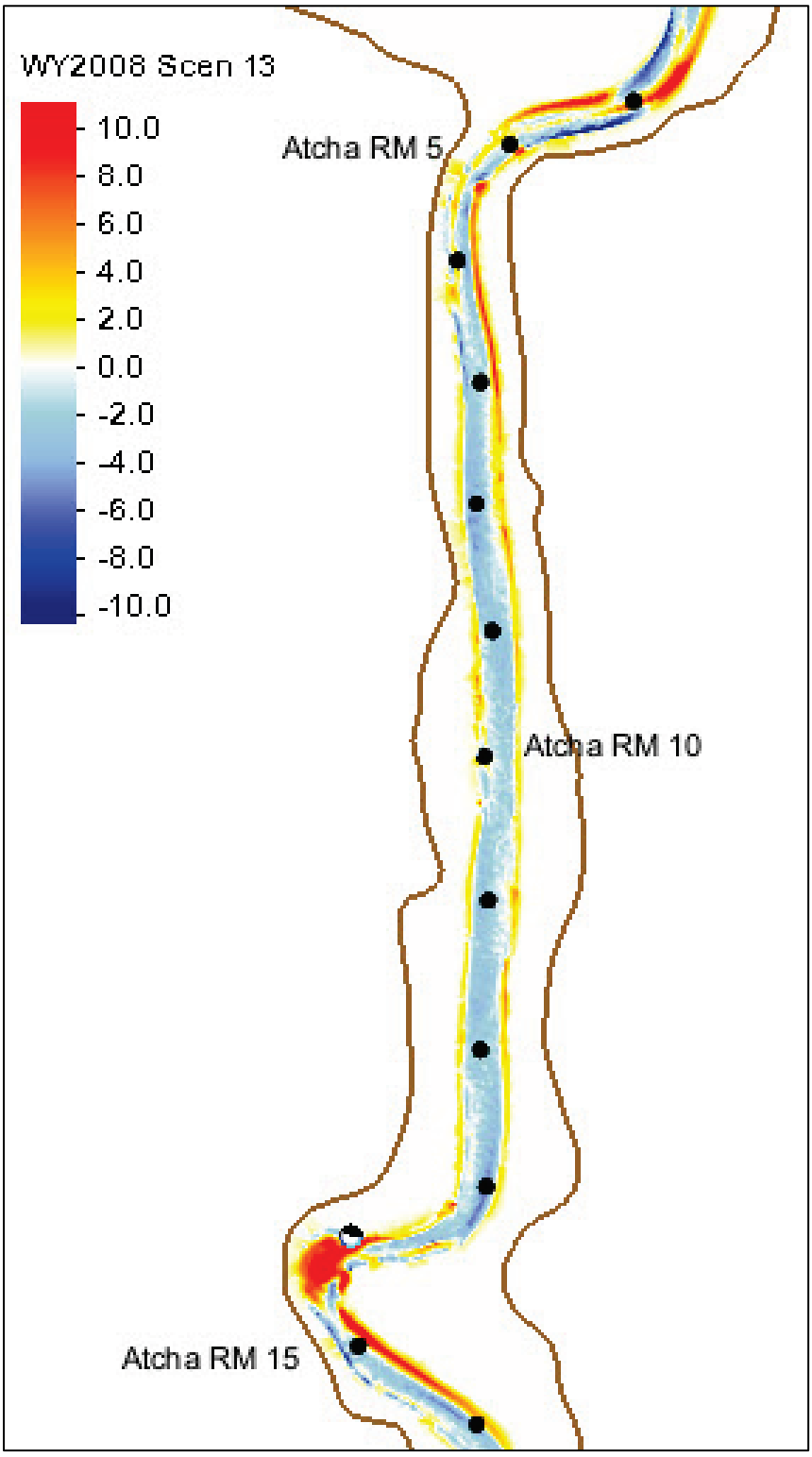
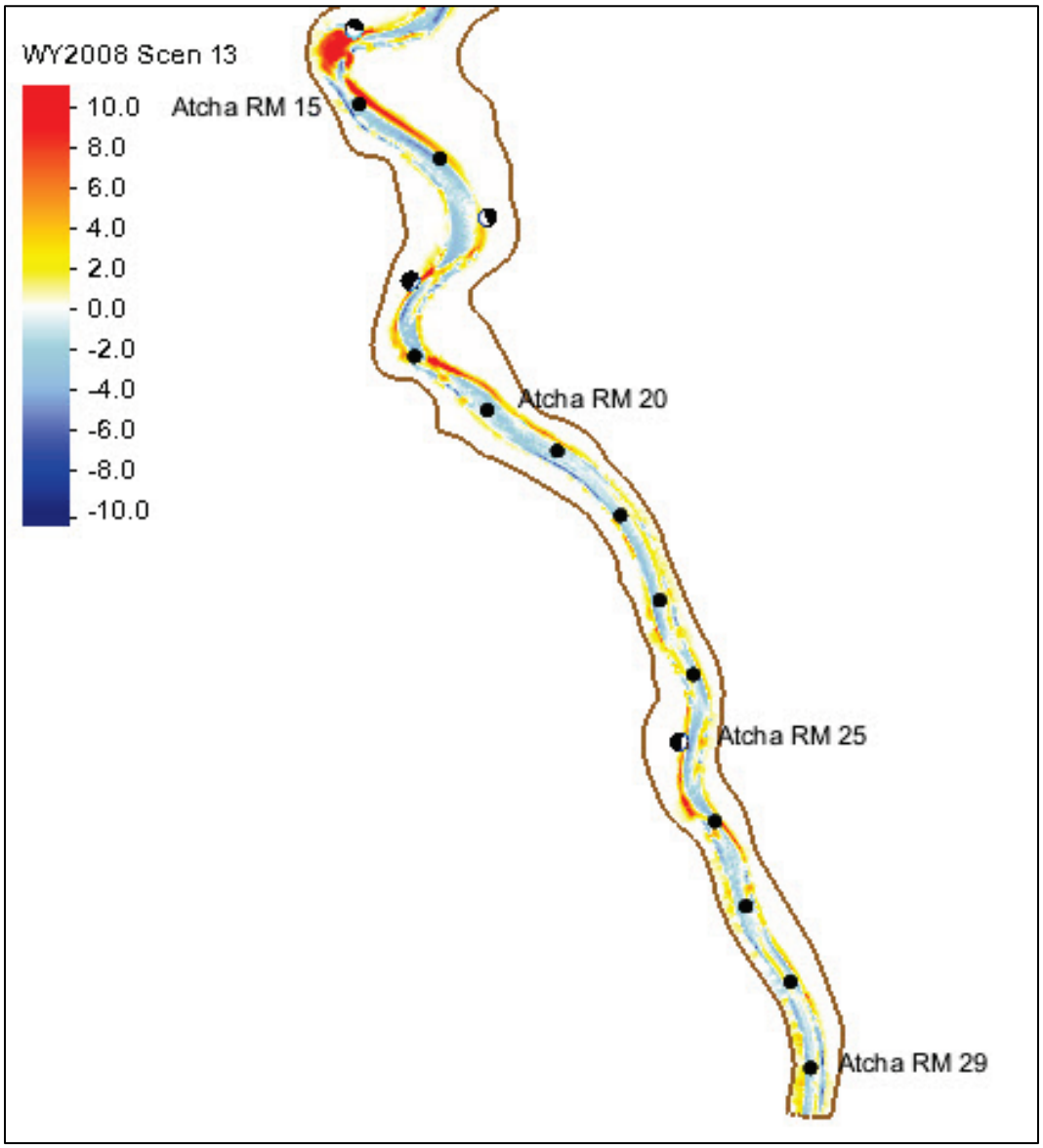


Plate A.113. WY2008 Scenario 13 BDD Atcha RM 15–Atcha RM 29.



A.11.4 Scenario 14

Plate A.114. WY2008 Scenario 14 BDD RR RM 43–RR RM 30.

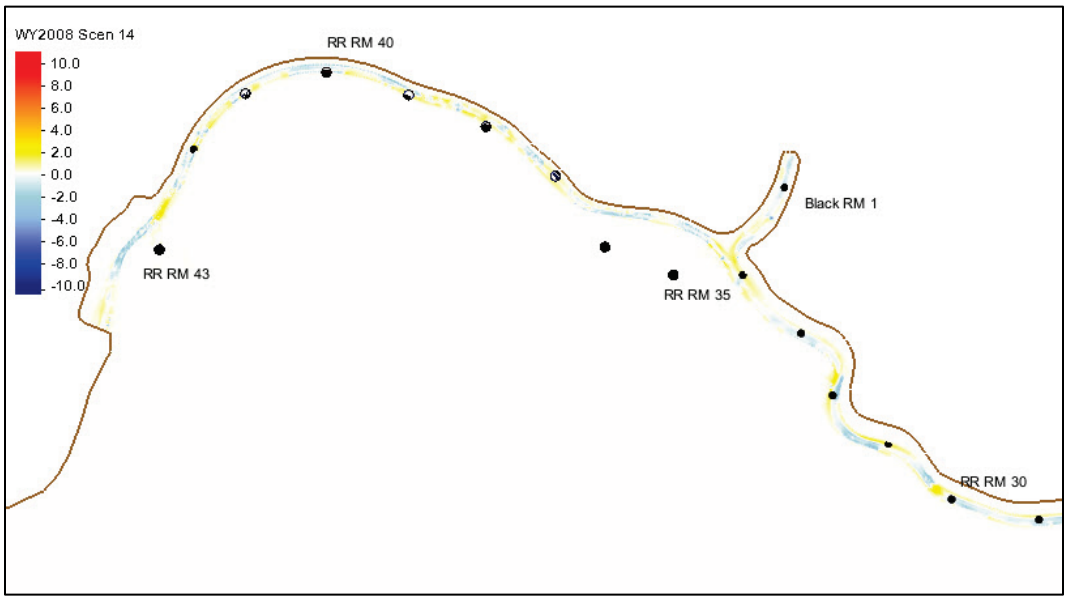


Plate A.115. WY2008 Scenario 14 BDD RR RM 30–RR RM 20.

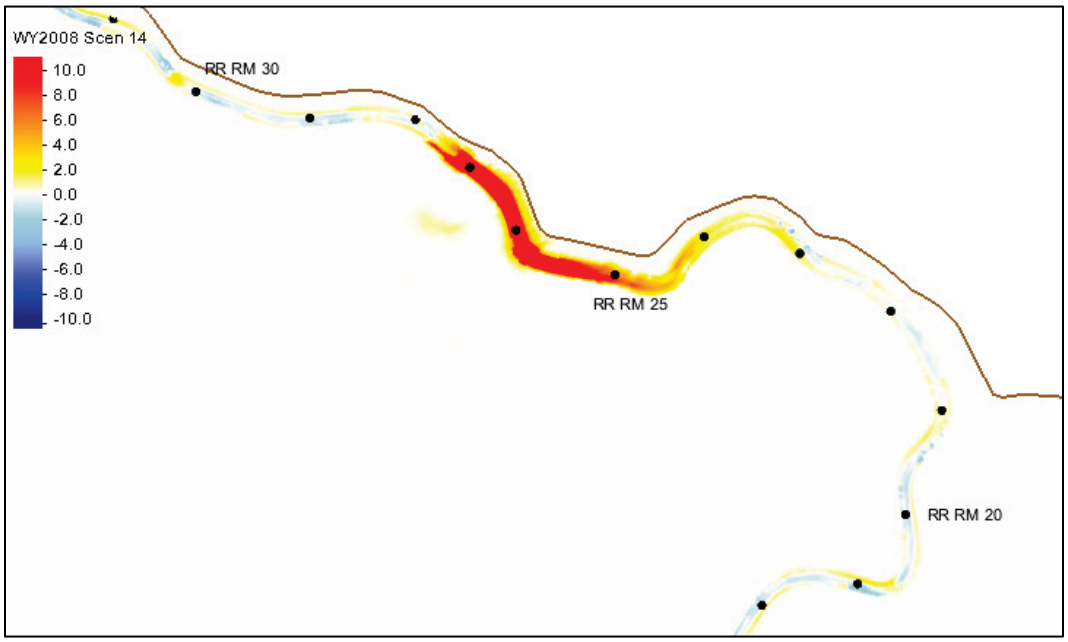


Plate A.116. WY2008 Scenario 14 BDD RR RM 20–RR RM 10.

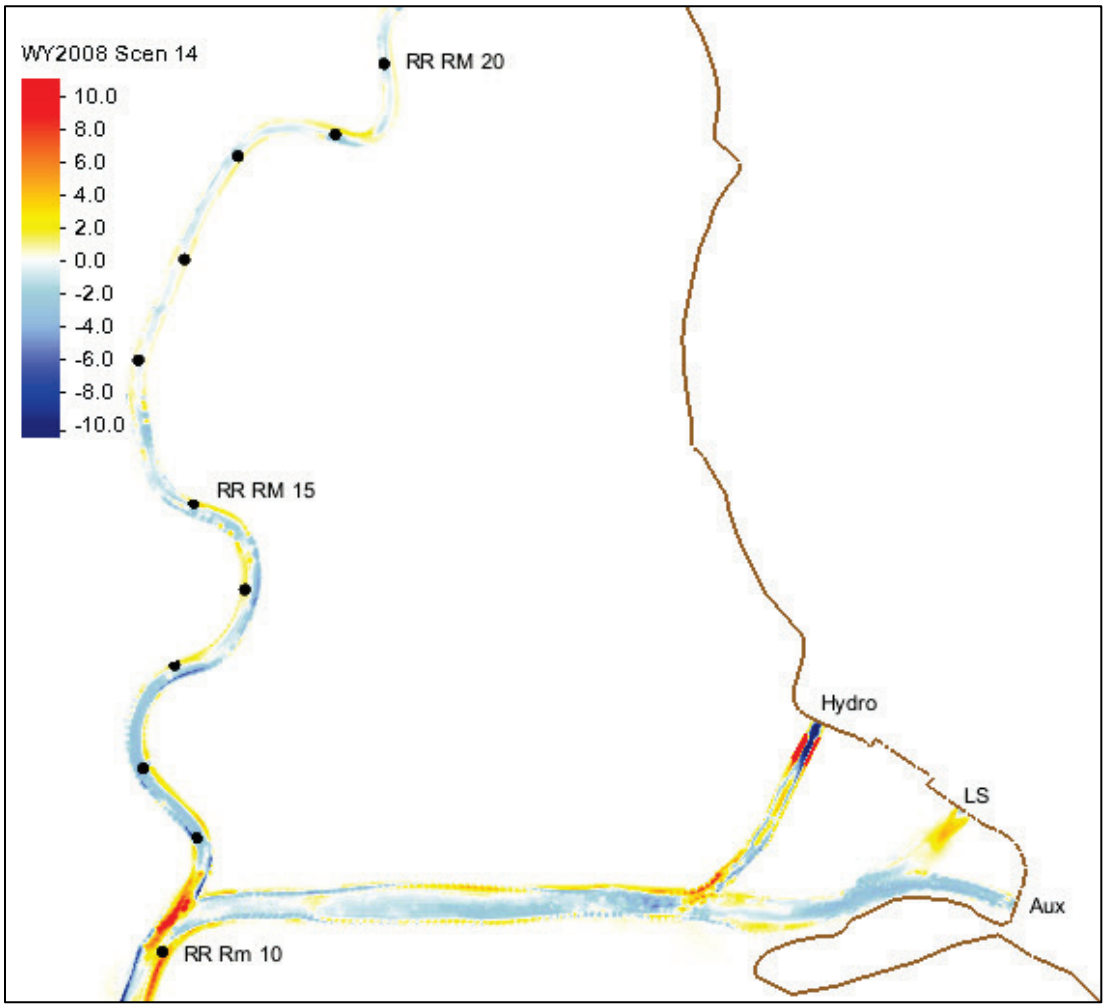


Plate A.117. WY2008 Scenario 14 BDD Outflow Channel.

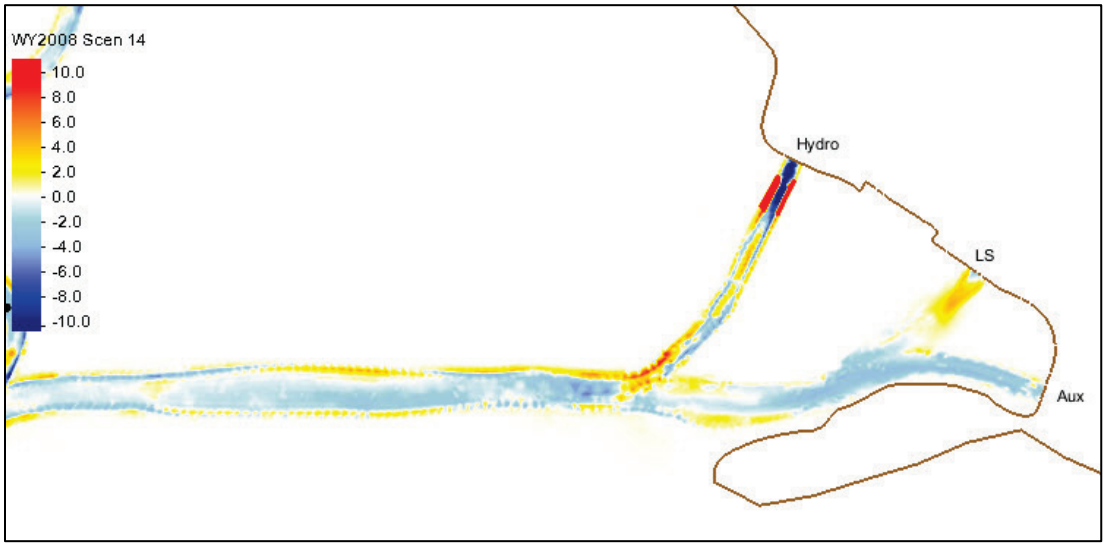


Plate A.118. WY2008 Scenario 14 BDD RR RM 10–Atcha RM 5.

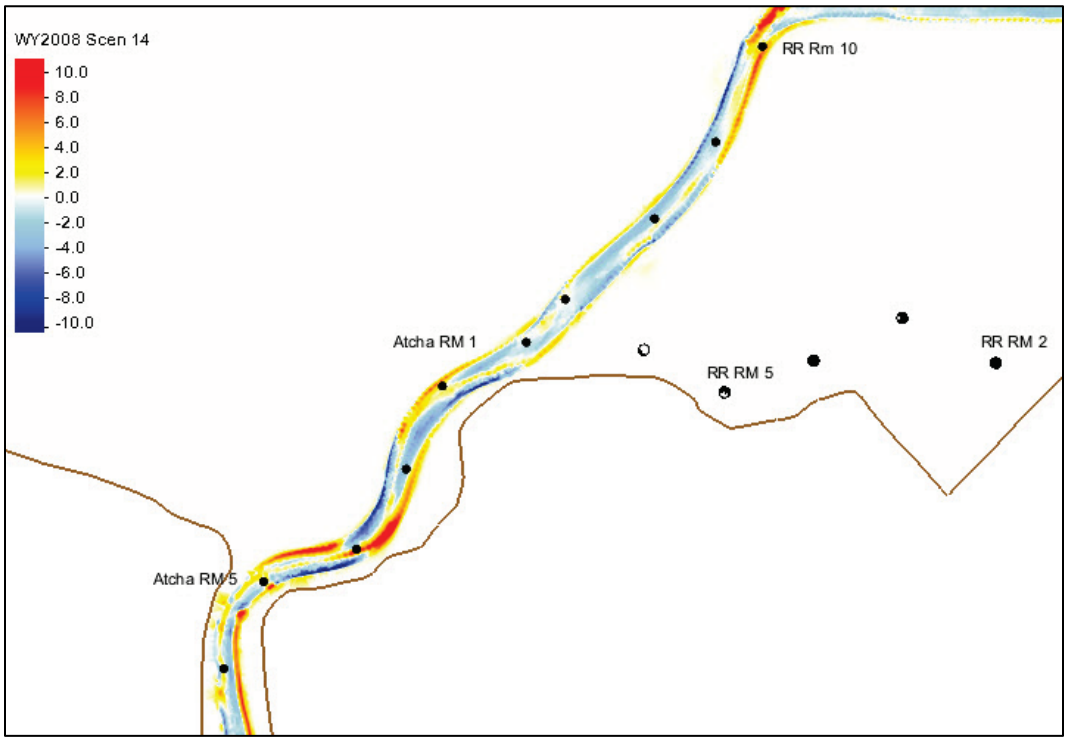


Plate A.119. WY2008 Scenario 14 BDD Atcha RM 5–Atcha RM 15.

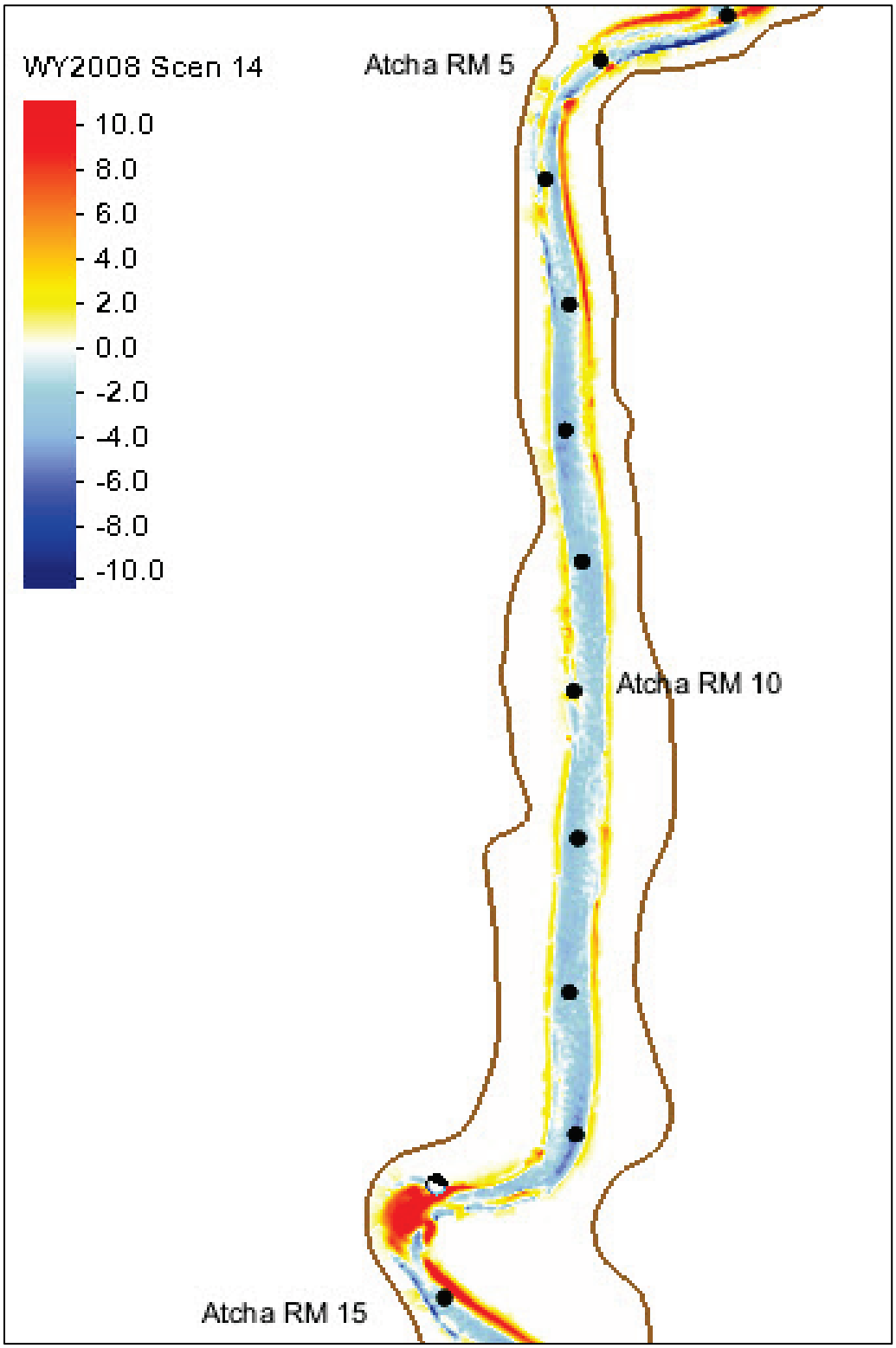
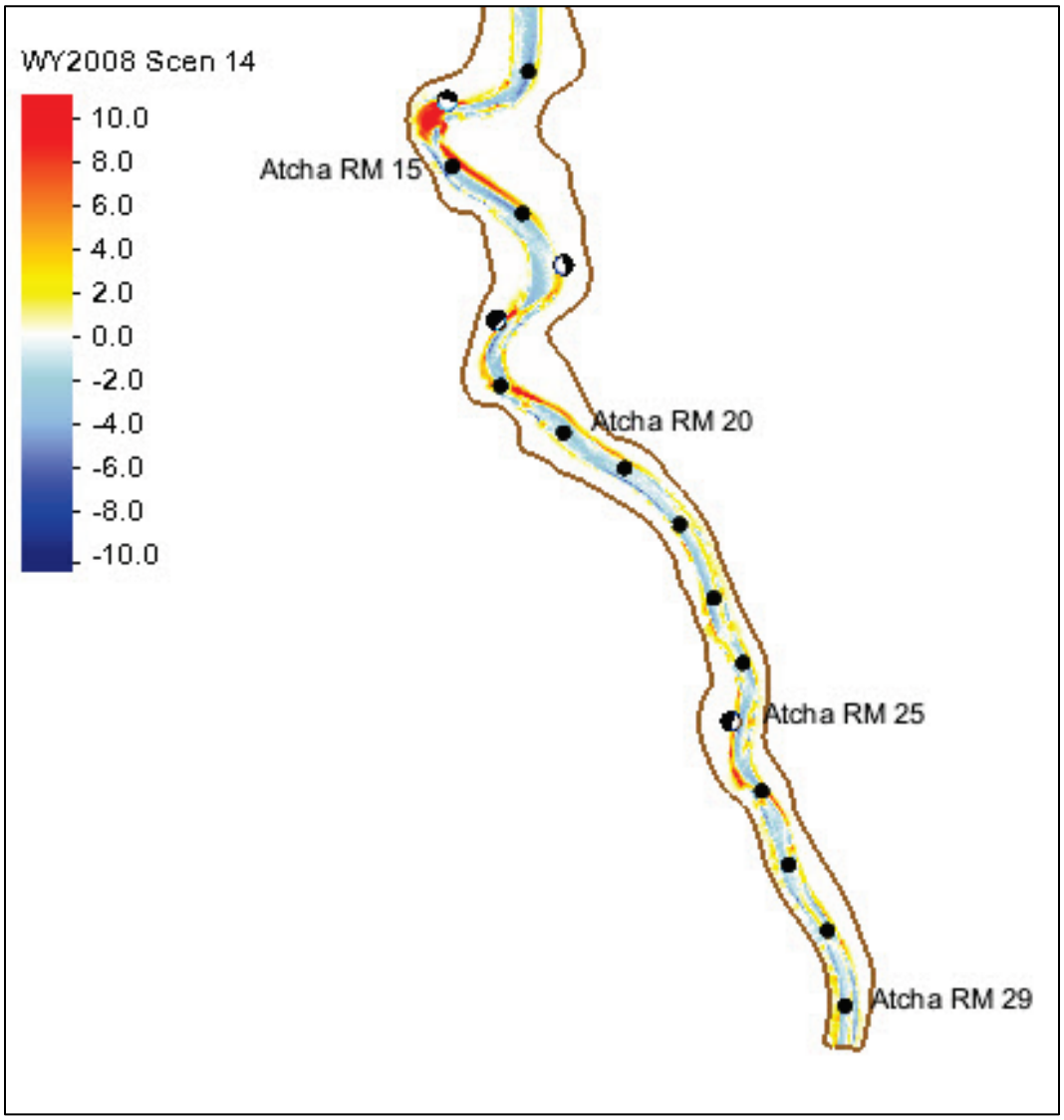


Plate A.120. WY2008 Scenario 14 BDD Atcha RM 15–Atcha RM 29.



A.12 Structure Options

A.12.1 Scenario 19

Plate A.121. WY2008 Scenario 19 BDD RR RM 43–RR RM 30.

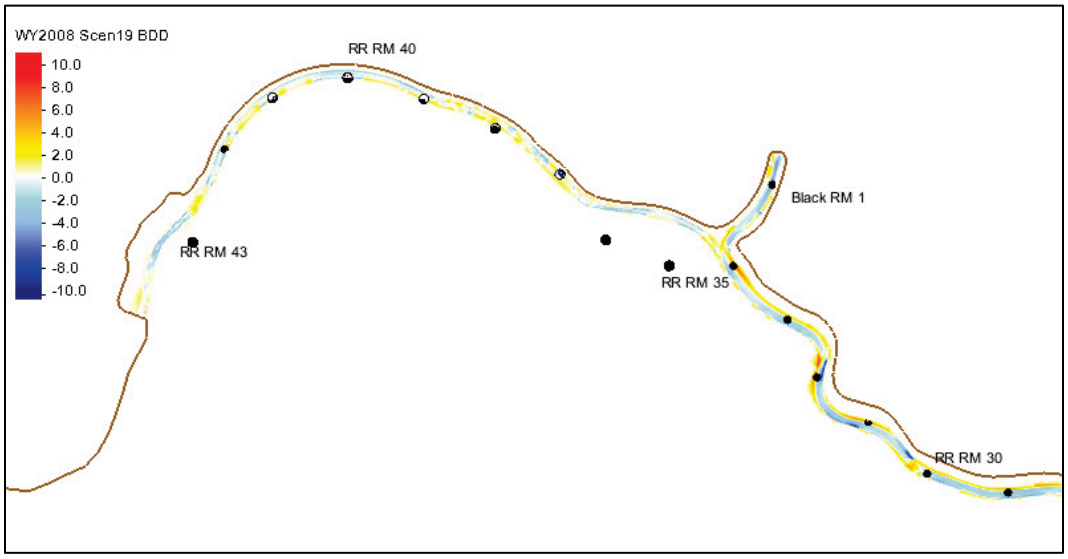


Plate A.122. WY2008 Scenario 19 BDD RR RM 30–RR RM 20.

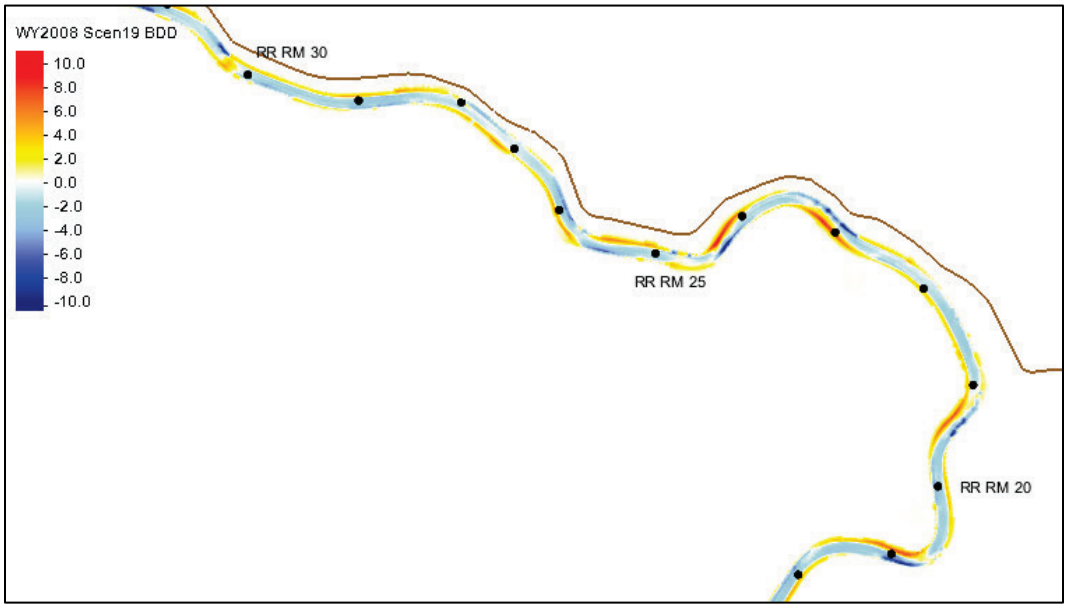


Plate A.123. WY2008 Scenario 19 BDD RR RM 20–RR RM 10.

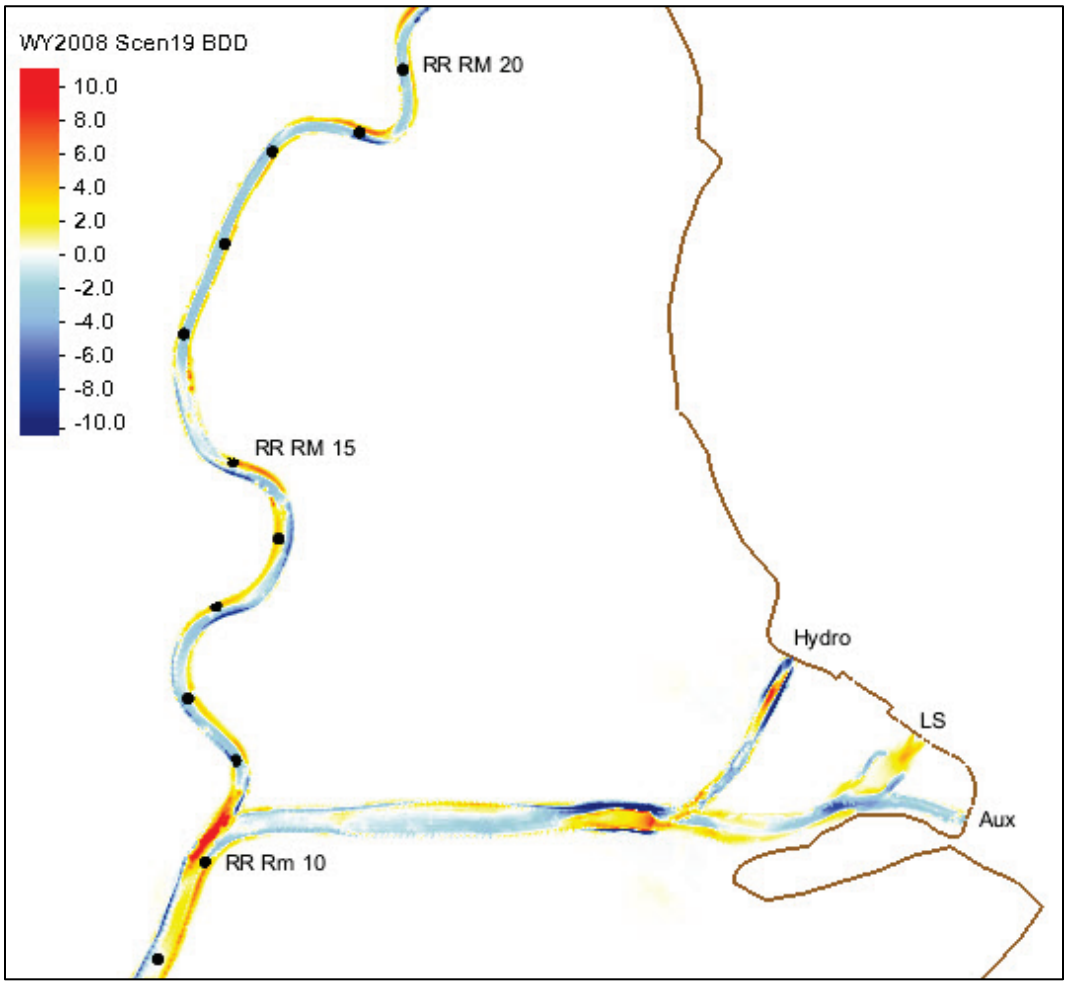


Plate A.124. WY2008 Scenario 19 BDD Outflow Channel.

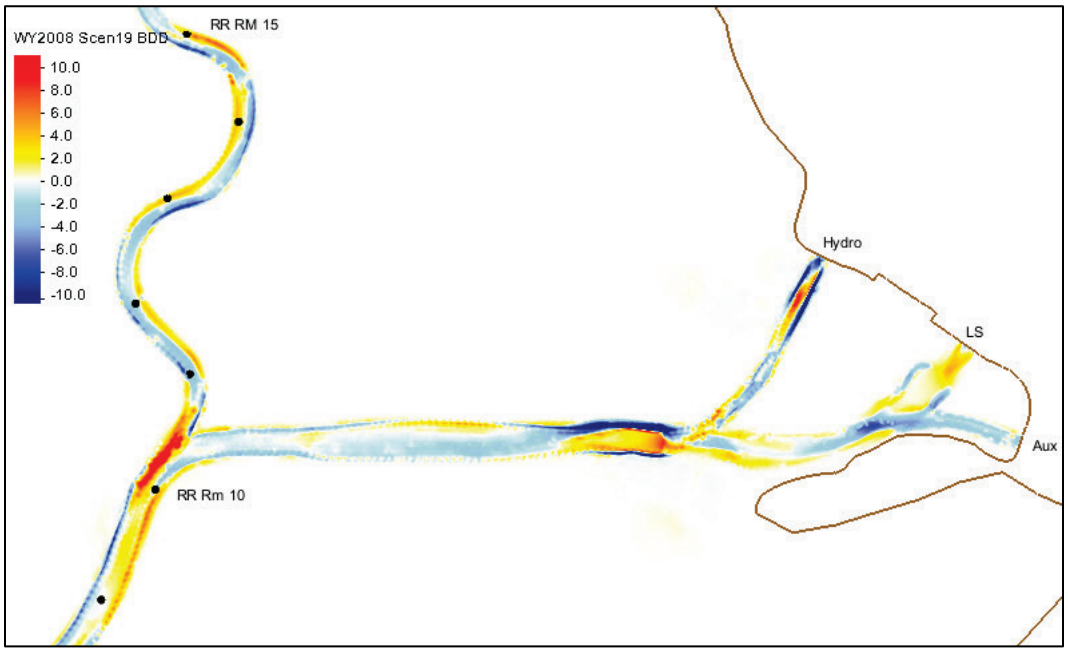


Plate A.125. WY2008 Scenario 19 BDD RR RM 10–Atcha RM 5.

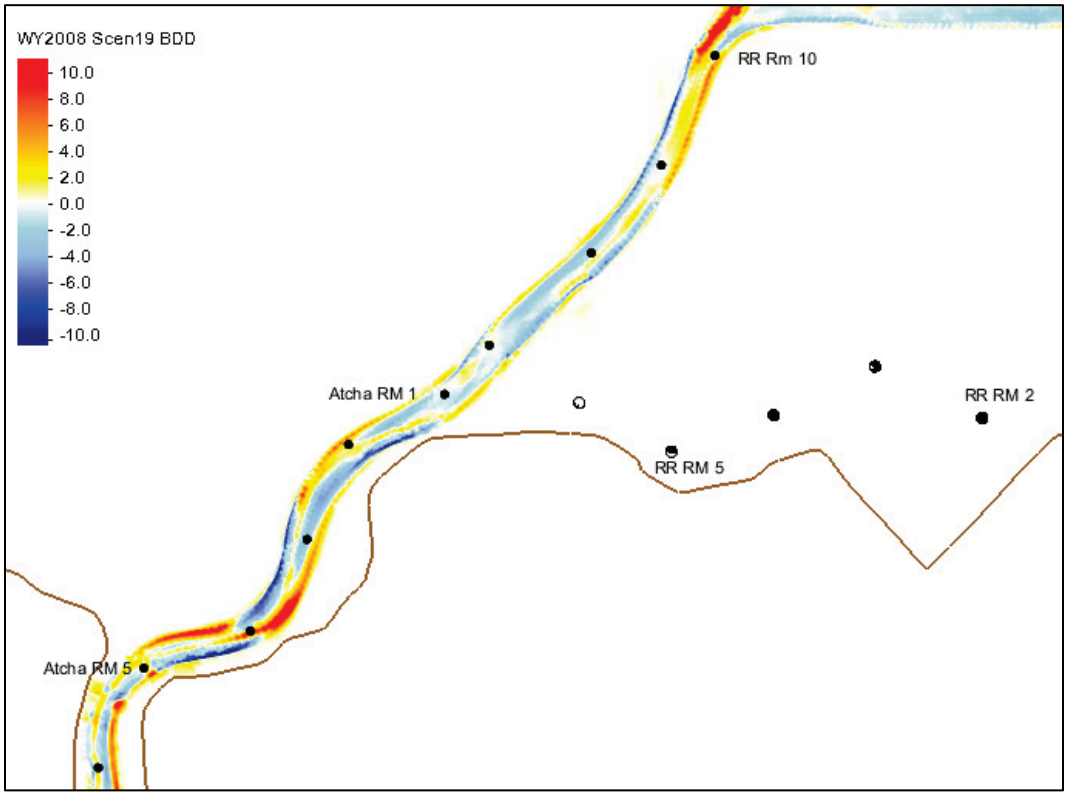


Plate A.126. WY2008 Scenario 19 BDD Atcha RM 5–Atcha RM 15.

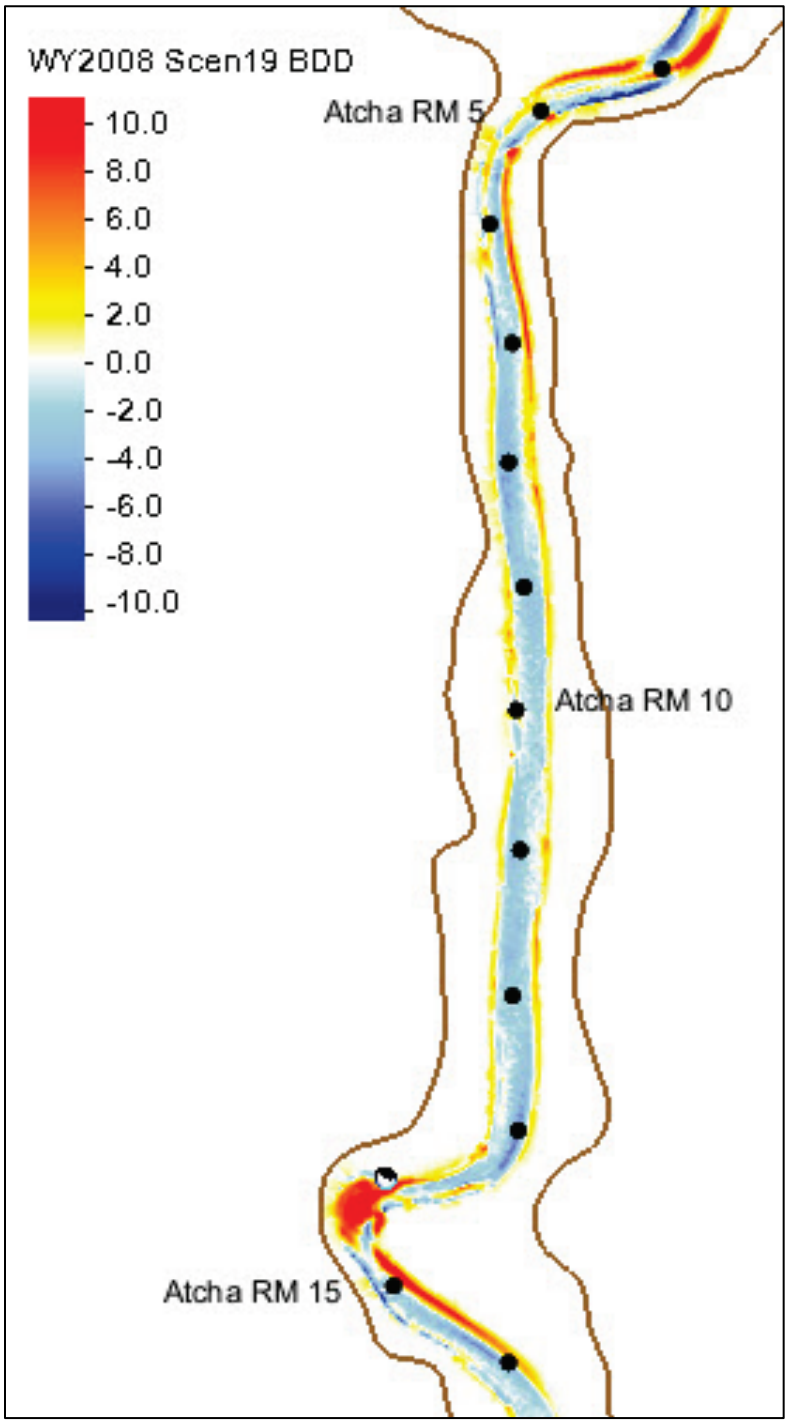
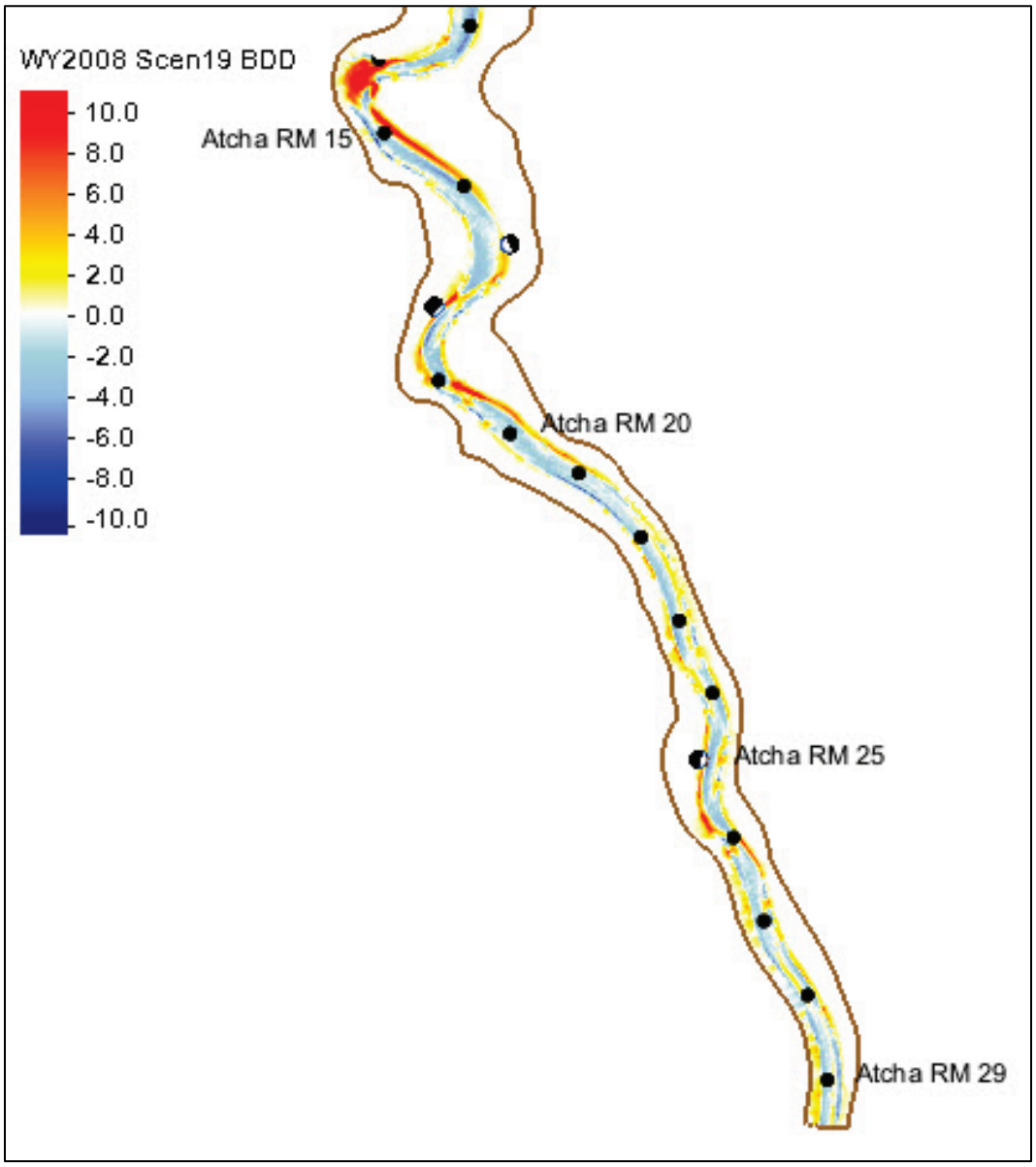


Plate A.127. WY2008 Scenario 19 BDD Atcha RM 15–Atcha RM 29.



A.12.2 Scenario 20

Plate A.128. WY2008 Scenario 20 BDD RR RM 43–RR RM 30.

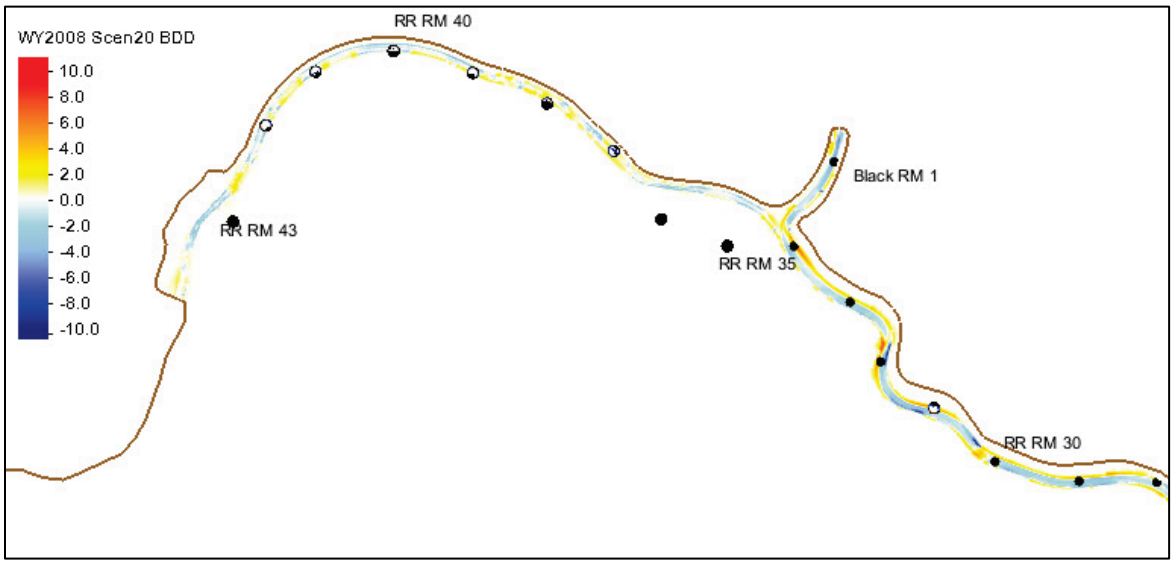


Plate A.129. WY2008 Scenario 20 BDD RR RM 30–RR RM 20.

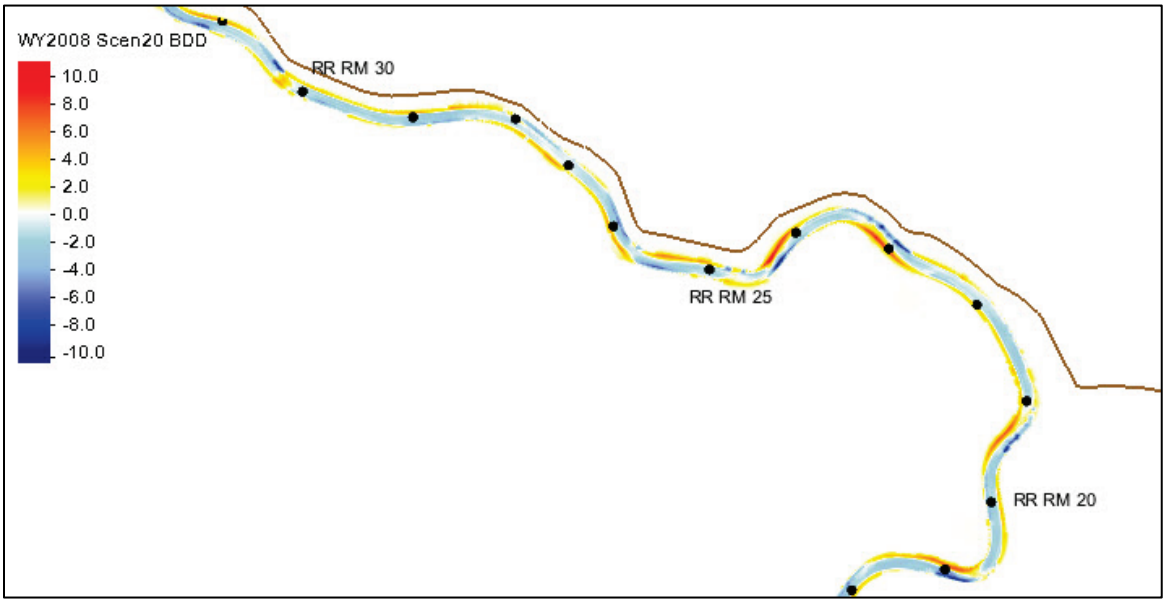


Plate A.130. WY2008 Scenario 20 BDD RR RM 20–RR RM 10.

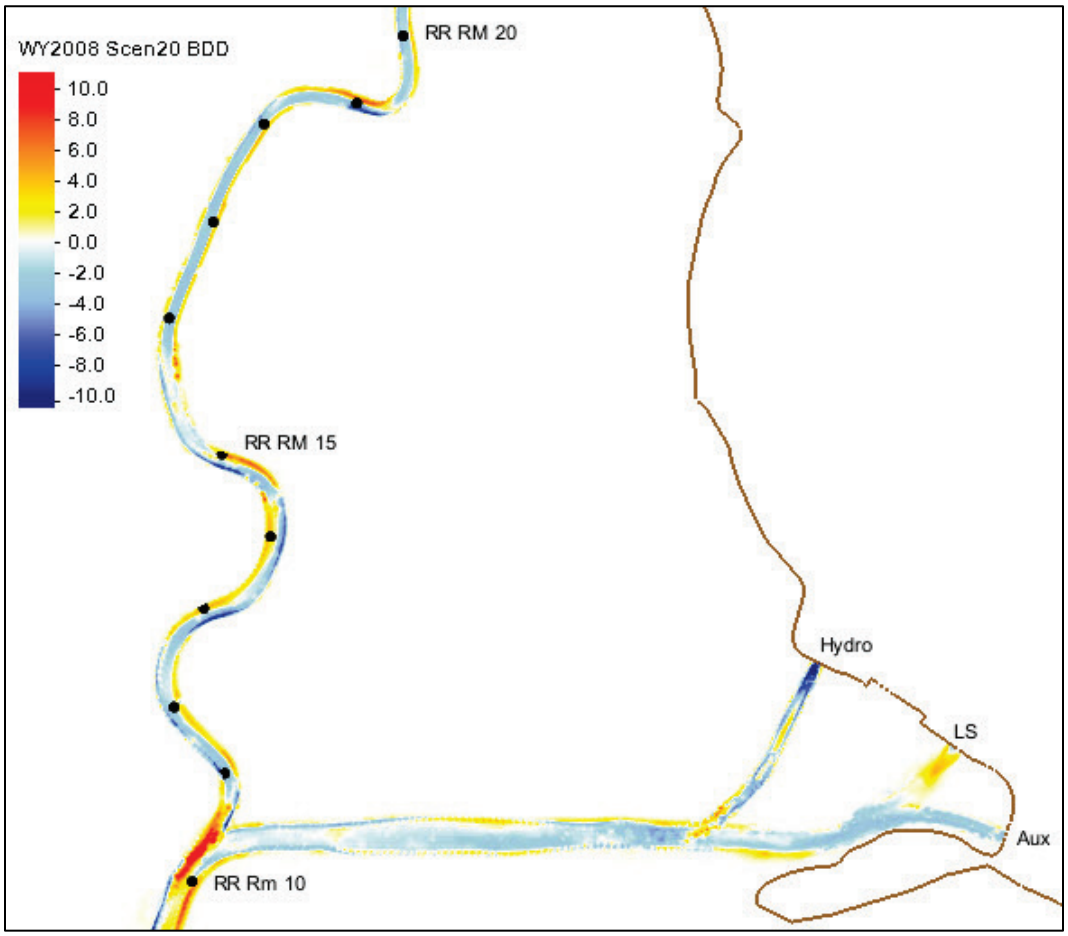


Plate A.131. WY2008 Scenario 20 BDD Outflow Channel.

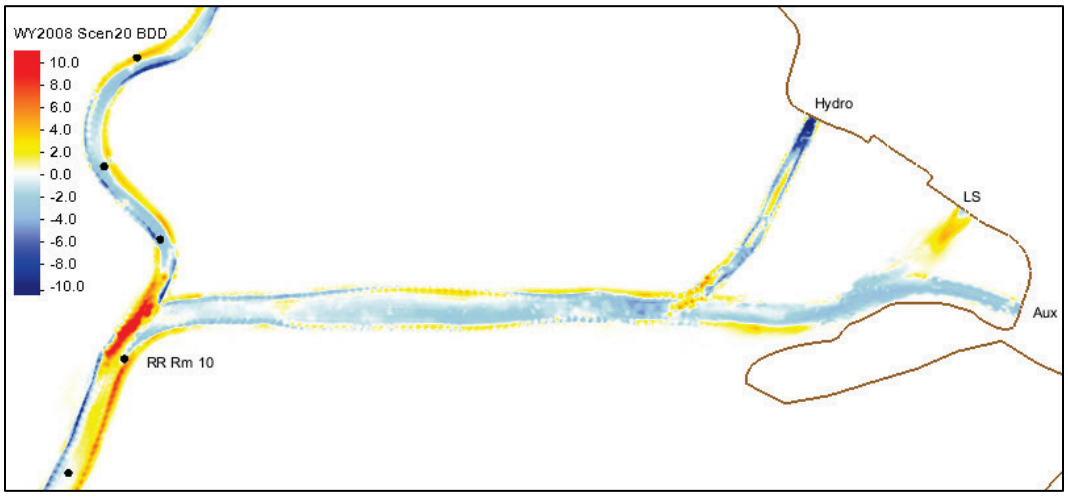


Plate A.132. WY2008 Scenario 20 BDD RR RM 10–Atcha RM 5.

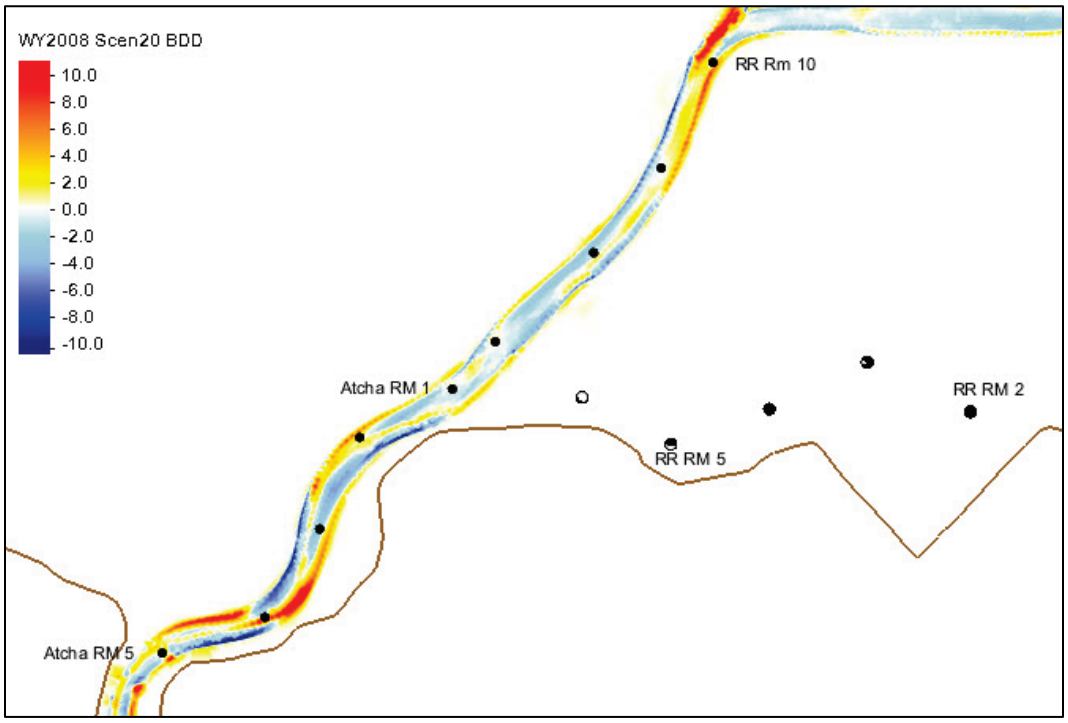


Plate A.133. WY2008 Scenario 20 BDD Atcha RM 5–Atcha RM 15.

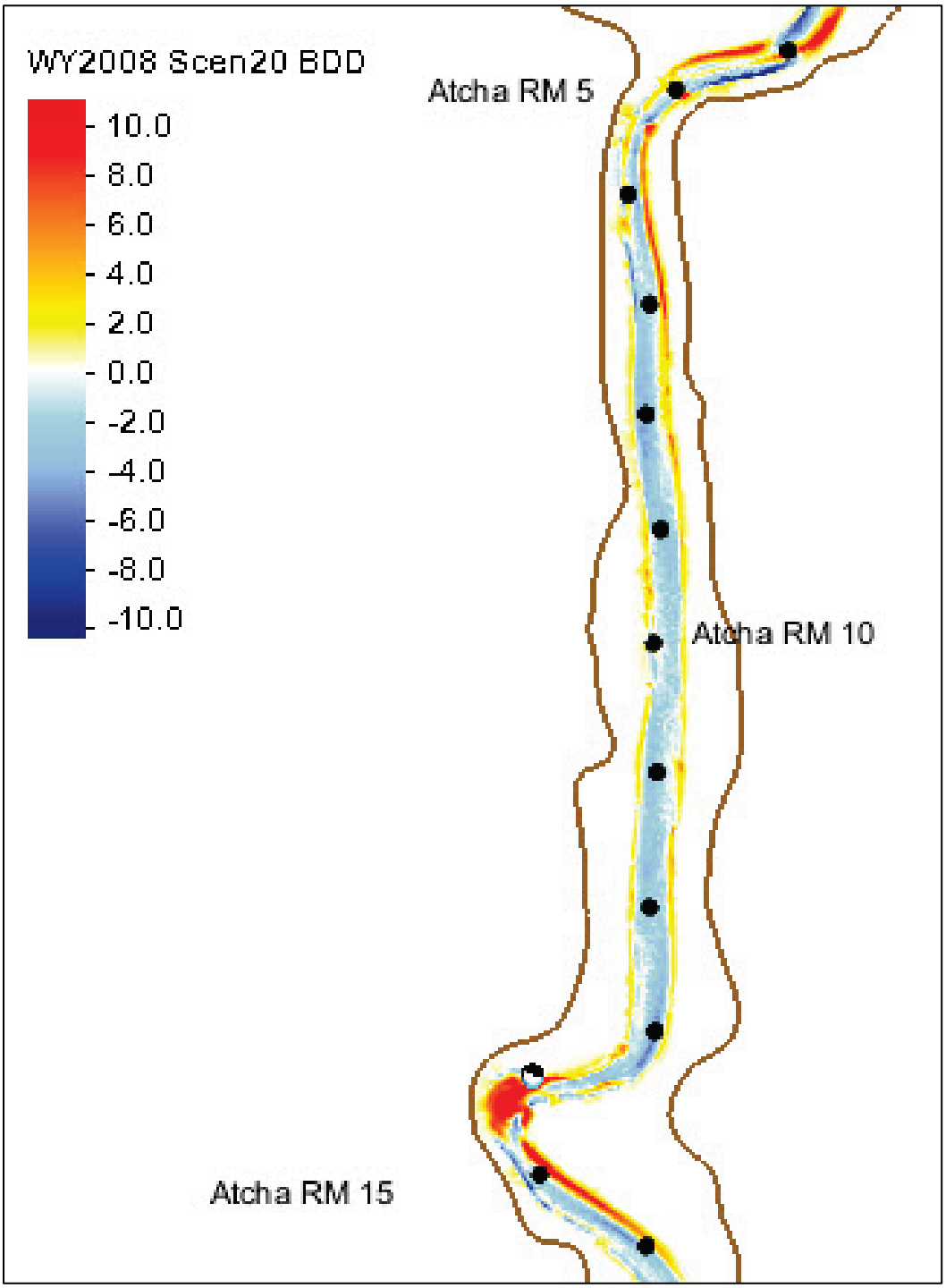
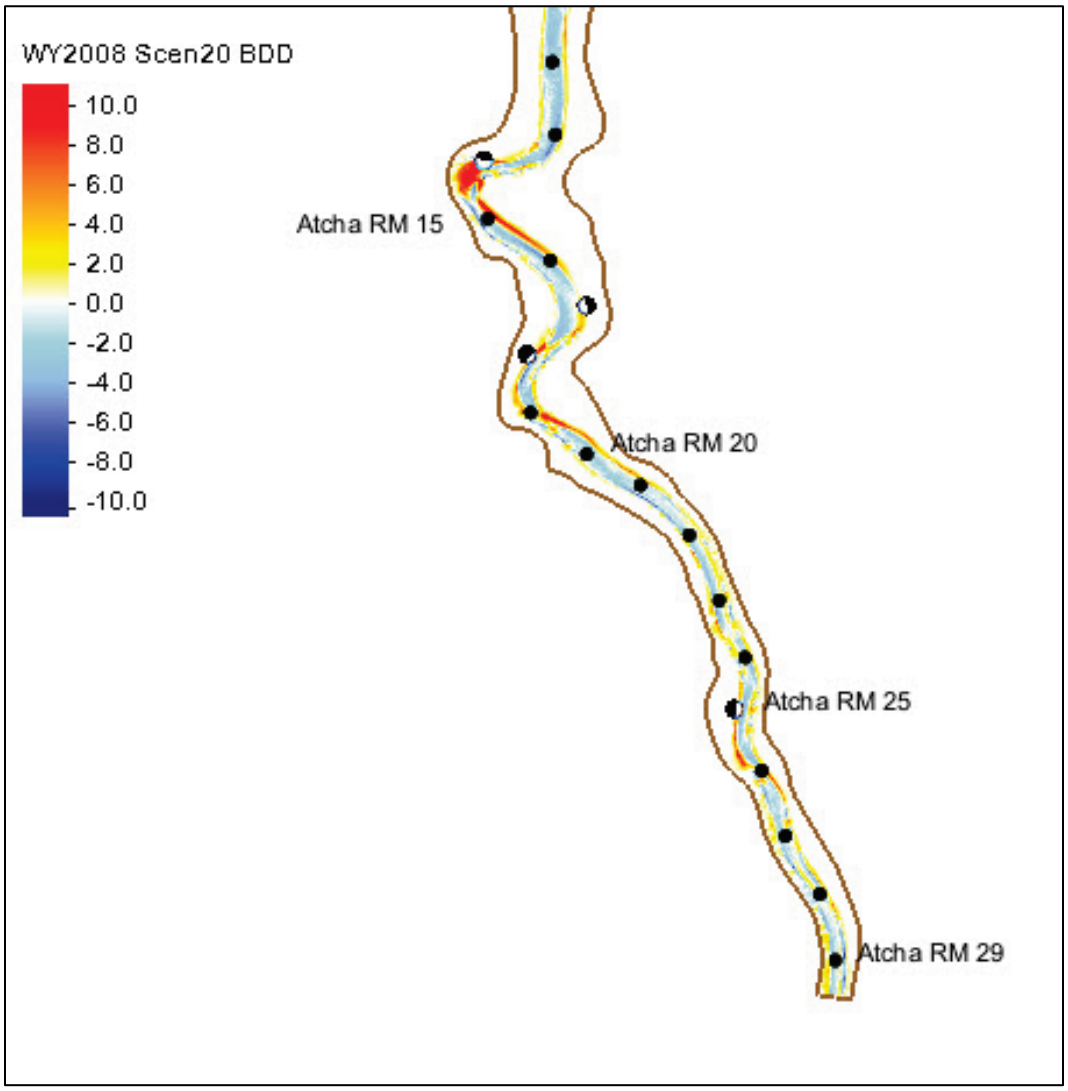


Plate A.134. WY2008 Scenario 20 BDD Atcha RM 15–Atcha RM 29.



Appendix B: WY2008 Bed Sediment Volume Change (BSVC)

B.1 Material 1 Base Run and Scenarios 3–10

Plate B.1. Material legend.

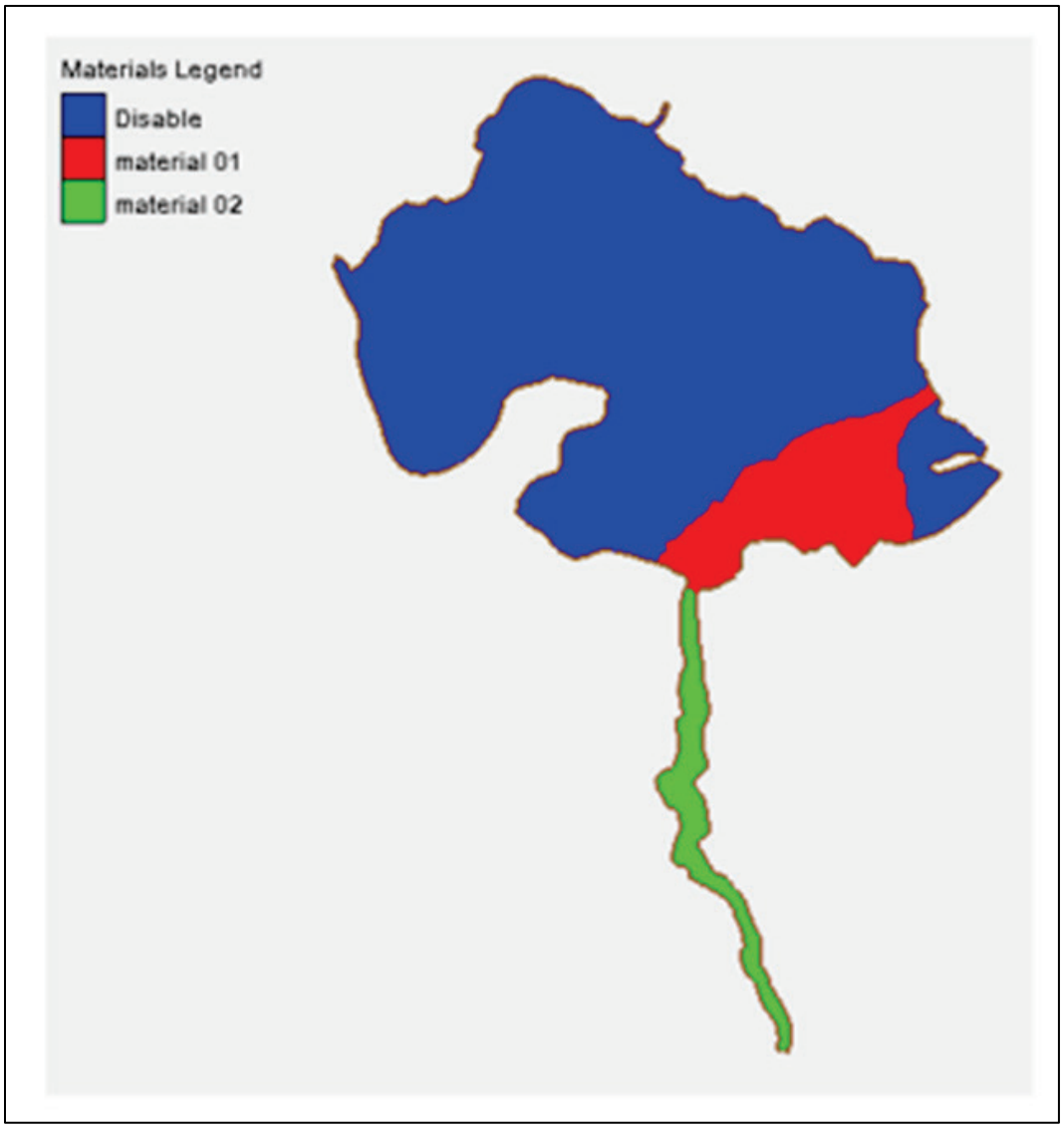


Plate B.2. Material 1 WY2008 Base Run time versus sediment volume change/Simmesport discharge.

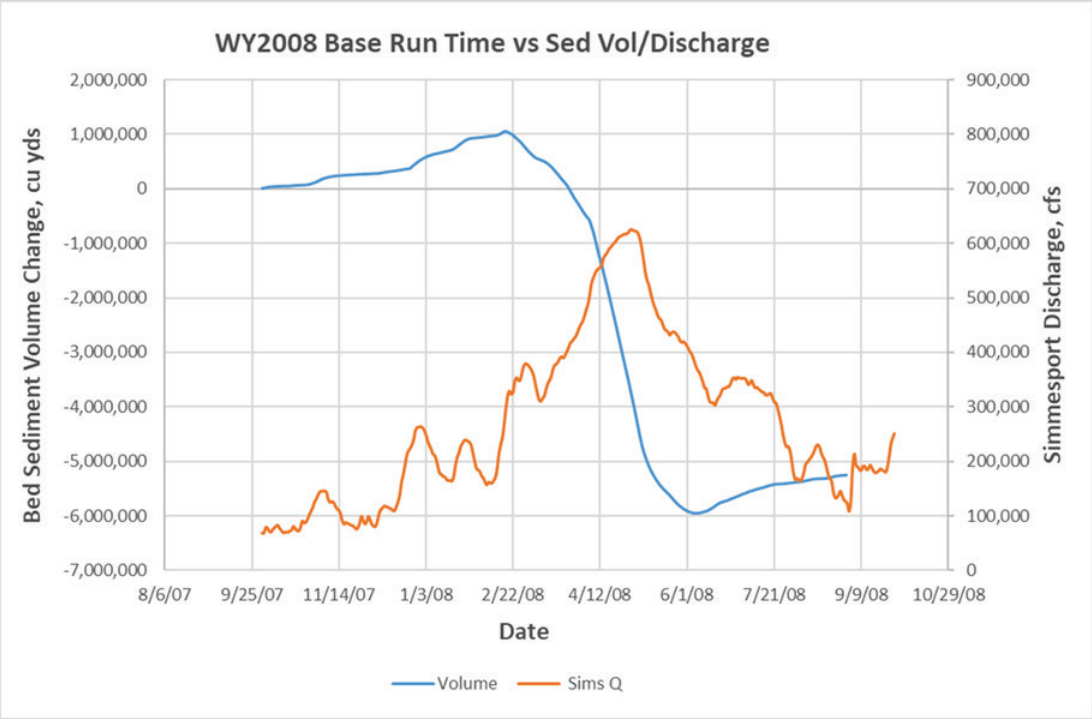


Plate B.3 Material 1 WY2008 Scenario 3 time versus sediment volume change/Simmesport discharge.

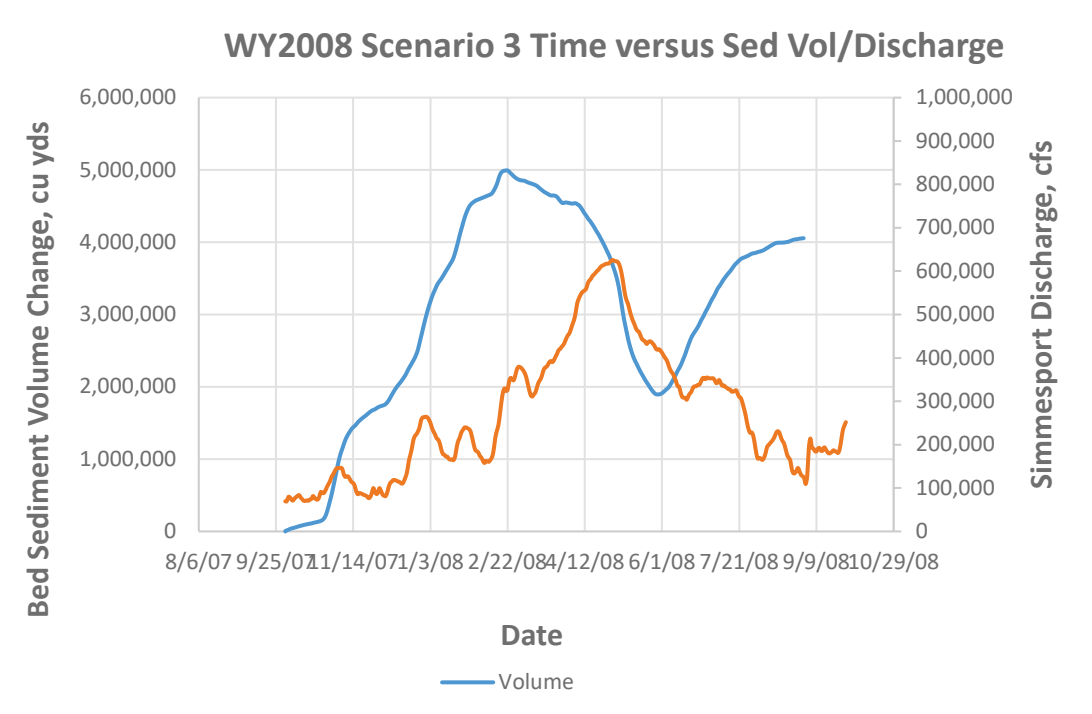


Plate B.4. Material 1 WY2008 Scenario 4 time versus sediment volume change/Simmesport discharge.

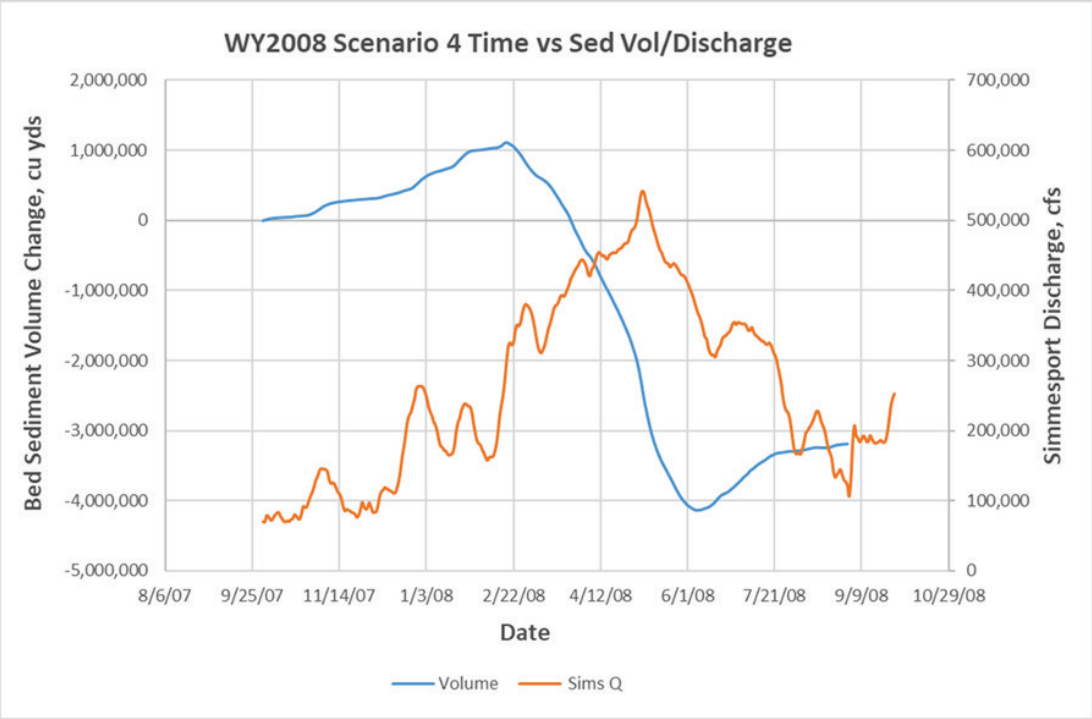


Plate B.5. Material 1 WY2008 Scenario 5 time versus sediment volume change/Simmesport discharge.

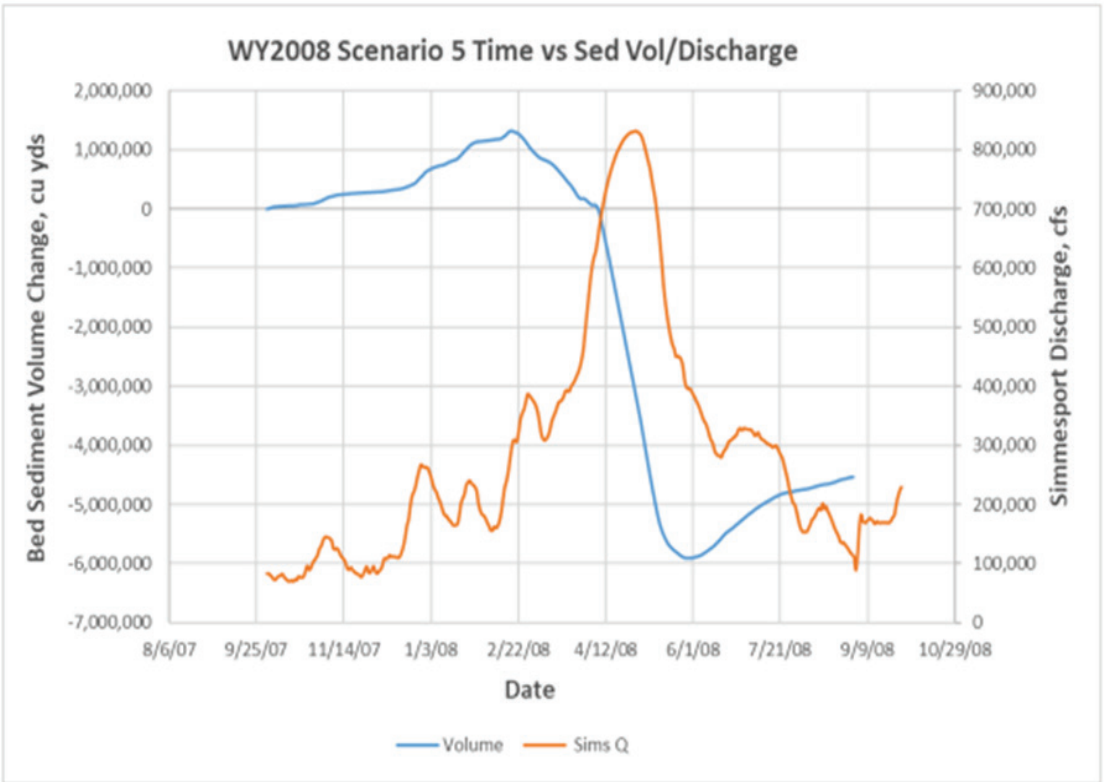


Plate B.6. Material 1 WY2008 Scenario 6 time versus sediment volume change/Simmesport discharge.

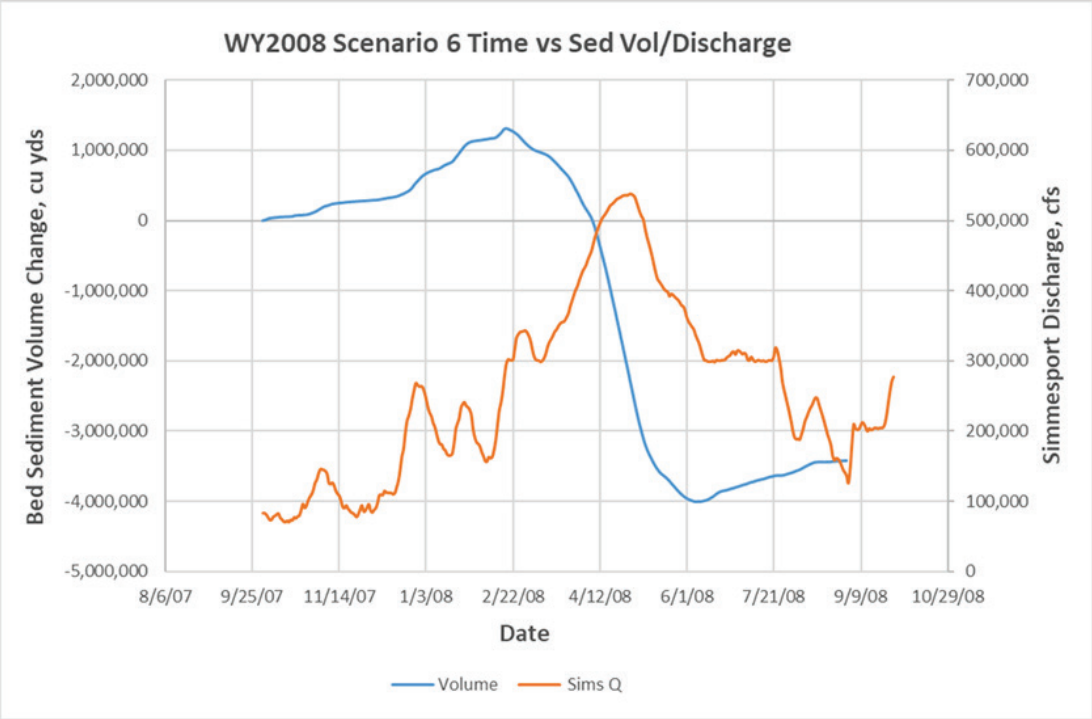


Plate B.7. Material 1 WY2008 Scenario 7 time versus sediment volume change/Simmesport discharge.

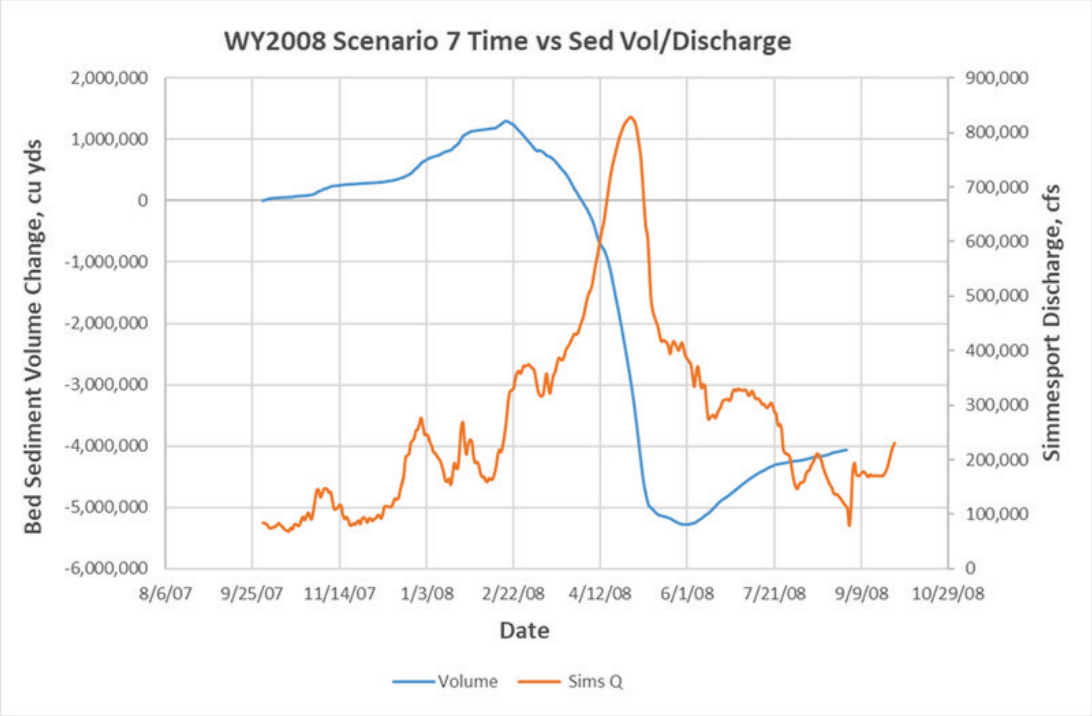


Plate B.8. Material 1 WY2008 Scenario 8a time versus sediment volume change/Simmesport discharge.

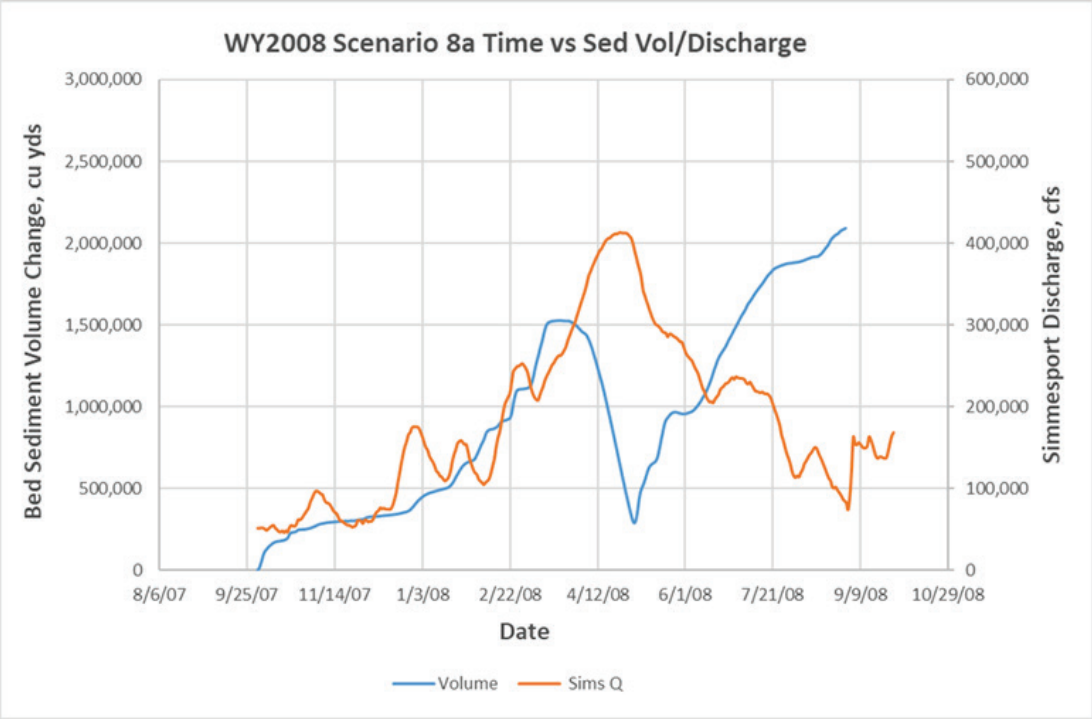


Plate B.9. Material 1 WY2008 Scenario 8b time versus sediment volume change/Simmesport discharge.

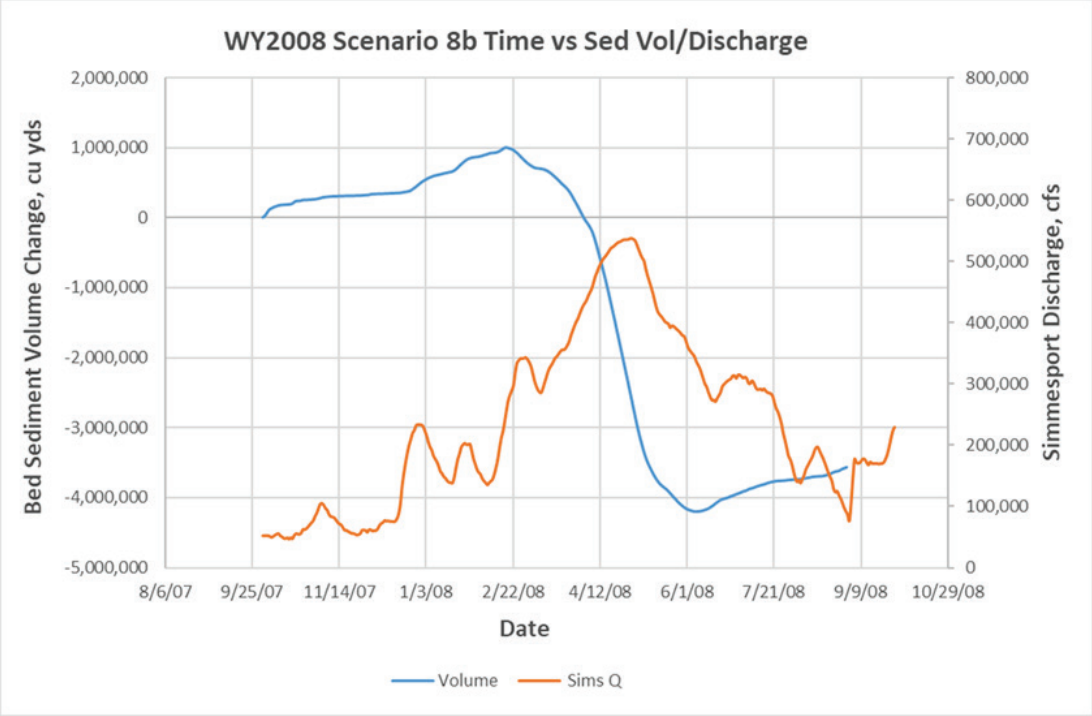


Plate B.10. Material 1 WY2008 Scenario 9 time versus sediment volume change/Simmesport discharge.

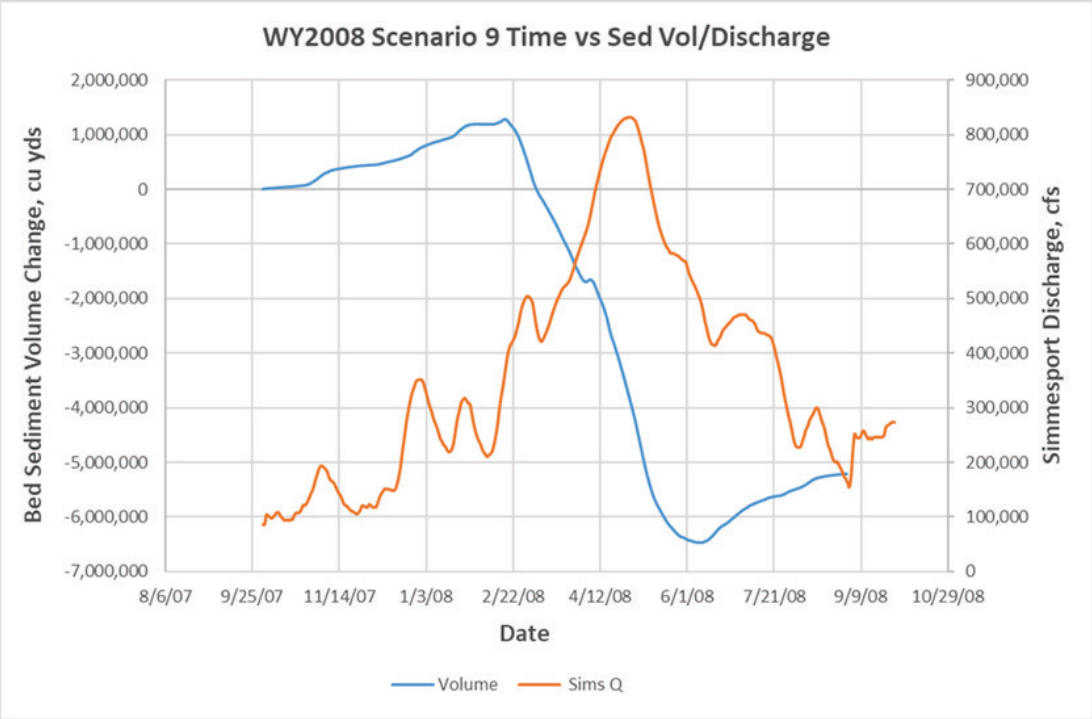


Plate B.11. Material 1 WY2008 Scenario 10 time versus sediment volume change/Simmesport discharge.

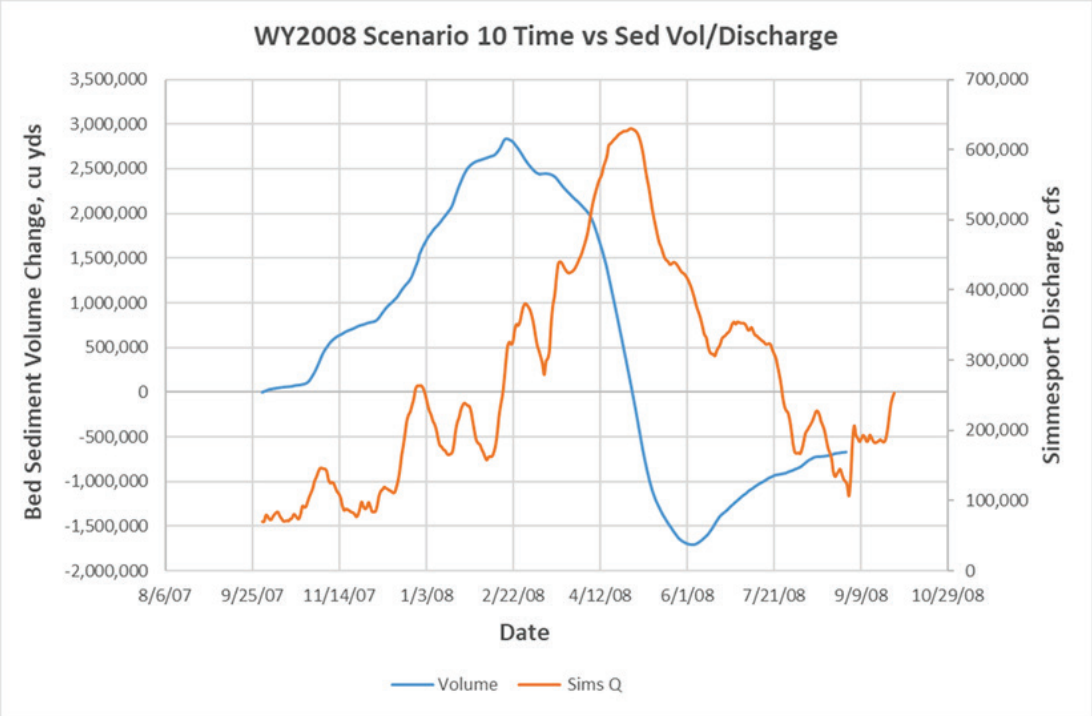
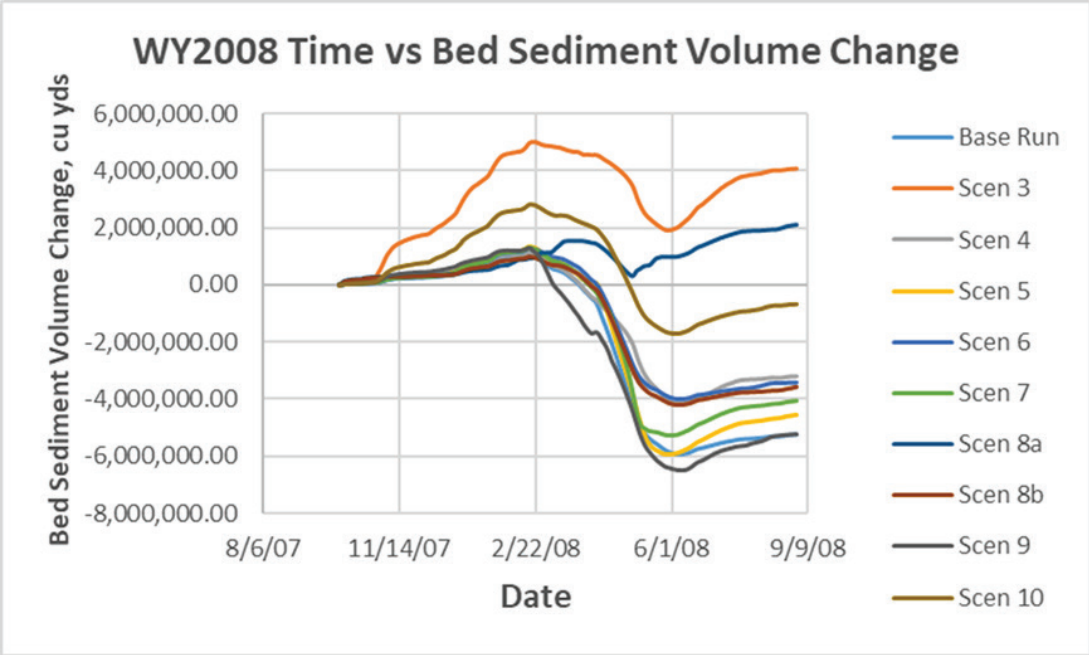


Plate B.12. Material 1 WY2008 Base Run and Scenarios 3–10 time versus sediment volume change.



B.2 Material 2 Base Run and Scenarios 3–10

Plate B.13. Material 2 Simmesport to Melville.

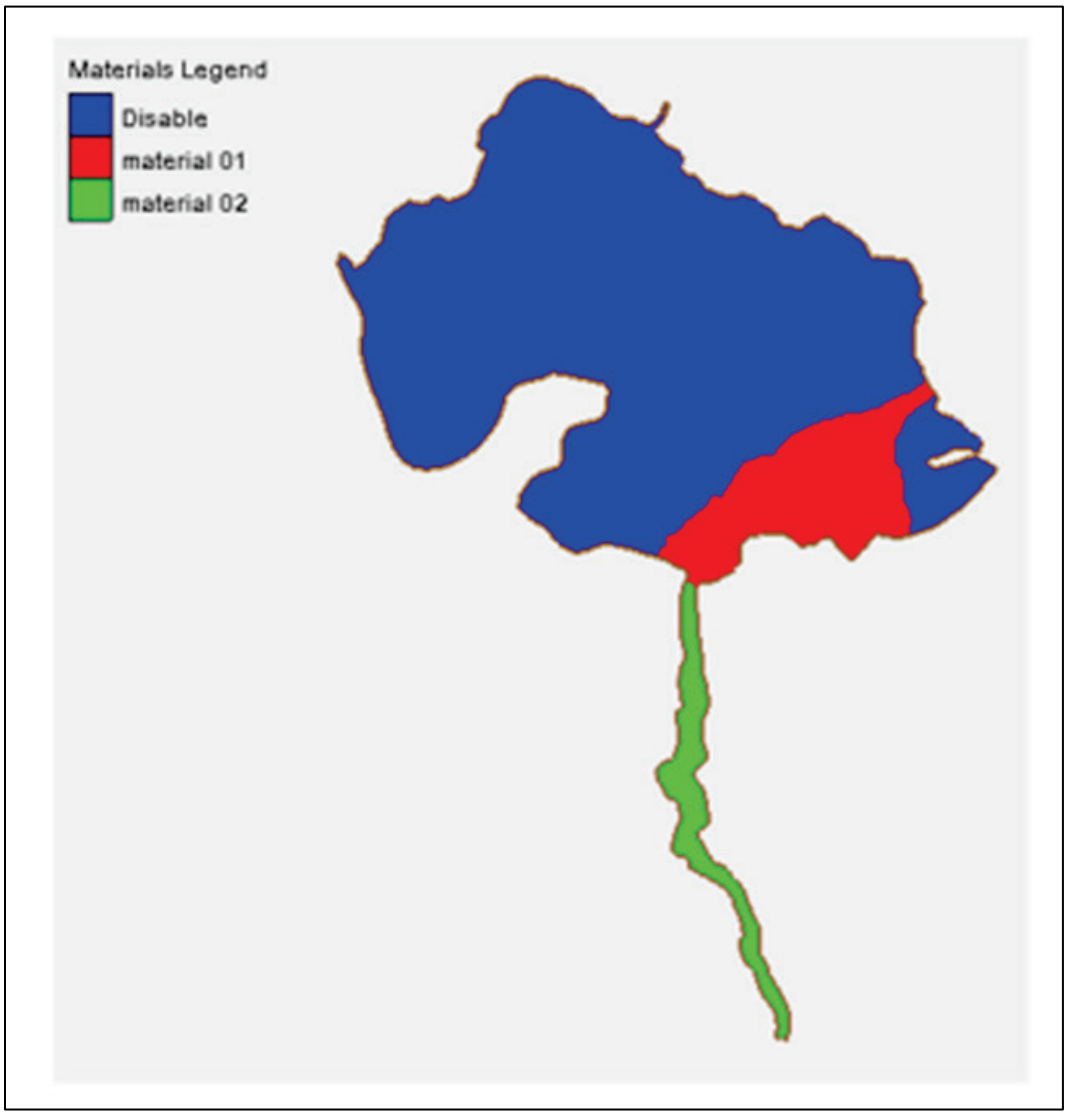


Plate B.14. Material 2 WY2008 Base Run time versus sediment volume change/Simmesport discharge.

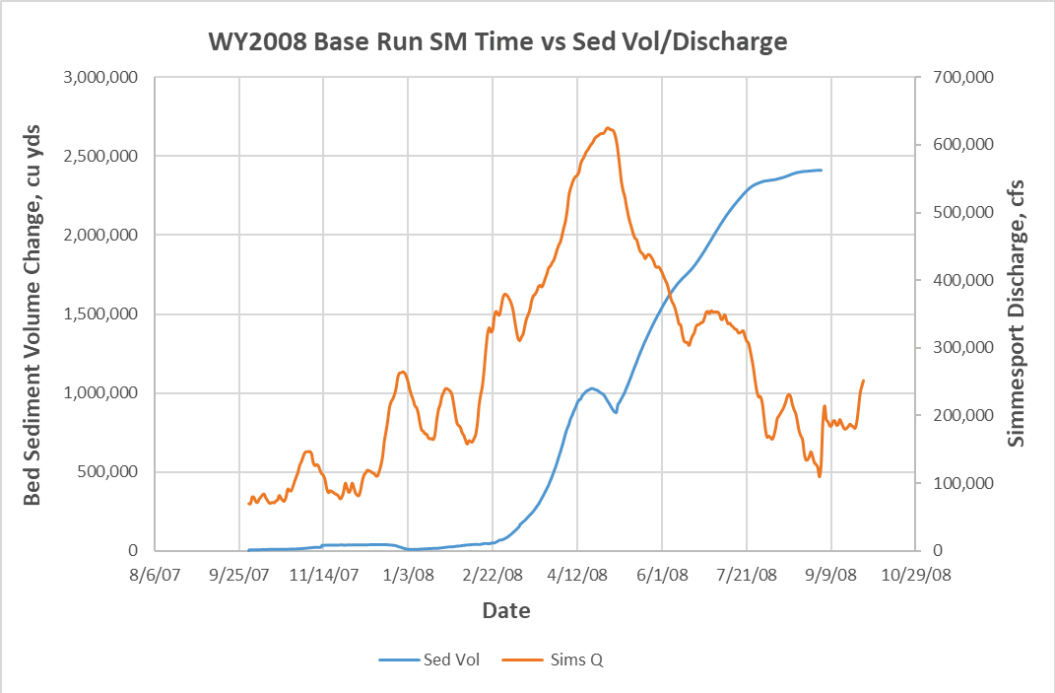


Plate B.15. Material 2 WY2008 Scenario 3 time versus sediment volume change/Simmesport discharge.

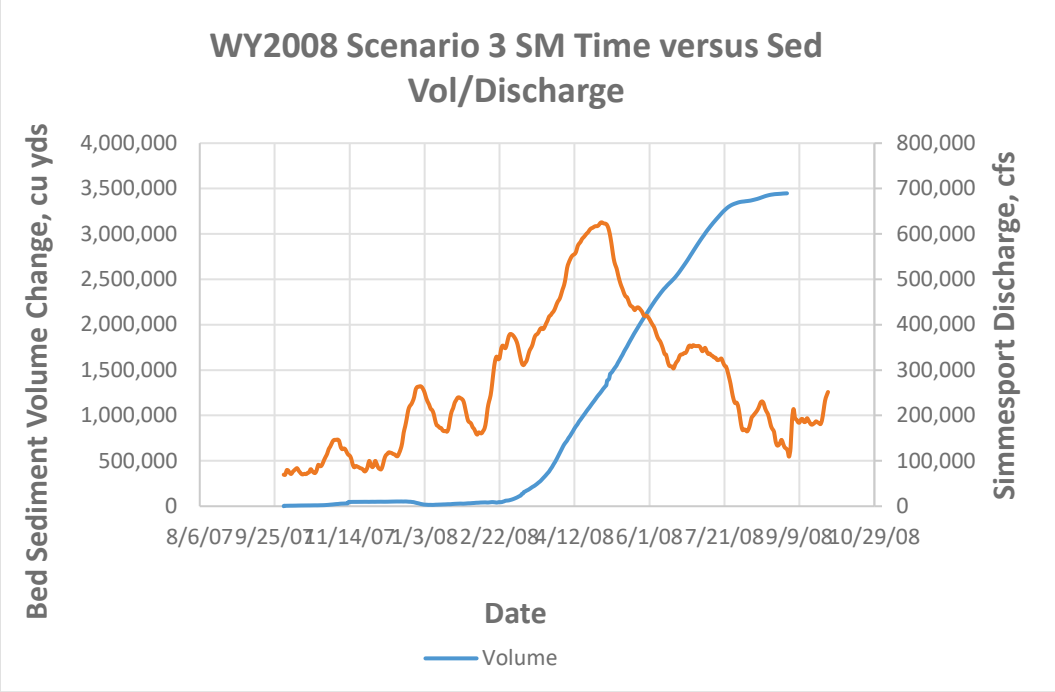


Plate B.16. Material 2 WY2008 Scenario 4 time versus sediment volume change/Simmesport discharge.

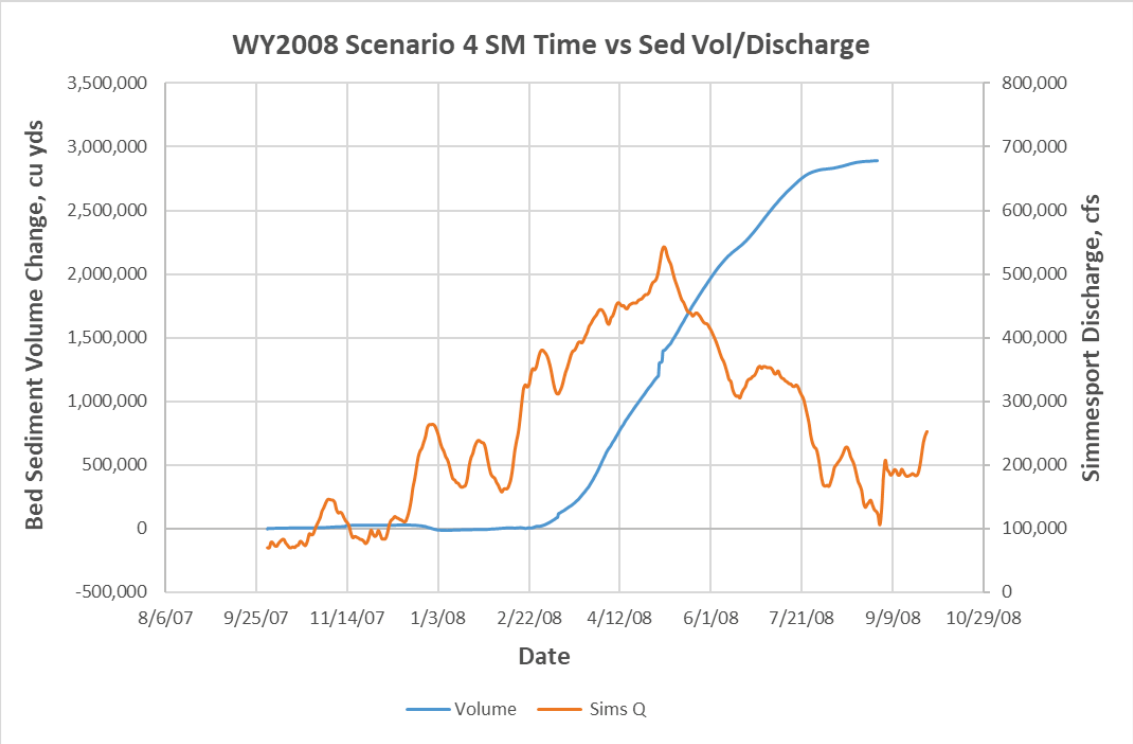


Plate B.17. Material 2 WY2008 Scenario 5 time versus sediment volume change/Simmesport discharge.

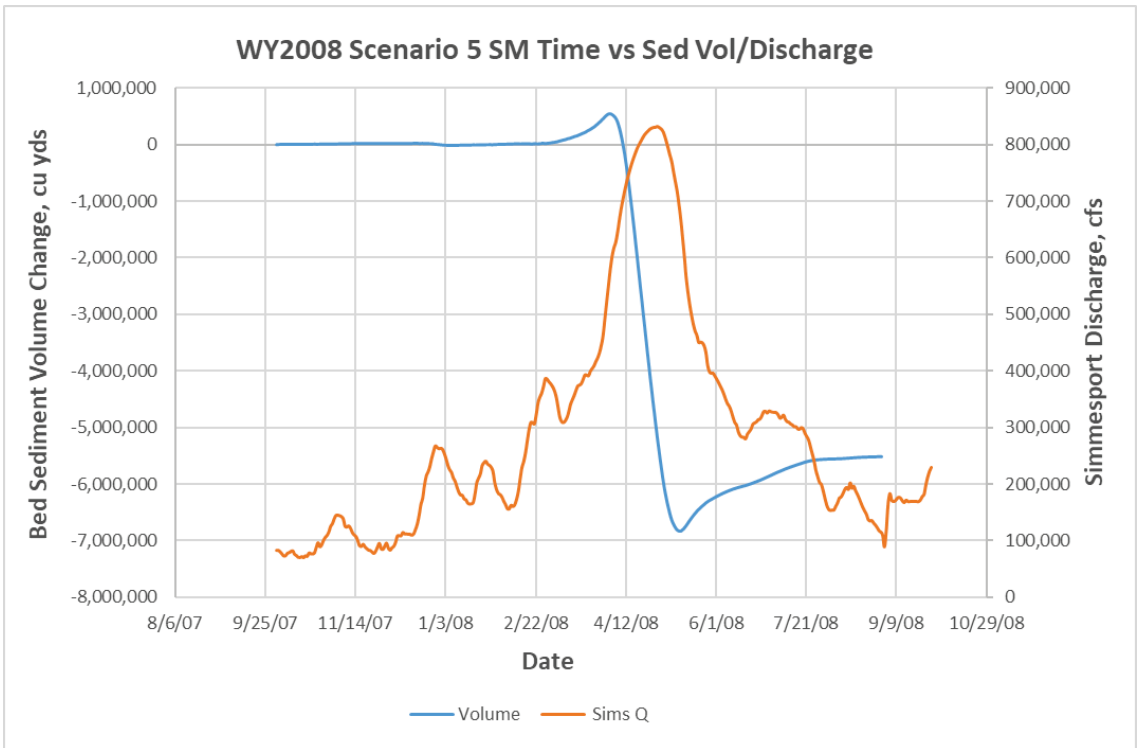


Plate B.18. Material 2 WY2008 Scenario 6 time versus sediment volume change/Simmesport discharge.

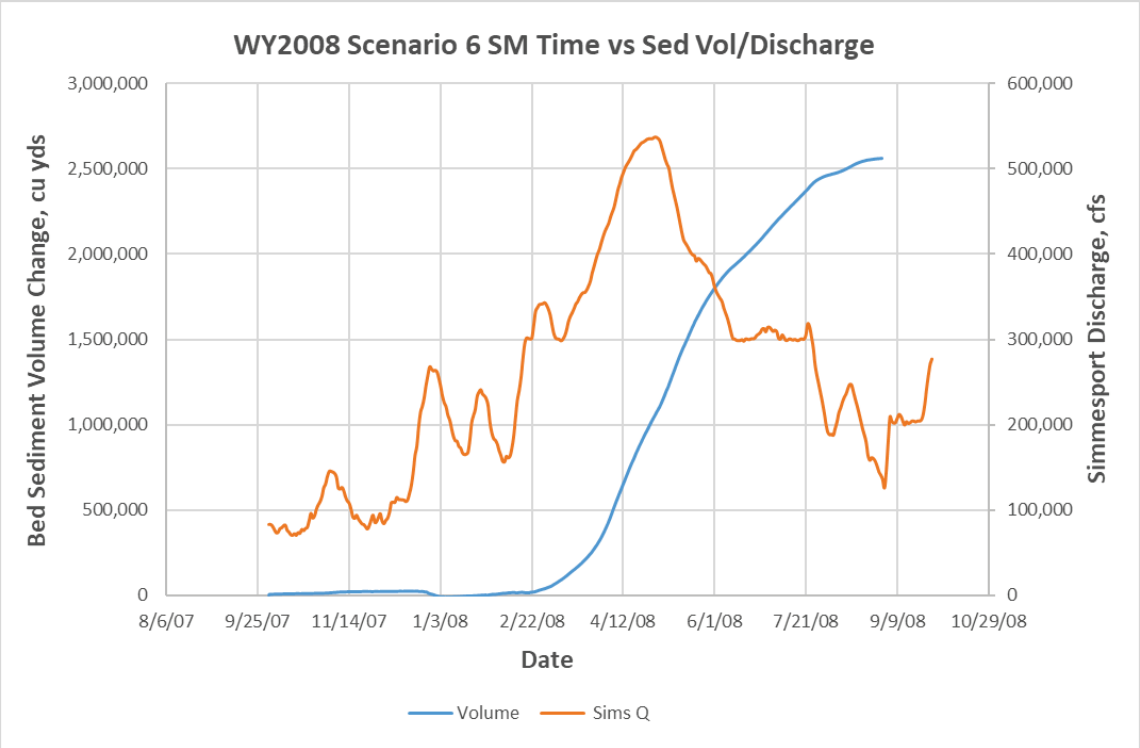


Plate B.19. Material 2 WY2008 Scenario 7 time versus sediment volume change/Simmesport discharge.

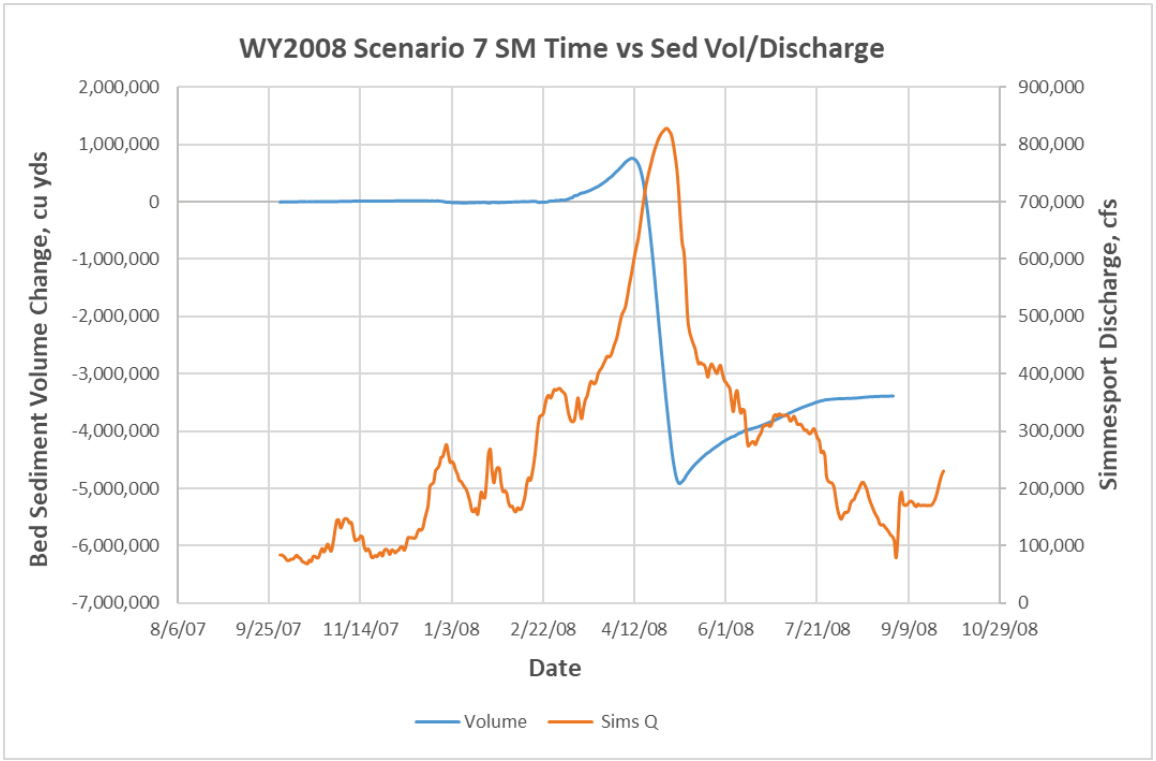


Plate B.20. Material 2 WY2008 Scenario 8a time versus sediment volume change/Simmesport discharge.

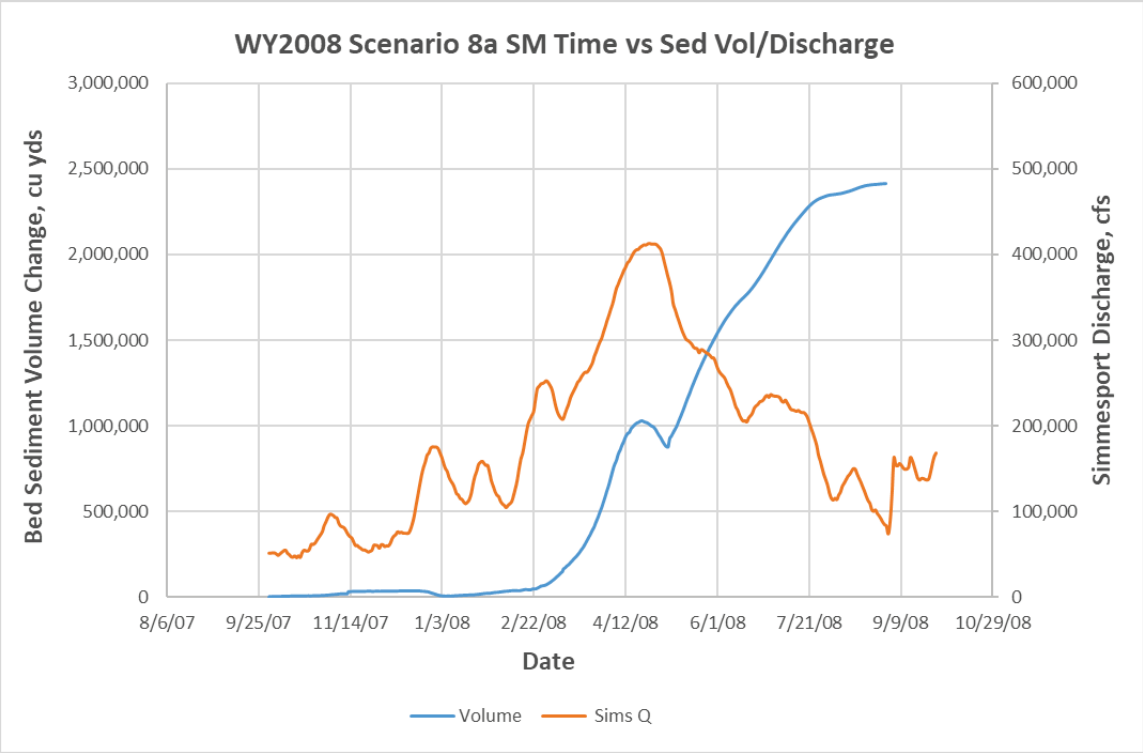


Plate B.21. Material 2 WY2008 Scenario 8b time versus sediment volume change/Simmesport discharge.

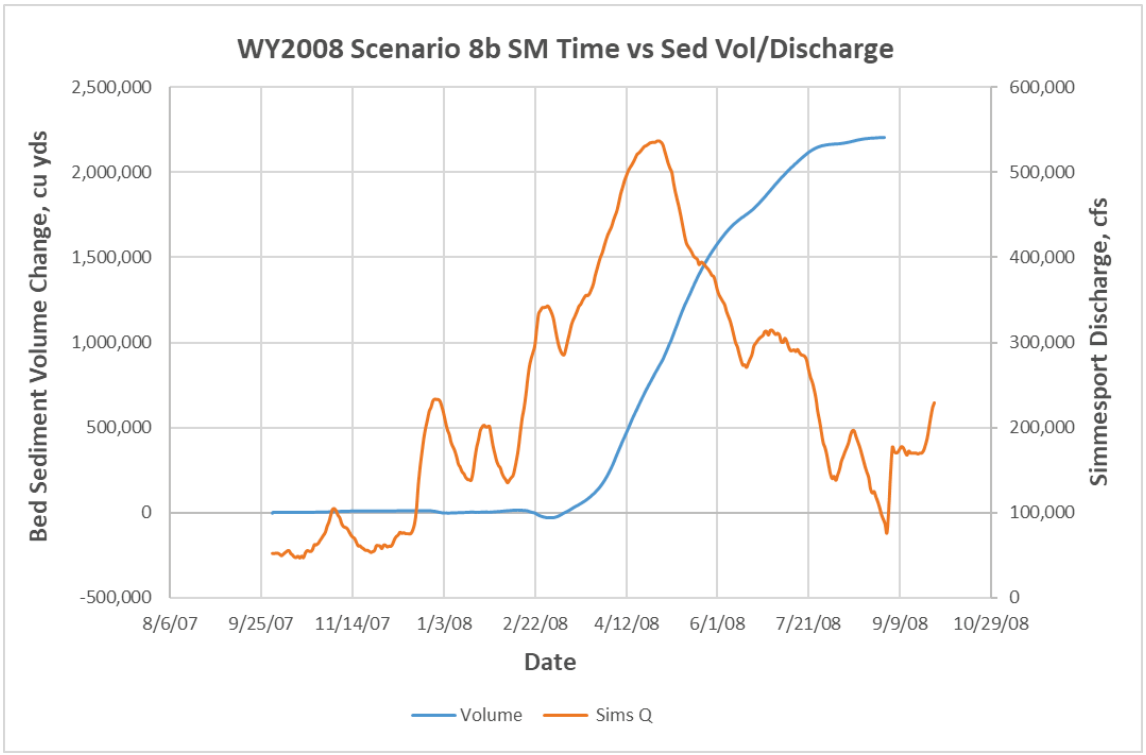


Plate B.22. Material 2 WY2008 Scenario 9 time versus sediment volume change/Simmesport discharge.

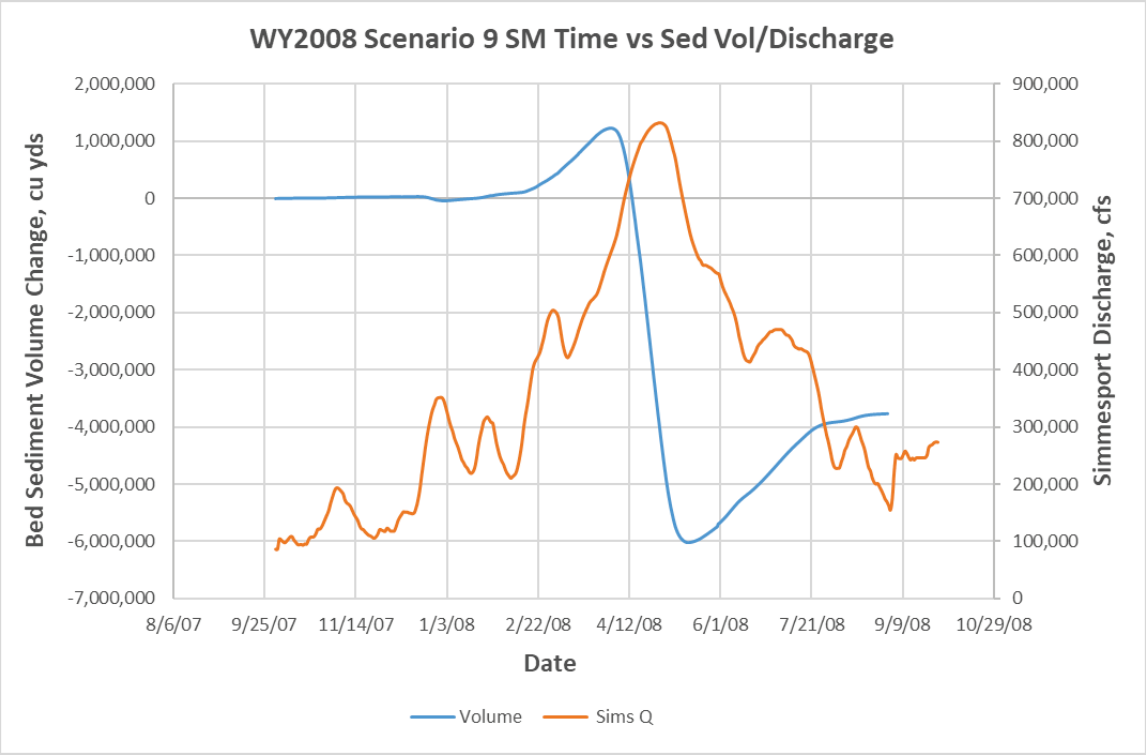


Plate B.23. Material 2 WY2008 Scenario 10 time versus sediment volume change/Simmesport discharge.

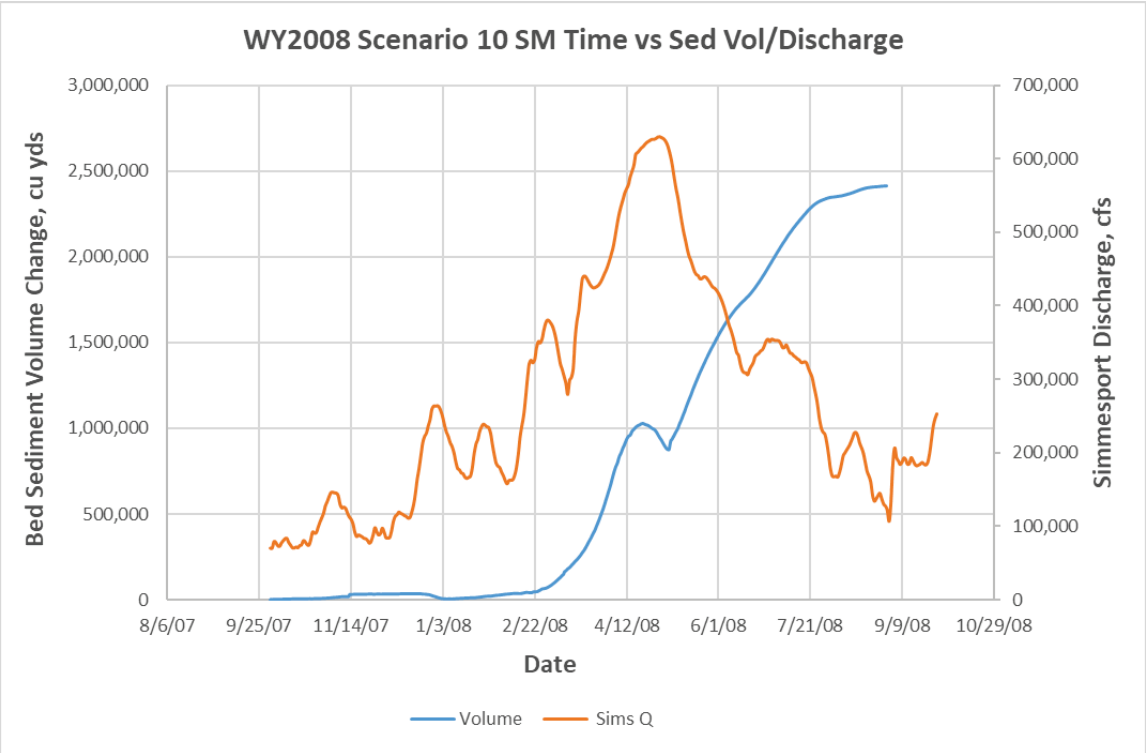
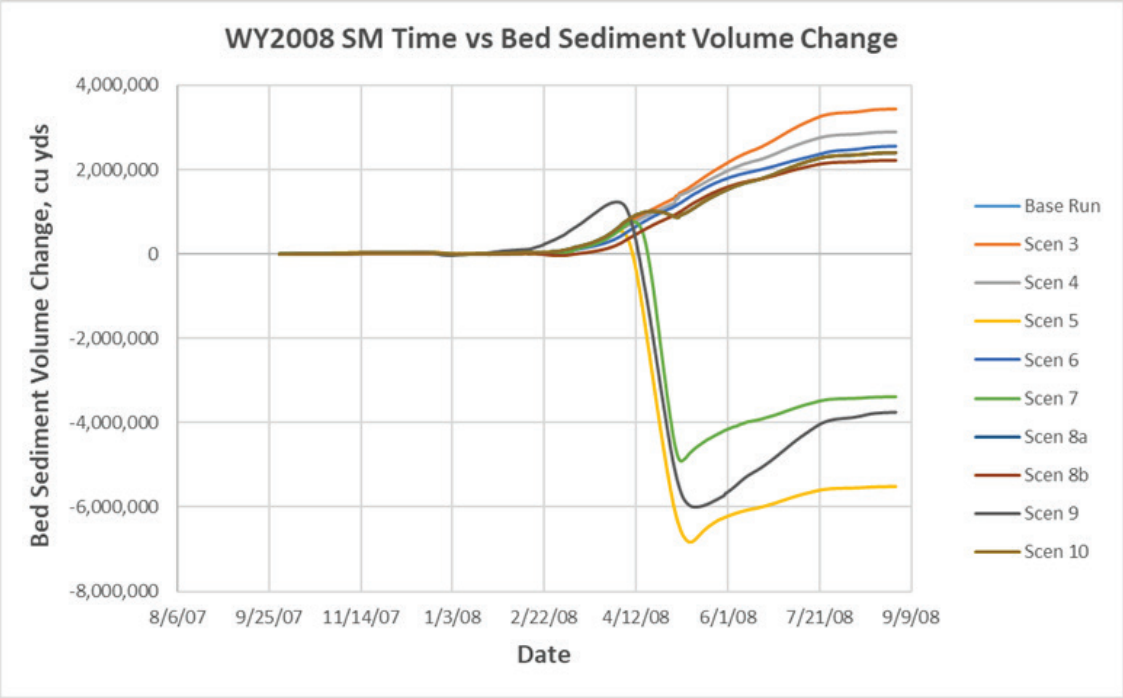


Plate B.24. Material 2 WY2008 Base Run and Scenarios 3–10 time versus sediment volume change.



B.3 Material 1 Dredge Placement Scenarios 11–14

Plate B.25. Material 1 Dredge Placement Scenarios 11–14.

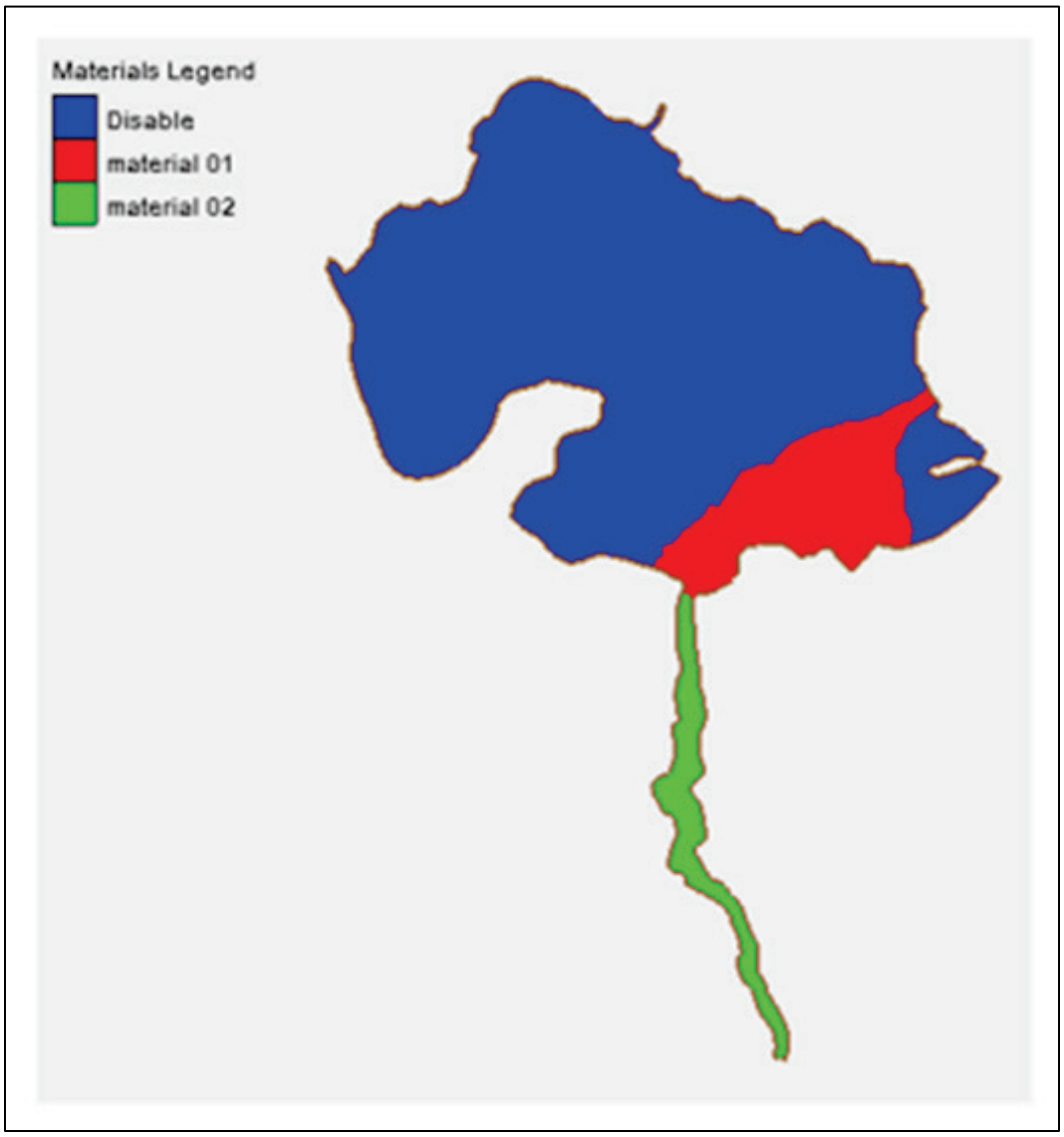


Plate B.26. Material 1 WY2008 Scenario 11 time versus sediment volume change/Simmesport discharge.

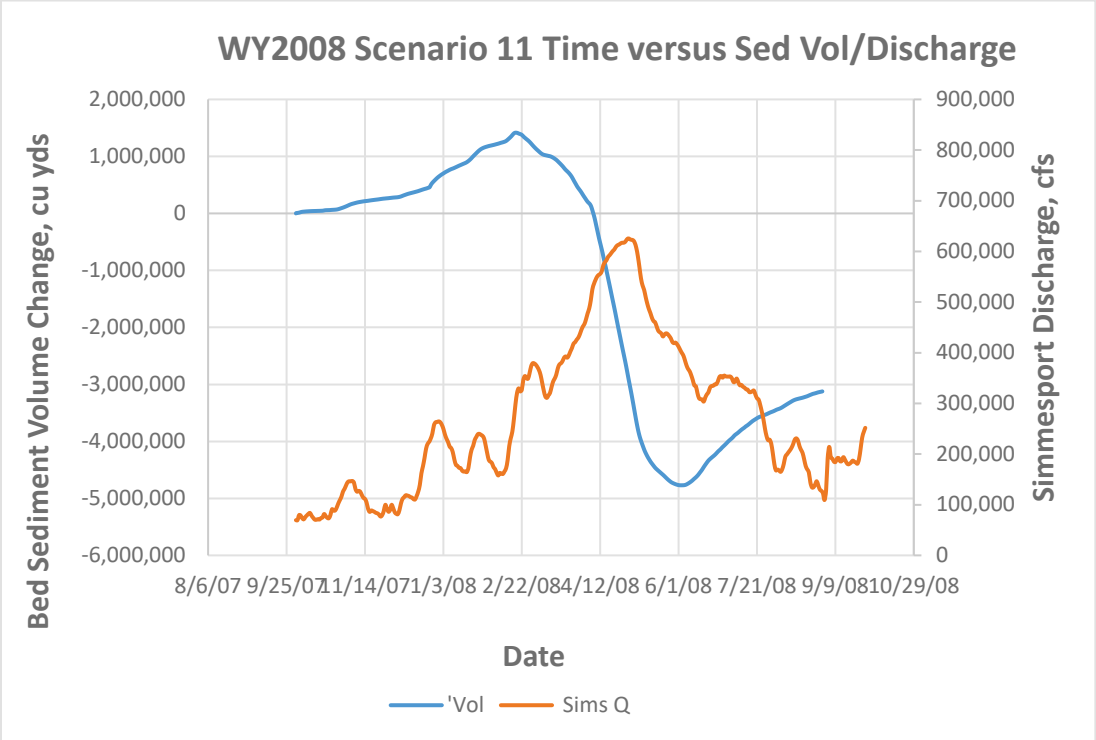


Plate B.27. Material 1 WY2008 Scenario 12 time versus sediment volume change/Simmesport discharge.

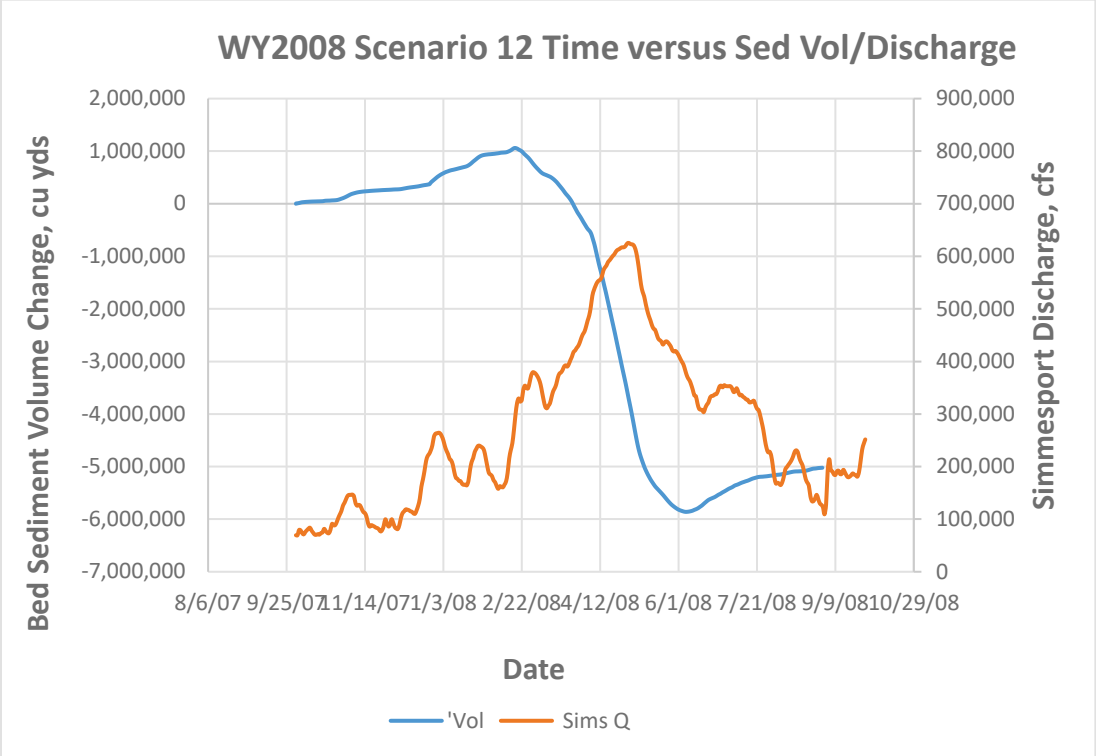


Plate B.28. Material 1 WY2008 Scenario 13 time versus sediment volume change/Simmesport discharge.

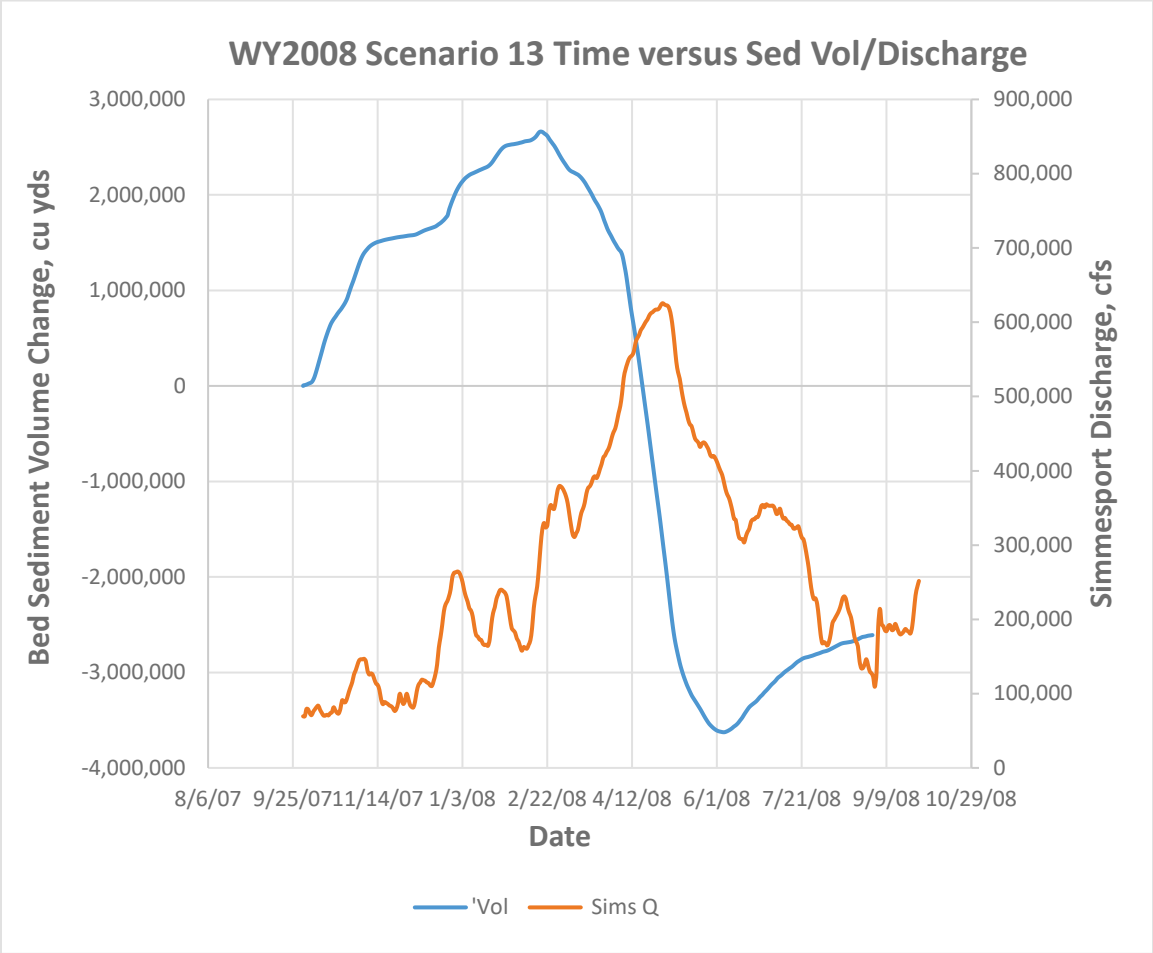


Plate B.29. Material 1 WY2008 Scenario 14 time versus sediment volume change/Simmesport discharge.

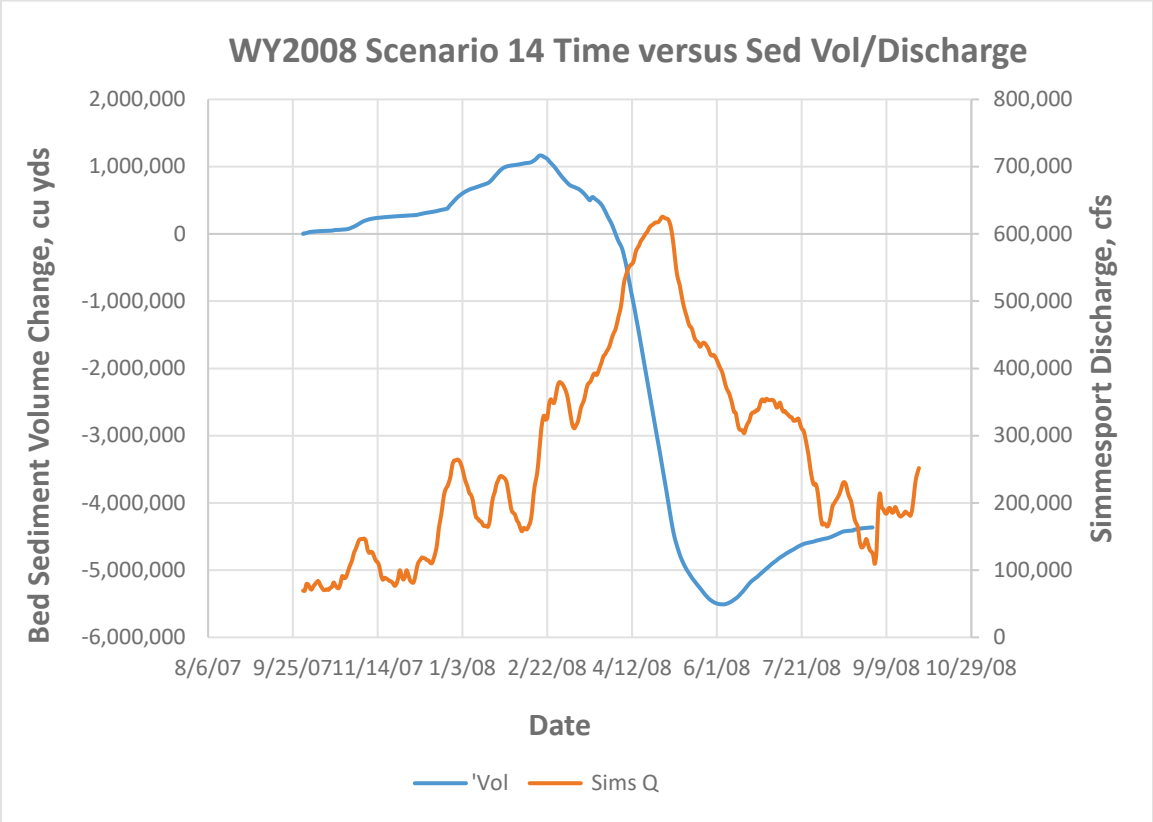
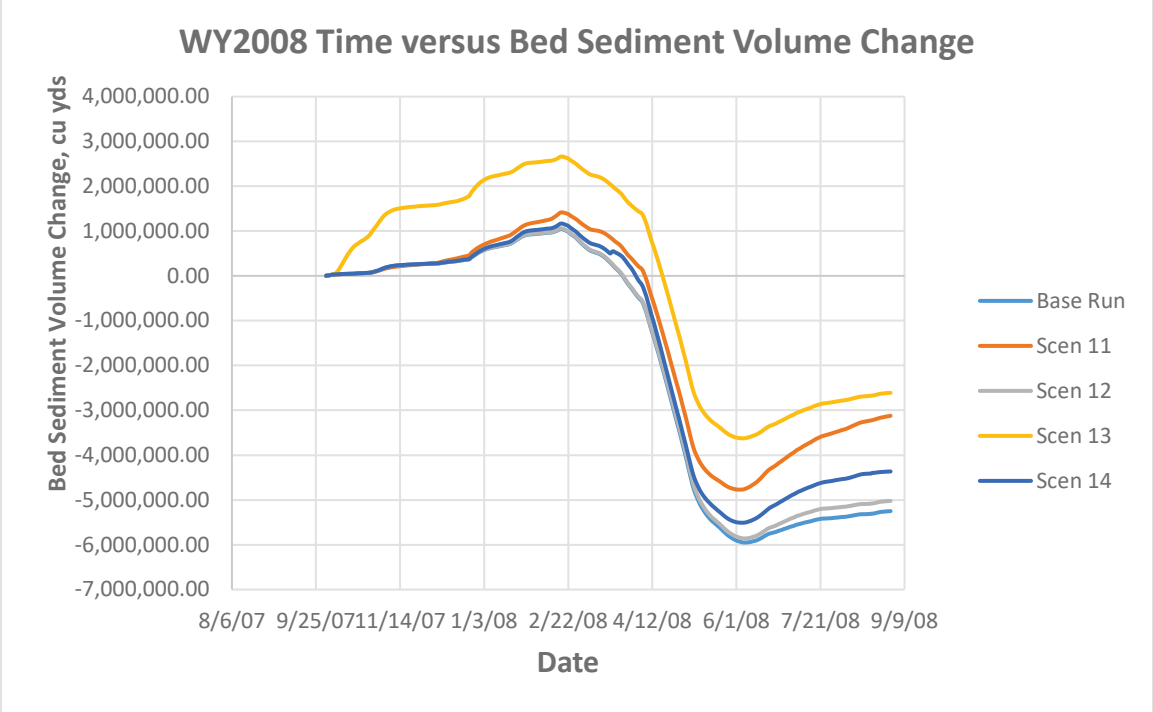


Plate B.30. Material 1 WY2008 Base Run and Scenario 11–14 time versus sediment volume change.



B.4 Material 2 Dredge Placement Scenarios 11–14

Plate B.31. Material 2 dredge placement scenarios.

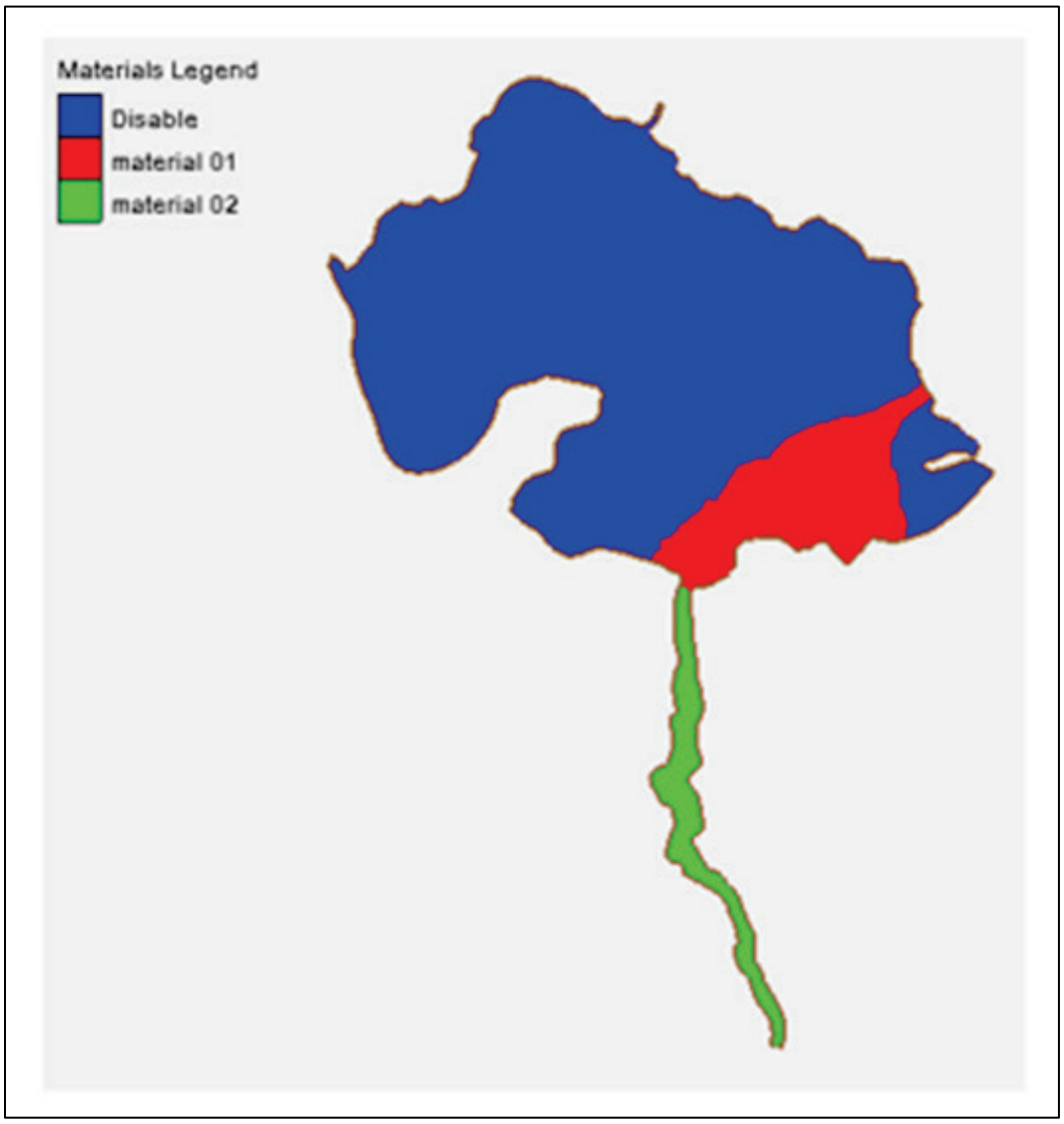


Plate B.32. Material 2 WY2008 Scenario 11 time versus sediment volume change/Simmesport discharge.

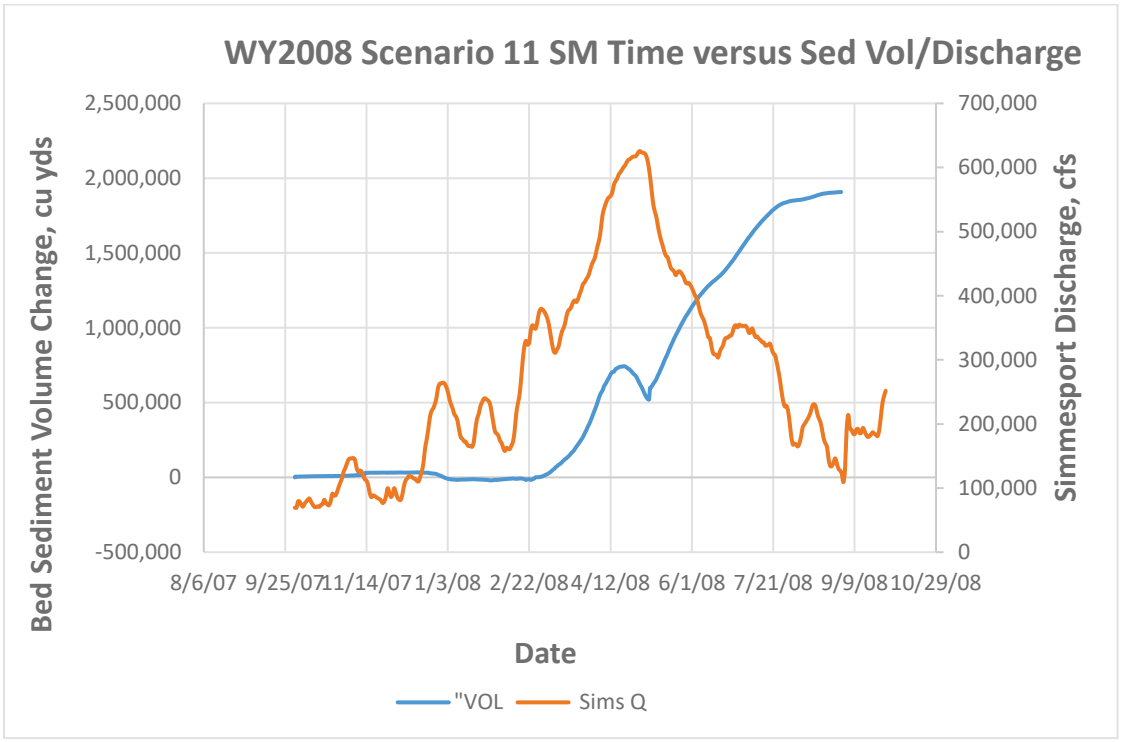


Plate B.33. Material 2 WY2008 Scenario 12 time versus sediment volume change/Simmesport discharge.

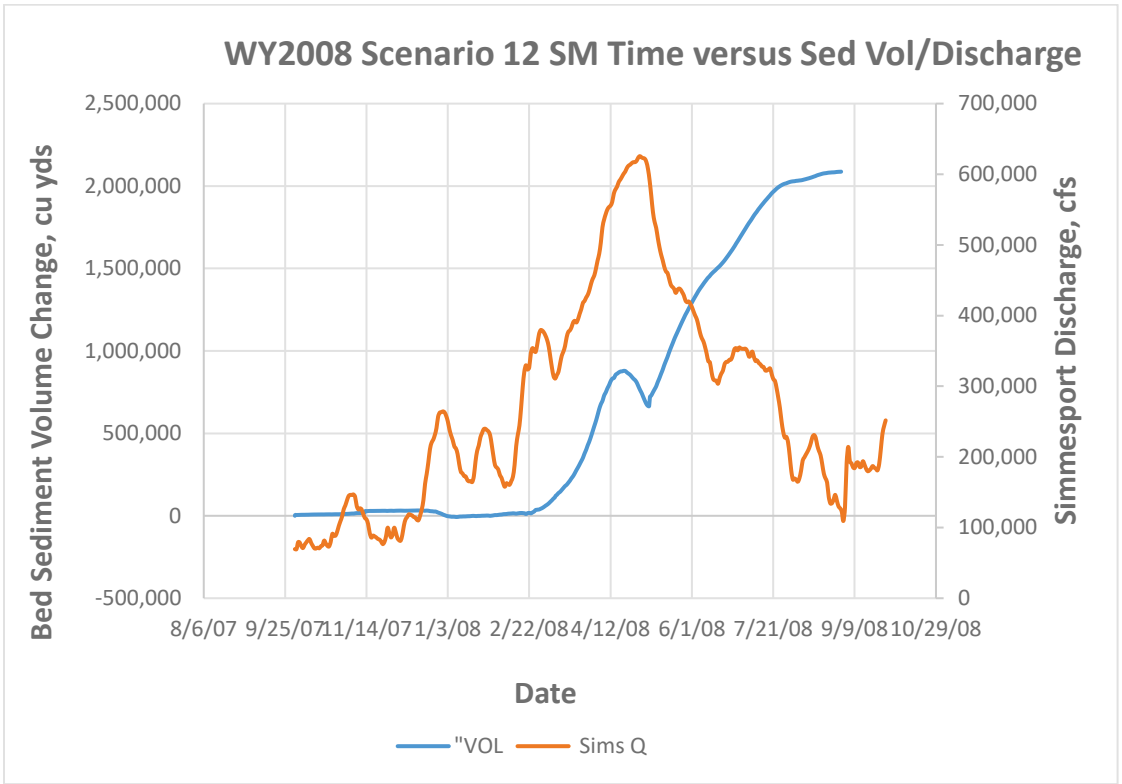


Plate B.34. Material 2 WY2008 Scenario 13 time versus sediment volume change/Simmesport discharge.

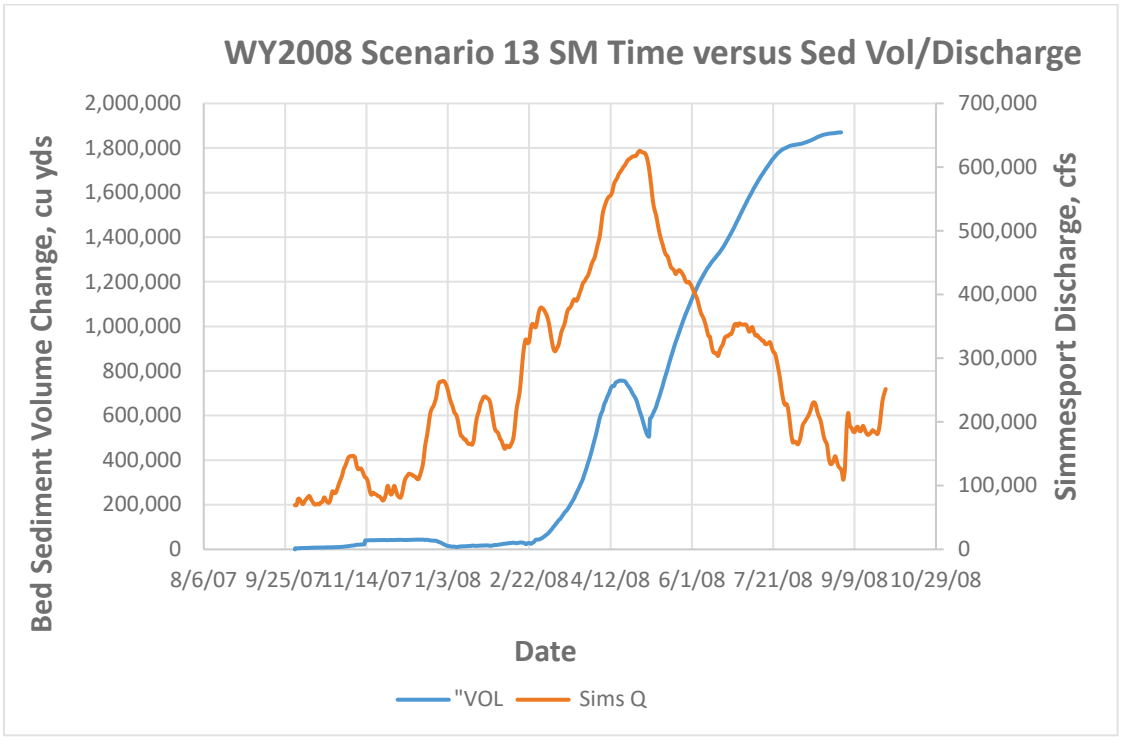


Plate B.35. Material 2 WY2008 Scenario 14 time versus sediment volume change/Simmesport discharge.

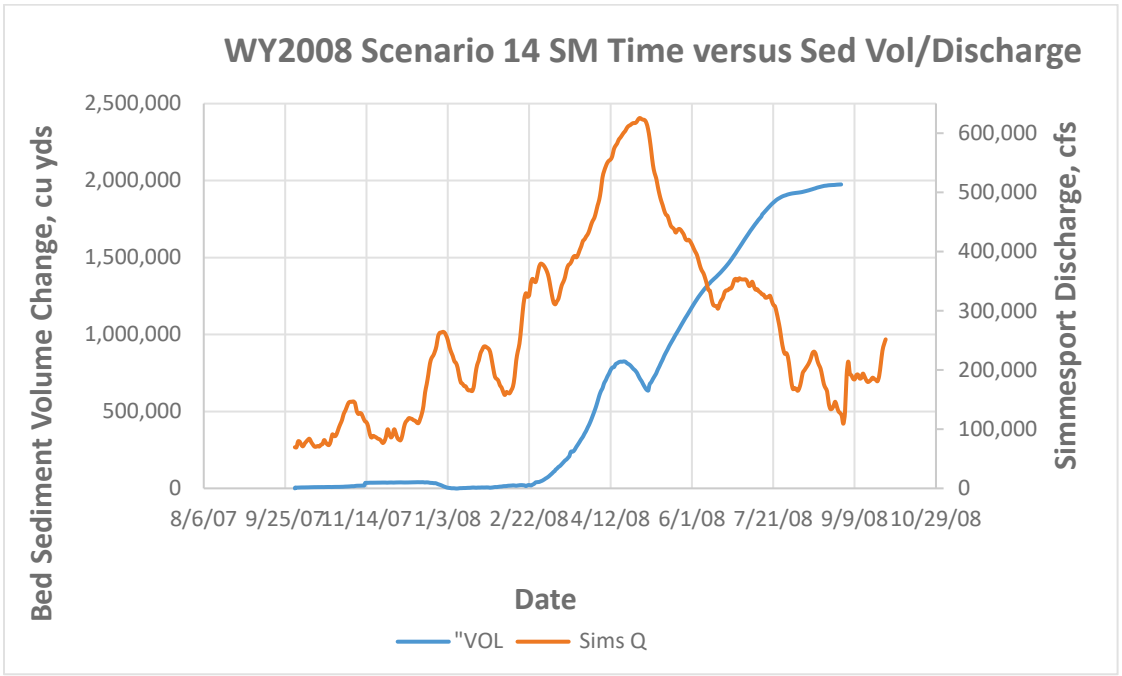
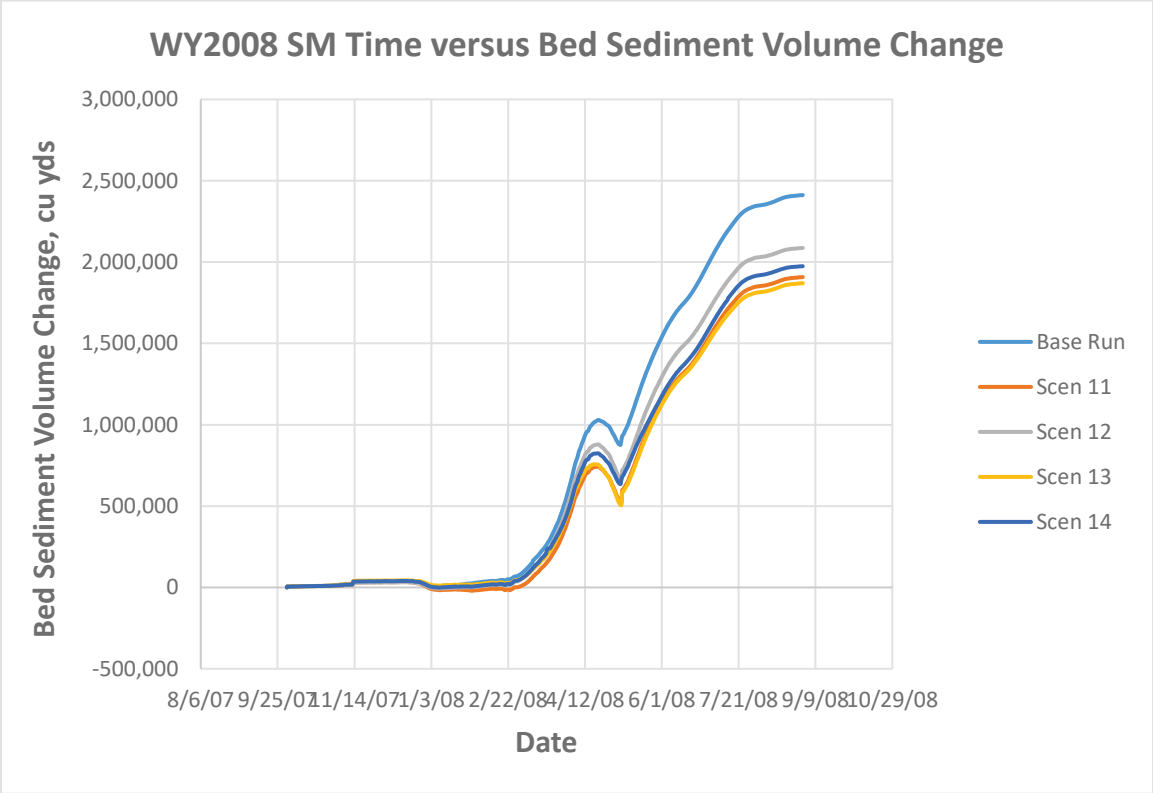


Plate B.36. Material 2 WY2008 Base Run and Scenario 11–14 time versus sediment volume change.



B.5 Material 1 Structure Options 19 and 20

Plate B.37. Material 1 Structures Options 19 and 20.

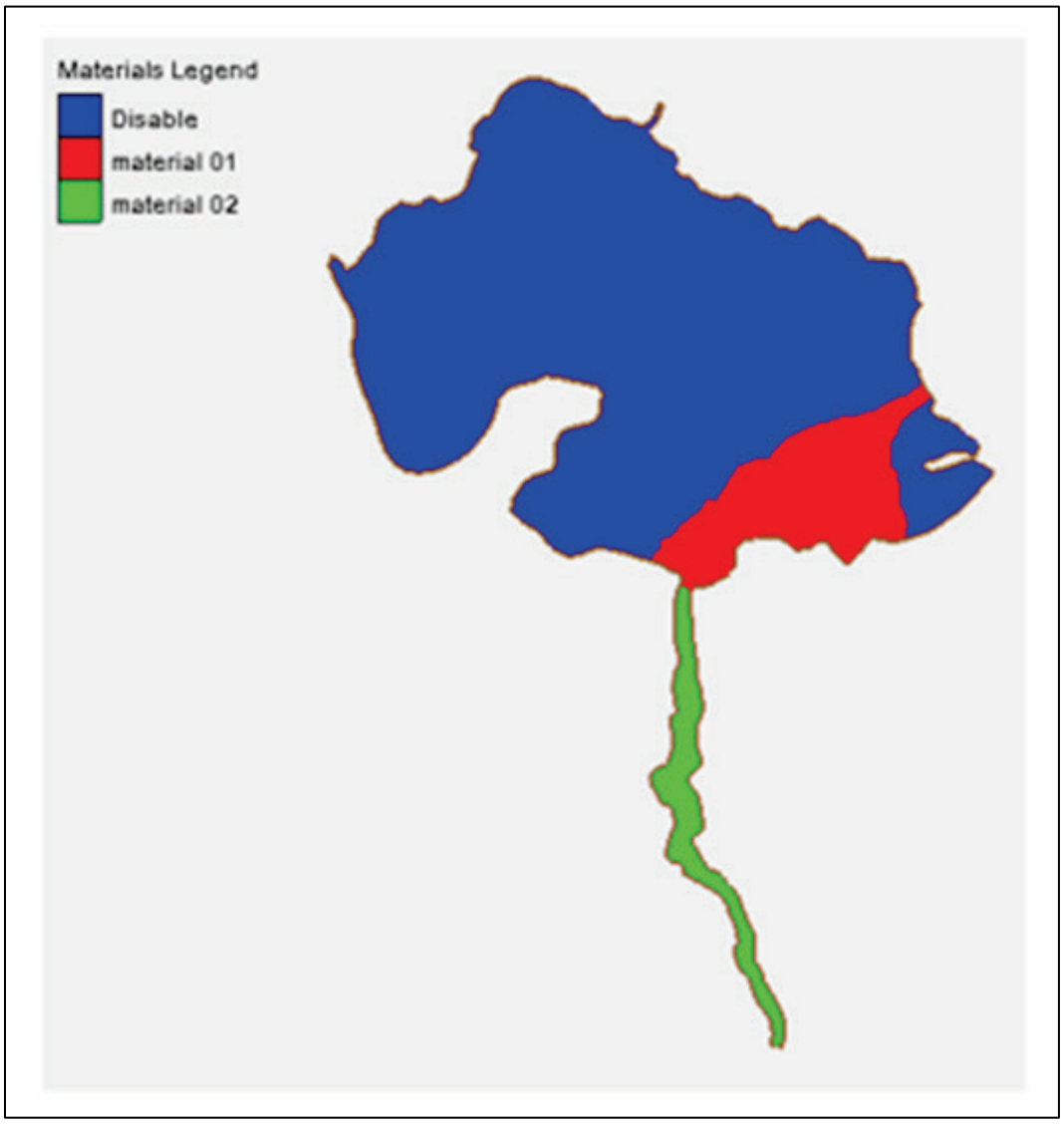


Plate B.38. Material 1 WY2008 Scenario 19 time versus sediment volume change/Simmesport discharge.

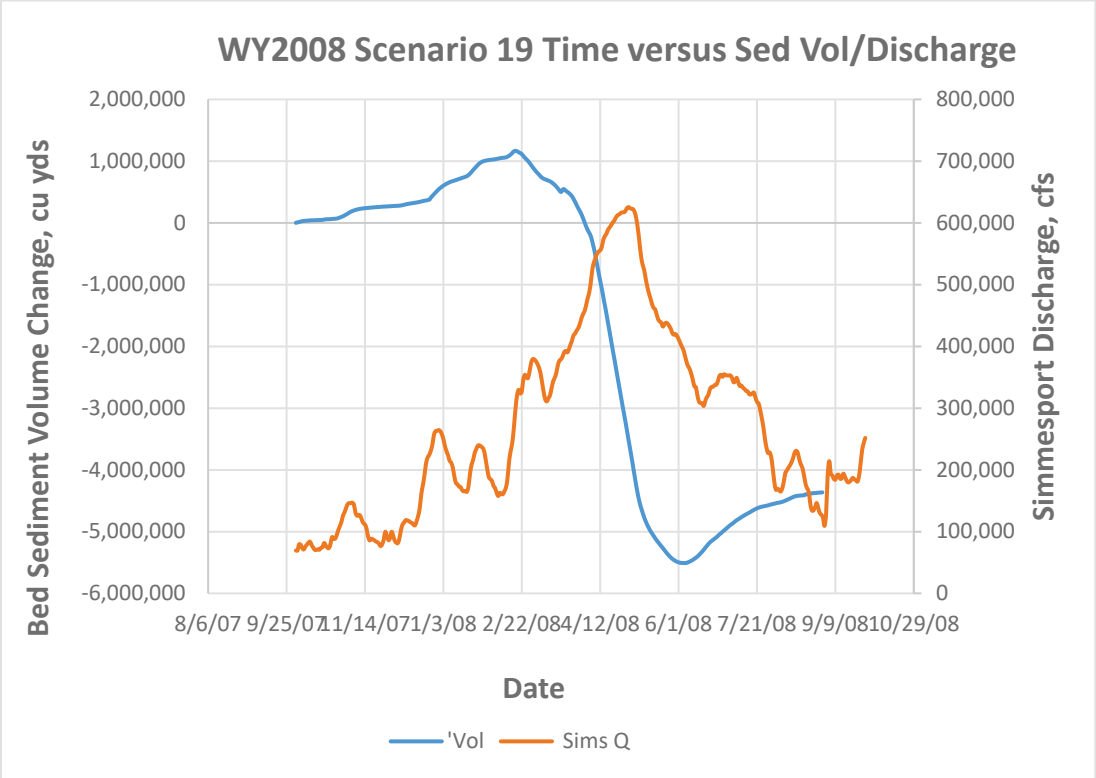


Plate B.39. Material 1 WY2008 Scenario 20 time versus sediment volume change/Simmesport discharge.

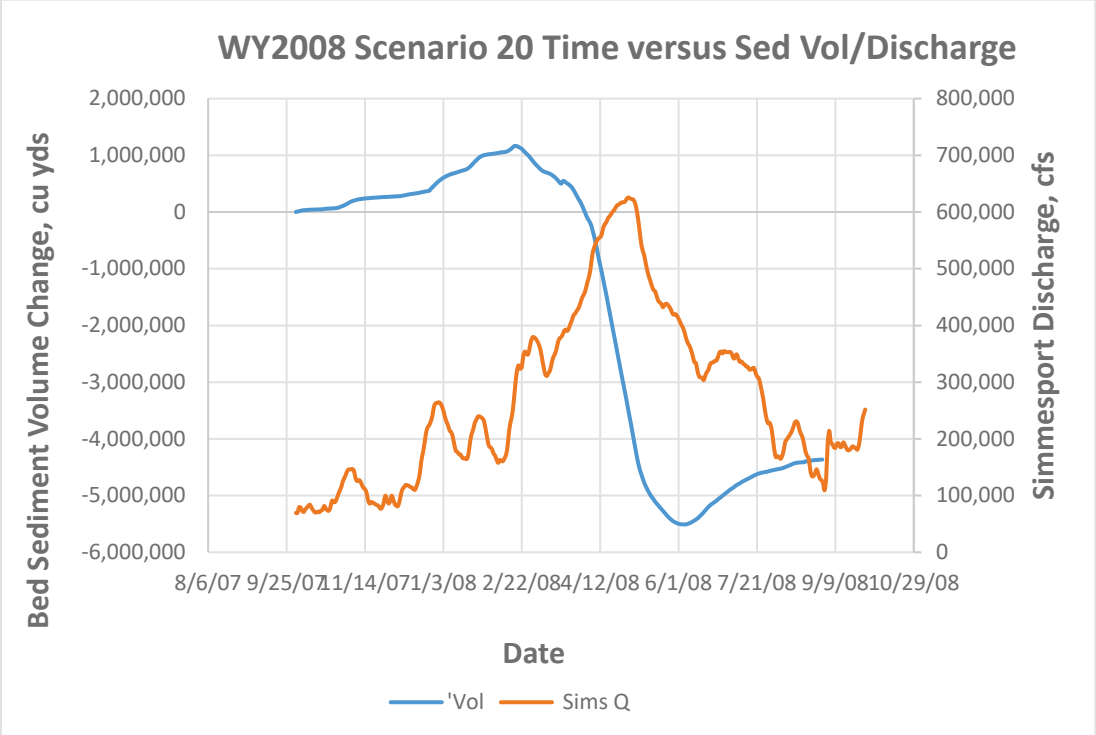
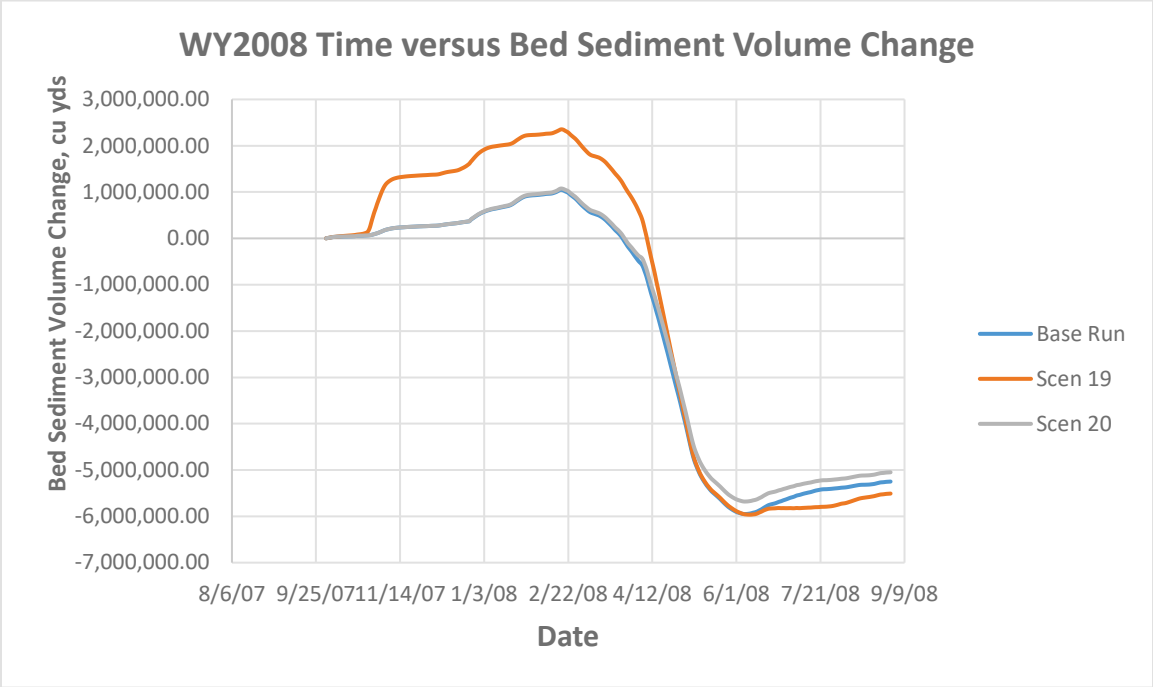


Plate B.40. Material 1 WY2008 Base Run, Scenario 19 and 20 time versus sediment volume change.



B.6 Material 2 Structure Options Scenario 19 and 20

Plate B.41. Material 2 Structure Options Scenario 19 and 20.

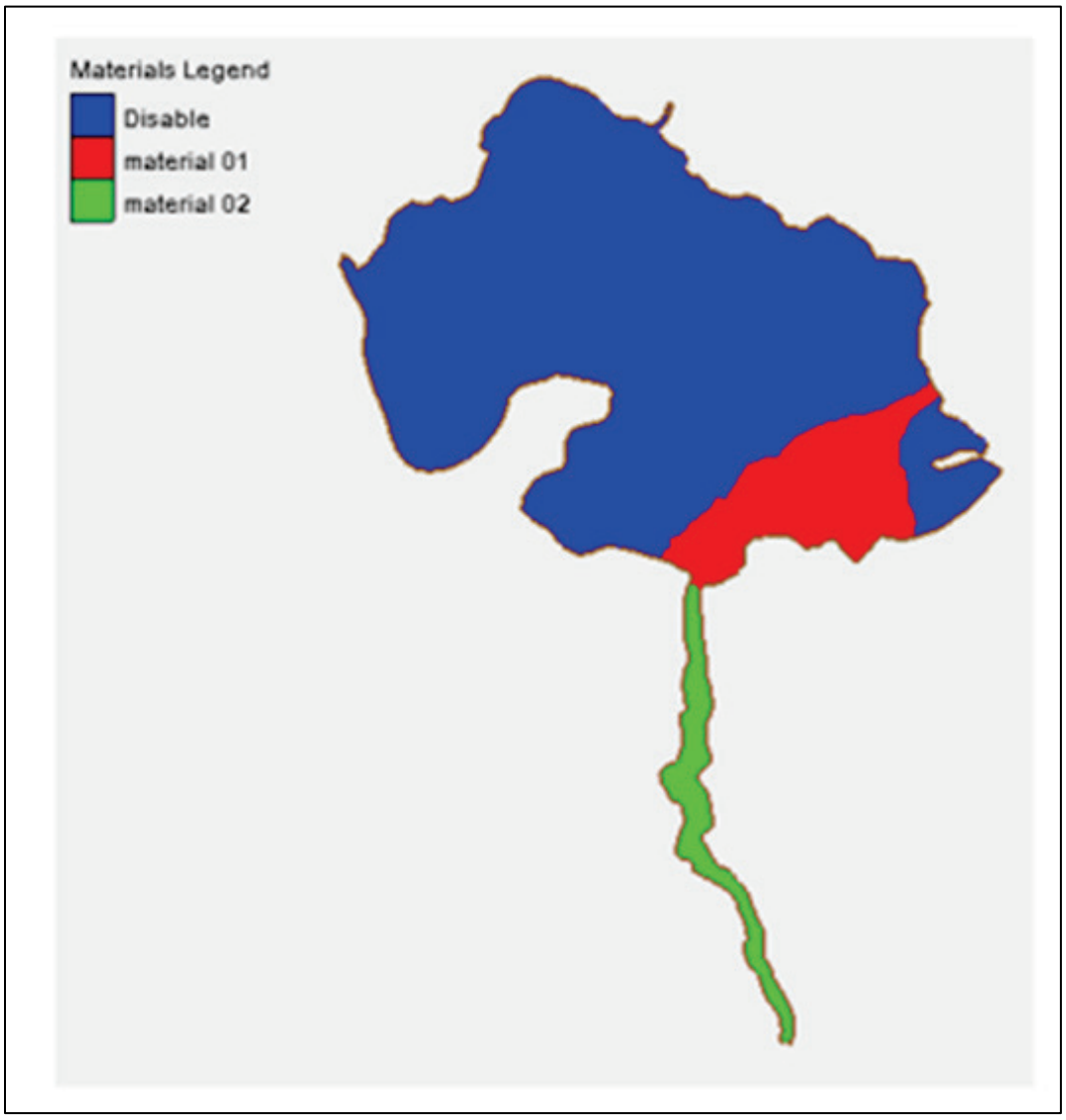


Plate B.42. Material 2 WY2008 Scenario 19 time versus sediment volume change/Simmesport discharge.

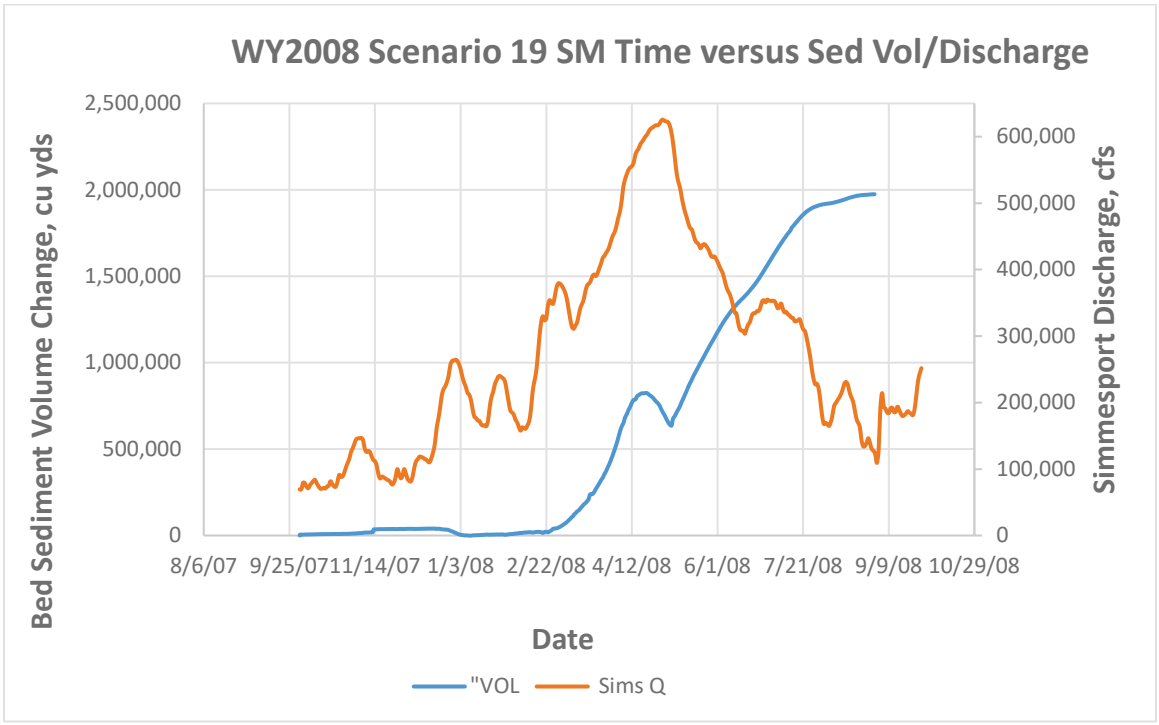


Plate B.43. Material 2 WY2008 Scenario 20 time versus sediment volume change/Simmesport discharge.

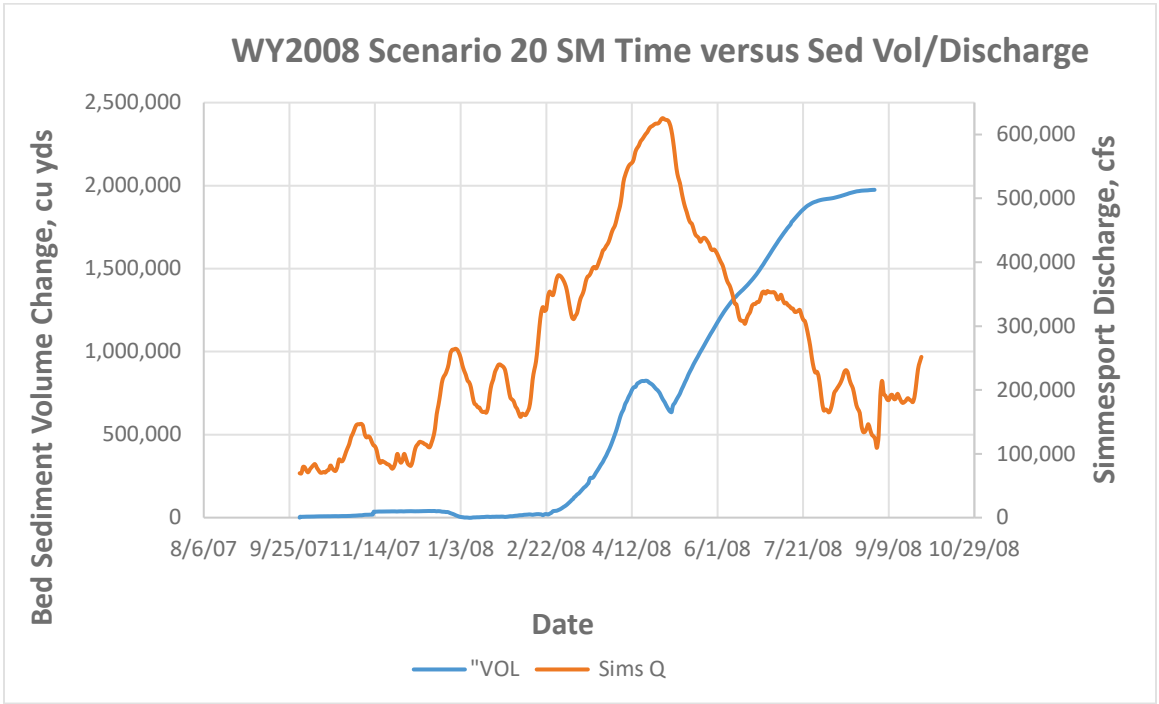
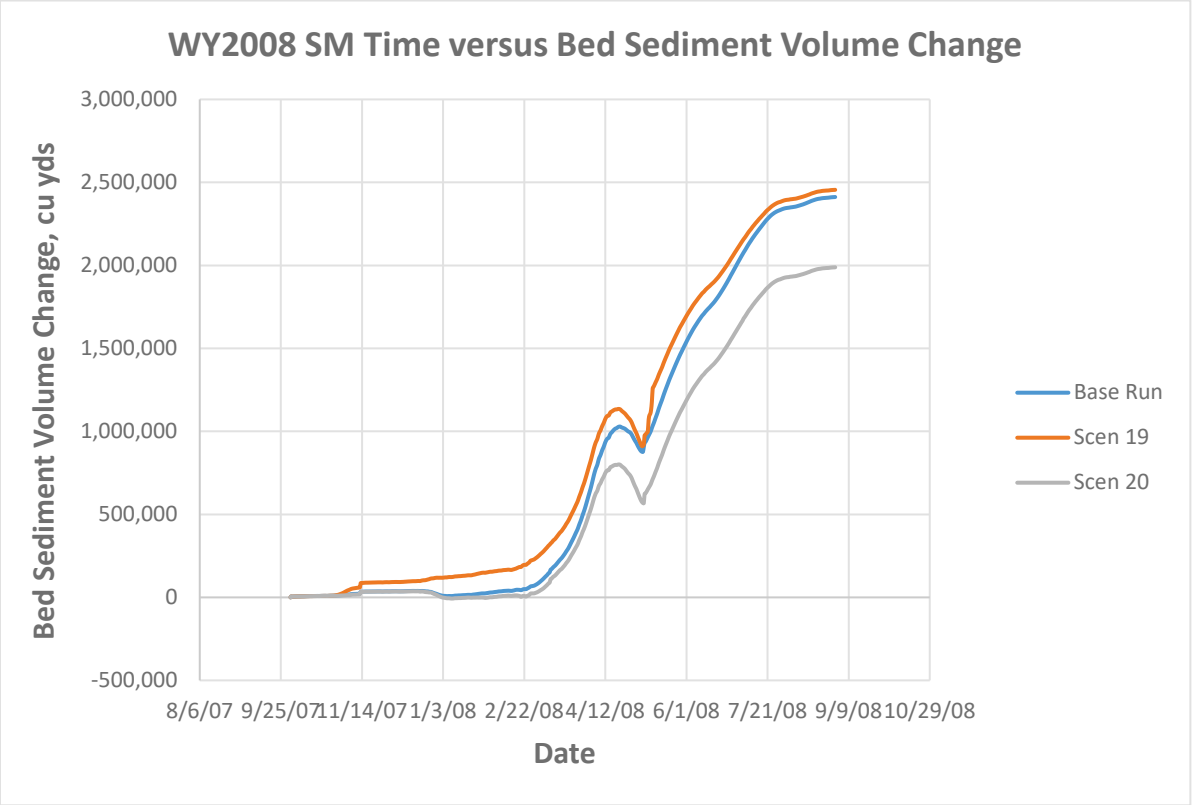


Plate B.44. Material 2 WY2008 Base Run, Scenario 19 and 20 time versus sediment volume change.



Appendix C: WY2008, WY2012, and WY2013 Accumulated Coarse Sediment Load

Plate C.1. WY2008, WY2012 and WY2013 Scenarios 3–10 Accumulated Coarse Sediment Load through Outflow Channel USGS gage Location.

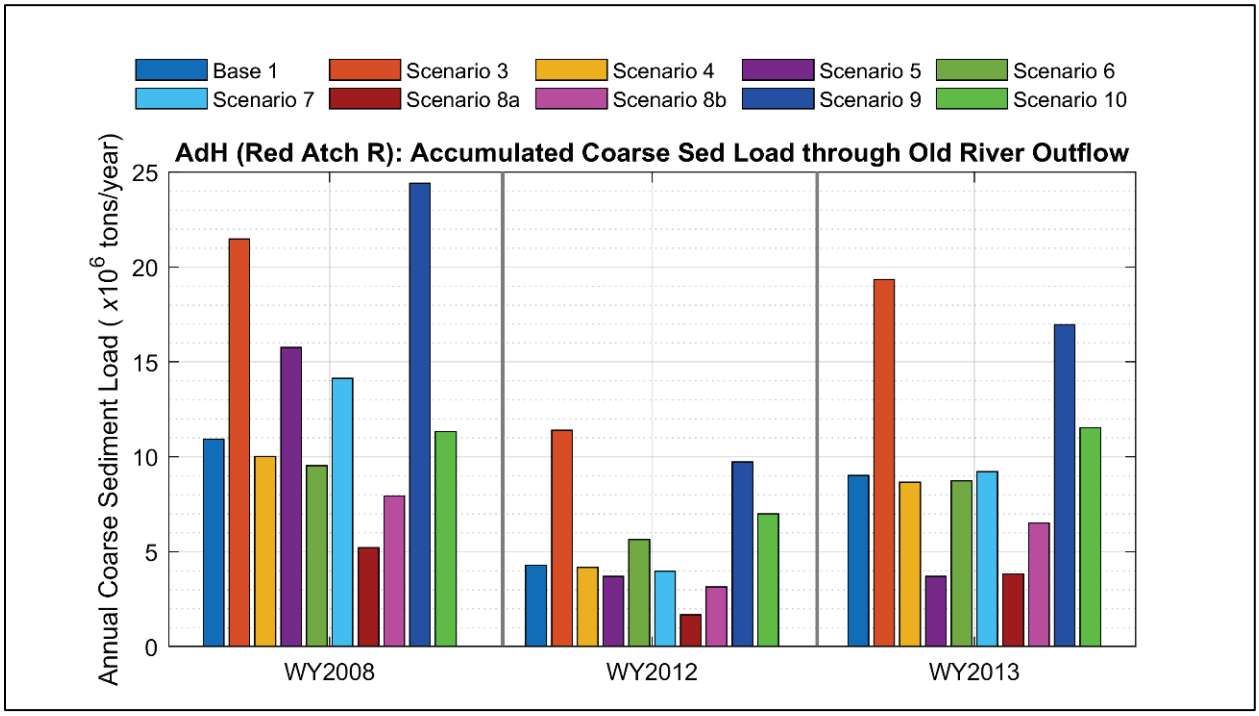


Plate C.2. WY2008, WY2012 and WY2013 Scenarios 3–10 Accumulated Coarse Sediment Load through Red River USGS gage Location.

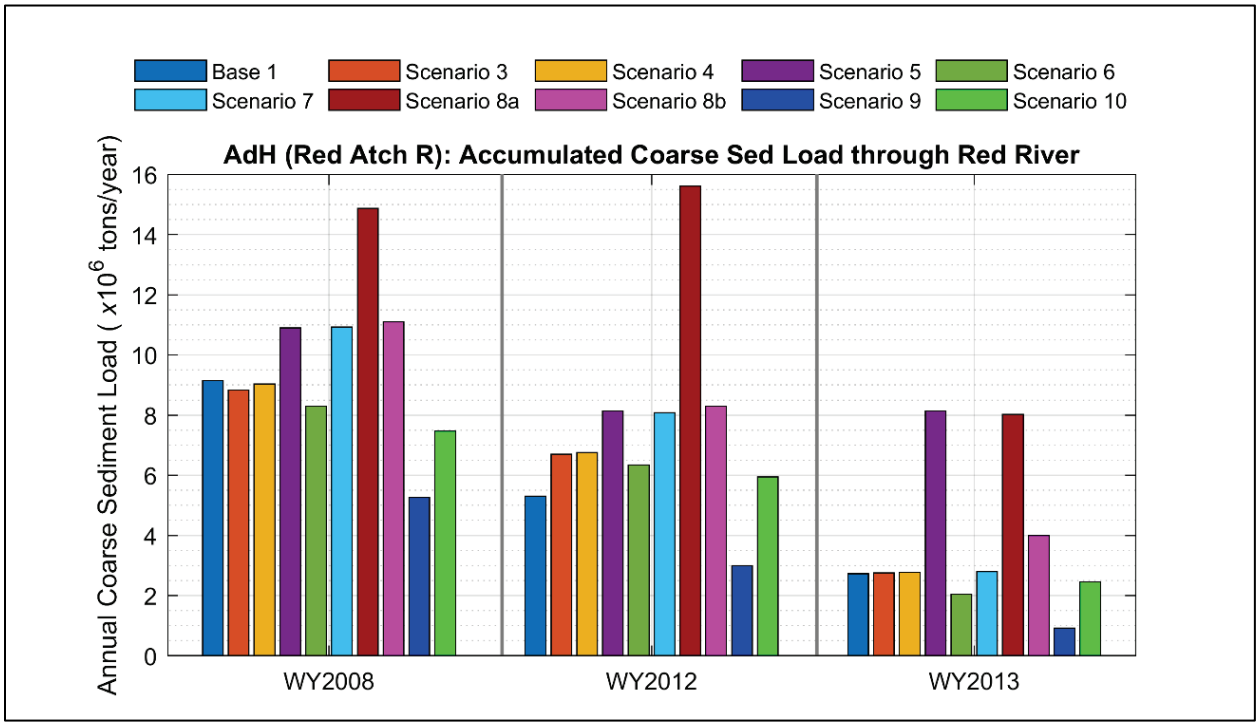


Plate C.3. WY2008, WY2012 and WY2013 Scenario 3–10 Accumulated Coarse Sediment Load through Simmesport USGS gage Location.

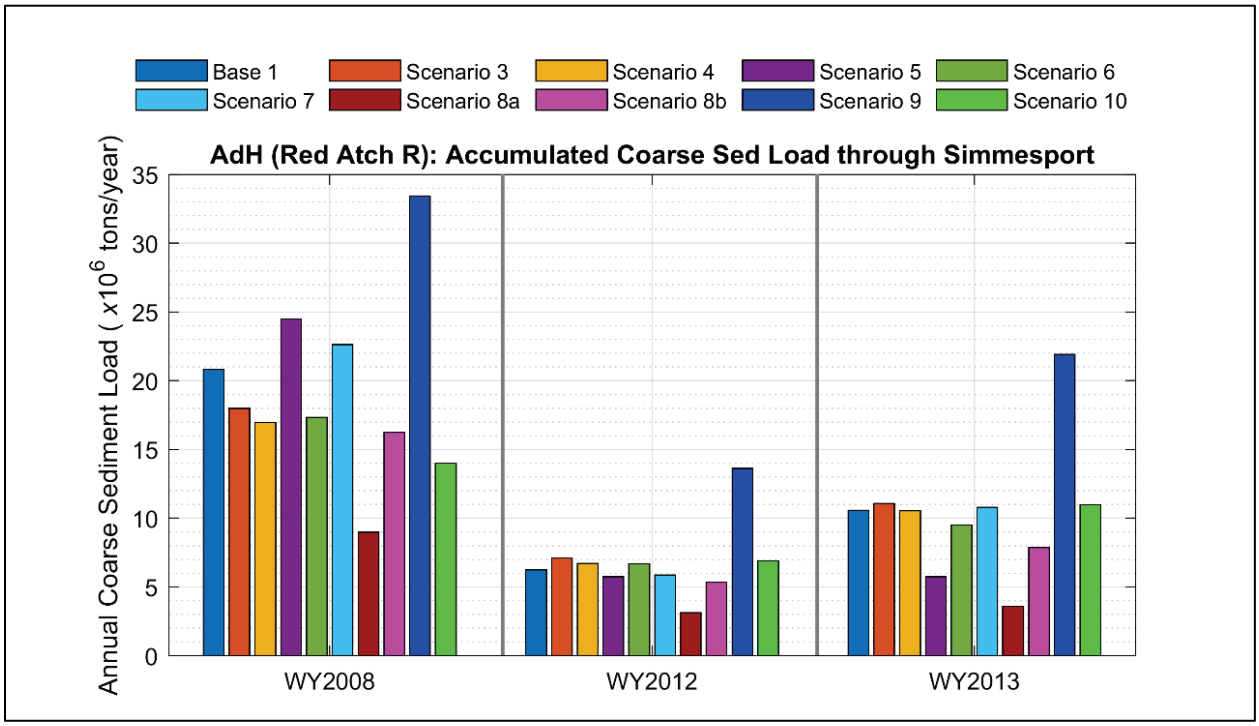


Plate C.4. WY2008, WY2012 and WY2013 Dredge Displacement Scenarios 11–14 Accumulated Coarse Sediment Load through Outflow Channel USGS gage Location.

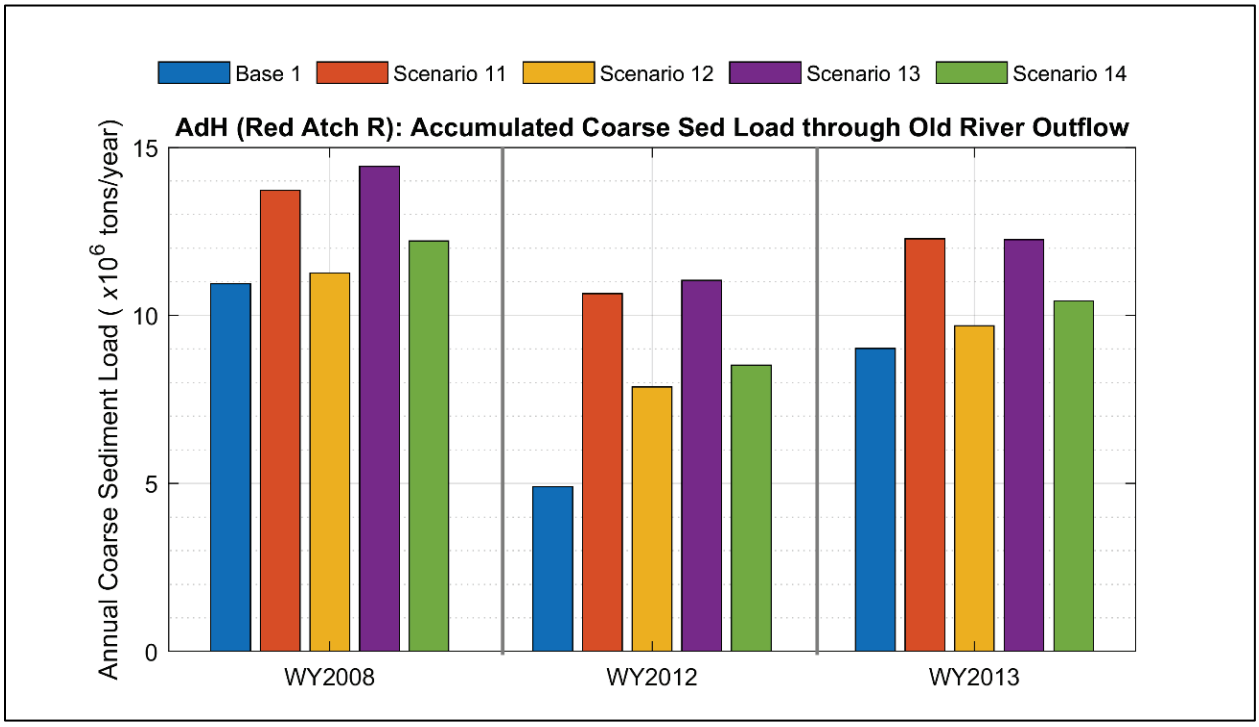


Plate C.5. WY2008, WY2012 and WY2013 Dredge Displacement Scenarios 11–14 Accumulated Coarse Sediment Load through Red River USGS gage Location.

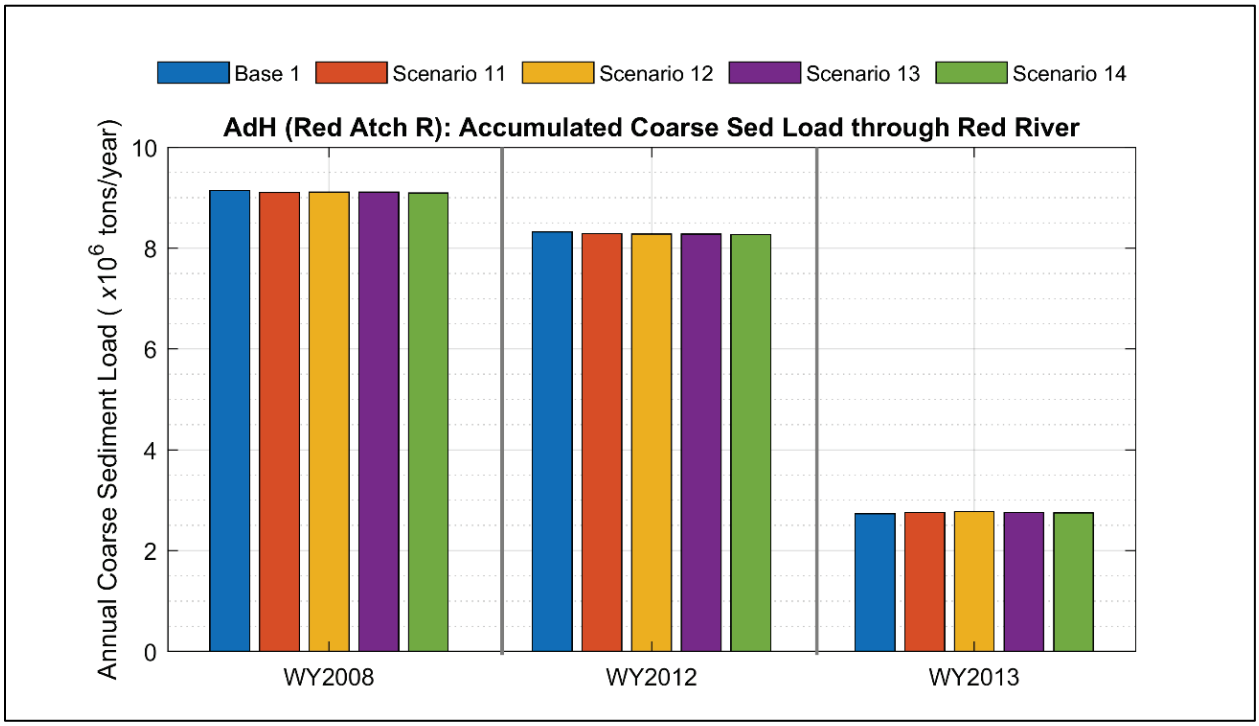


Plate C.6. WY2008, WY2012 and WY2013 Dredge Displacement Scenarios 11–14
Accumulated Coarse Sediment Load through Simmesport USGS gage Location.

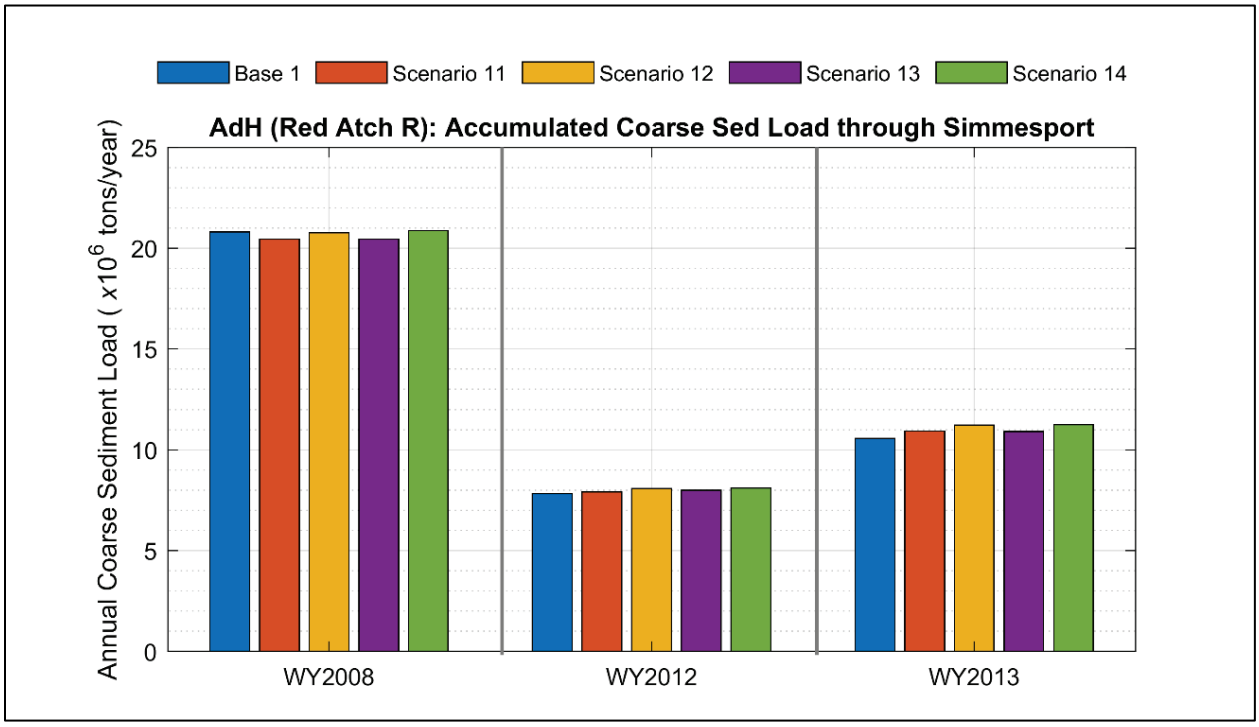


Plate C.7. WY2008, WY2012 and WY2013 Structures Options Scenarios 19 and 20
Accumulated Coarse Sediment Load through Outflow Channel USGS gage Location.

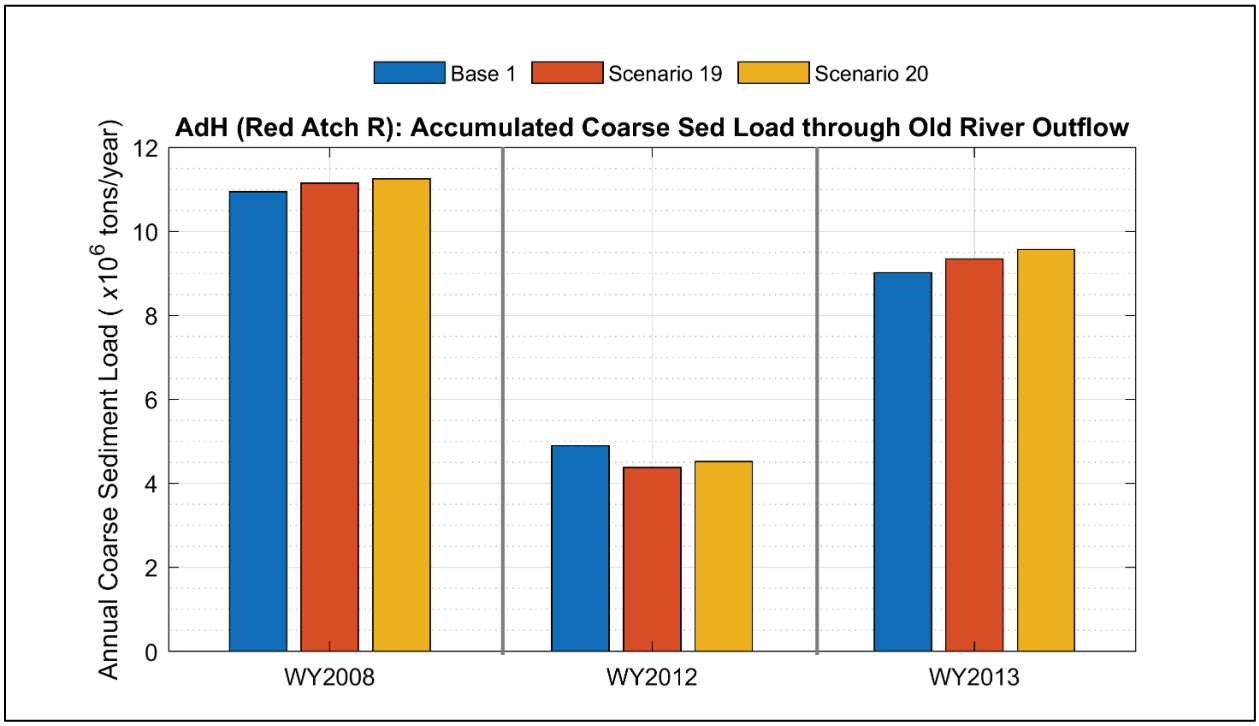


Plate C.8. WY2008, WY2012 and WY2013 Structures Options Scenarios 19 and 20 Accumulated Coarse Sediment Load through Red River USGS gage Location.

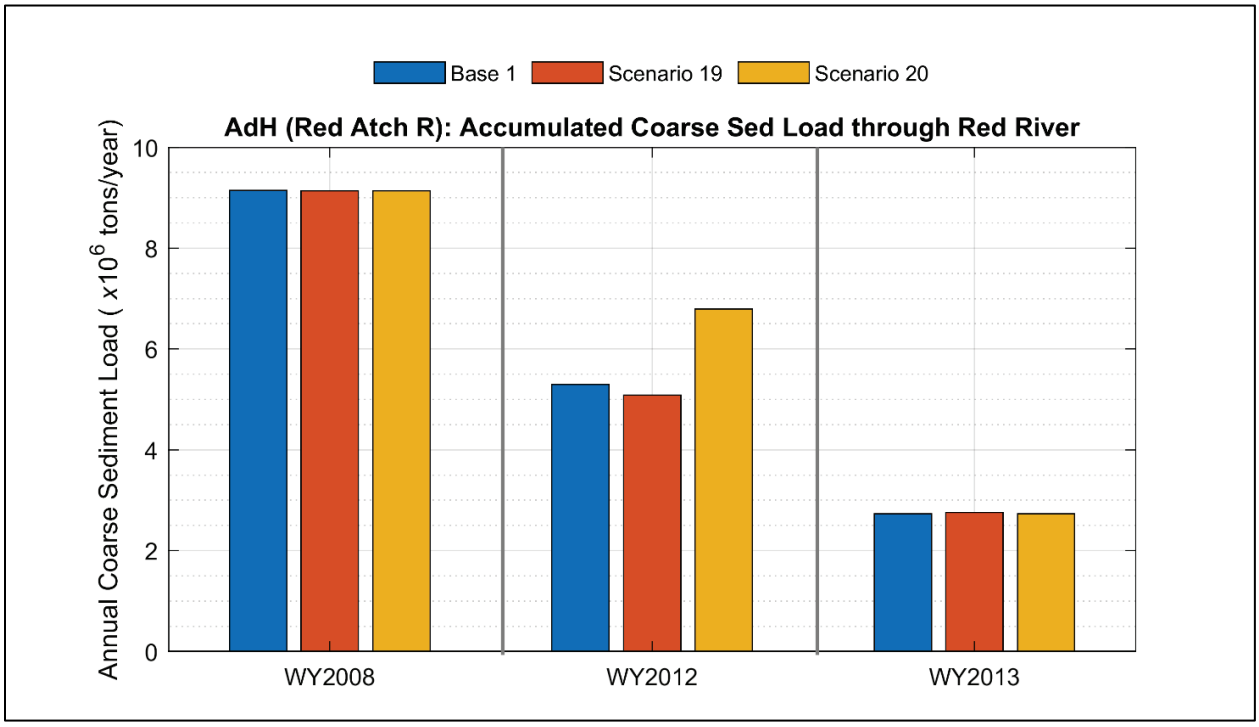
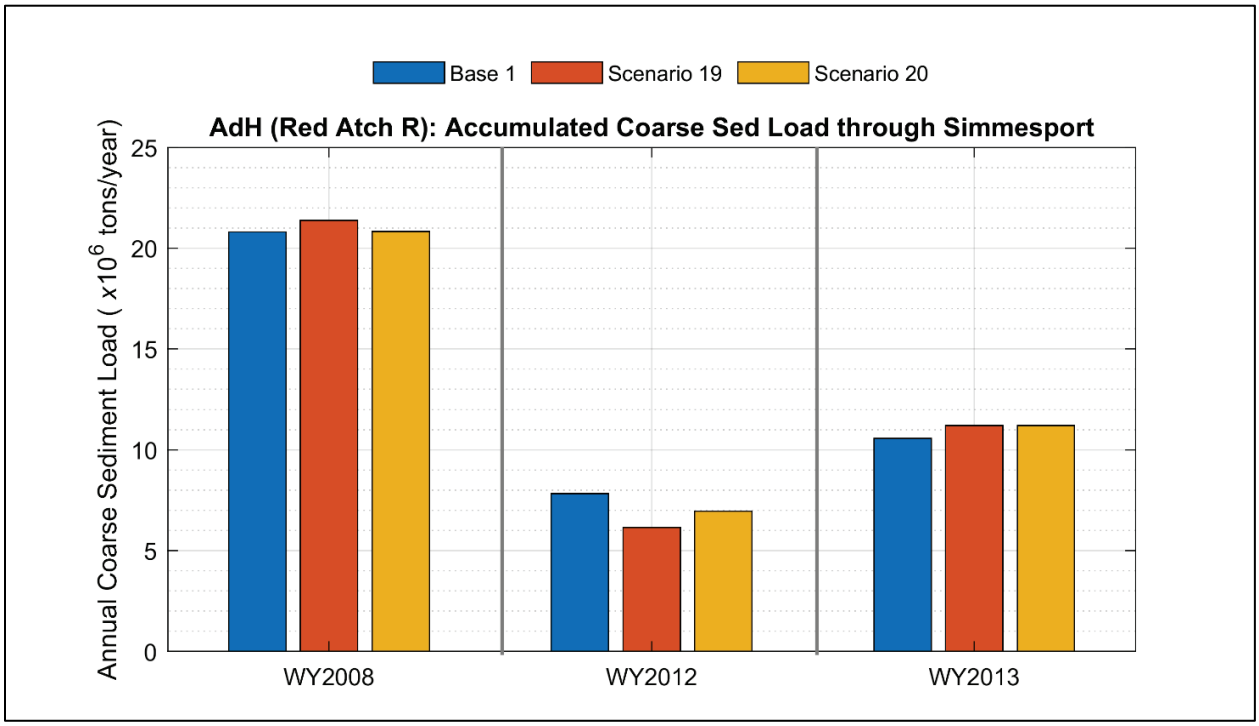


Plate C.9. WY2008, WY2012 and WY2013 Structures Options Scenarios 19 and 20 Accumulated Coarse Sediment Load through Simmesport USGS gage Location.



Appendix D: WY2012 BDD

The BDD presented in this appendix are screen captures of the Surface Modeling System (SMS) software used to visualize the bed transformation for the last time step of WY2012. The legend is in meters and is color coded to visualize the sediment transport trends over the whole water year.

D.1 WY2012 Base Run

Plate D.1. WY2012 Base Run BDD RR RM 43–RR RM 39.

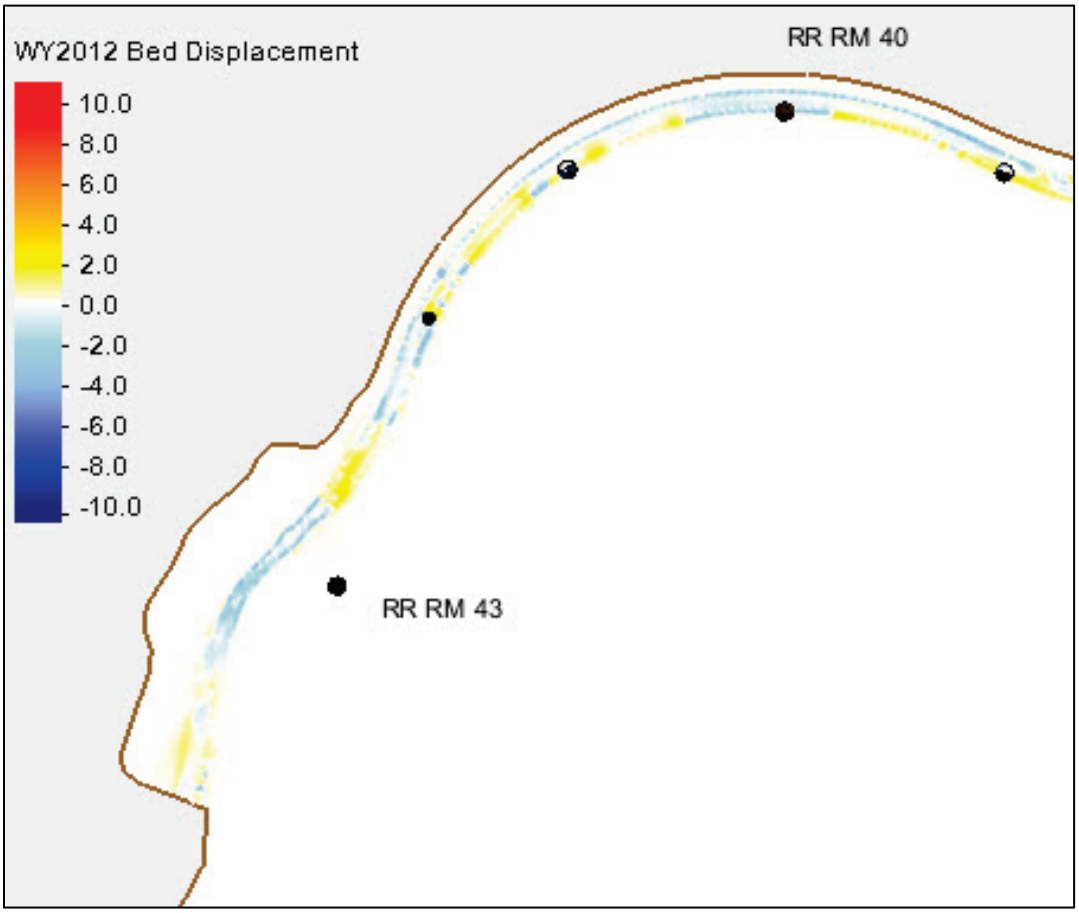


Plate D.2. WY2012 Base Run BDD RR RM 40–RR RM 35.

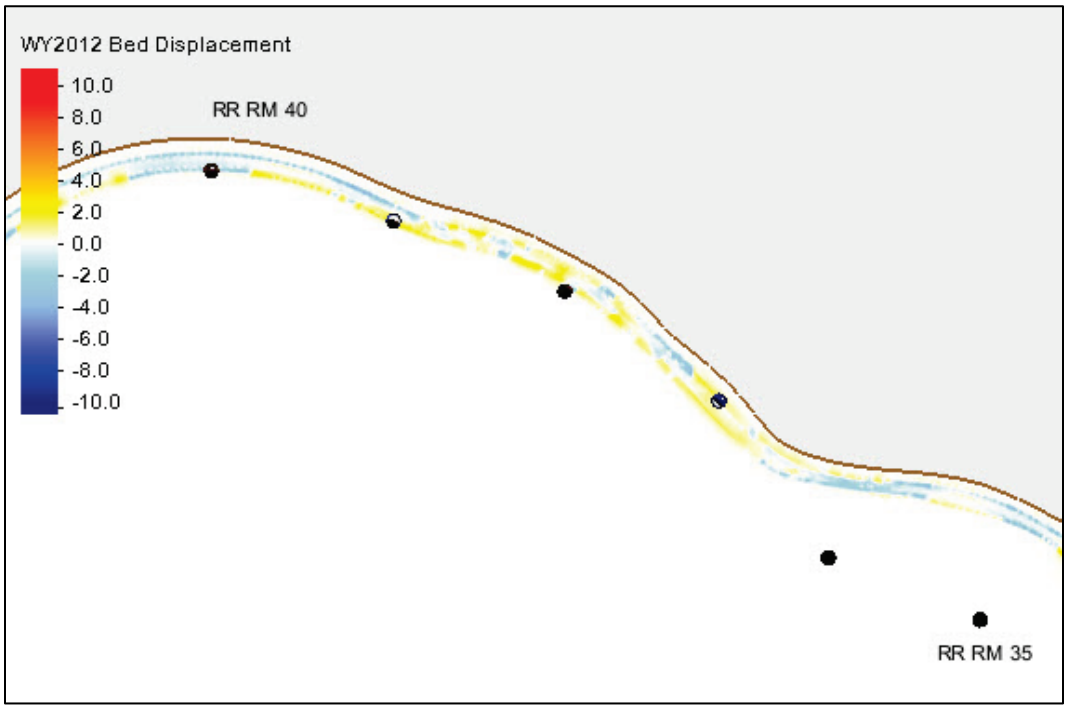


Plate D.3. WY2012 Base Run BDD RR RM 35–RR RM 30.

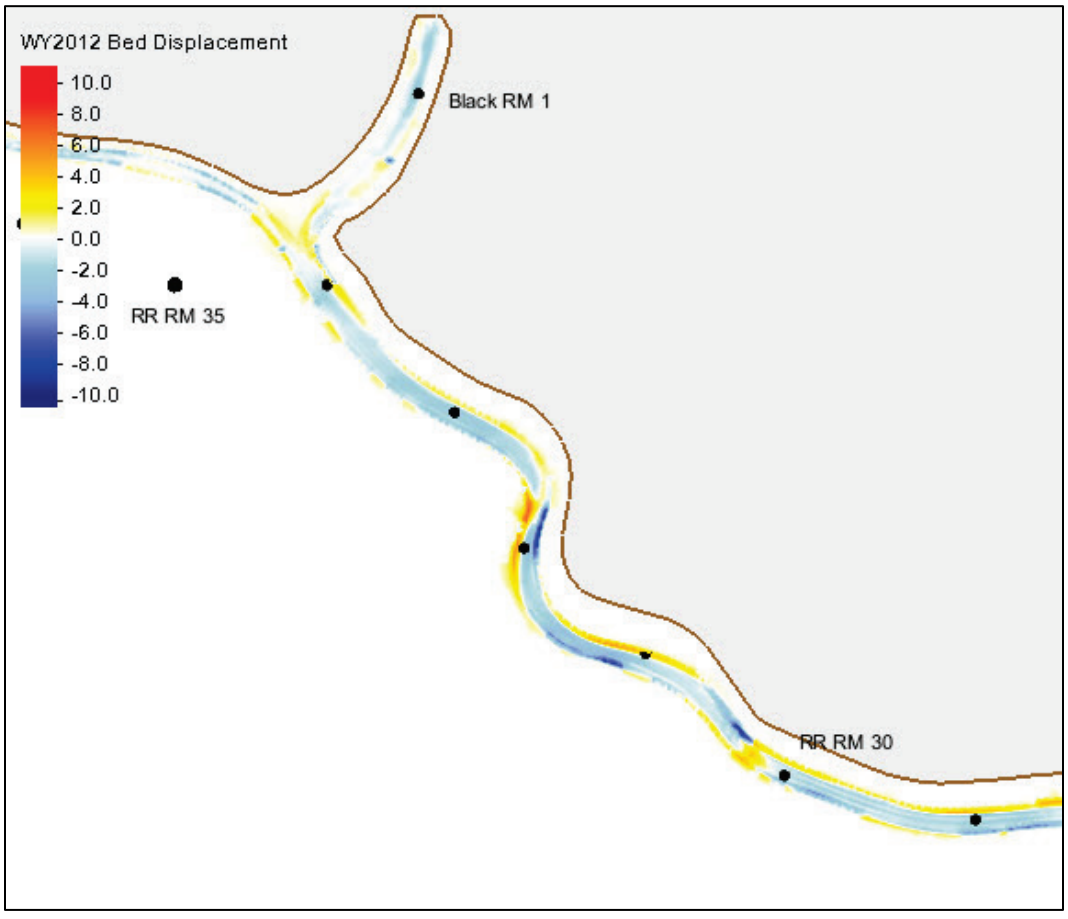


Plate D.4. WY2012 Base Run BDD RR RM 30–RR RM 25.

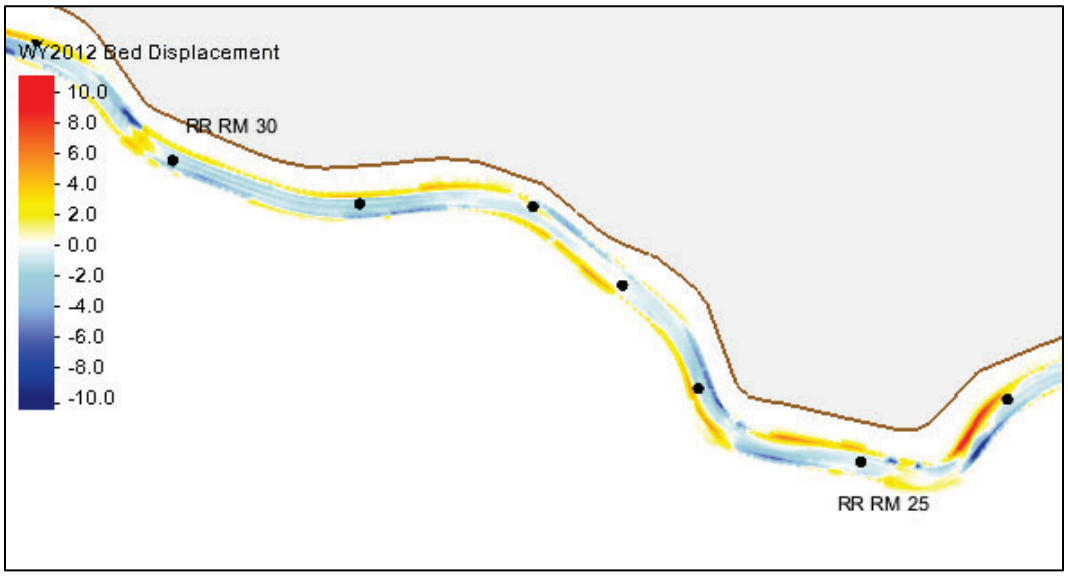


Plate D.5. WY2012 Base Run BDD RR RM 25–RR RM 18.

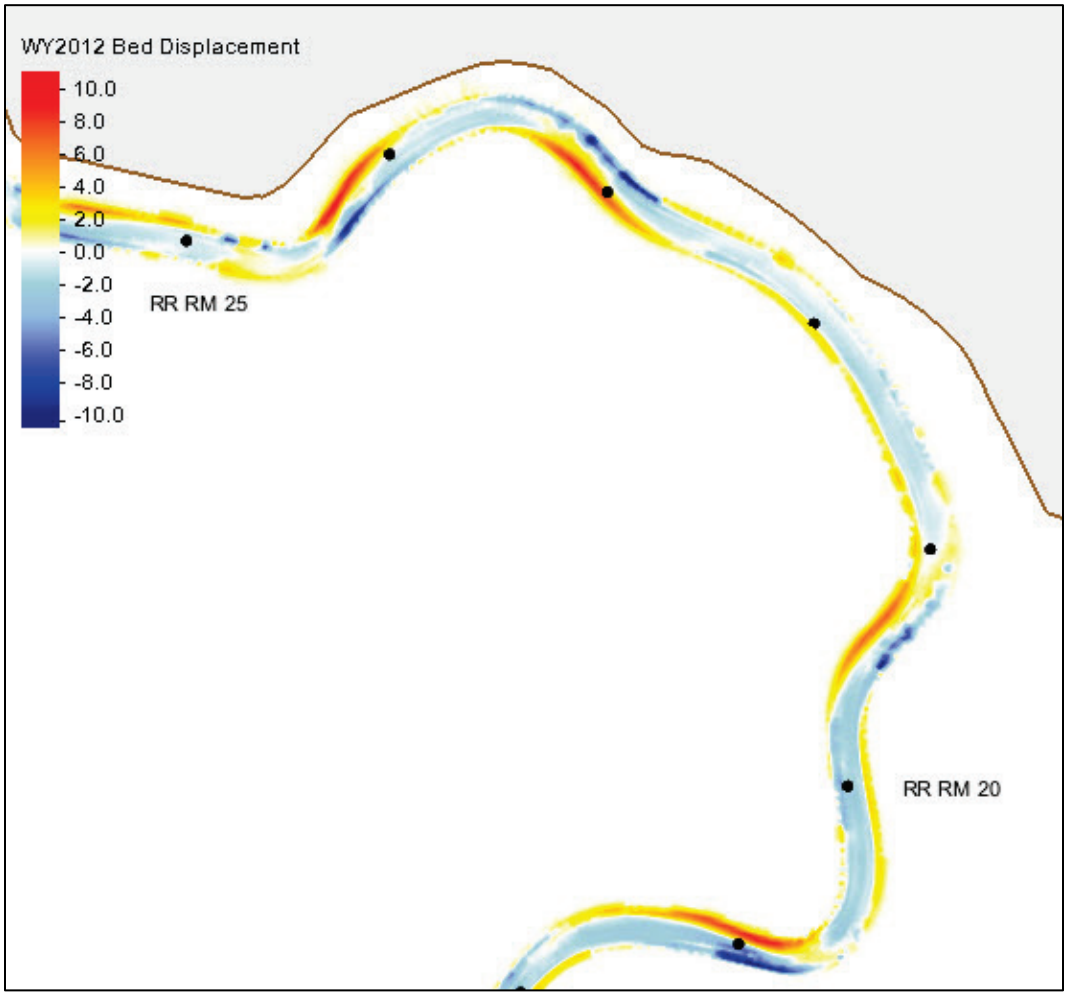


Plate D.6. WY2012 Base Run BDD RR RM 20–RR RM 14.

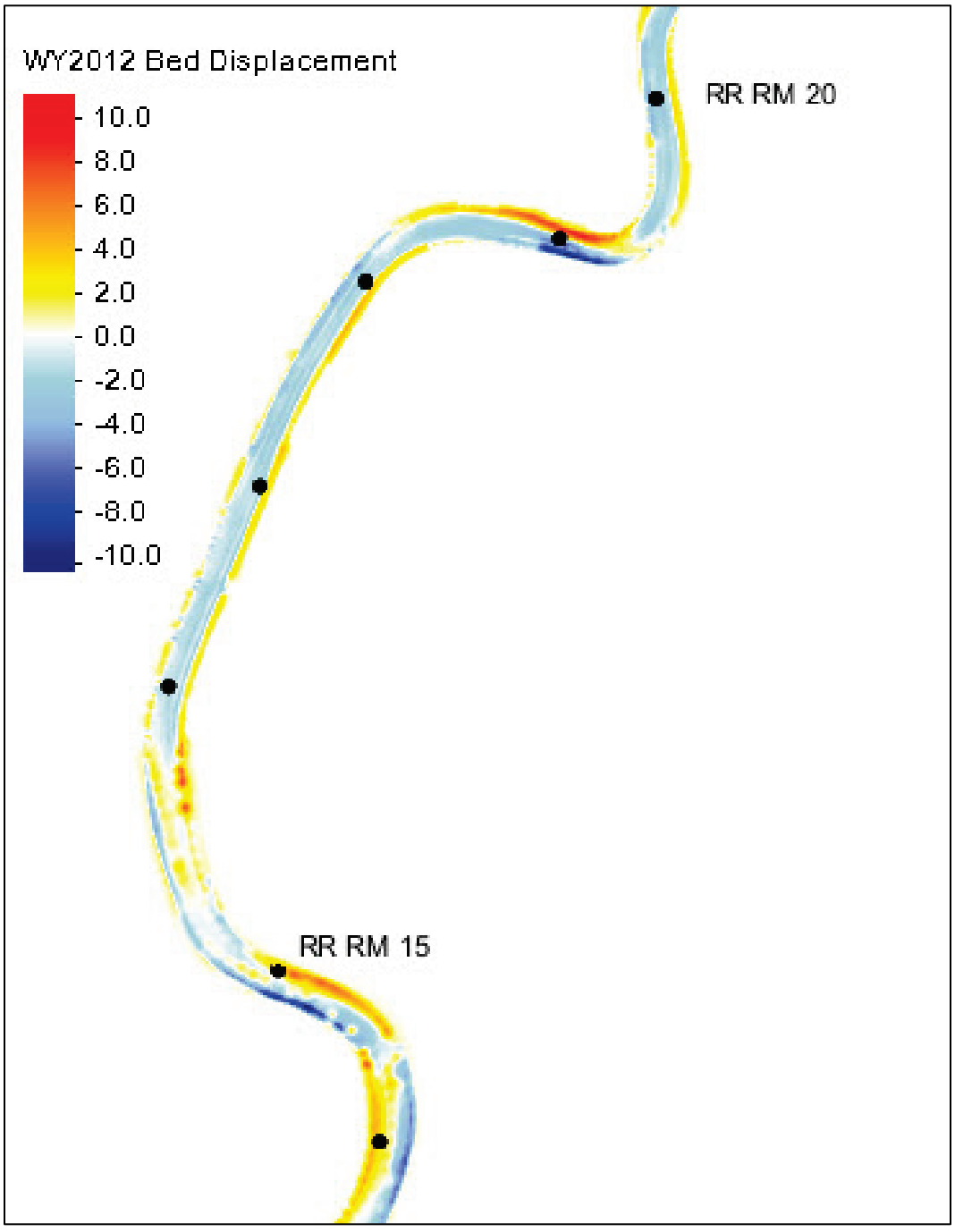


Plate D.7. WY2012 Base Run BDD RR RM 15–RR RM 10 and Outflow Channel.

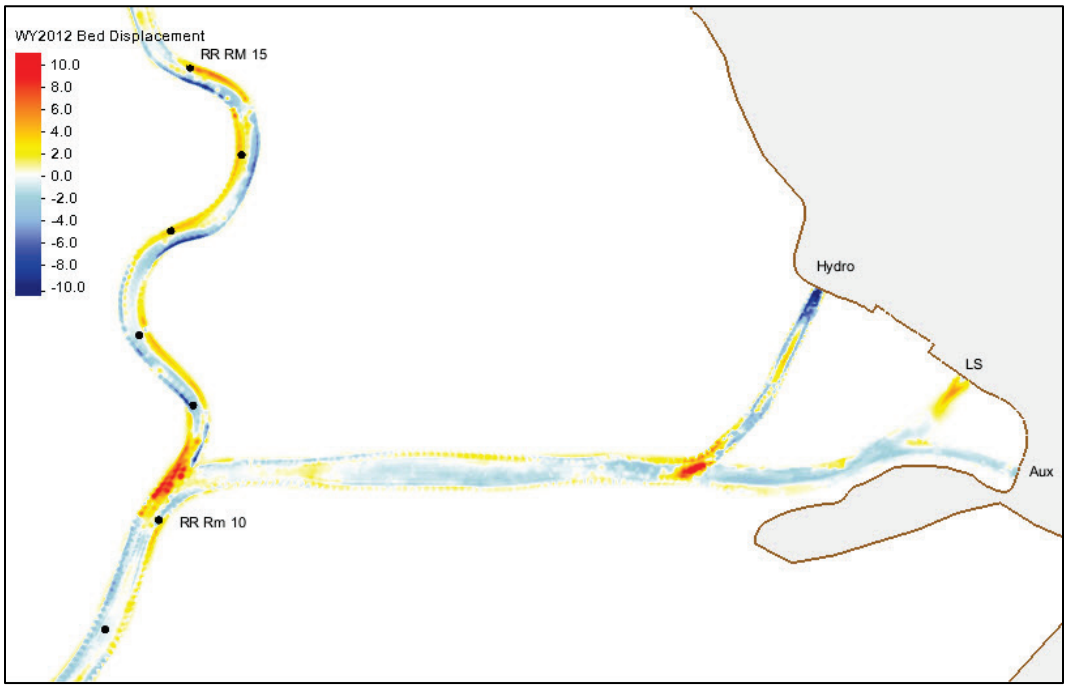


Plate D.8. WY2012 Base Run BDD Outflow Channel.

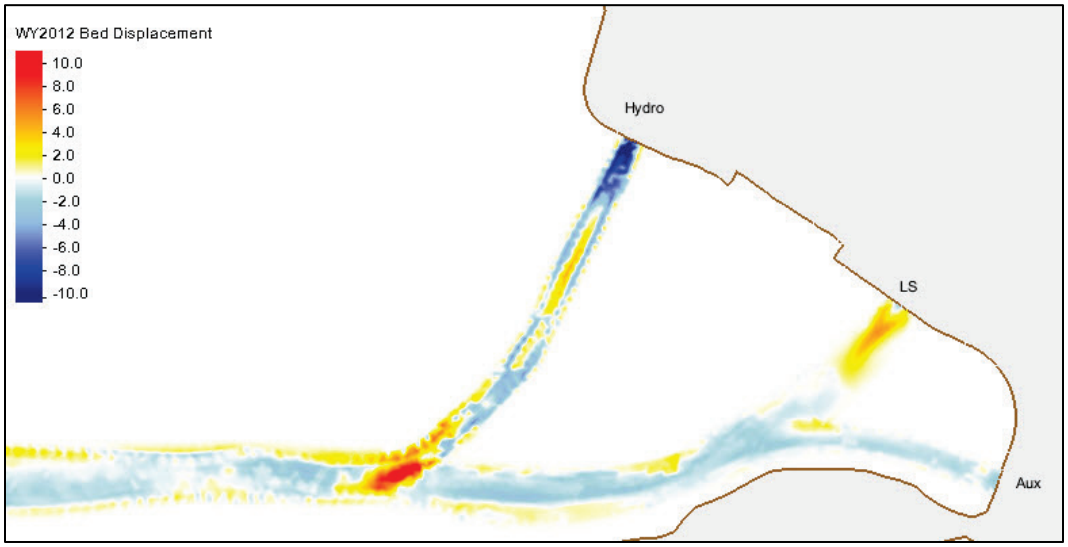


Plate D.9. WY2012 Base Run BDD RR RM 10–Atcha RM 2.

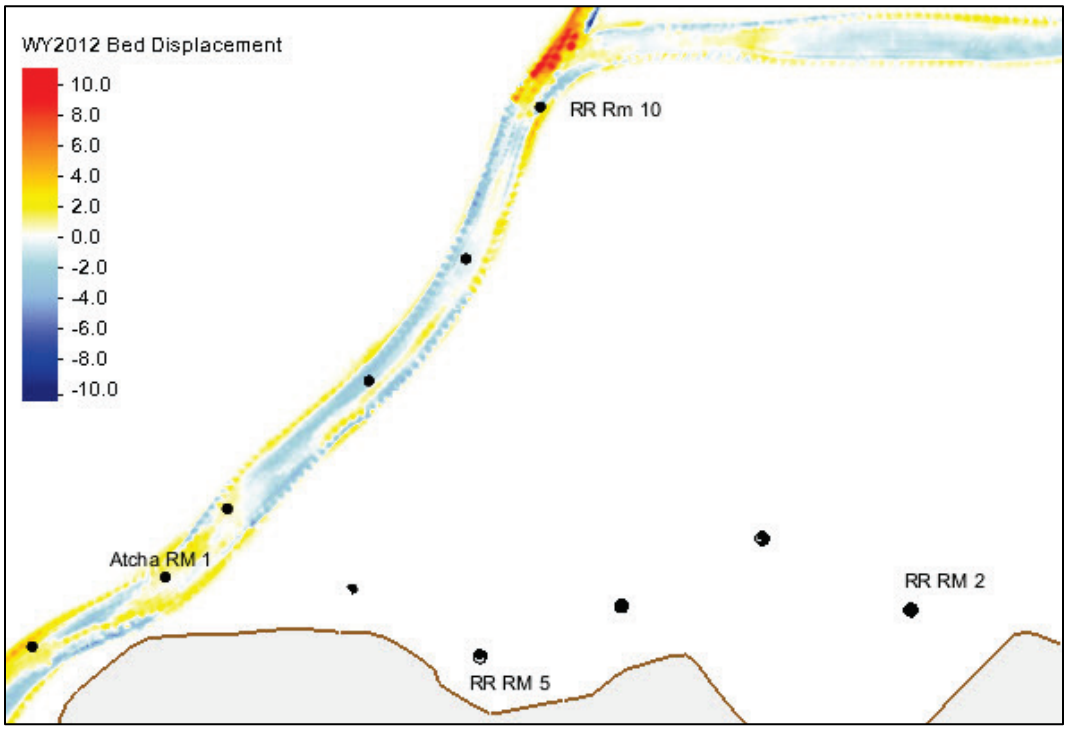


Plate D.10. WY2012 Base Run BDD Atcha RM 1–Atcha RM 5.

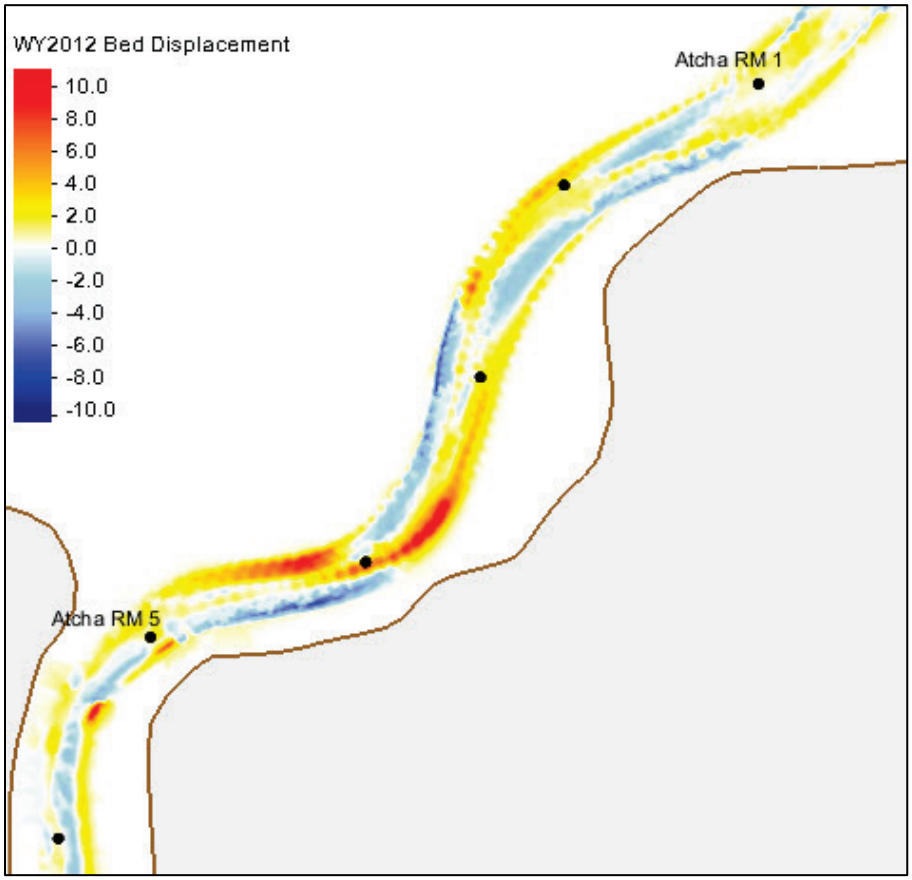


Plate D.11. WY2012 Base Run BDD Atcha RM 5–Atcha RM 10.

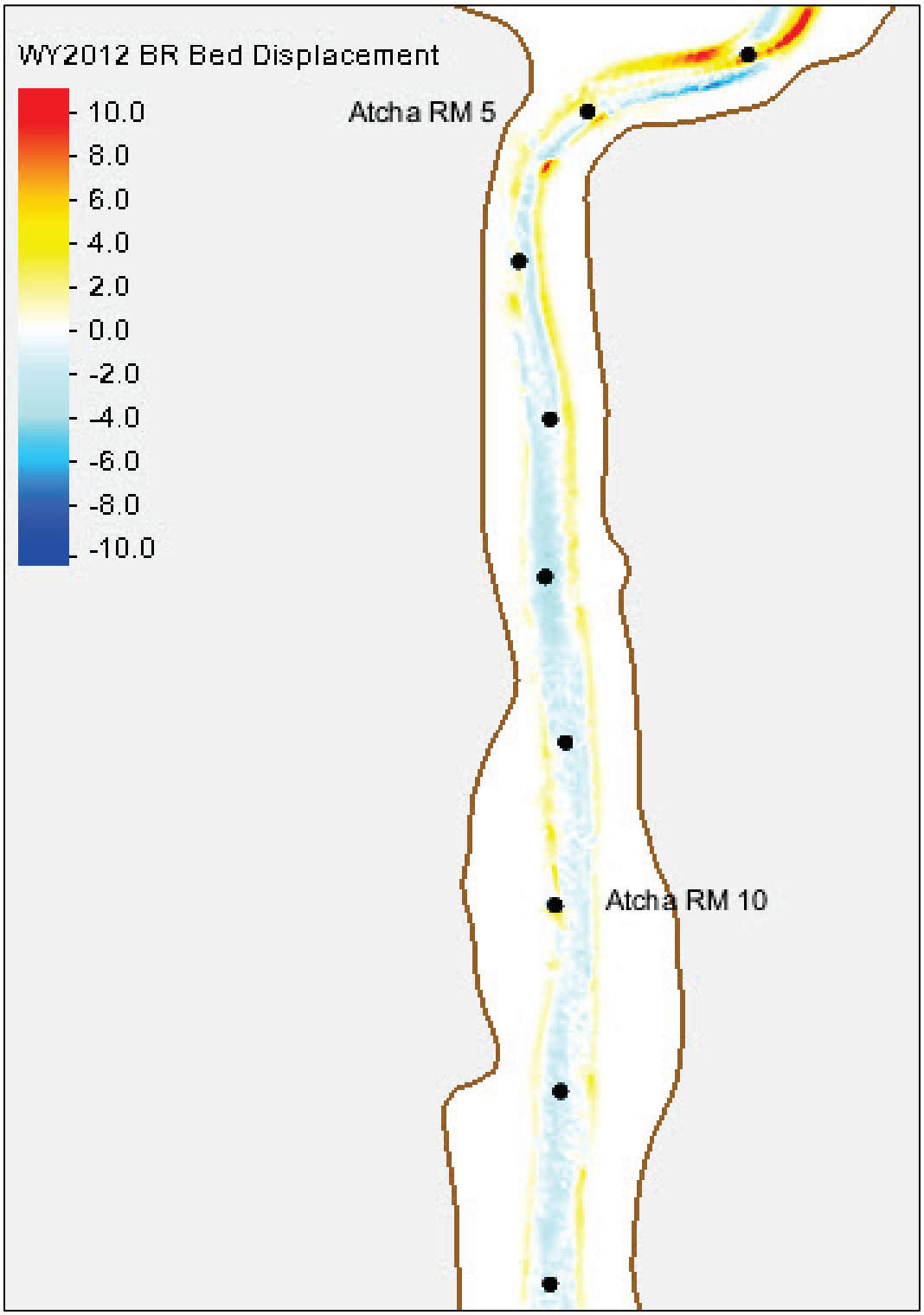


Plate D.12. WY2012 Base Run BDD Atcha RM 10–Atcha RM 15.

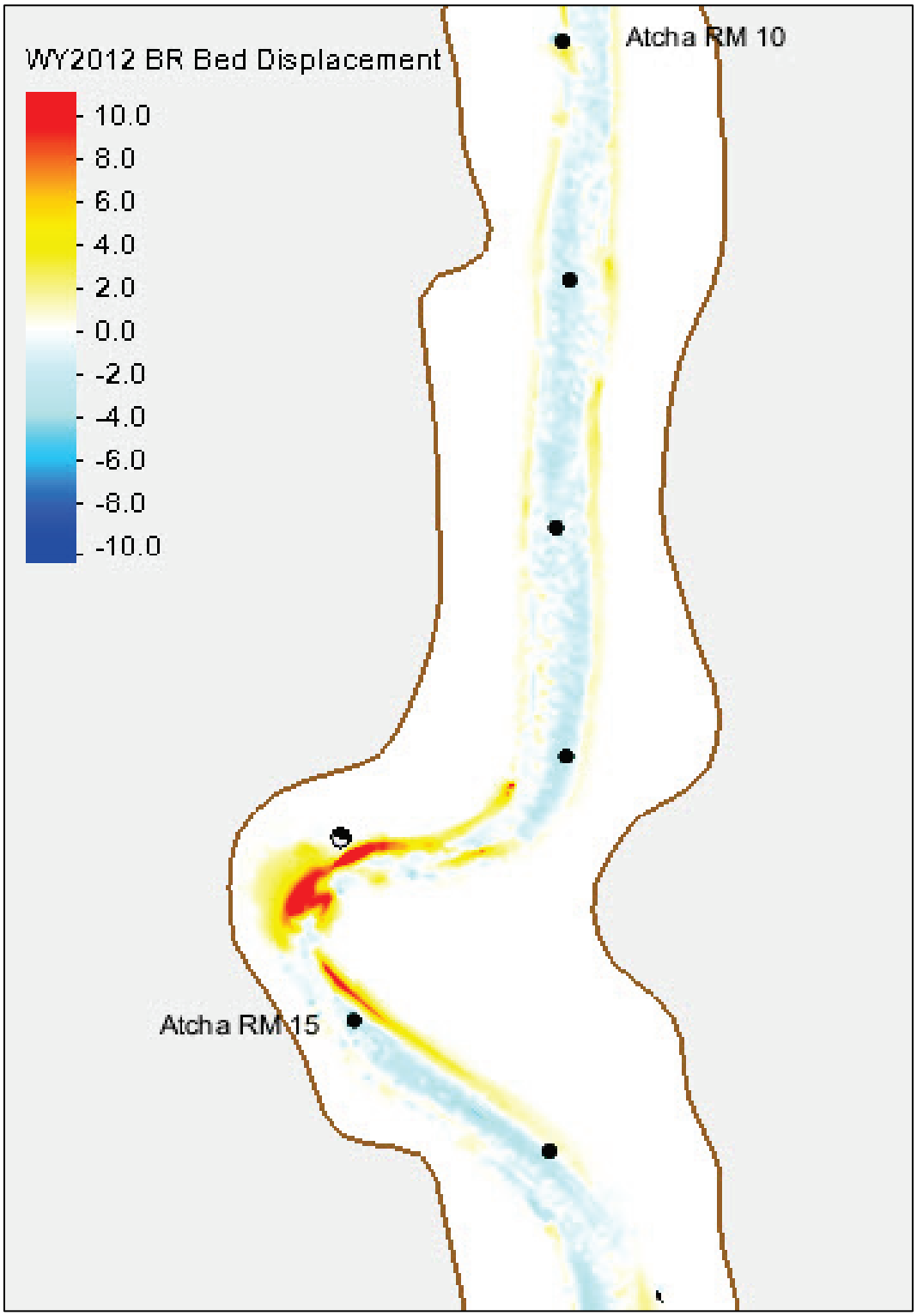


Plate D.13. WY2012 Base Run BDD Atcha RM 15–Atcha RM 20.

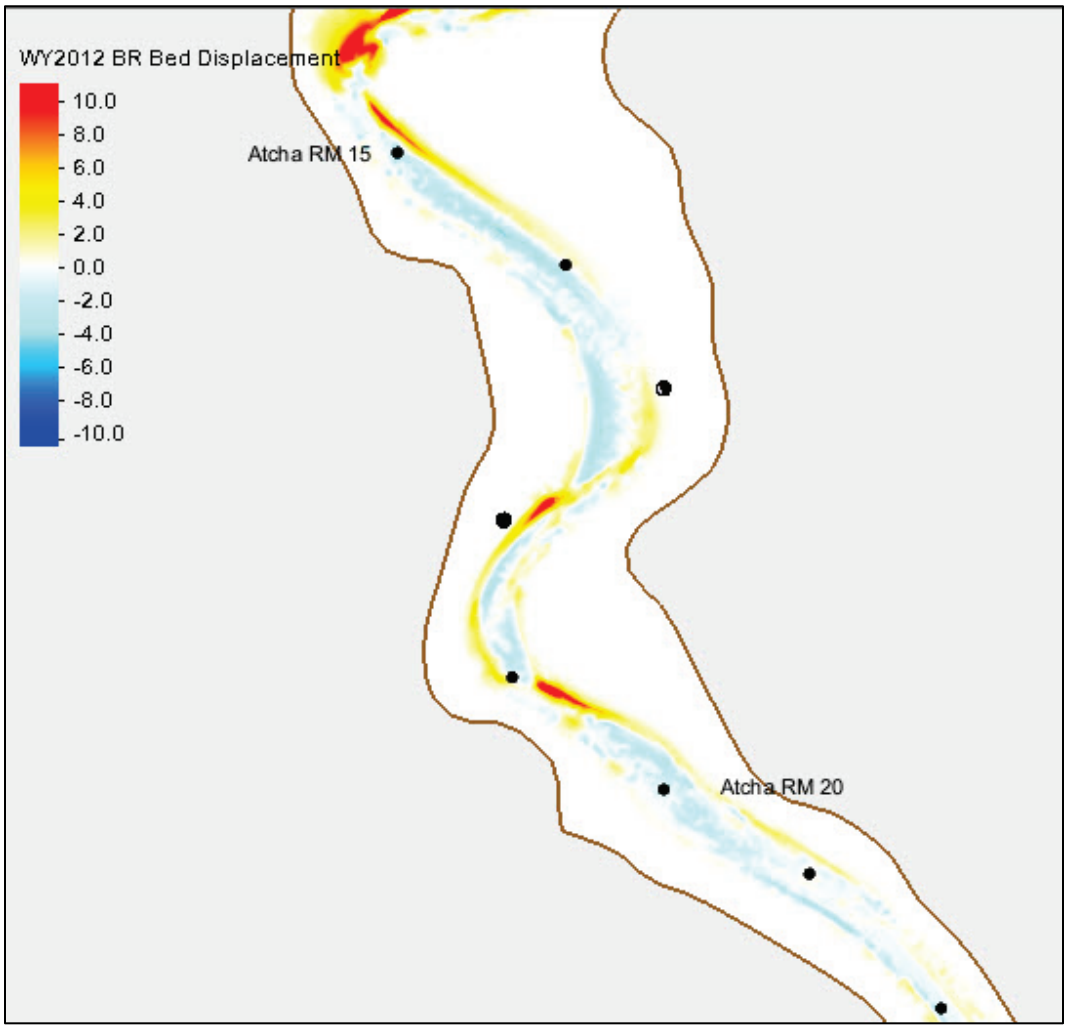


Plate D.14. WY2012 Base Run BDD Atcha RM 20–Atcha RM 25.

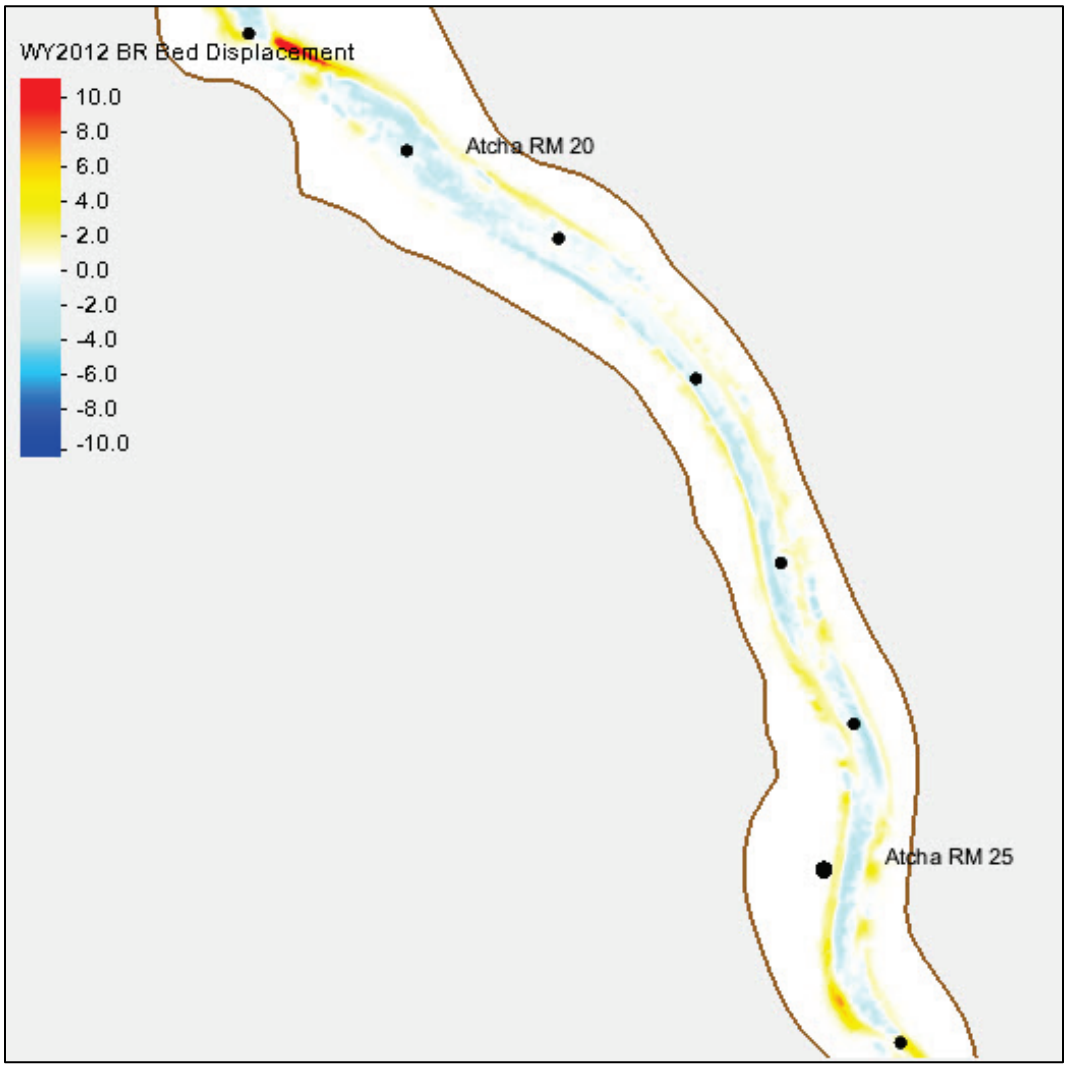
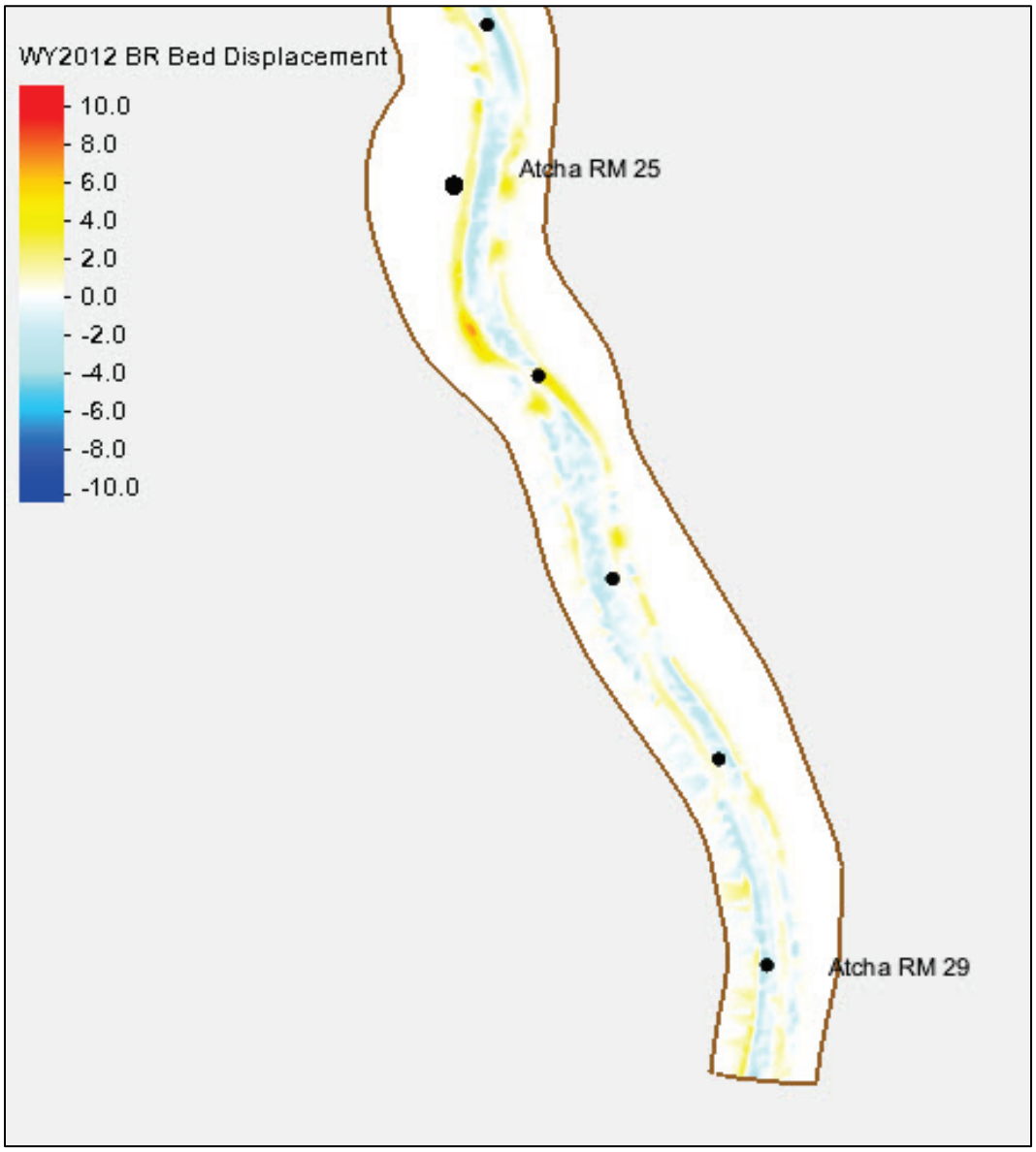


Plate D.15. WY2012 Base Run BDD Atcha RM 25–Atcha RM 29.



D.2 Scenario 3

Plate D.16. WY2012 Scenario 3 BDD RR RM 43–RR RM 39.

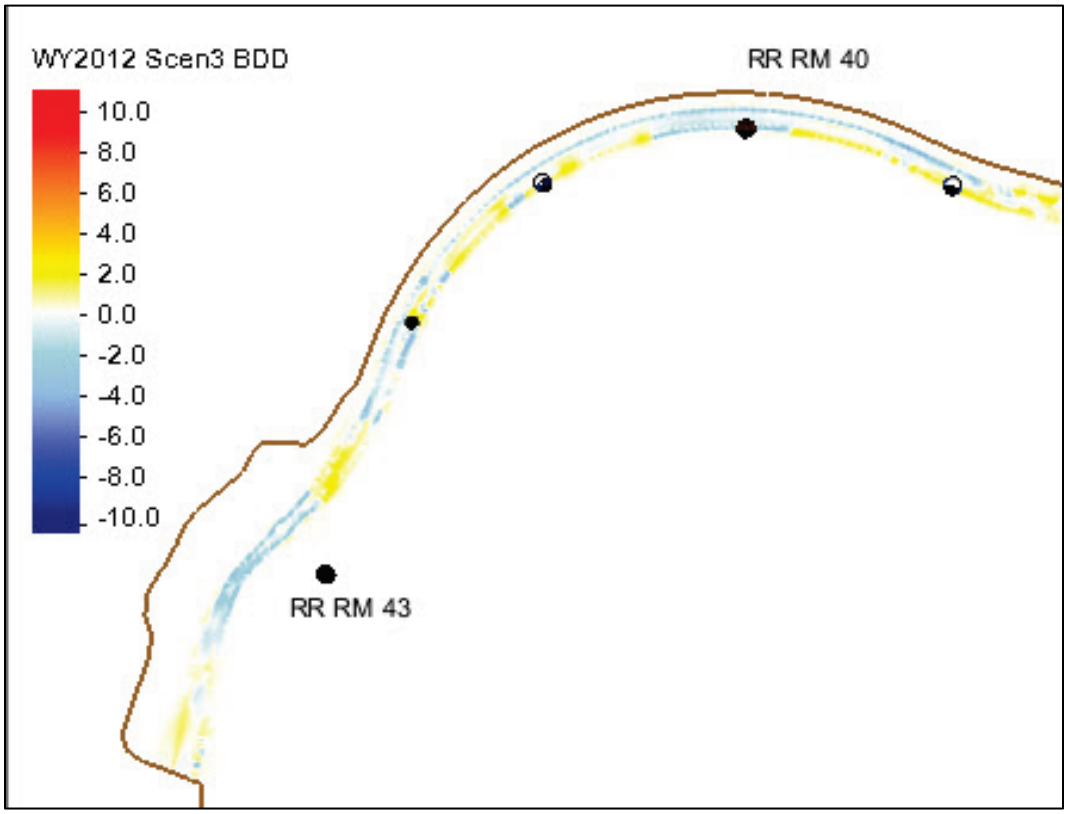


Plate D.17. WY2012 Scenario 3 BDD RR RM 40–RR RM 33.

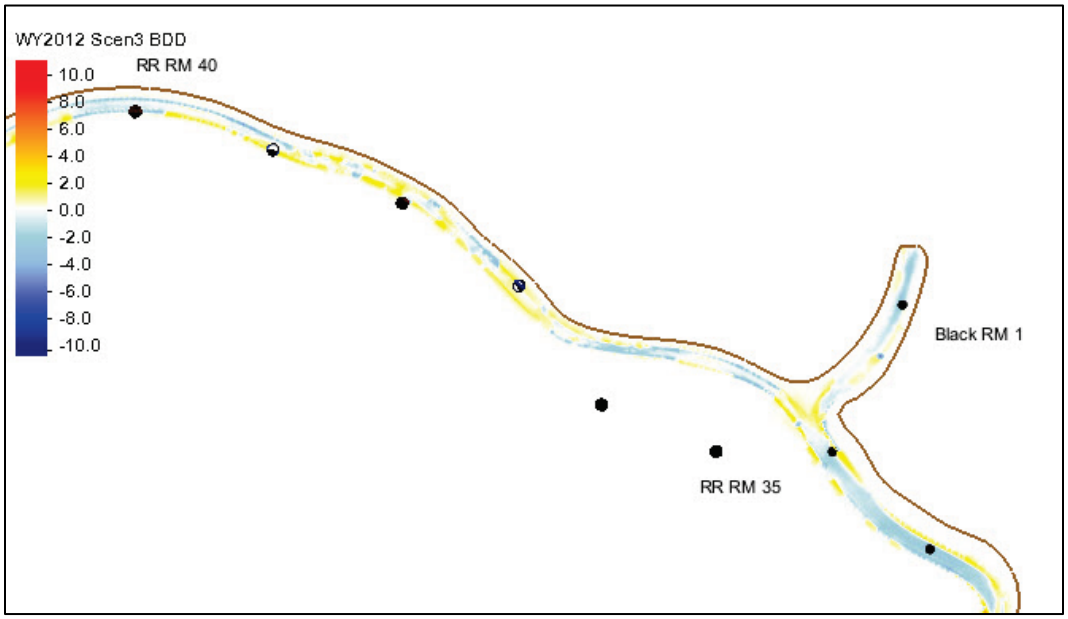


Plate D.18. WY2012 Scenario 3 BDD RR RM 35–RR RM 27.

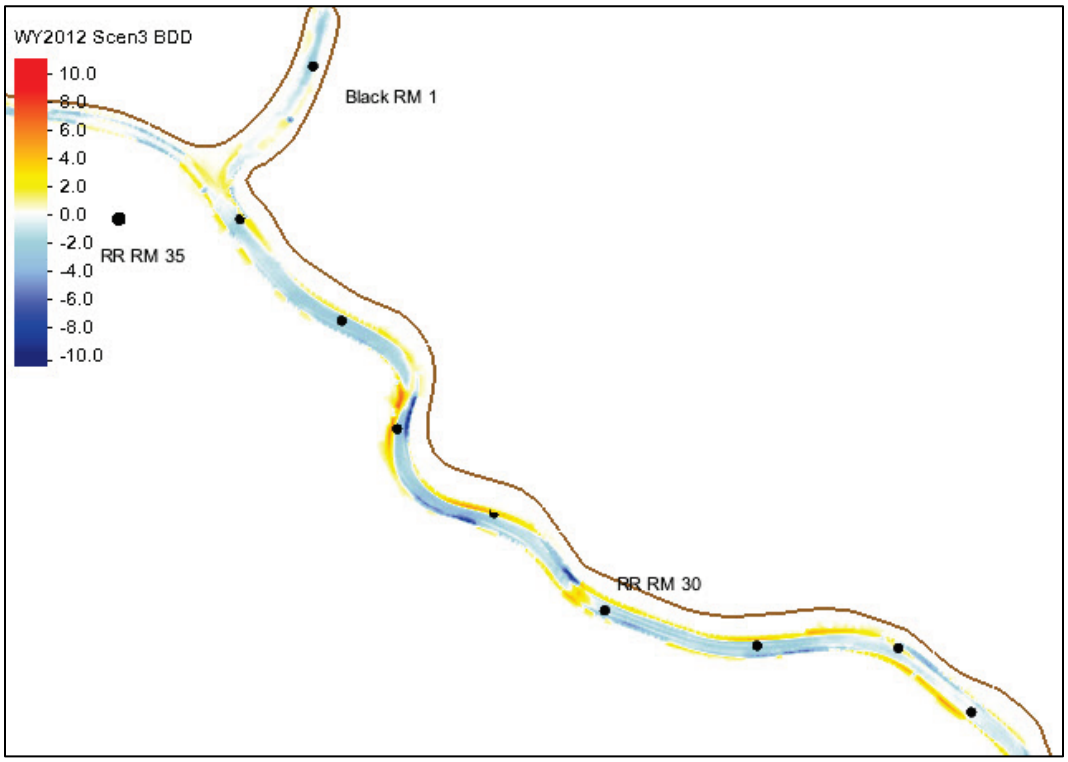


Plate D.19. WY2012 Scenario 3 BDD RR RM 30–RR RM 25.

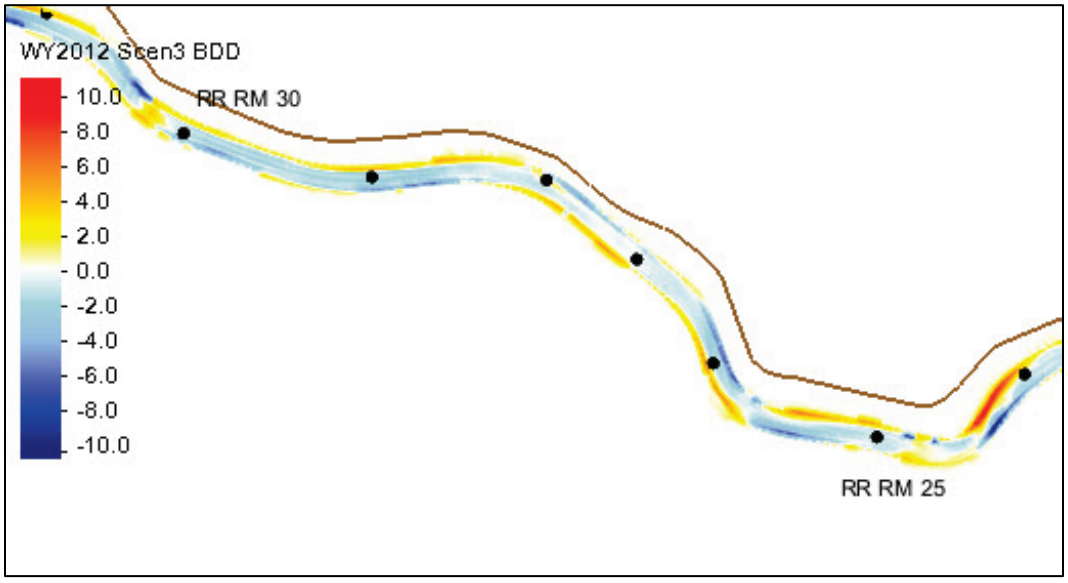


Plate D.20. WY2012 Scenario 3 BDD RR RM 25–RR RM 18.

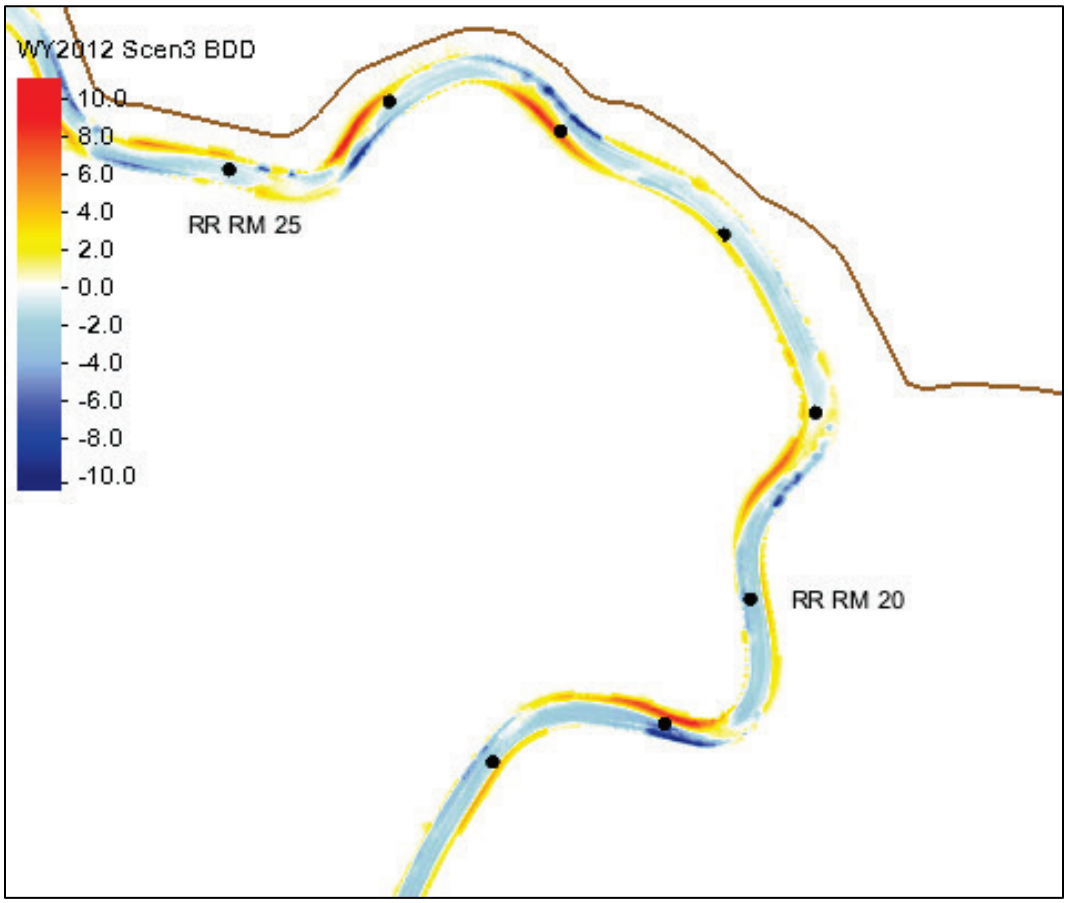


Plate D.21. WY2012 Scenario 3 BDD RR RM 20–RR RM 15.

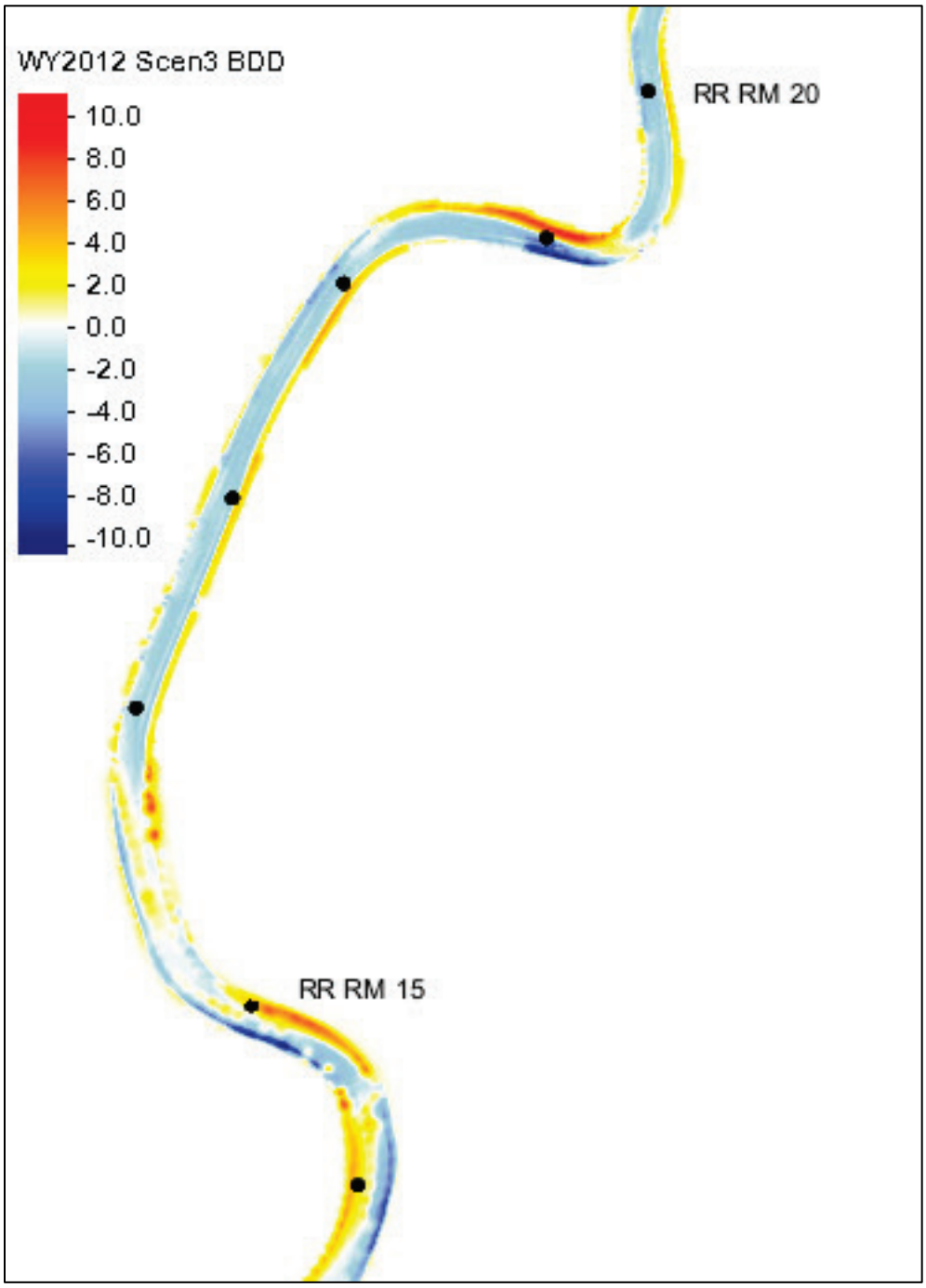


Plate D.22. WY2012 Scenario 3 BDD RR RM 15–RR RM 10 and Outflow Channel.

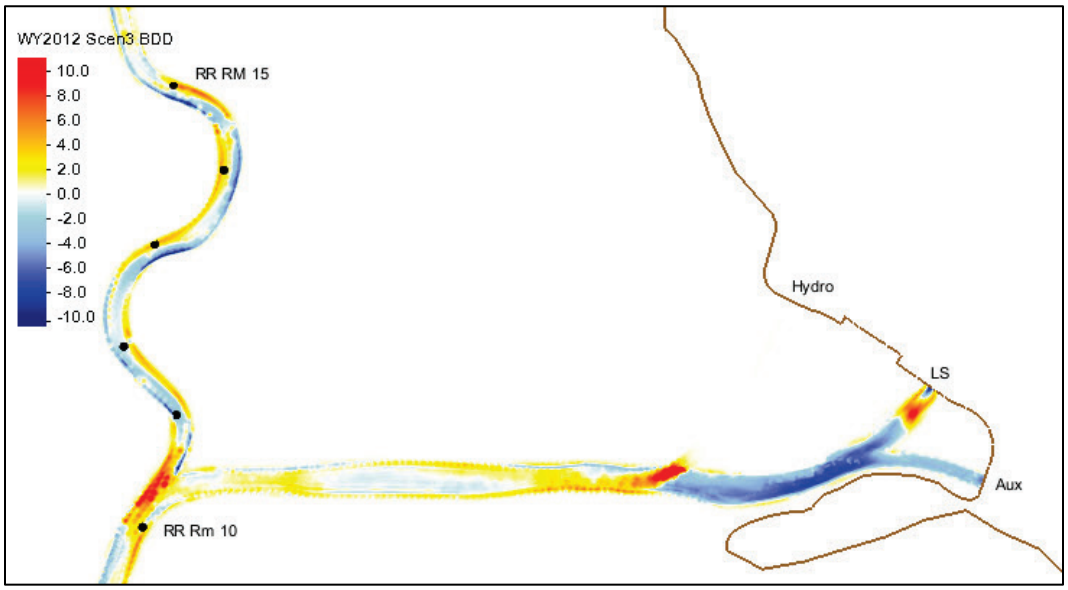


Plate D.23. WY2012 Scenario 3 BDD RR RM 10–Atcha RM 1.

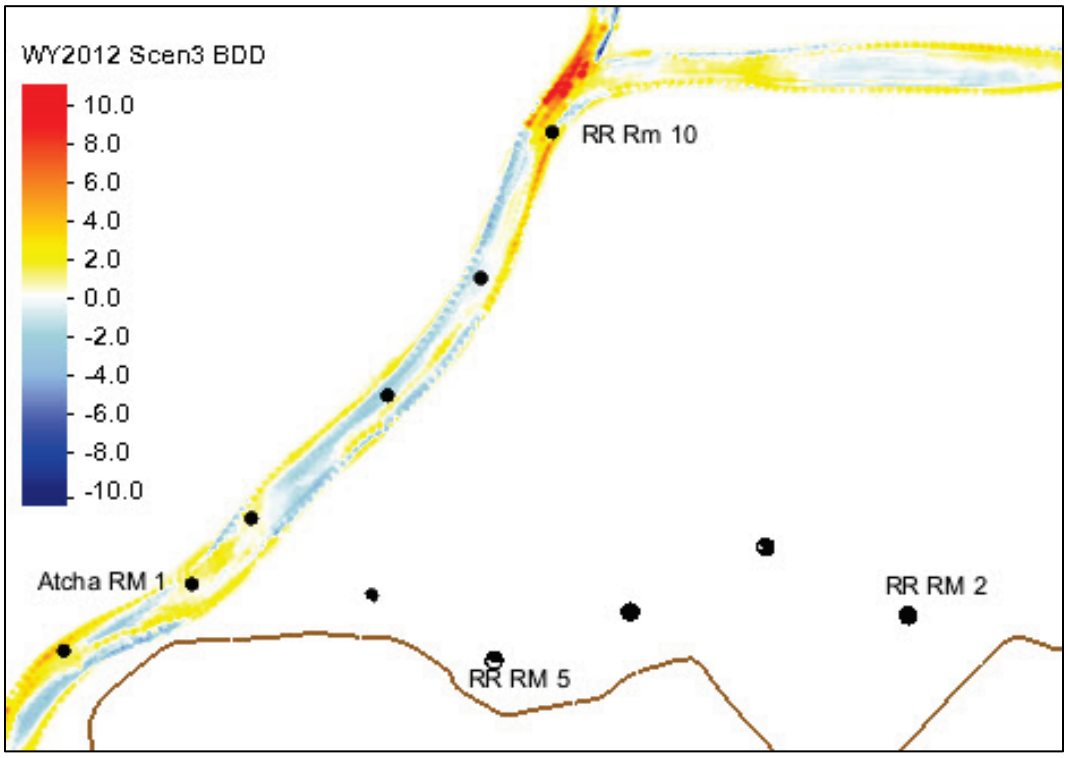


Plate D.24. WY2012 Scenario 3 BDD Atcha RM 1–Atcha RM 5.

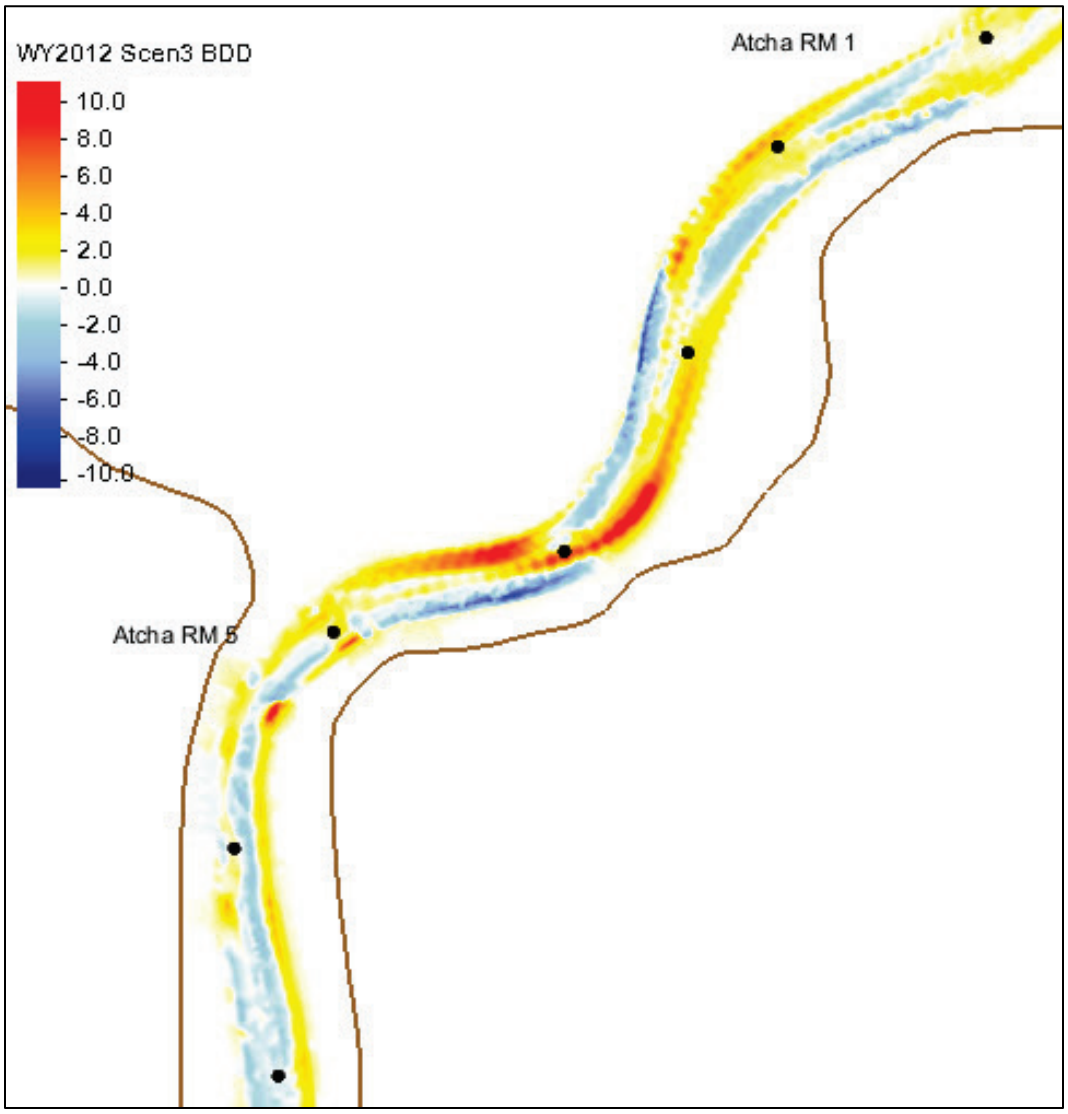


Plate D.25. WY2012 Scenario 3 BDD Atcha RM 5–Atcha RM 10.

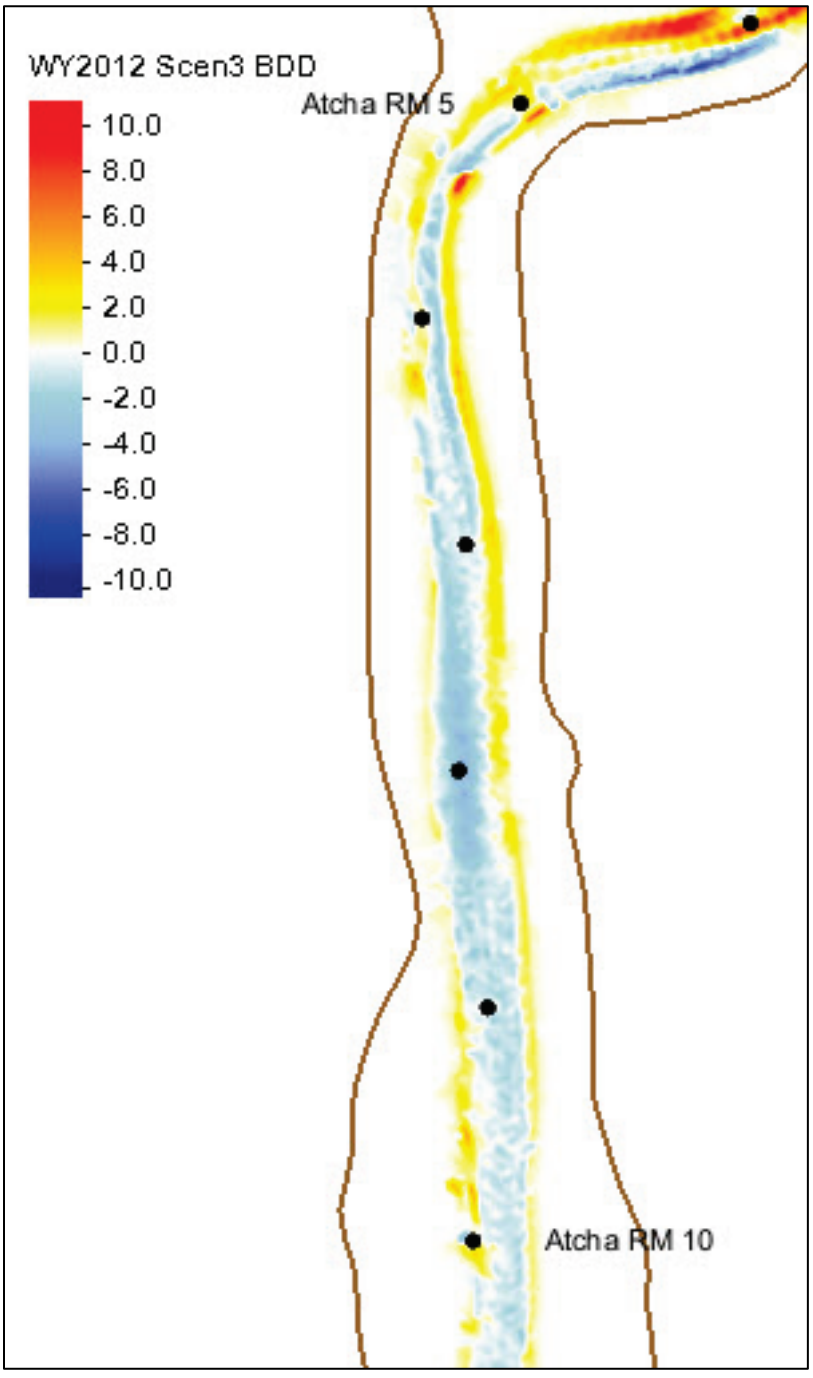


Plate D.26. WY2012 Scenario 3 BDD Atcha RM 10–Atcha RM 15.

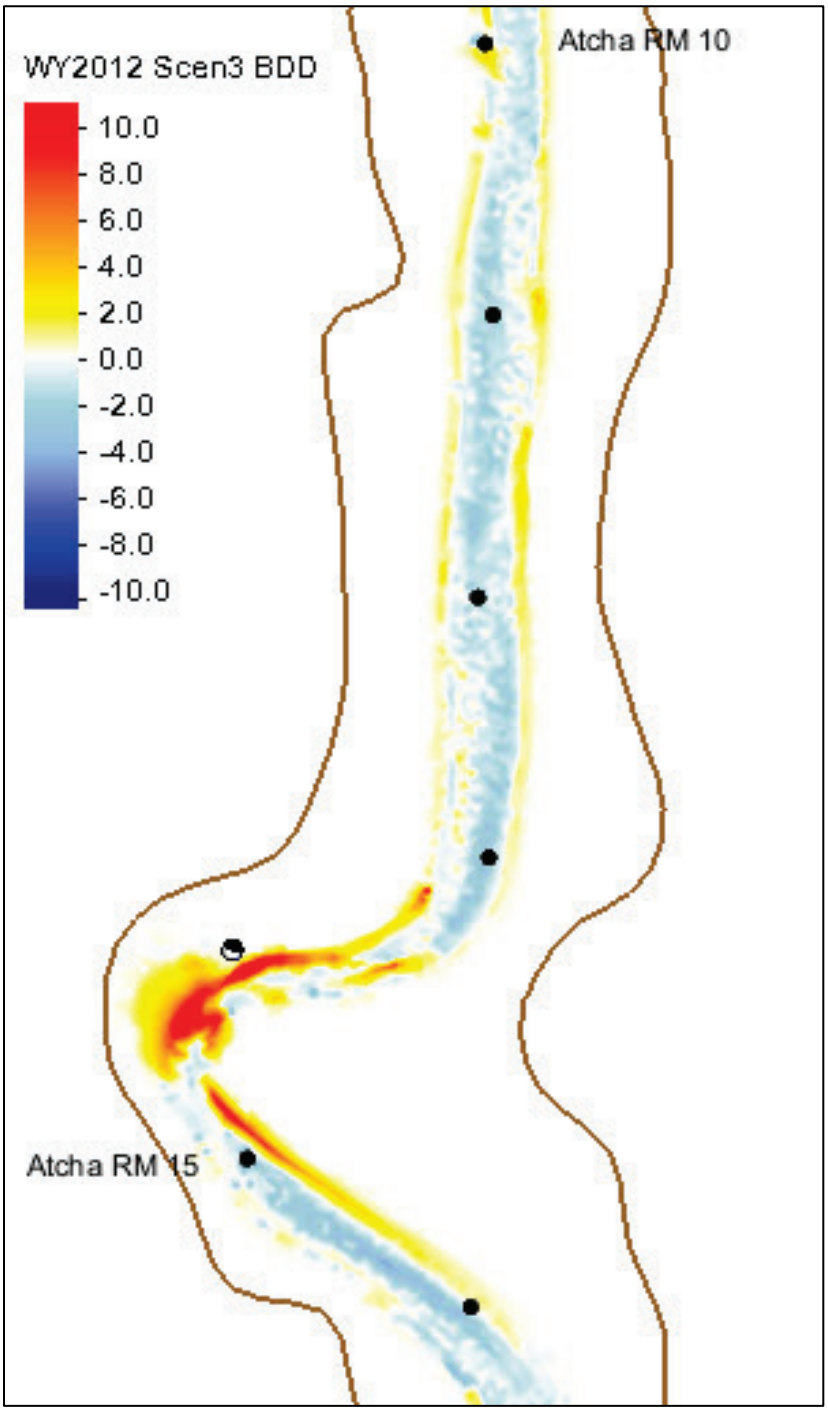


Plate D.27. WY2012 Scenario 3 BDD Atcha RM 15–Atcha RM 20.

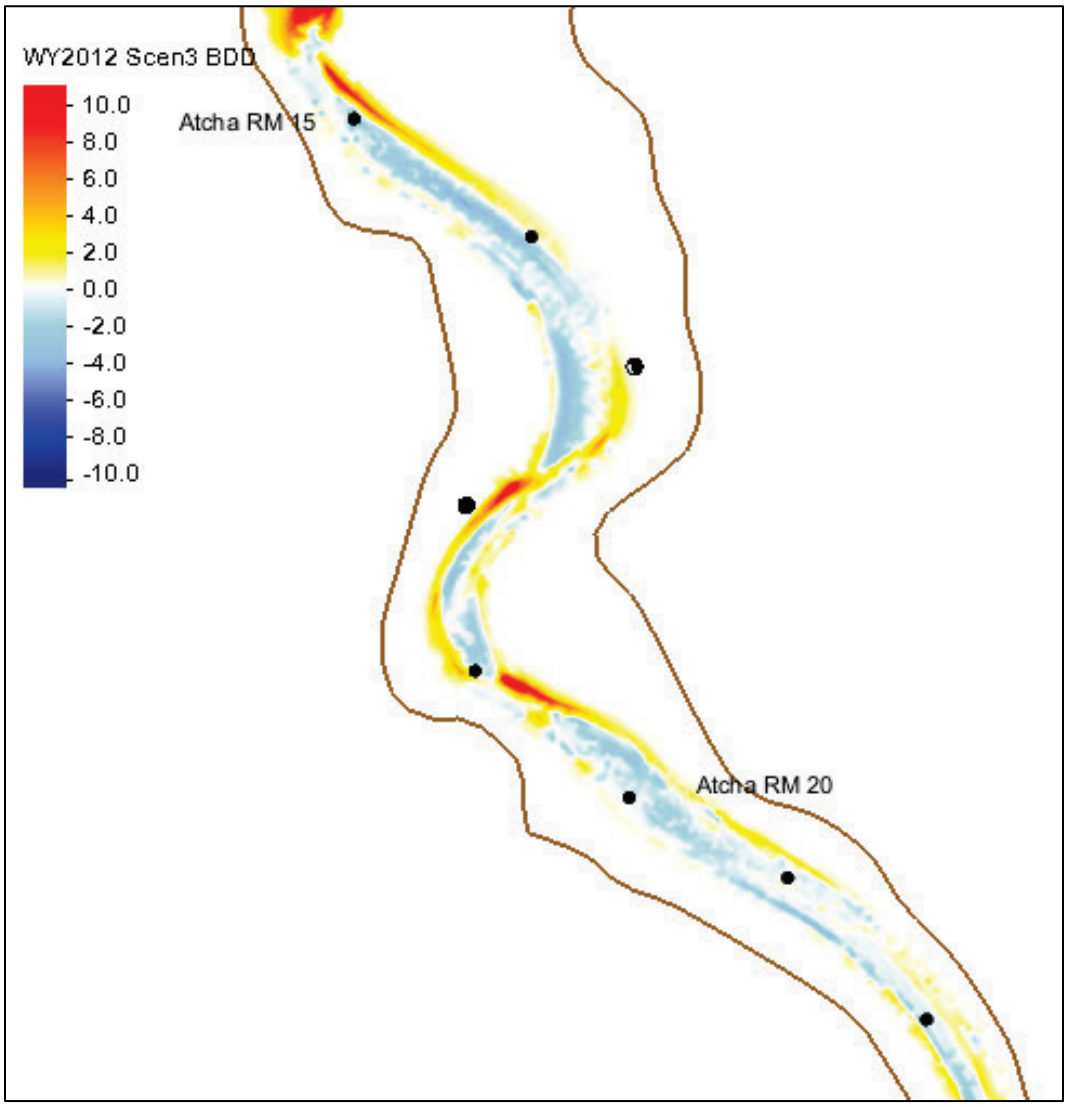


Plate D.28. WY2012 Scenario 3 BDD Atcha RM 20–Atcha RM 25.

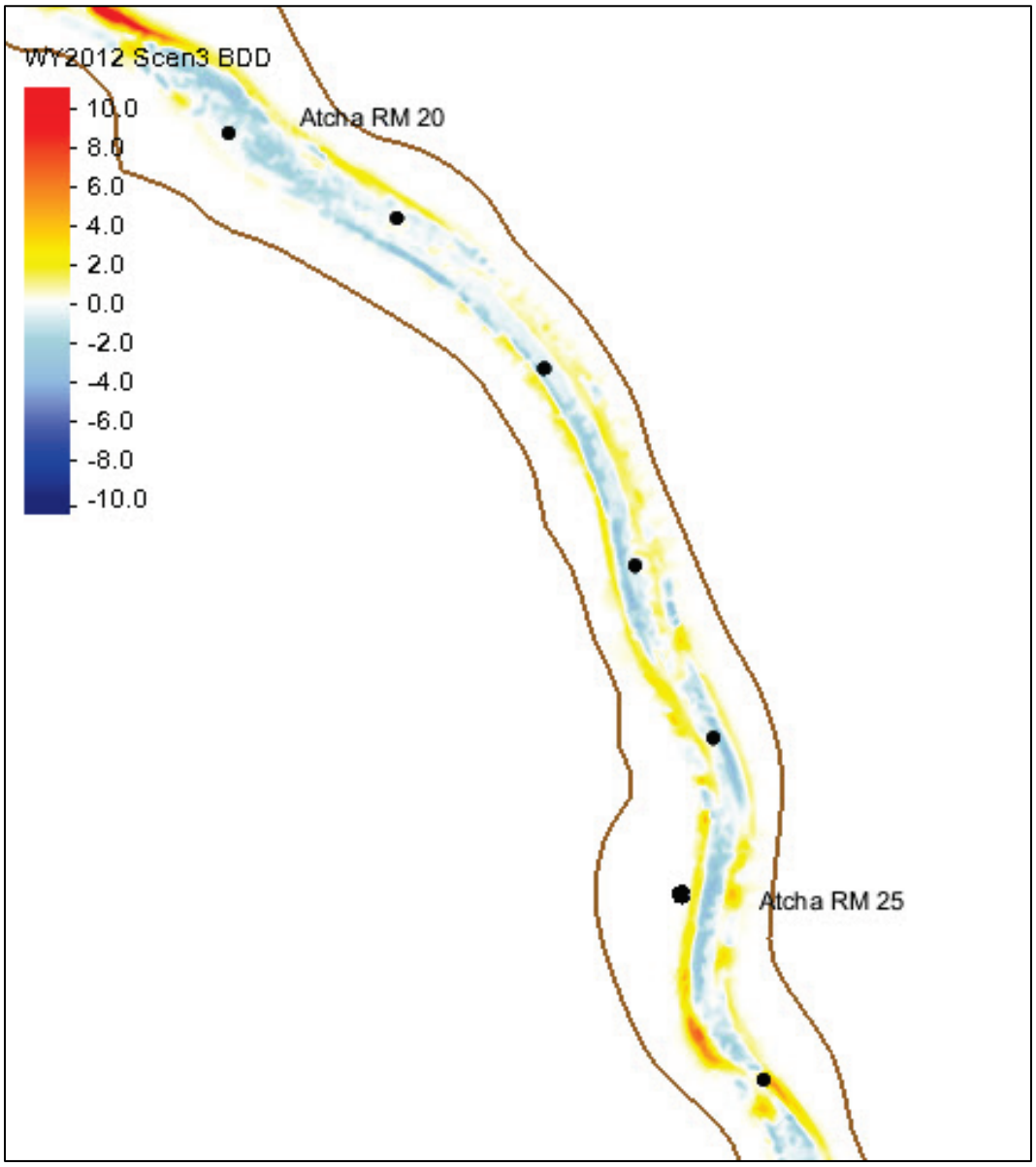
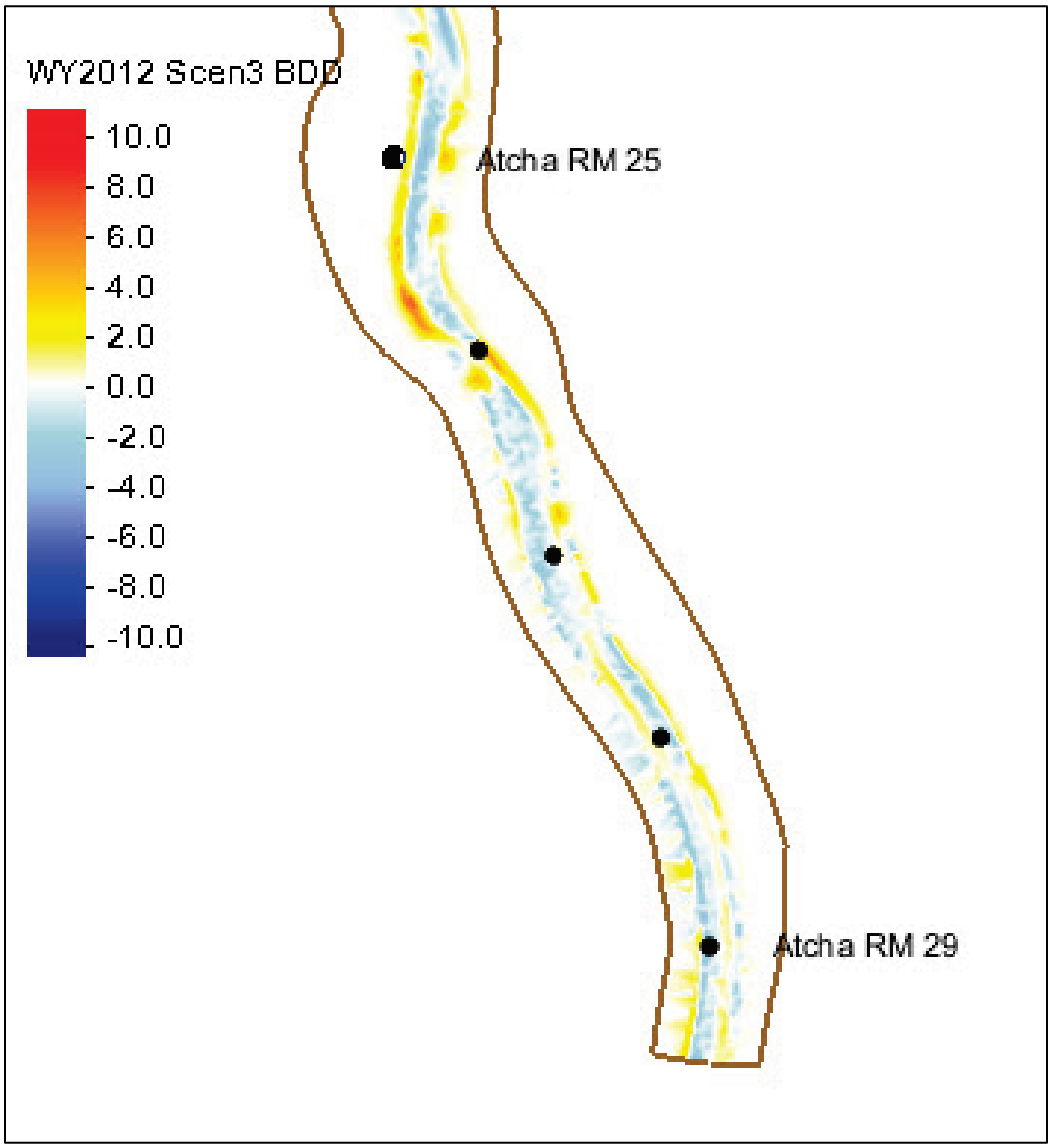


Plate D.29. WY2012 Scenario 3 BDD Atcha RM 25–Atcha RM 29.



D.3 Scenario 4

Plate D.30. WY2012 Scenario 4 BDD RR RM 43–RR RM 30.

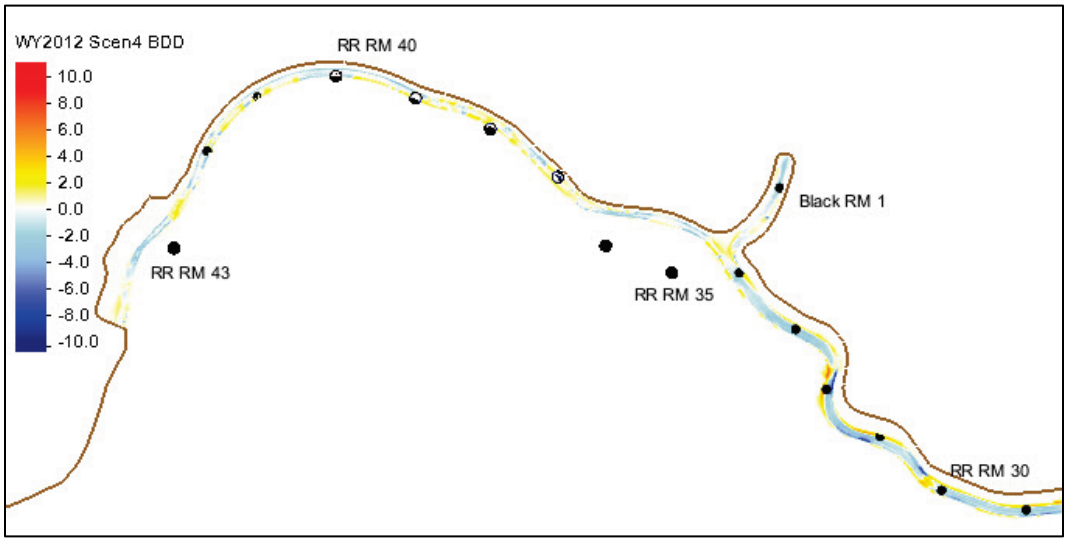


Plate D.31. WY2012 Scenario 4 BDD RR RM 30–RR RM 20.

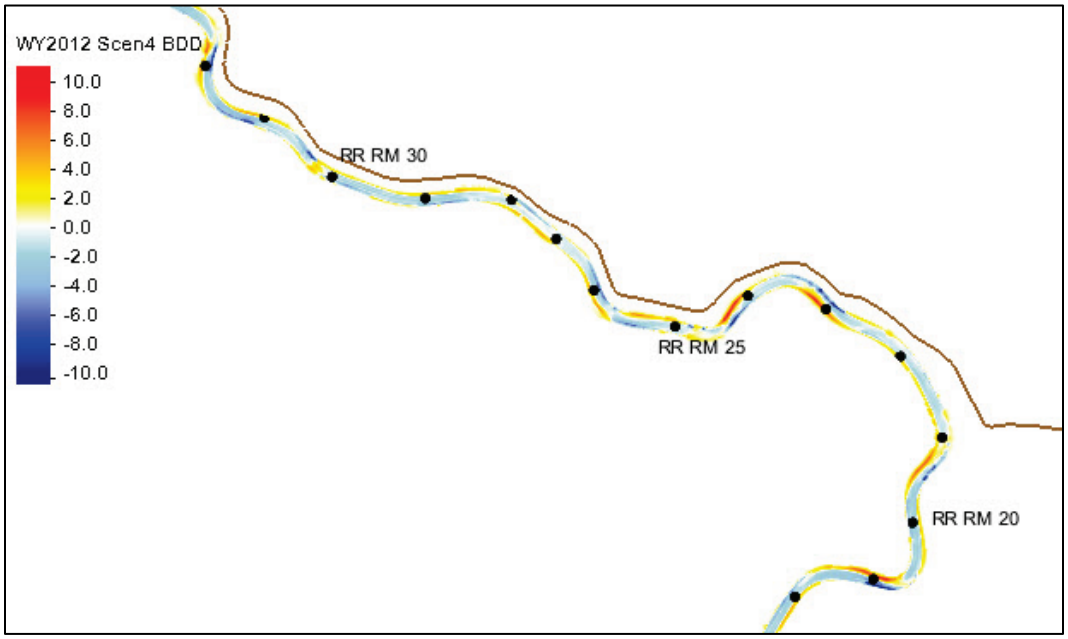


Plate D.32. WY2012 Scenario 4 BDD RR RM 20–RR RM 10.

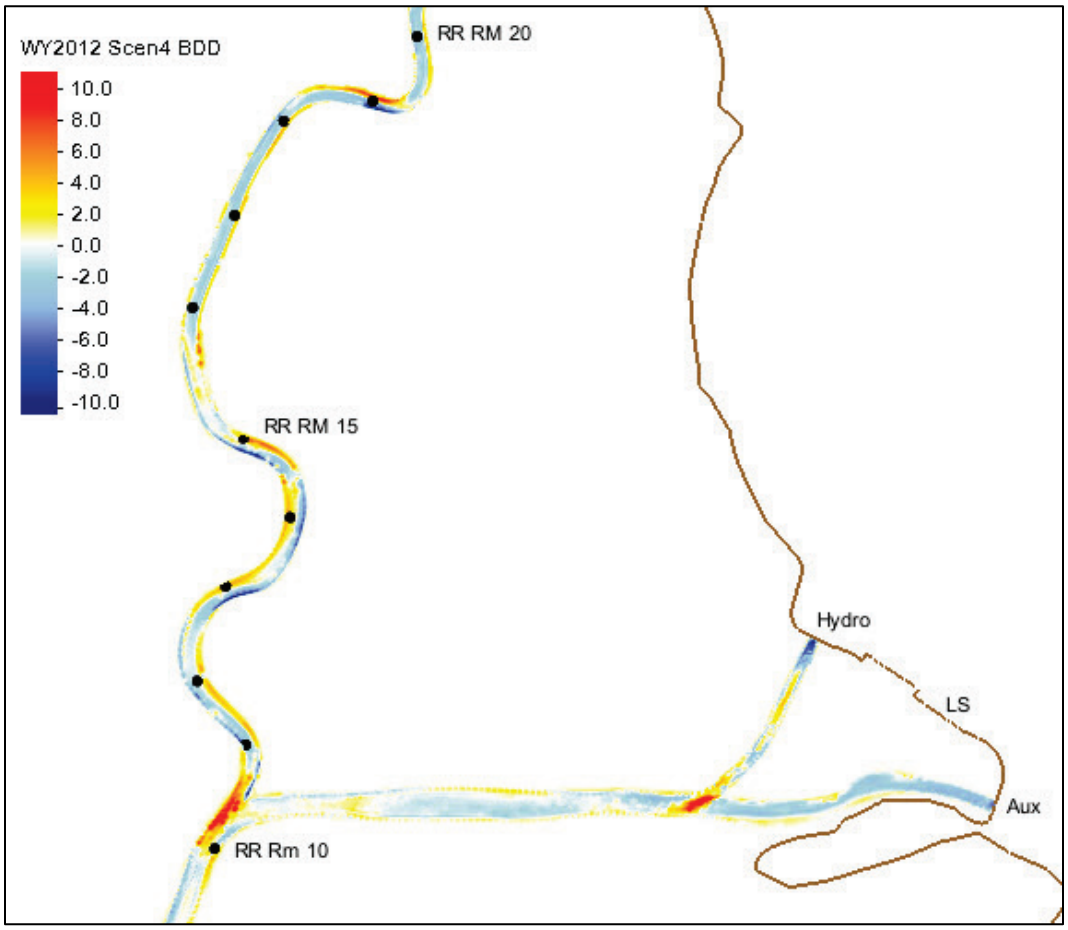


Plate D.33. WY2012 Scenario 4 BDD Outflow Channel.

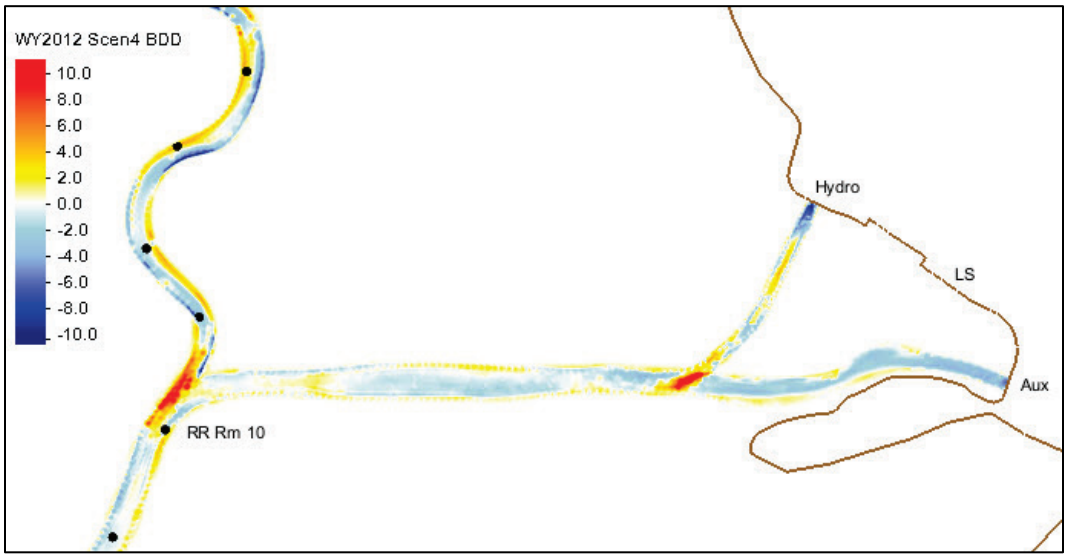


Plate D.34. WY2012 Scenario 4 BDD RR RM 10–Atcha RM 5.

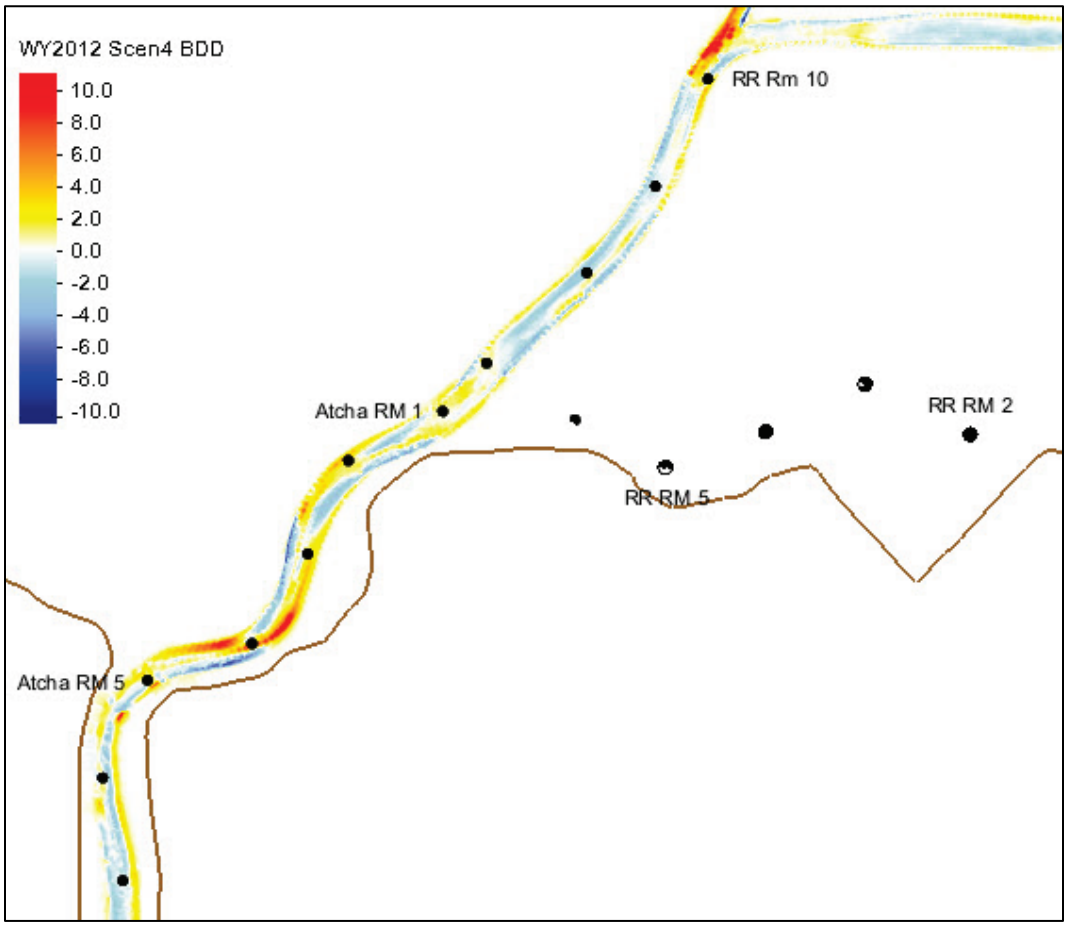


Plate D.35. WY2012 Scenario 4 BDD Atcha RM 5–Atcha RM 15.

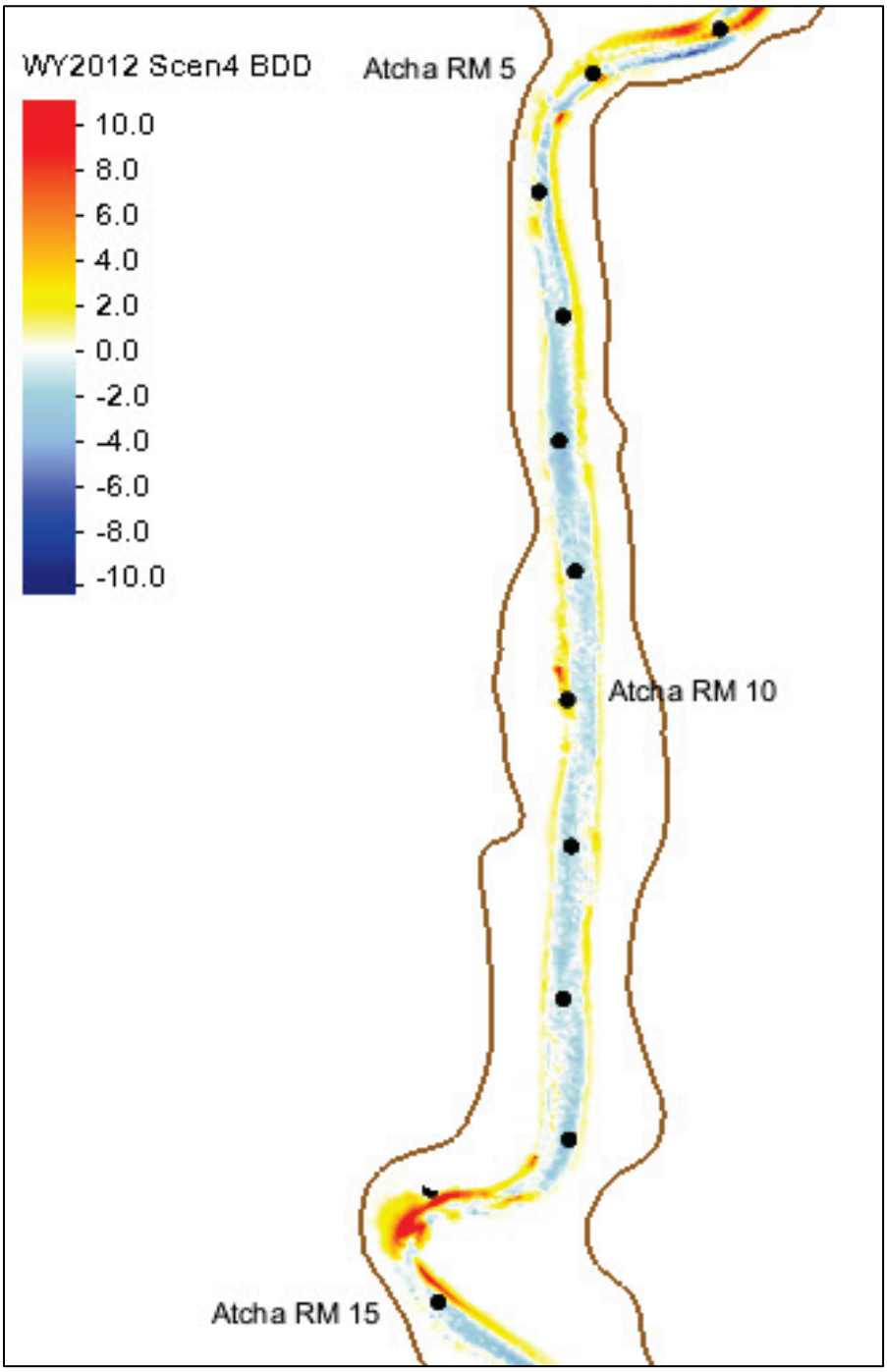
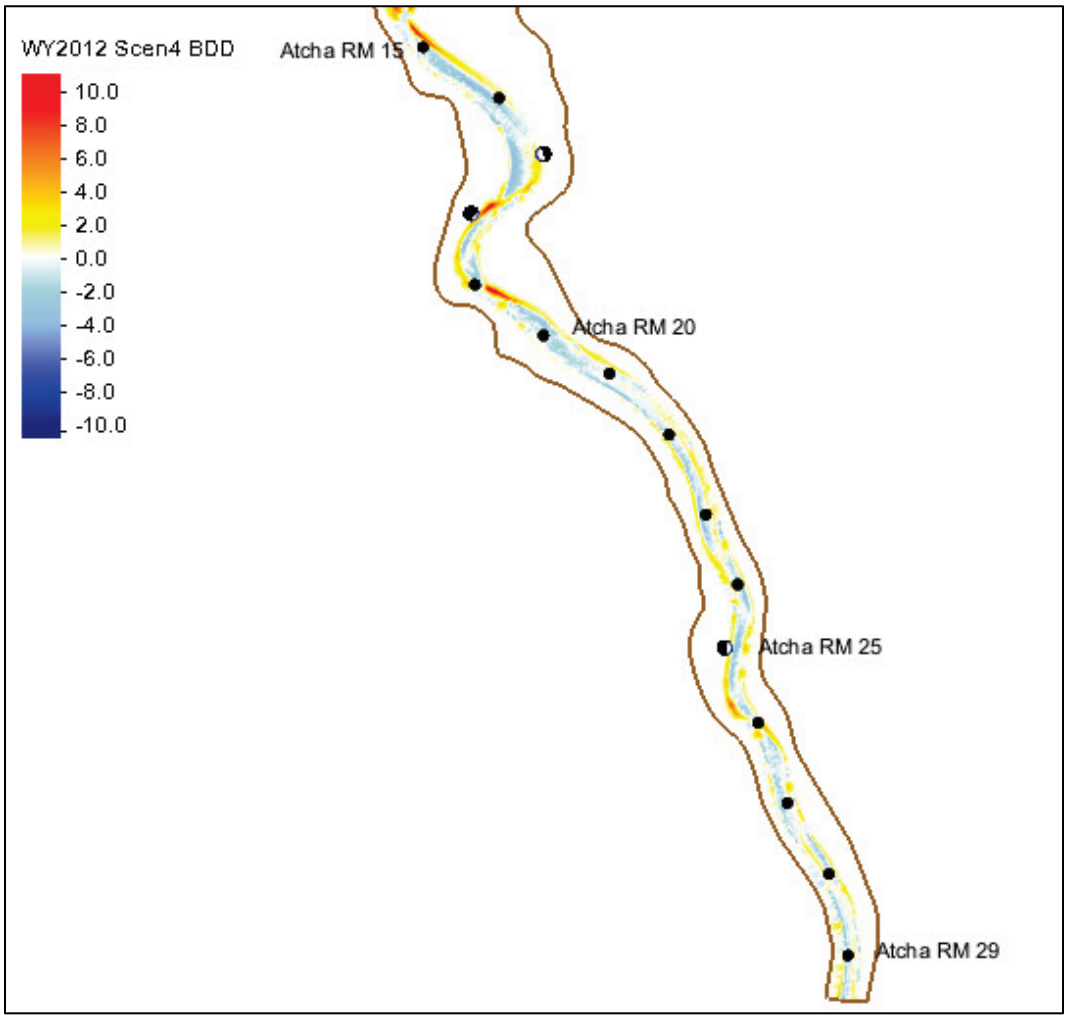


Plate D.36. WY2012 Scenario 4 BDD Atcha RM 15–Atcha RM 29.



D.4 Scenario 5

Plate D.37. WY2012 Scenario 5 BDD RR RM 43–RR RM 30.

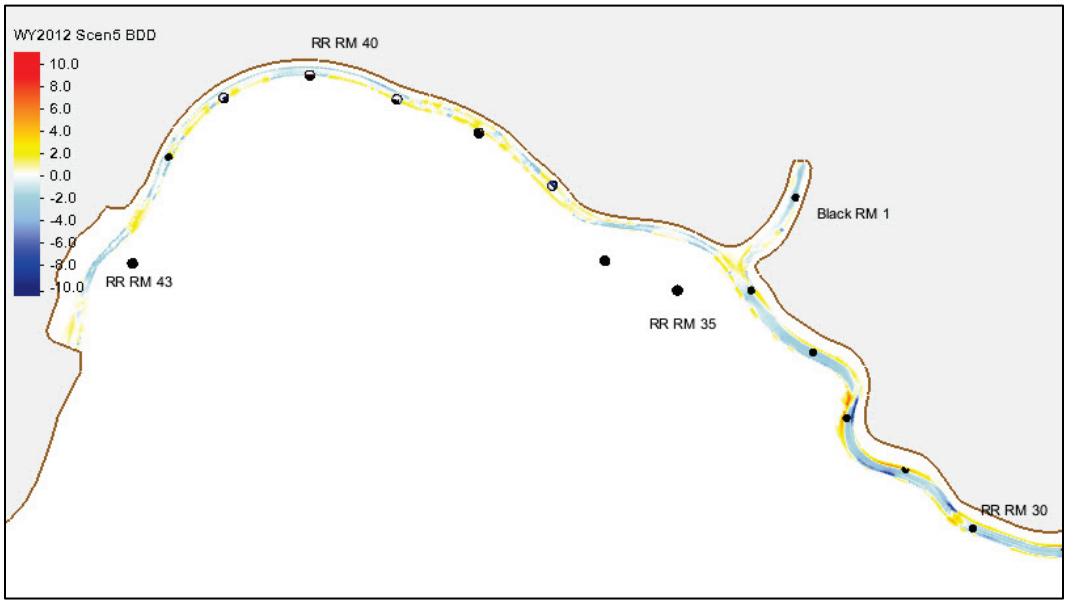


Plate D.38. WY2012 Scenario 5 BDD RR RM 30–RR RM 20.

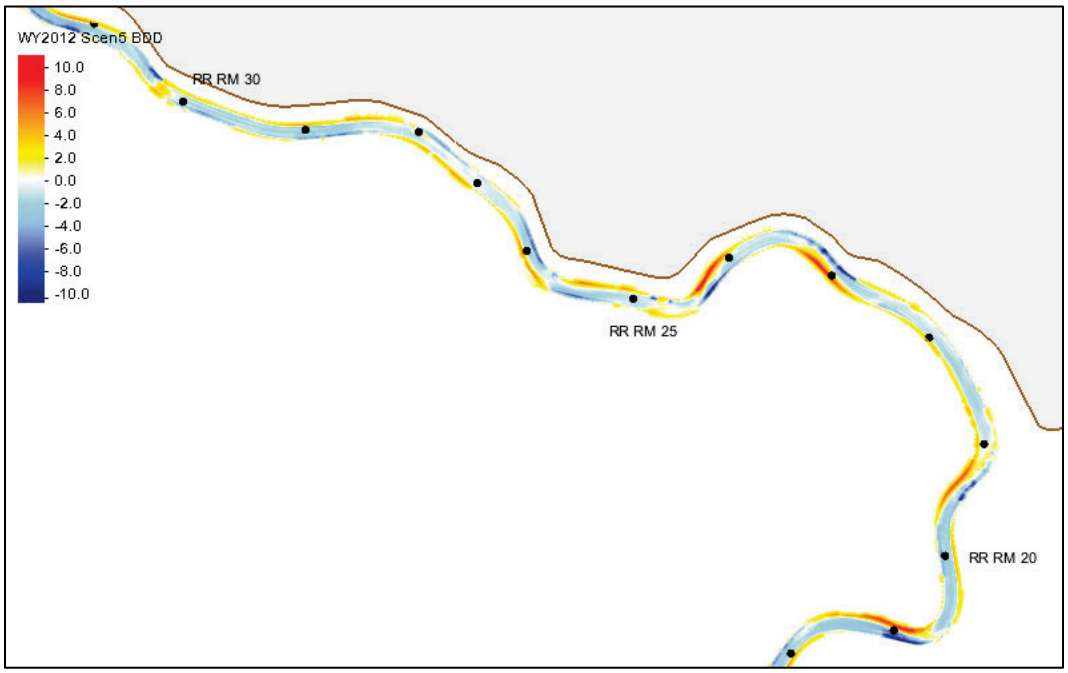


Plate D.39. WY2012 Scenario 5 BDD RR RM 20–RR RM 10.

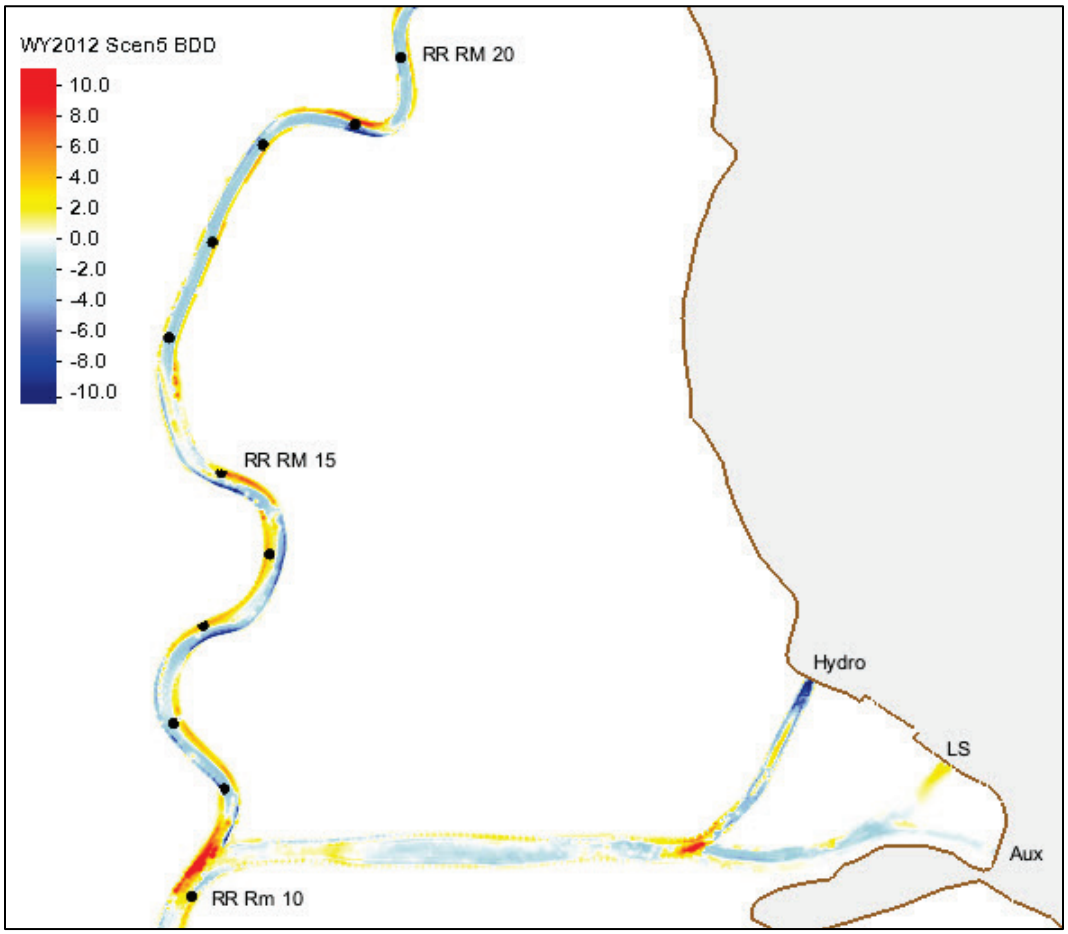


Plate D.40. WY2012 Scenario 5 BDD Outflow Channel.

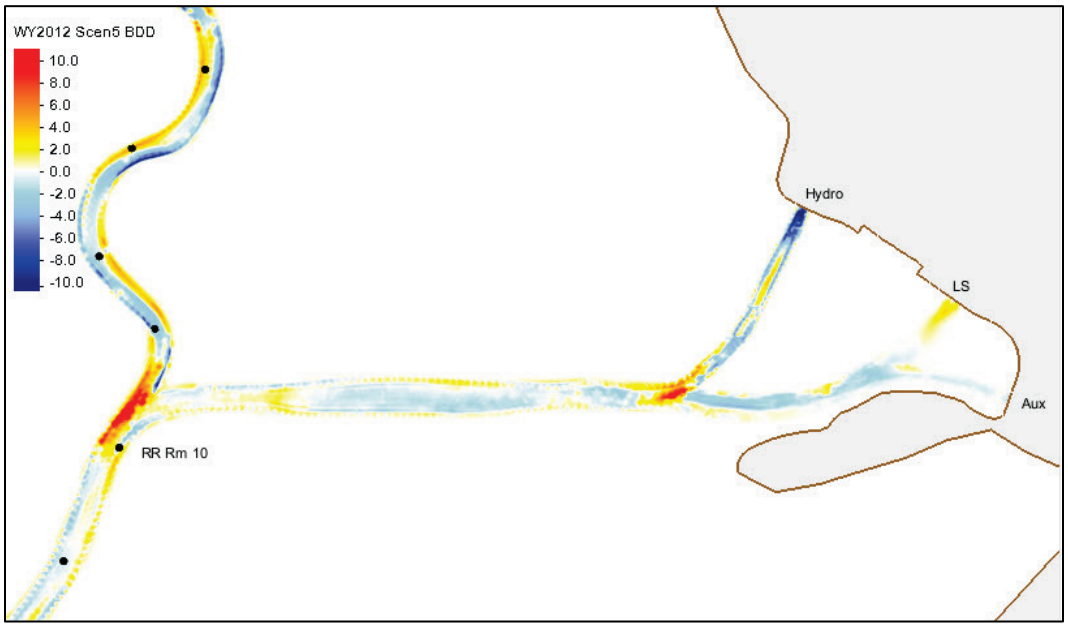


Plate D.41. WY2012 Scenario 5 BDD RR RM 10–Atcha RM 5.

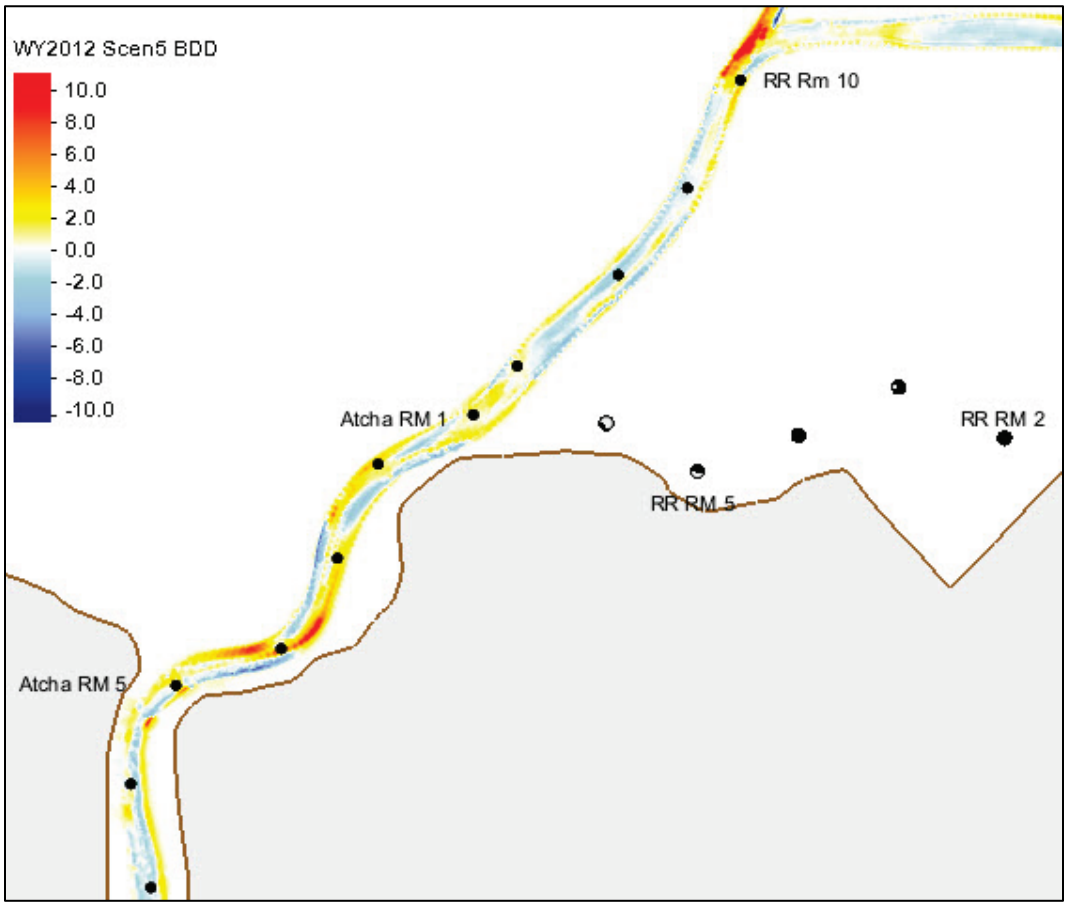


Plate D.42. WY2012 Scenario 5 BDD Atcha RM 5–Atcha RM 15.

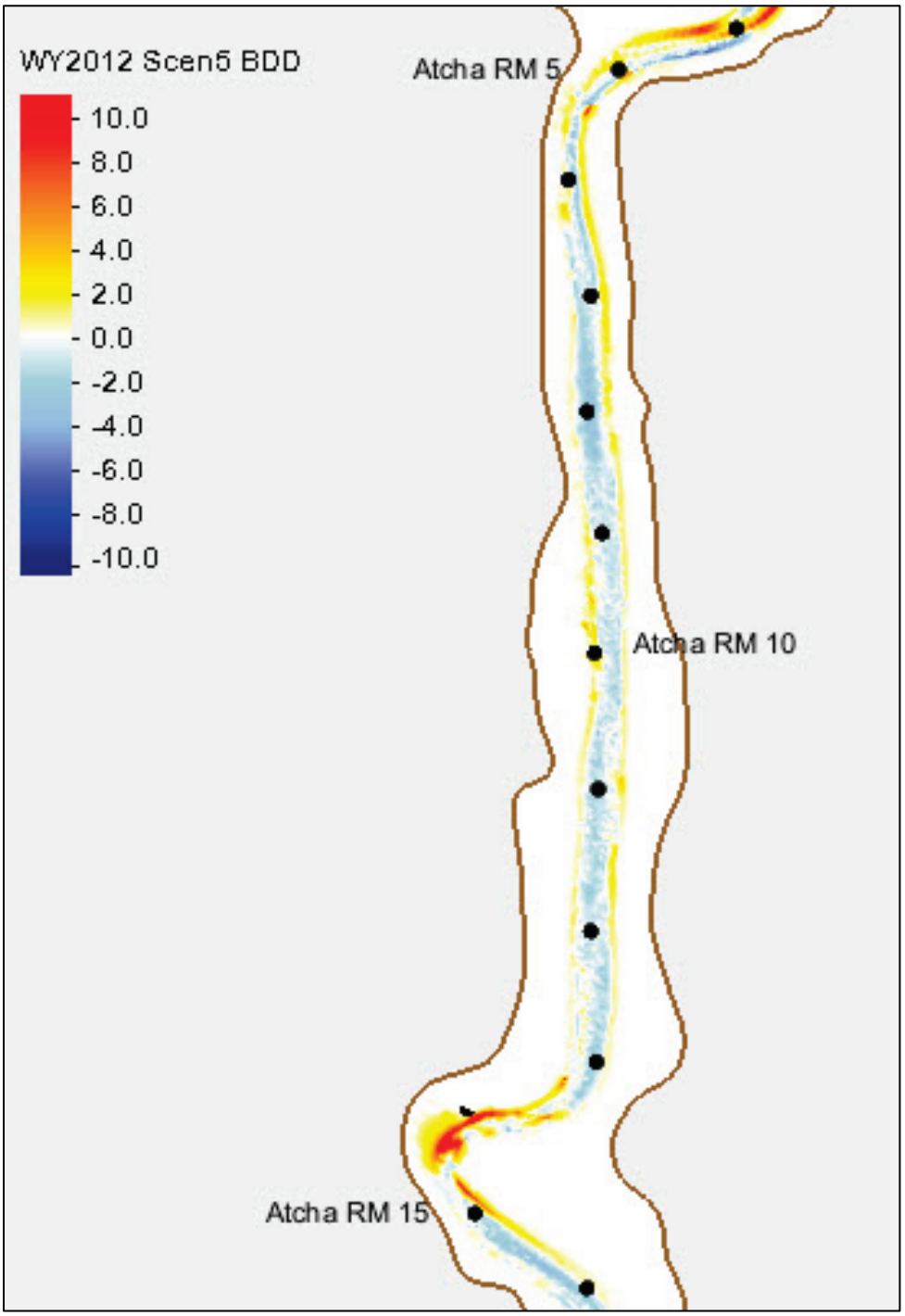
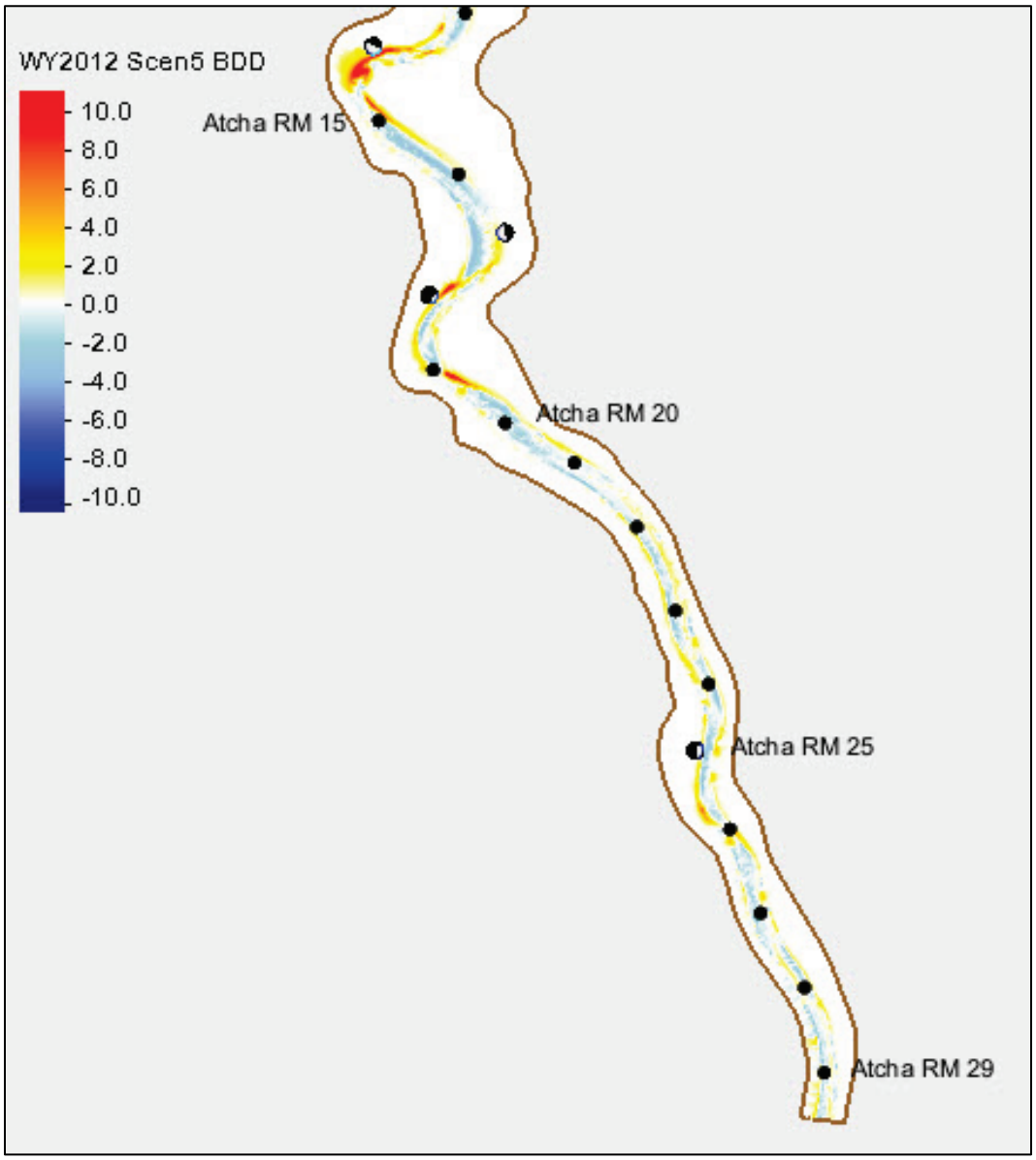


Plate D.43. WY2012 Scenario 5 BDD Atcha RM 15–Atcha RM 29.



D.5 Scenario 6

Plate D.44. WY2012 Scenario 6 BDD RR RM 43–RR RM 30.

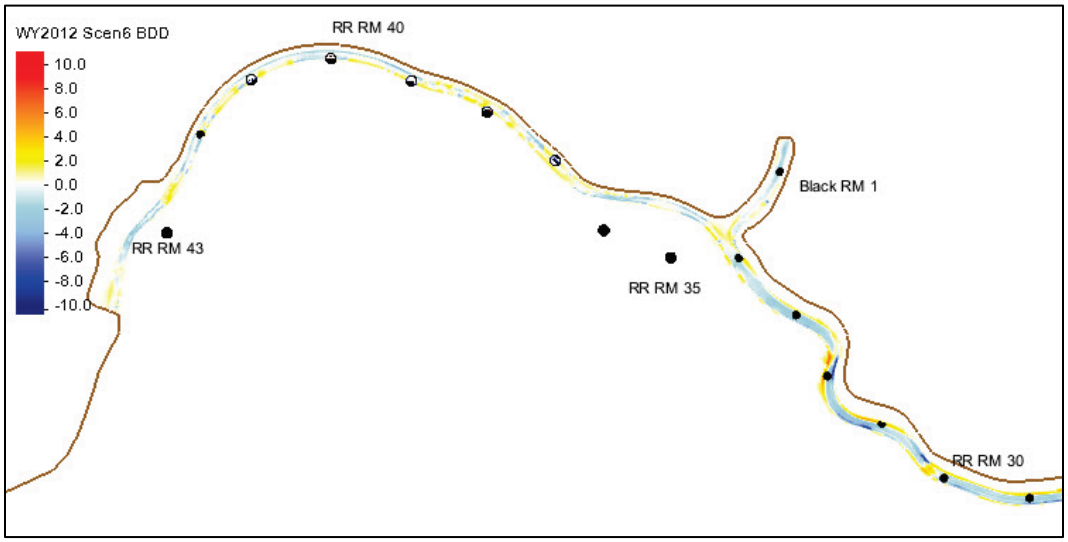


Plate D.45. WY2012 Scenario 6 BDD RR RM 30–RR RM 20.

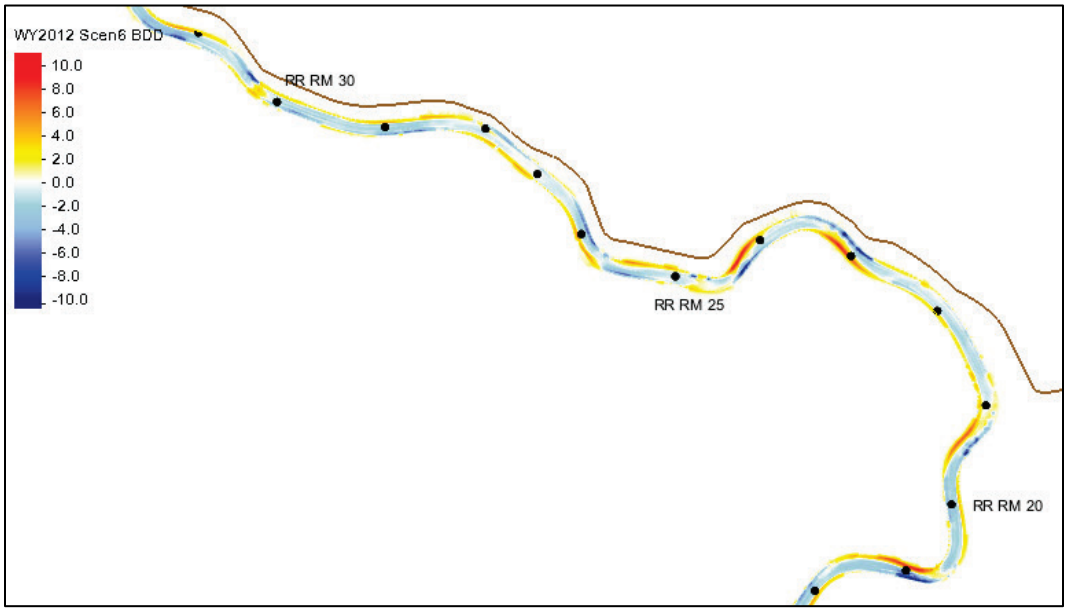


Plate D.46. WY2012 Scenario 6 BDD RR RM 20–RR RM 10 and Outflow Channel.

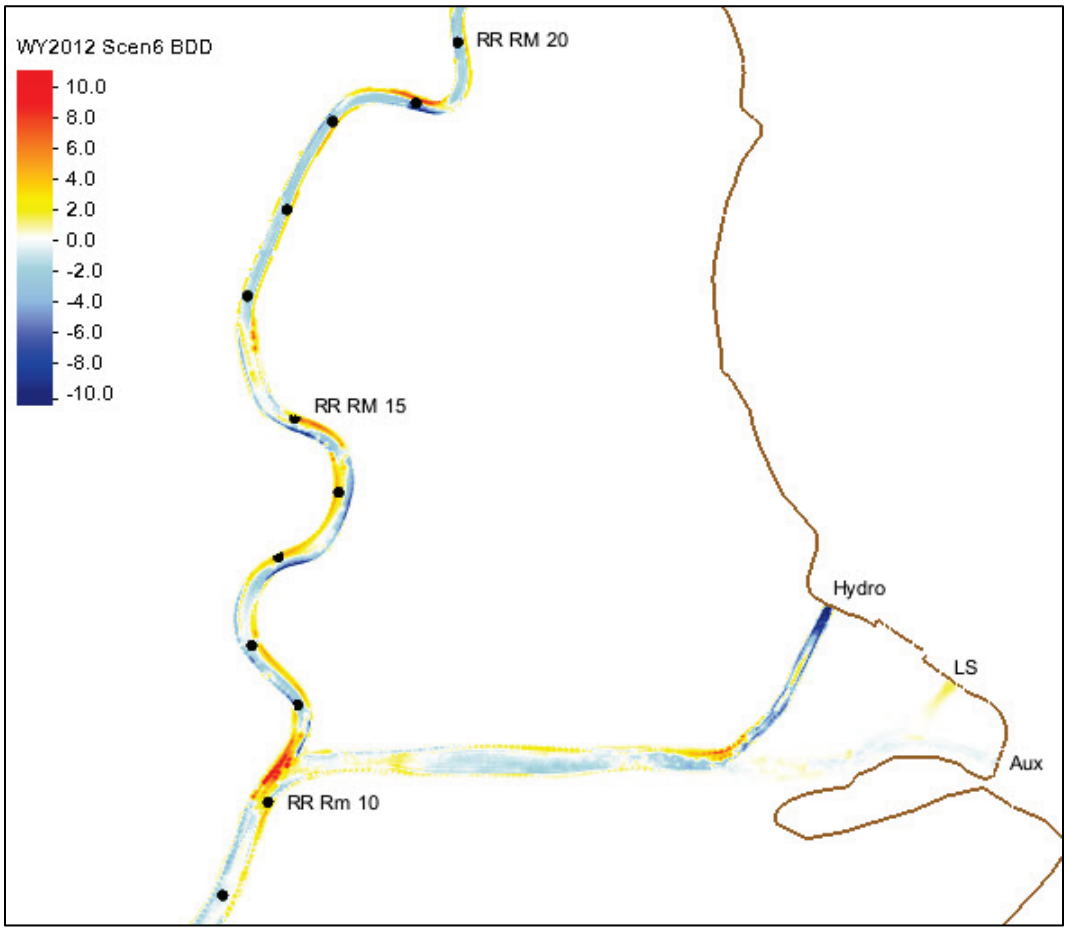


Plate D.47. WY2012 Scenario 6 BDD Outflow Channel.

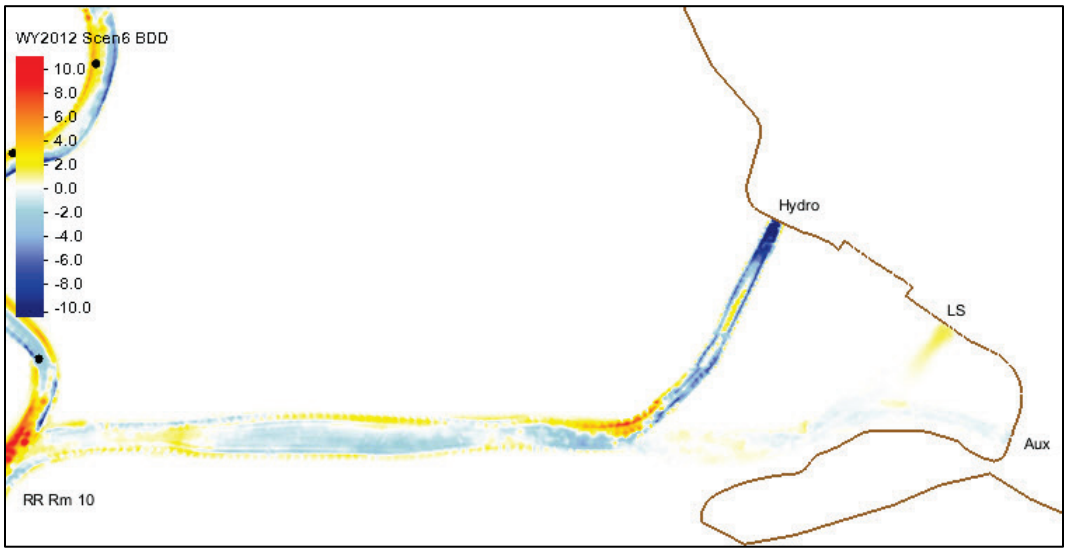


Plate D.48. WY2012 Scenario 6 BDD RR RM 10–Atcha RM 5.

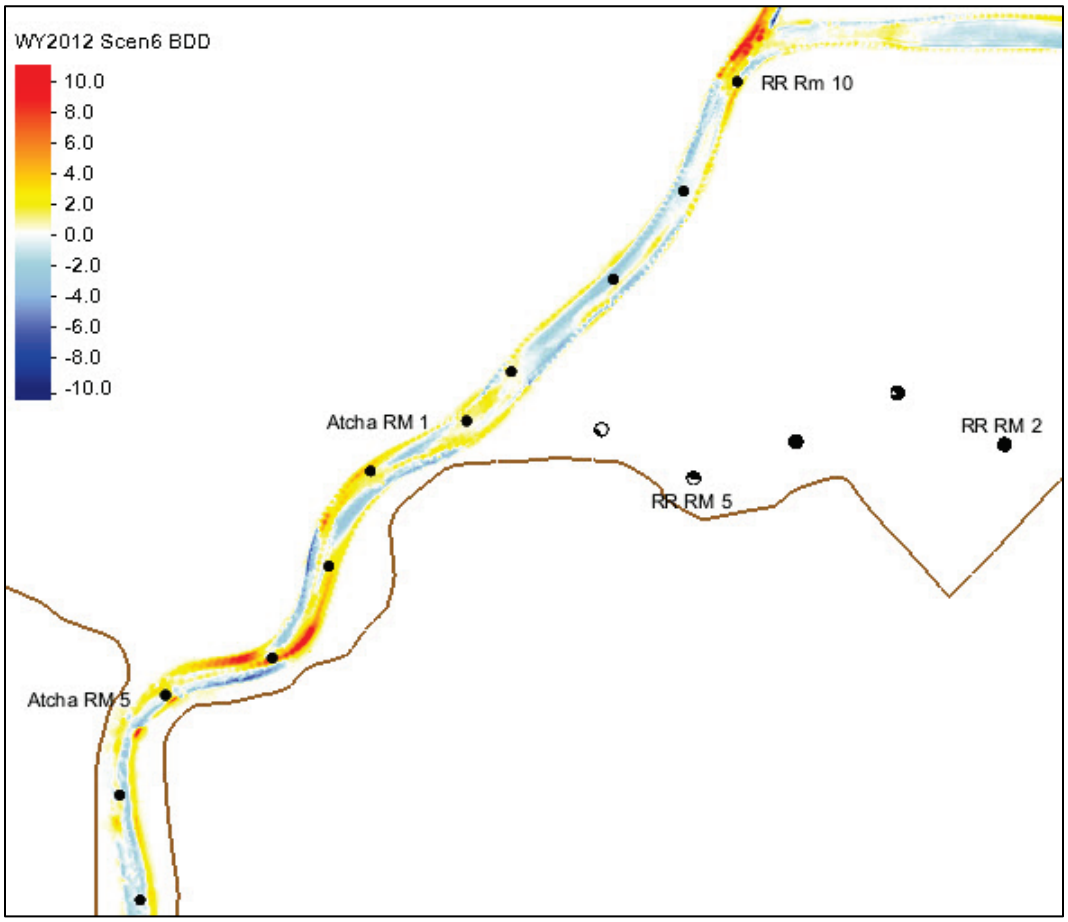


Plate D.49. WY2012 Scenario 6 BDD Atcha RM 5–Atcha RM 15.

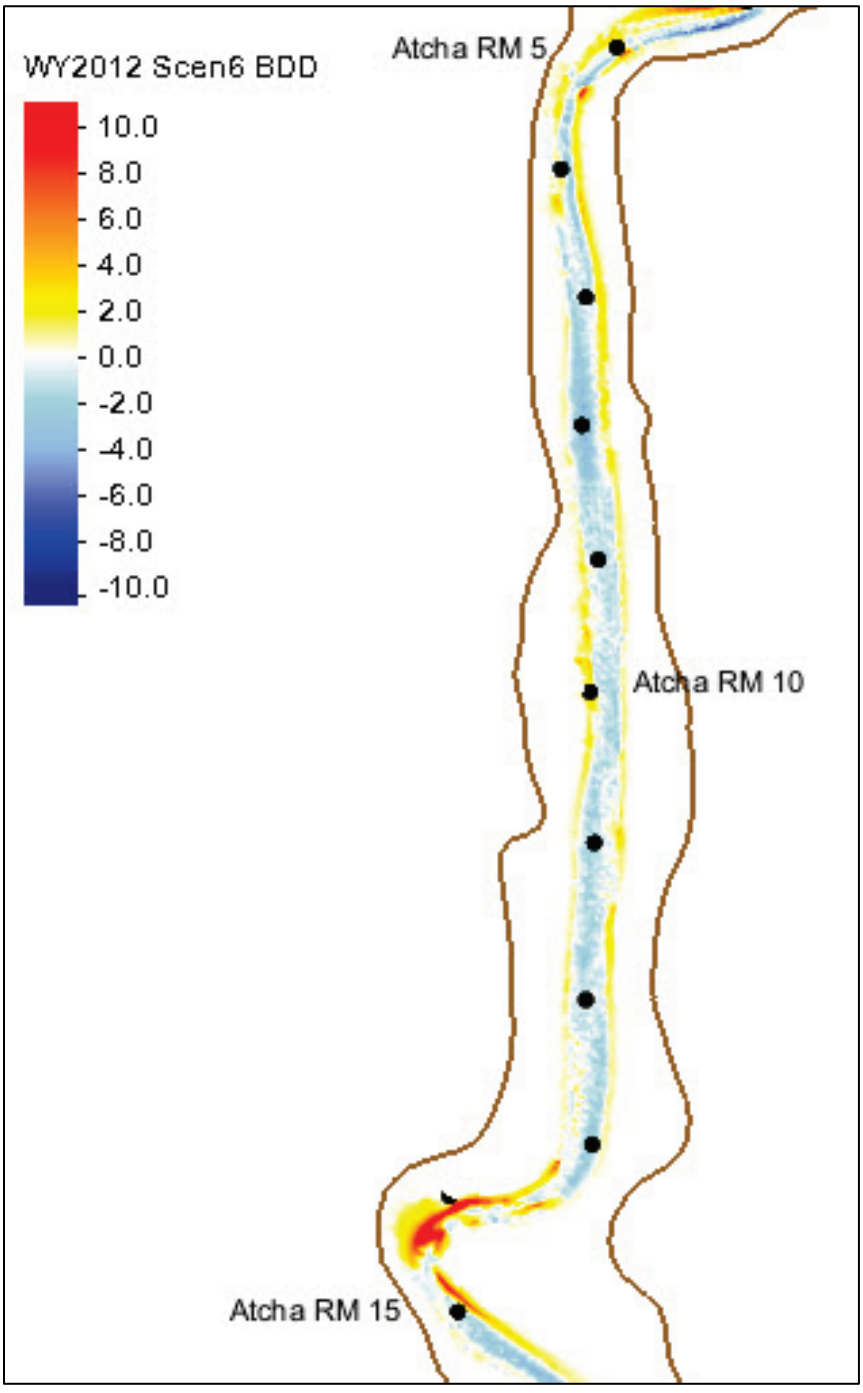
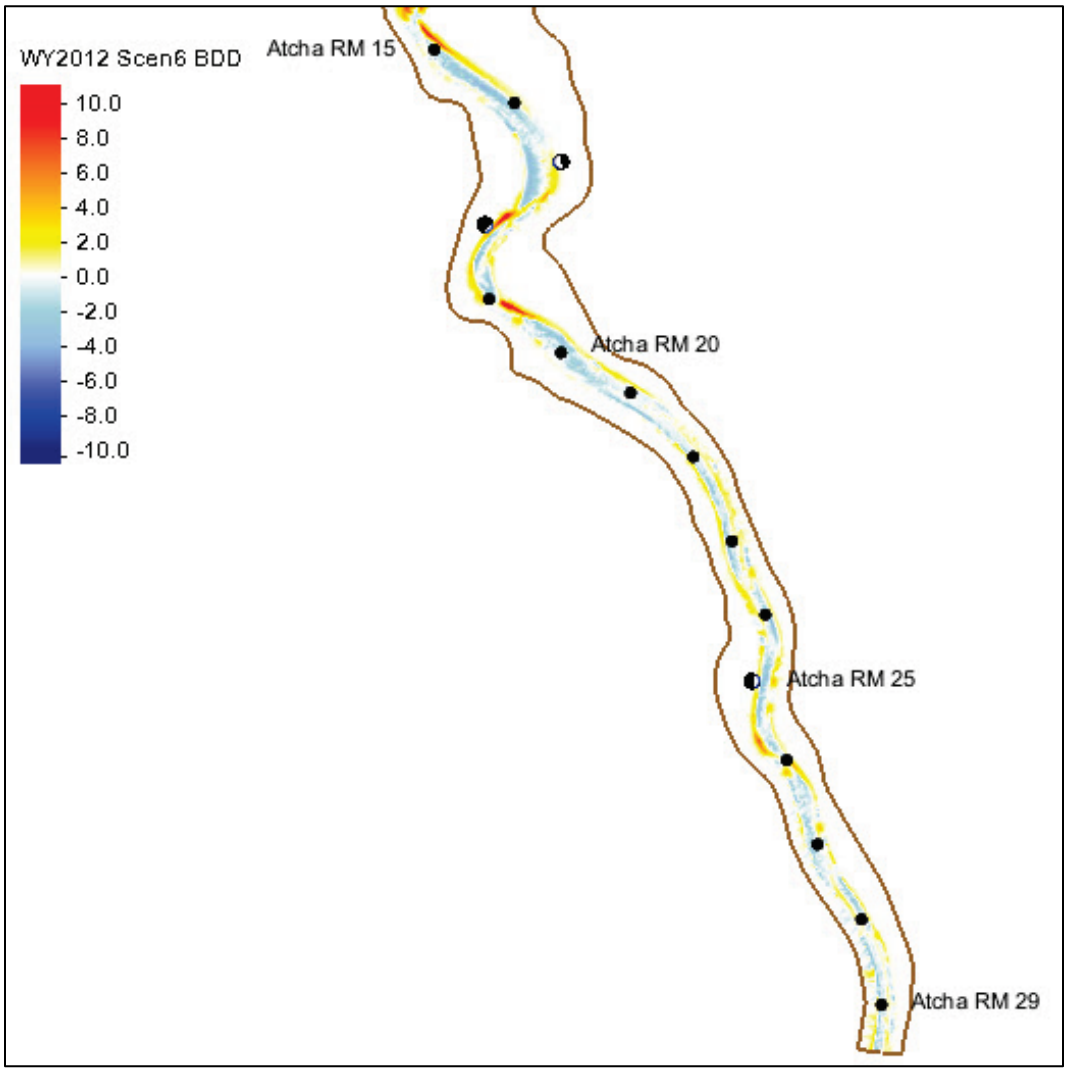


Plate D.50. WY2012 Scenario 6 BDD Atcha RM 15–Atcha RM 29.



D.6 Scenario 7

Plate D.51. WY2012 Scenario 7 BDD RR RM 43–RR RM 30.

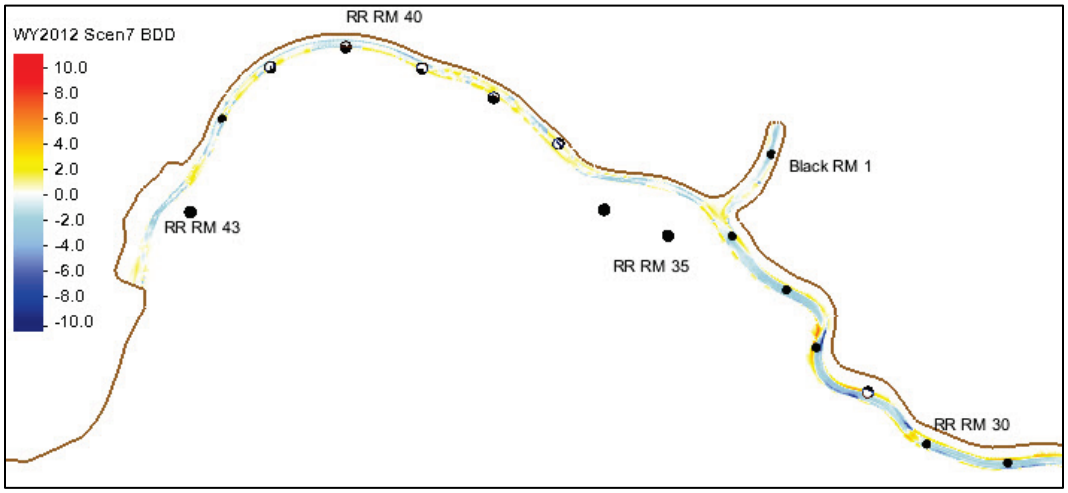


Plate D.52. WY2012 Scenario 7 BDD RR RM 30–RR RM 20.

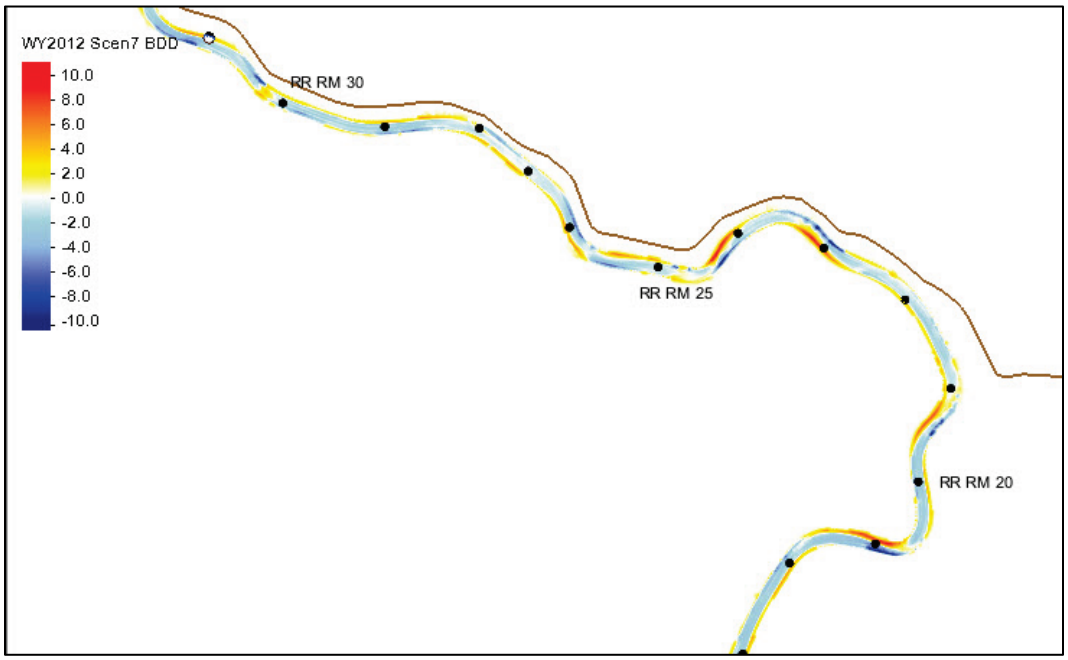


Plate D.53. WY2012 Scenario 7 BDD RR RM 20–RR RM 10.

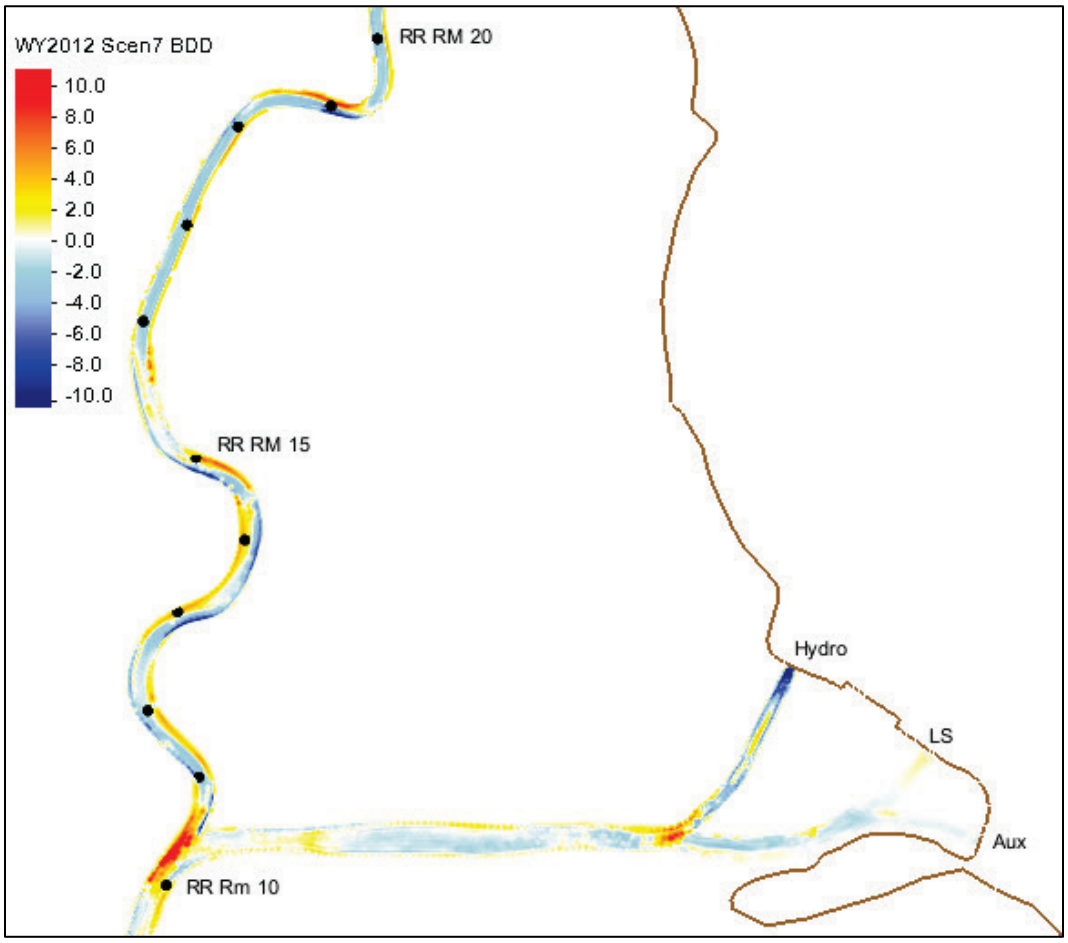


Plate D.54. WY2012 Scenario 7 BDD Outflow Channel.

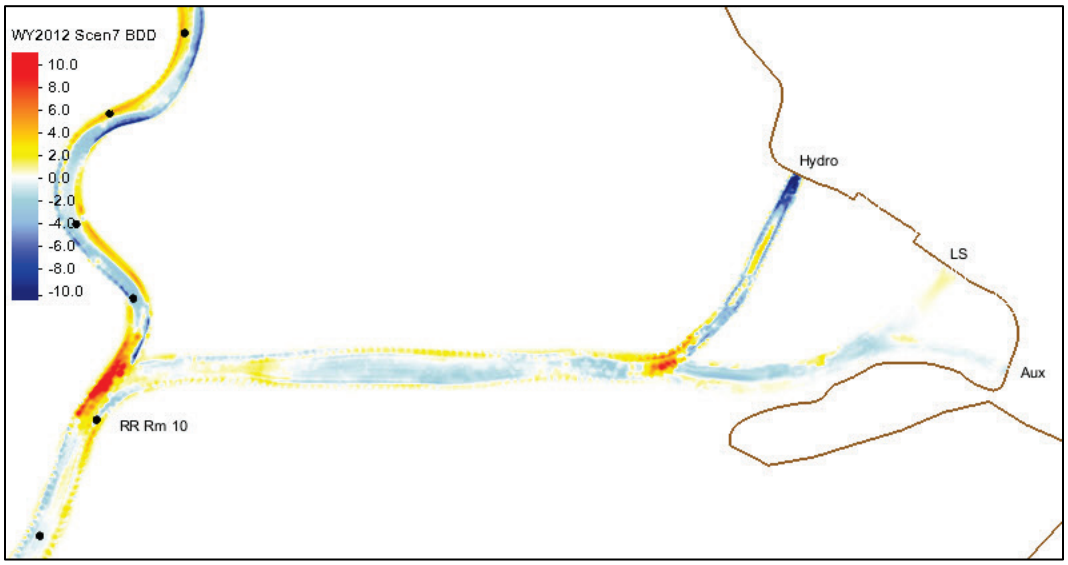


Plate D.55. WY2012 Scenario 7 BDD RR RM 10–Atcha RM 5.

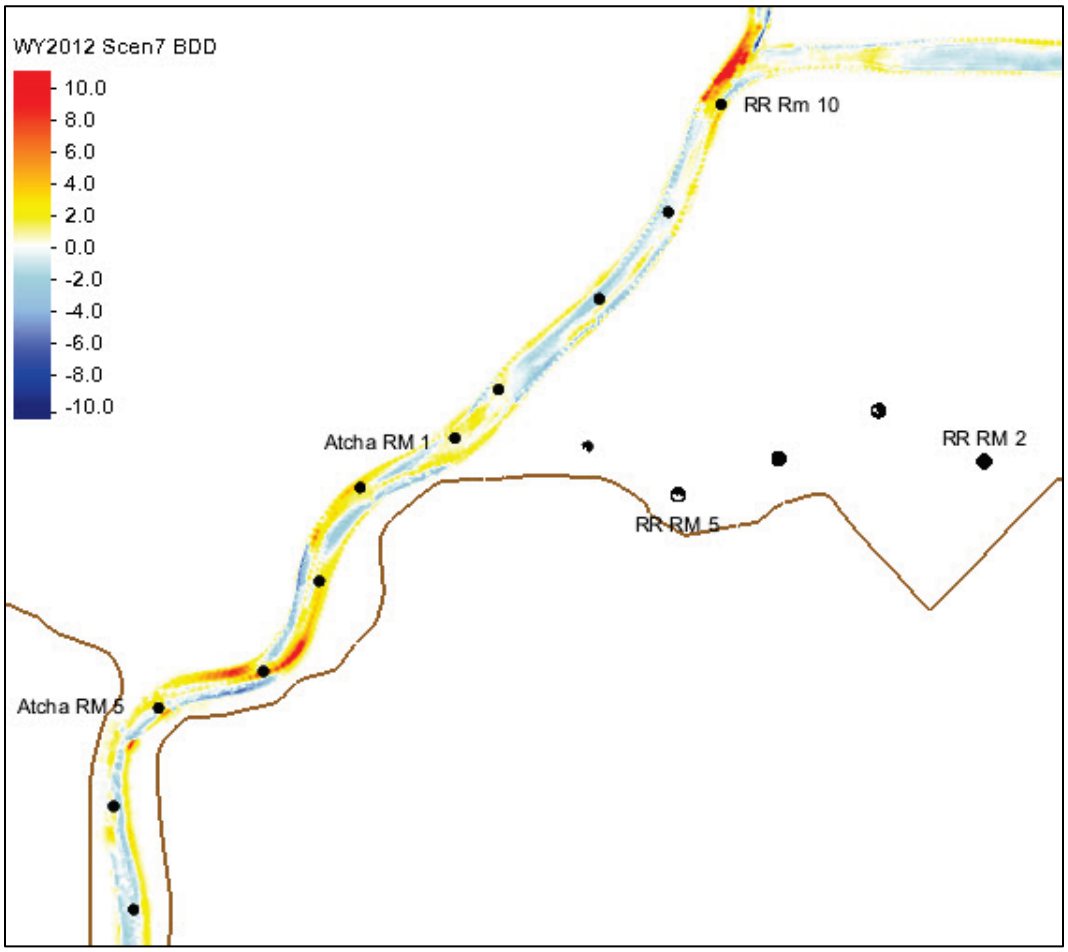


Plate D.56. WY2012 Scenario 7 BDD Atcha RM 5–Atcha RM 15.

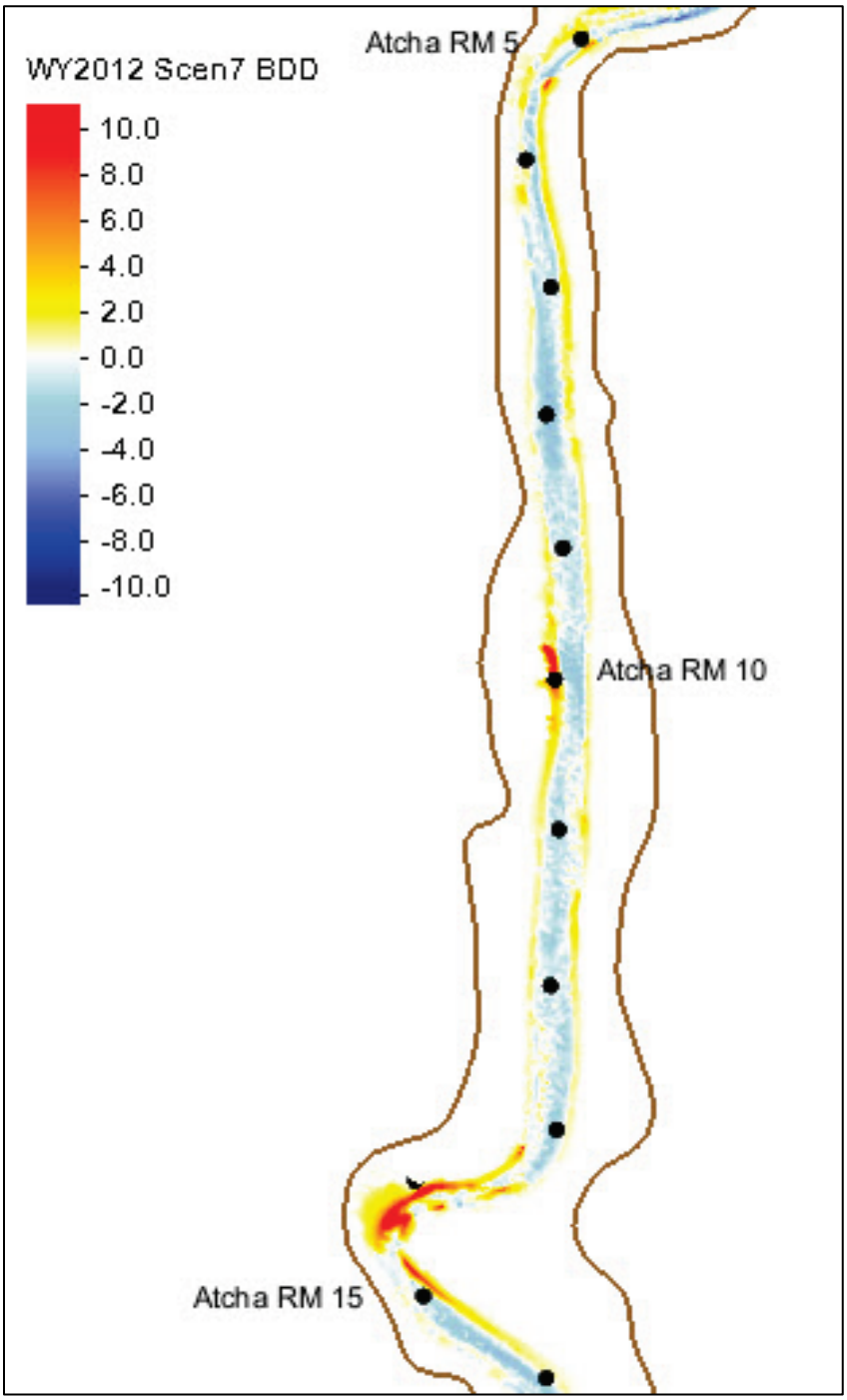
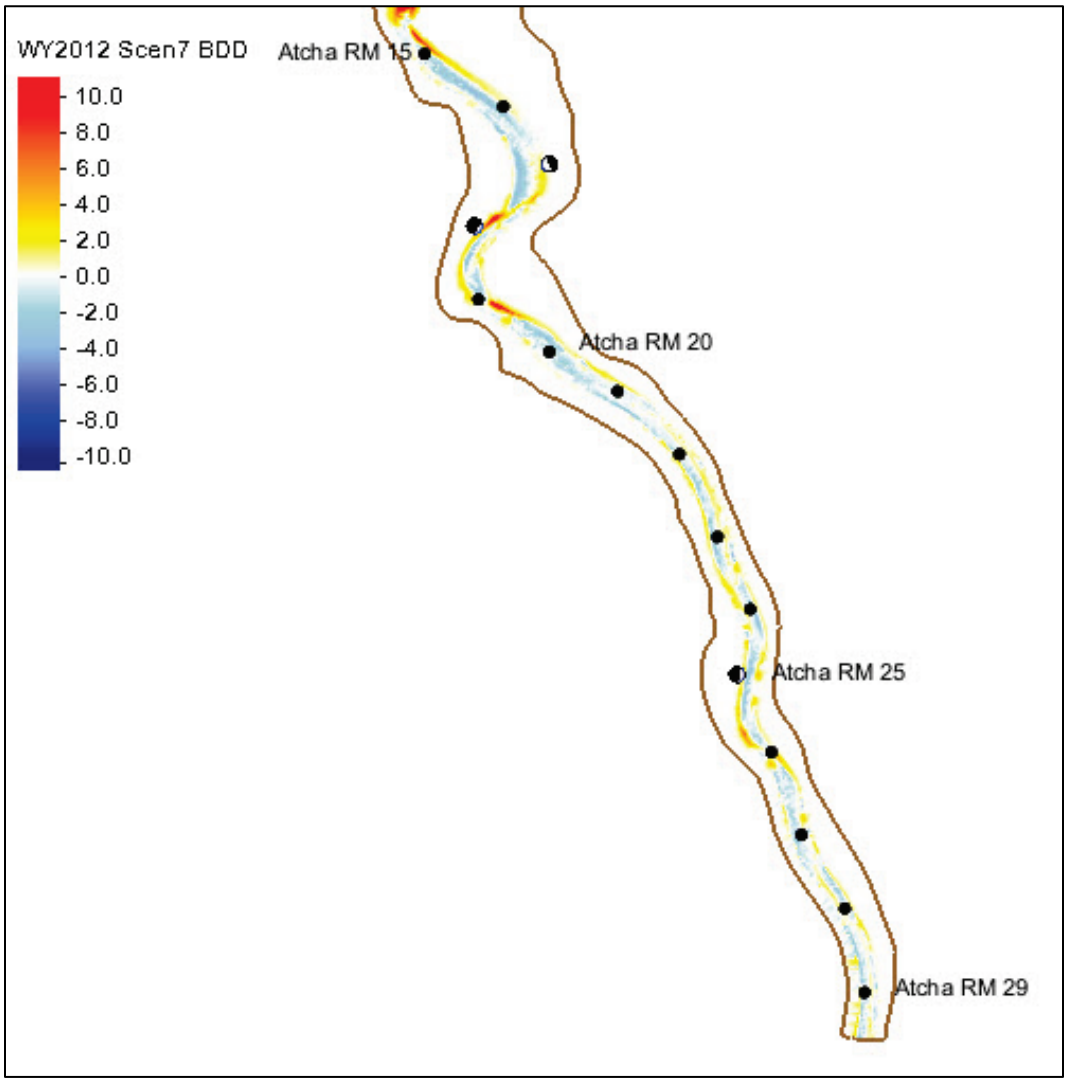


Plate D.57. WY2012 Scenario 7 BDD Atcha RM 15–Atcha RM 29.



D.7 Scenario 8a

Plate D.58. WY2012 Scenario 8a BDD RR RM 43–RR RM 30.

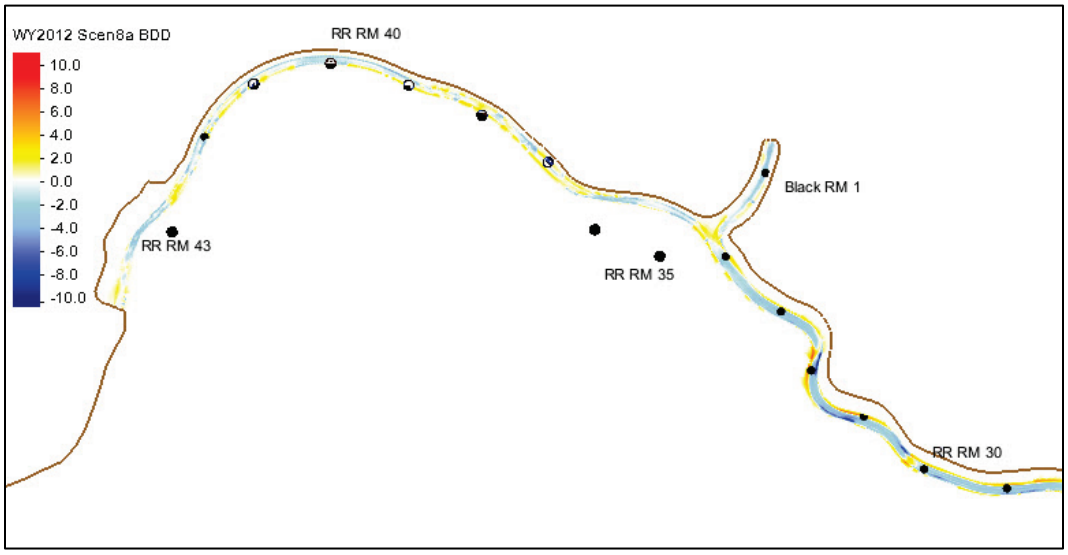


Plate D.59. WY2012 Scenario 8a BDD RR RM 30–RR RM 20.

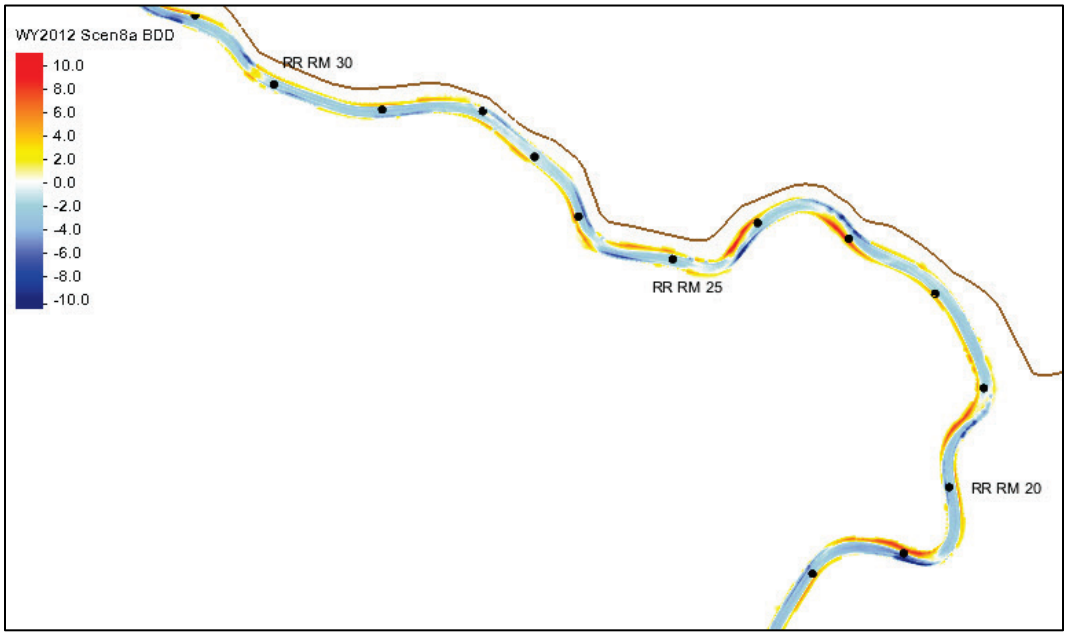


Plate D.60. WY2012 Scenario 8a BDD RR RM 20–RR RM 10.

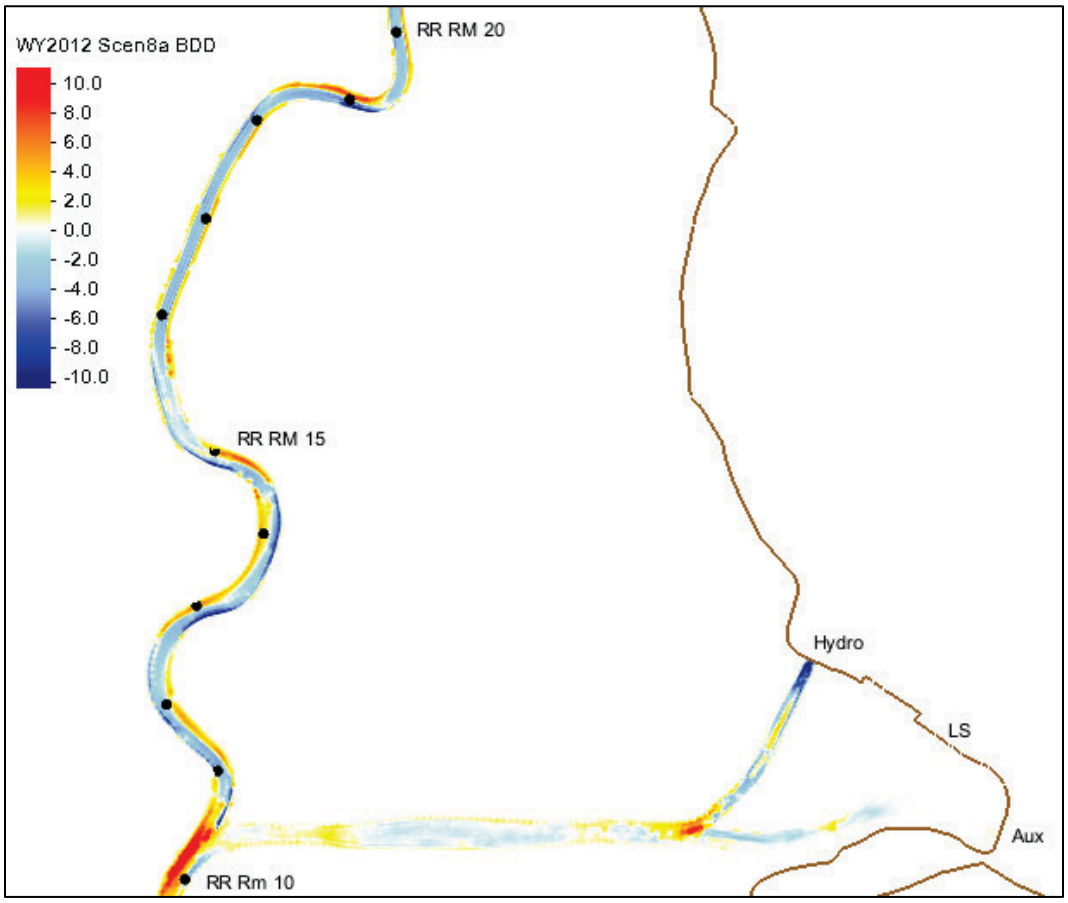


Plate D.61. WY2012 Scenario 8a BDD Outflow Channel.

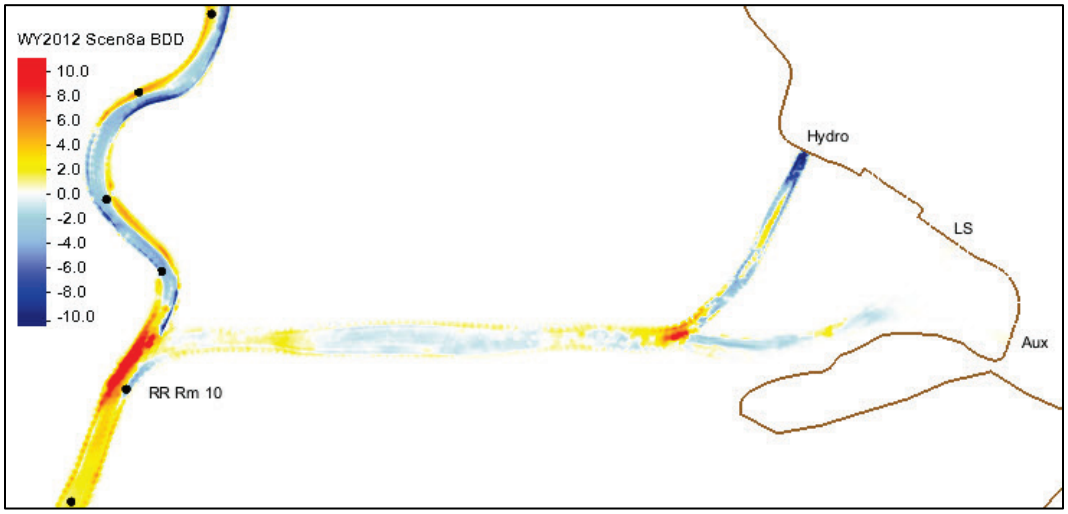


Plate D.62. WY2012 Scenario 8a BDD RR RM 10–Atcha RM 5.

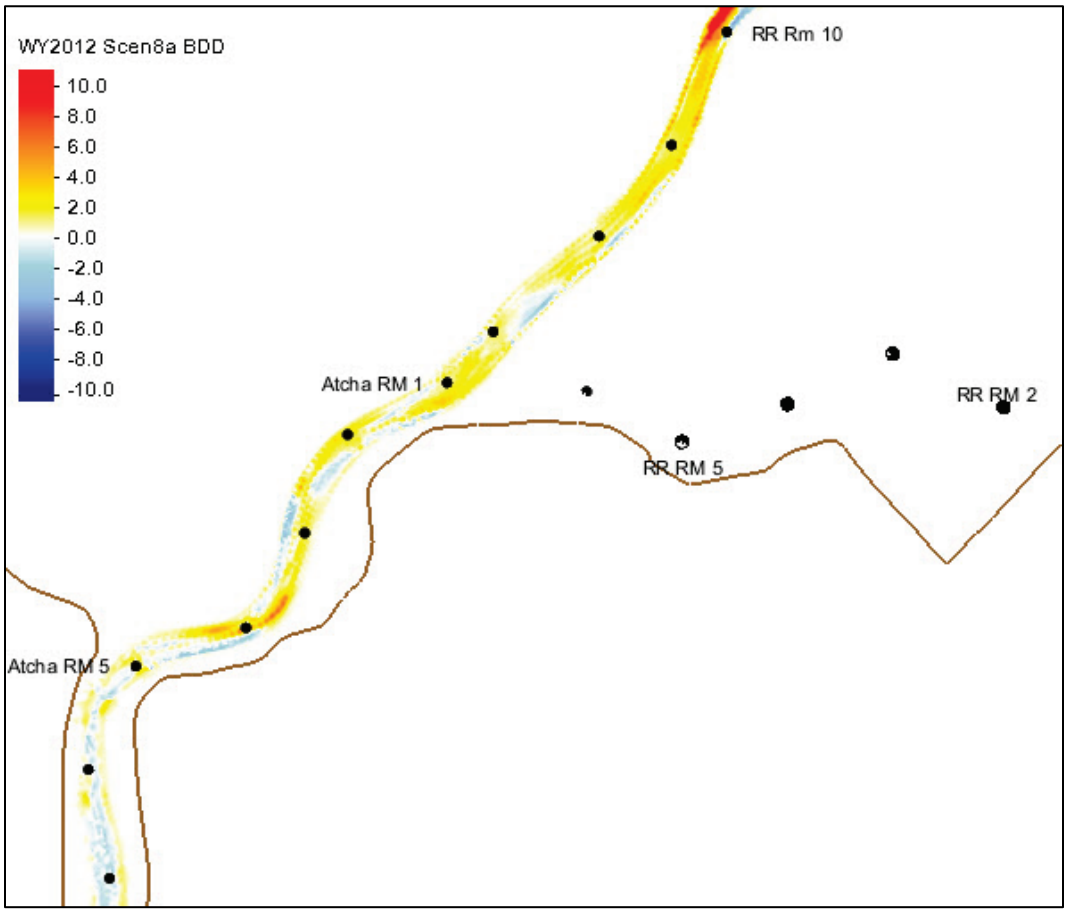


Plate D.63. WY2012 Scenario 8a BDD Atcha RM 5–Atcha RM 15.

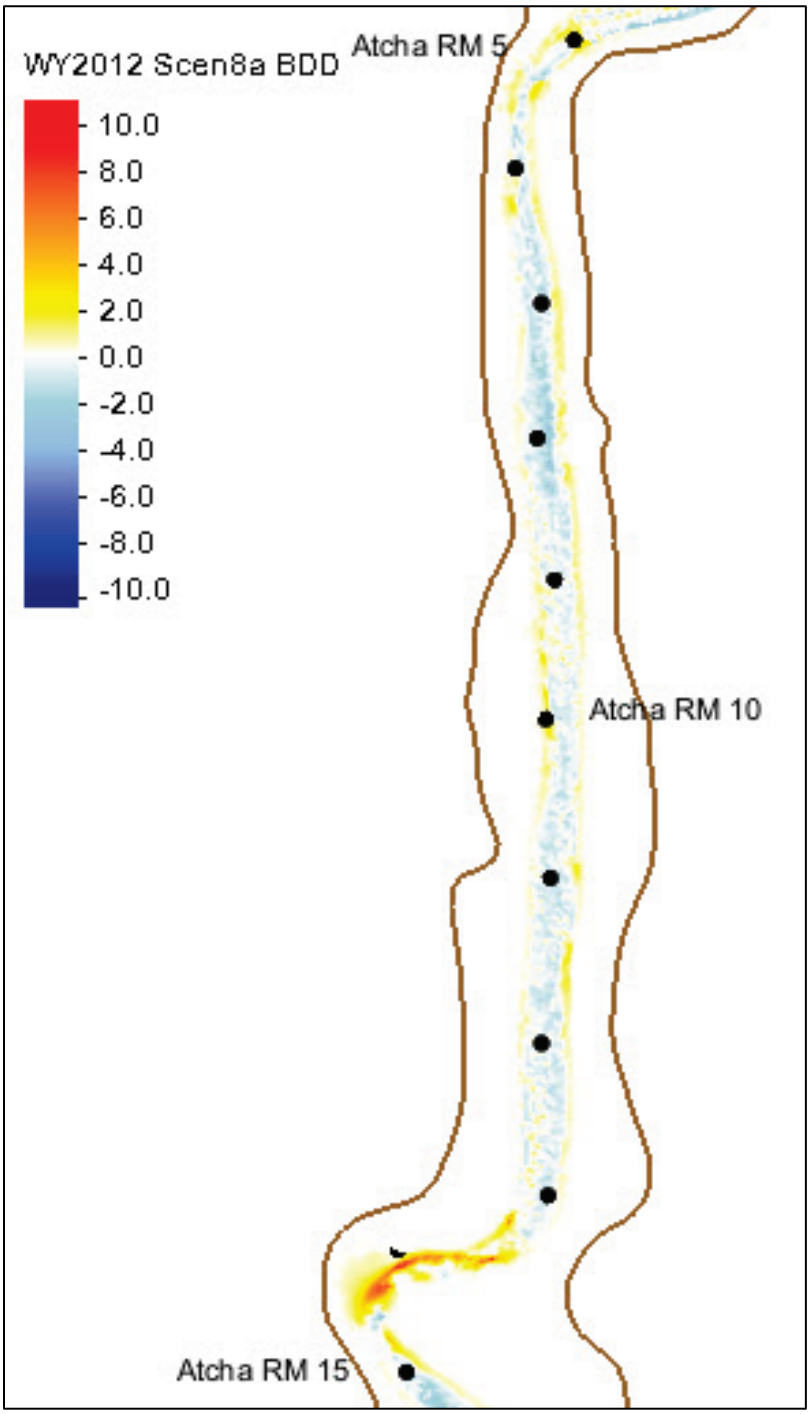
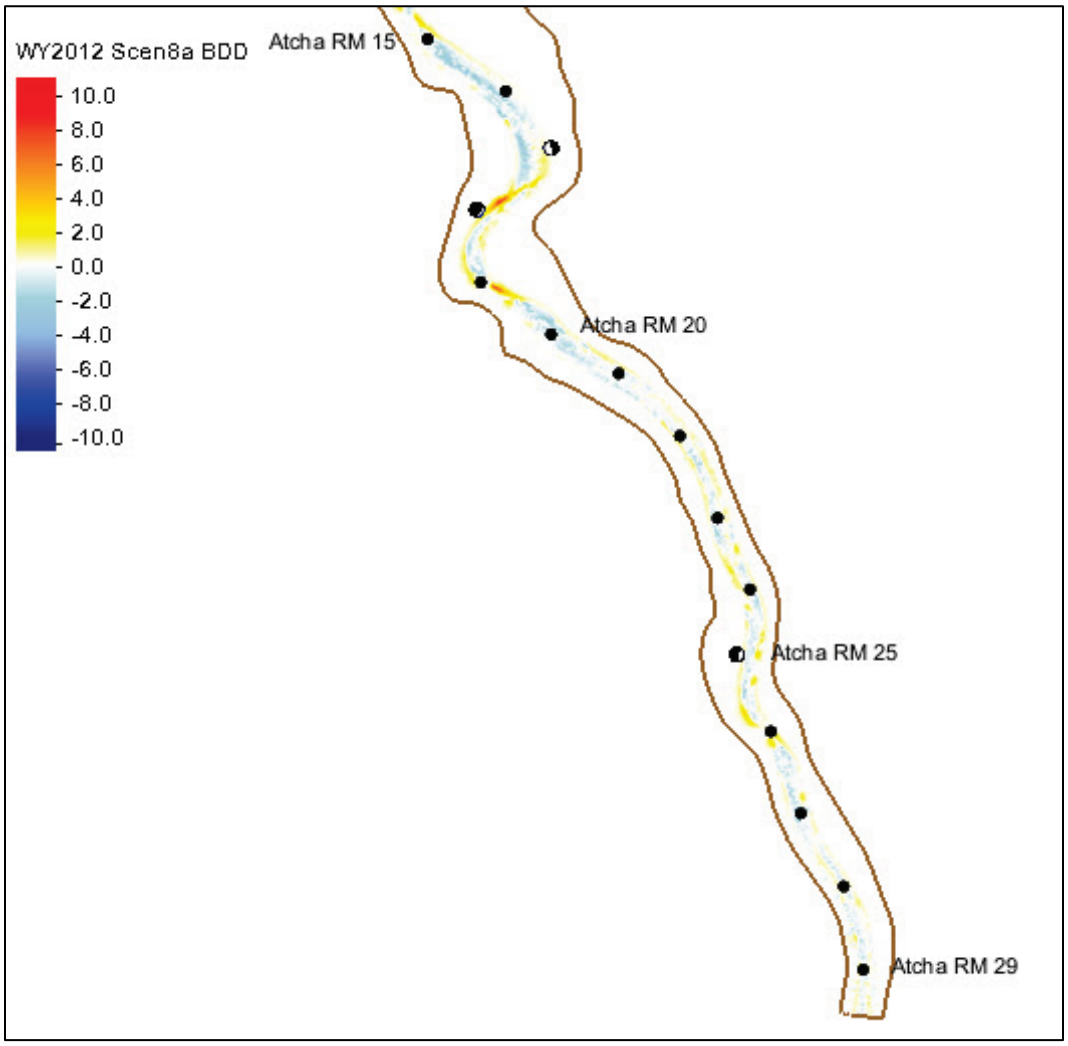


Plate D.64. WY2012 Scenario 8a BDD Atcha RM 15–Atcha RM 29.



D.8 Scenario 8b

Plate D.65. WY2012 Scenario 8b BDD RR RM 43–RR RM 30.

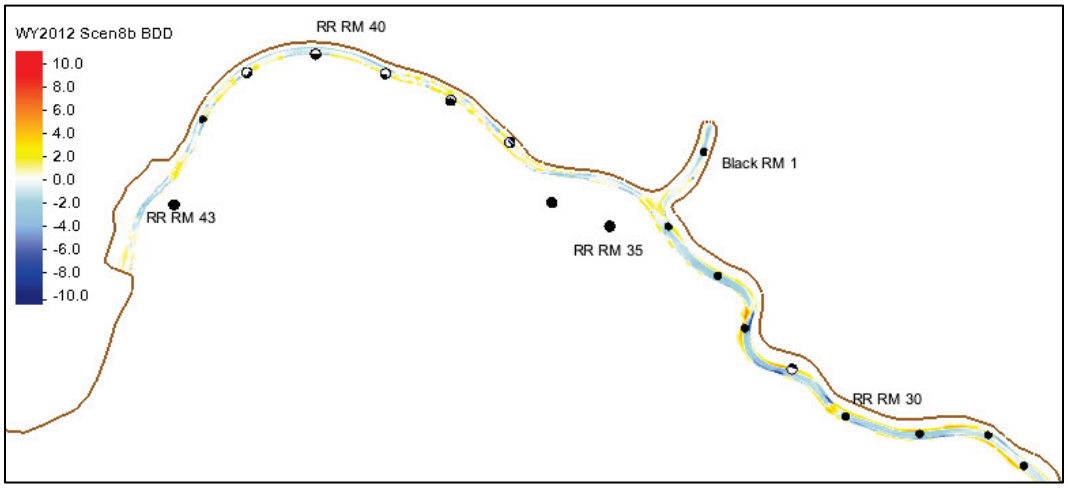


Plate D.66. WY2012 Scenario 8b BDD RR RM 30–RR RM 20.

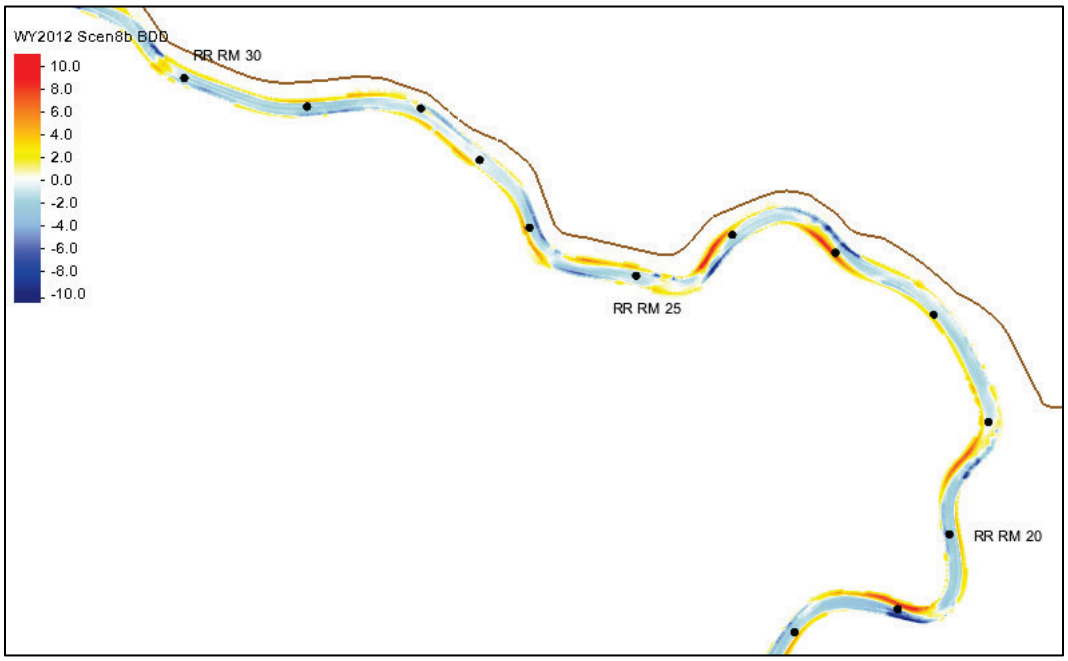


Plate D.67. WY2012 Scenario 8b BDD RR RM 20–RR RM 10.

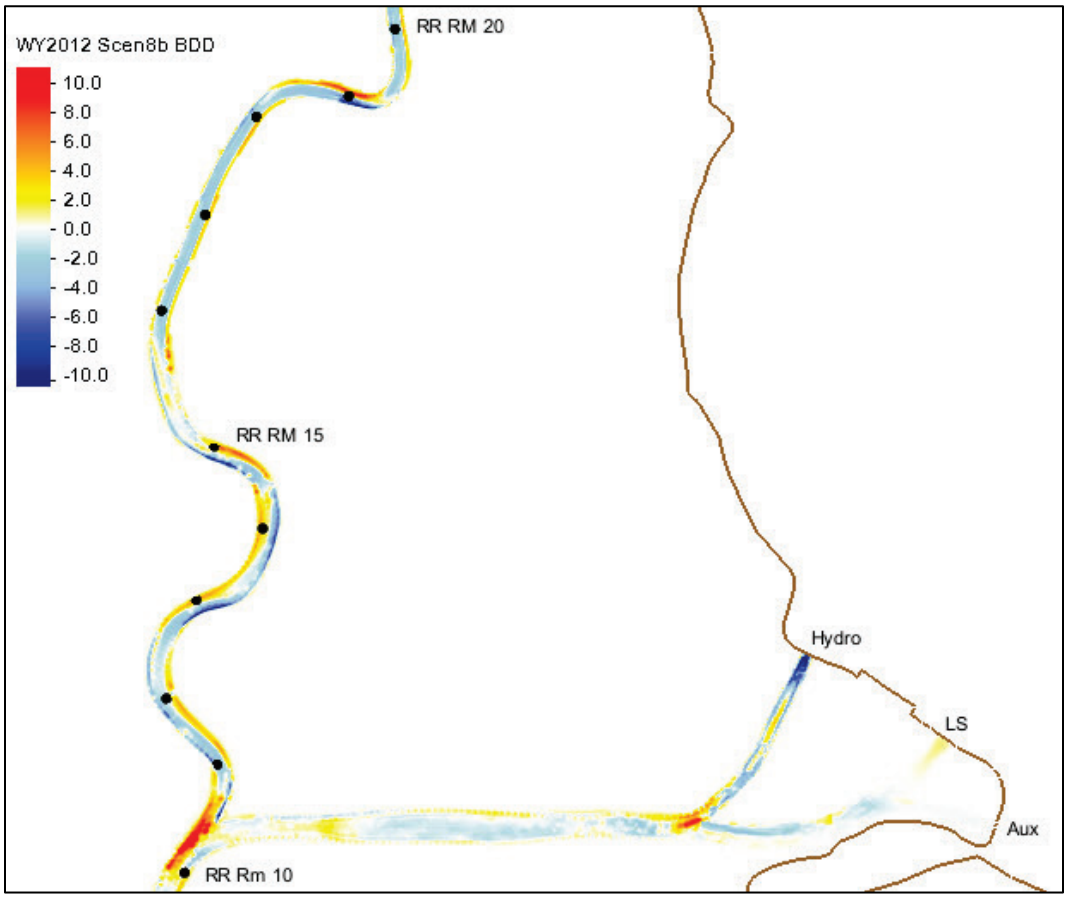


Plate D.68. WY2012 Scenario 8b BDD Outflow Channel.

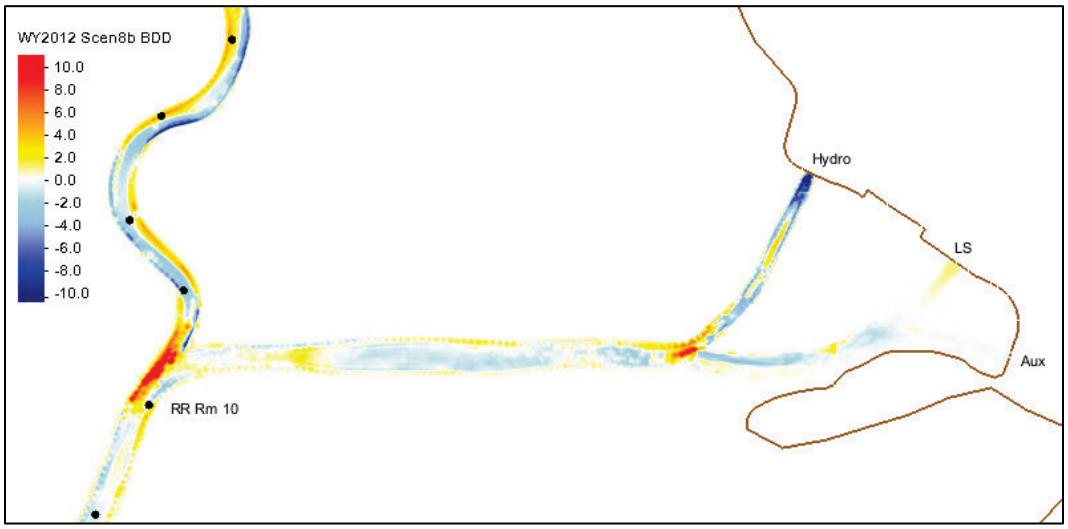


Plate D.69. WY2012 Scenario 8b BDD RR RM 10–Atcha RM 5.

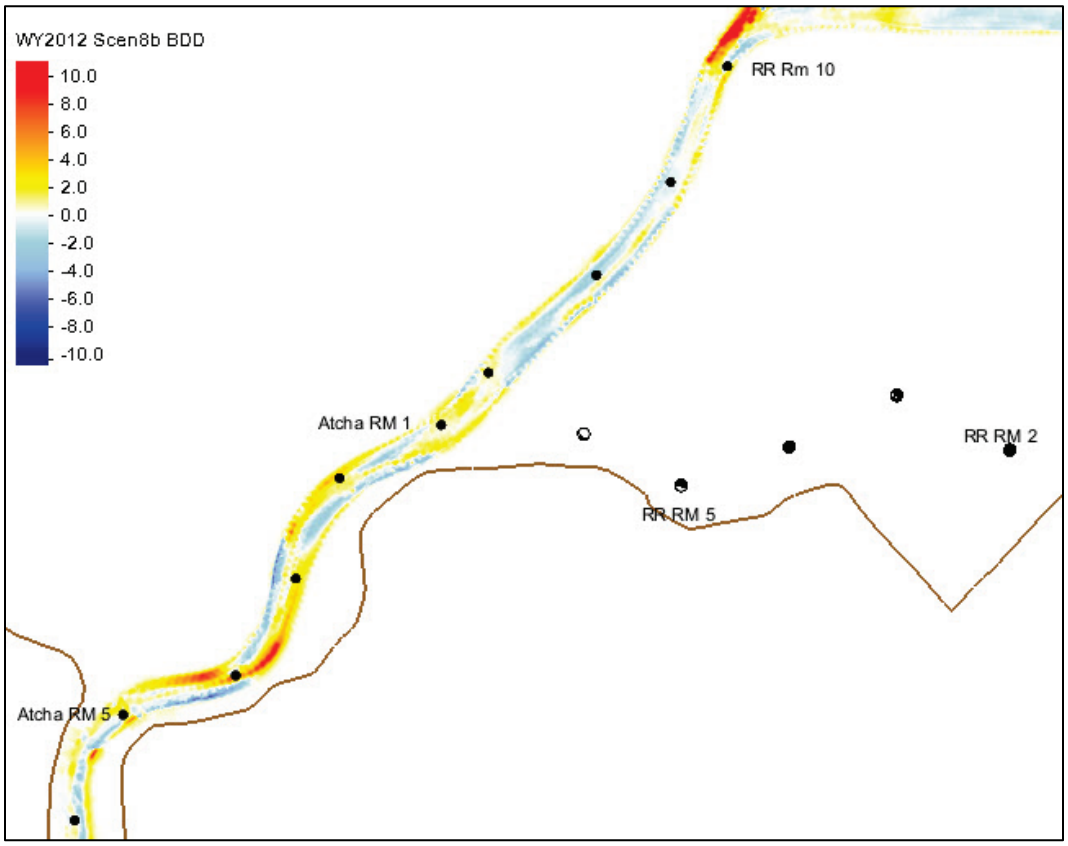


Plate D.70. WY2012 Scenario 8b BDD Atcha RM 5–Atcha RM 15.

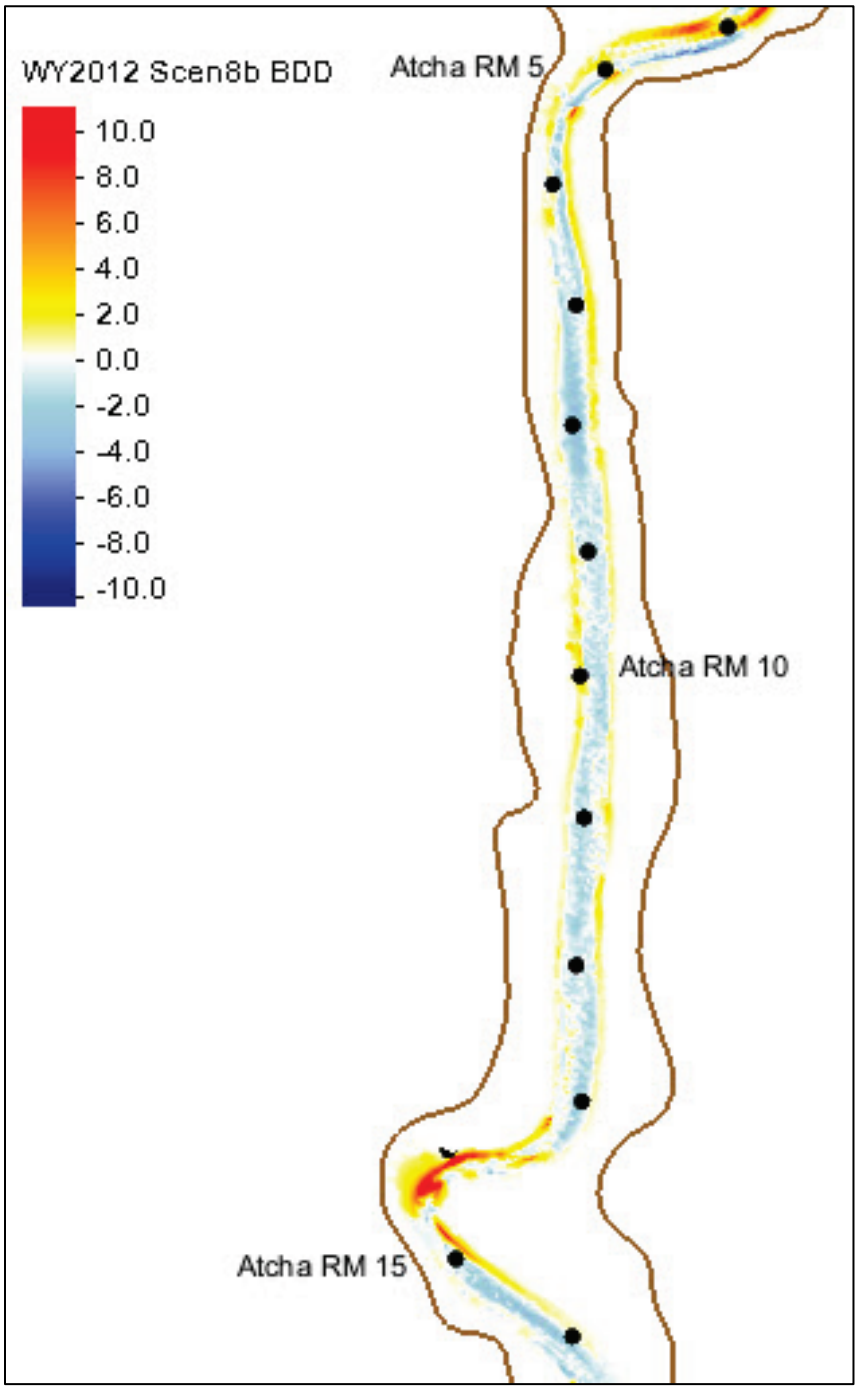
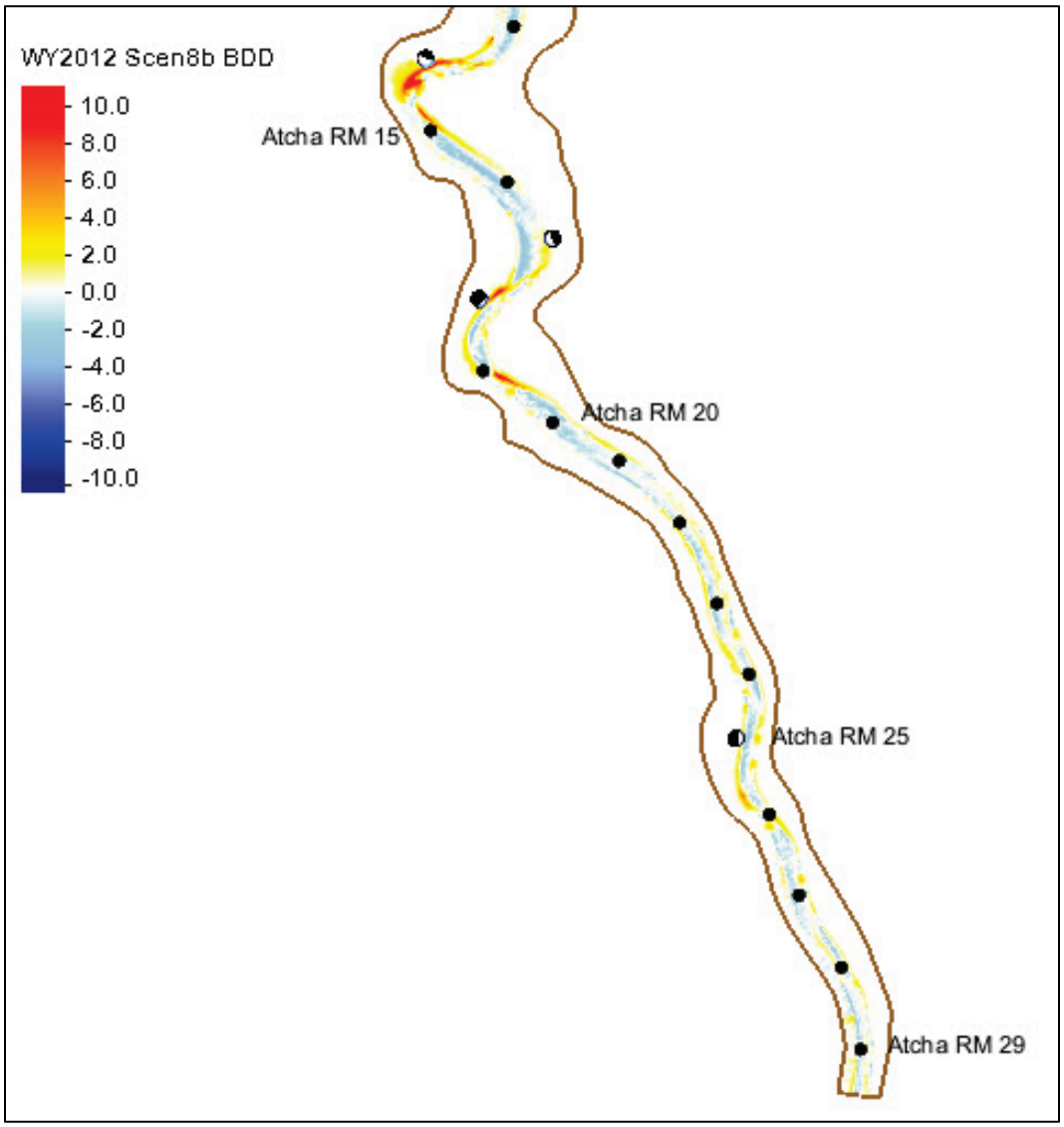


Plate D.71. WY2012 Scenario 8b BDD Atcha RM 15–Atcha RM 29.



D.9 Scenario 9

Plate D.72. WY2012 Scenario 9 BDD RR RM 43–RR RM 30.

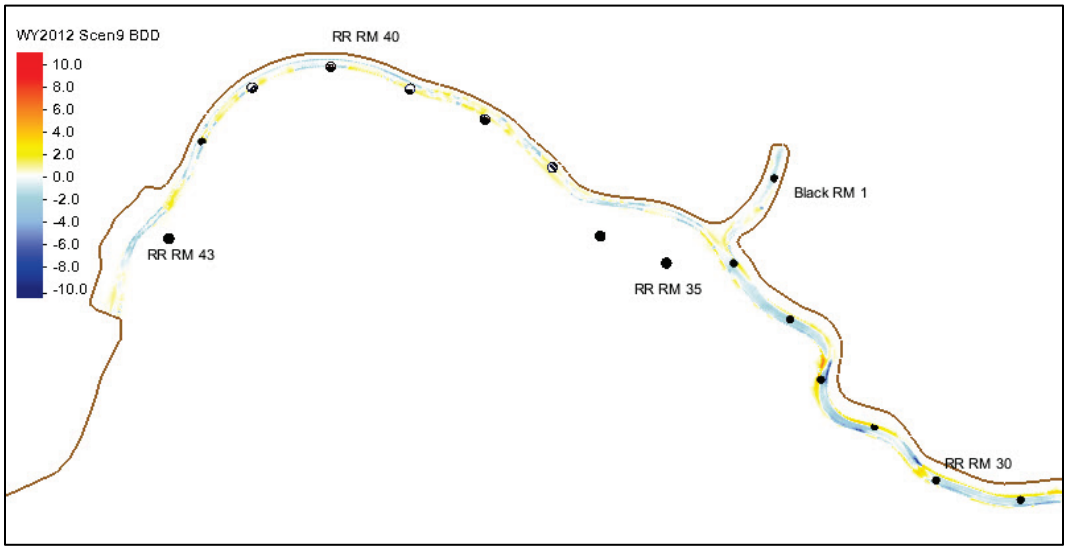


Plate D.73. WY2012 Scenario 9 BDD RR RM 30–RR RM 20.

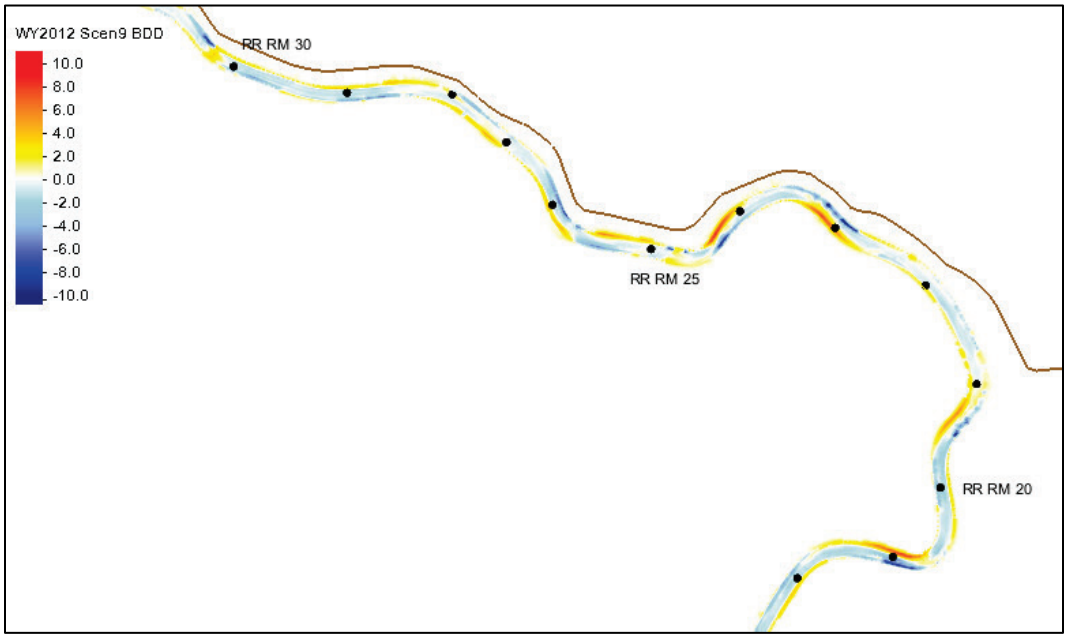


Plate D.74. WY2012 Scenario 9 BDD RR RM 20–RR RM 10 and Outflow Channel.

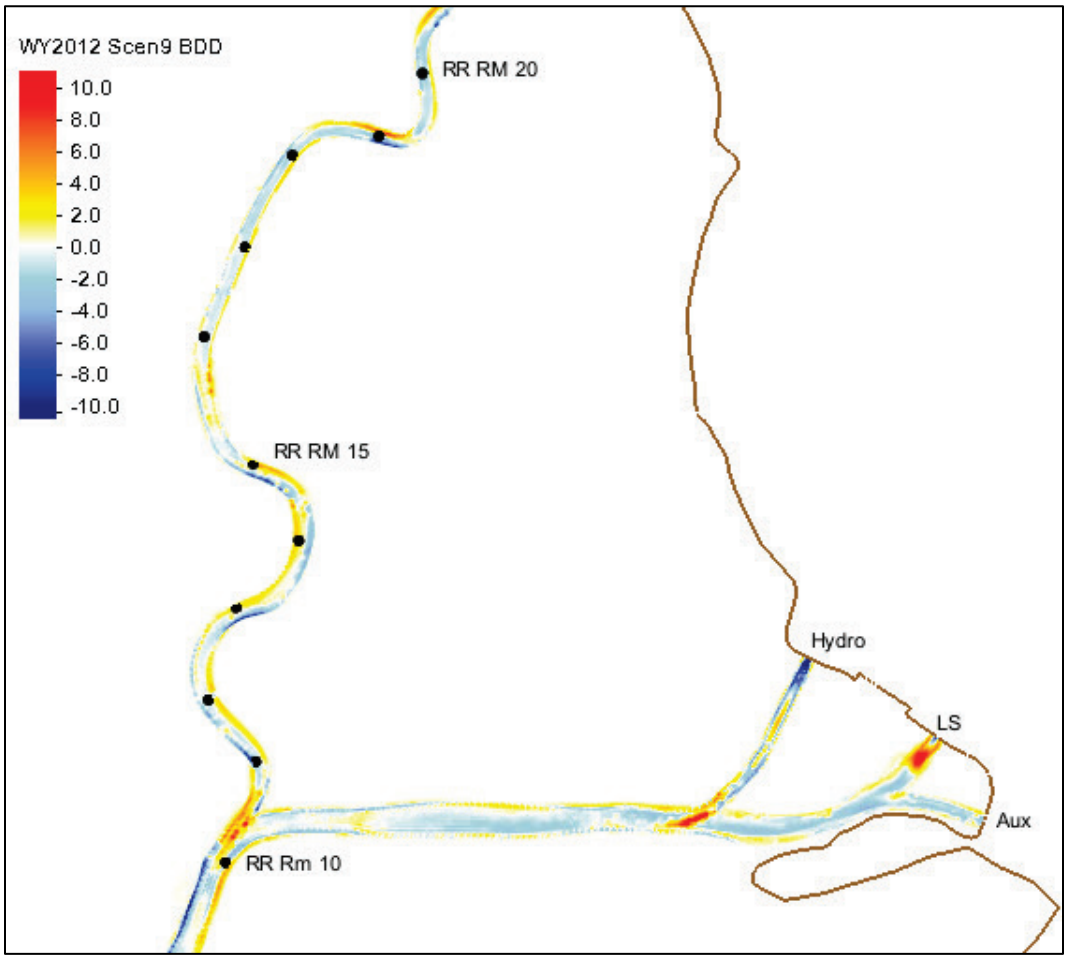


Plate D.75. WY2012 Scenario 9 BDD Outflow Channel.

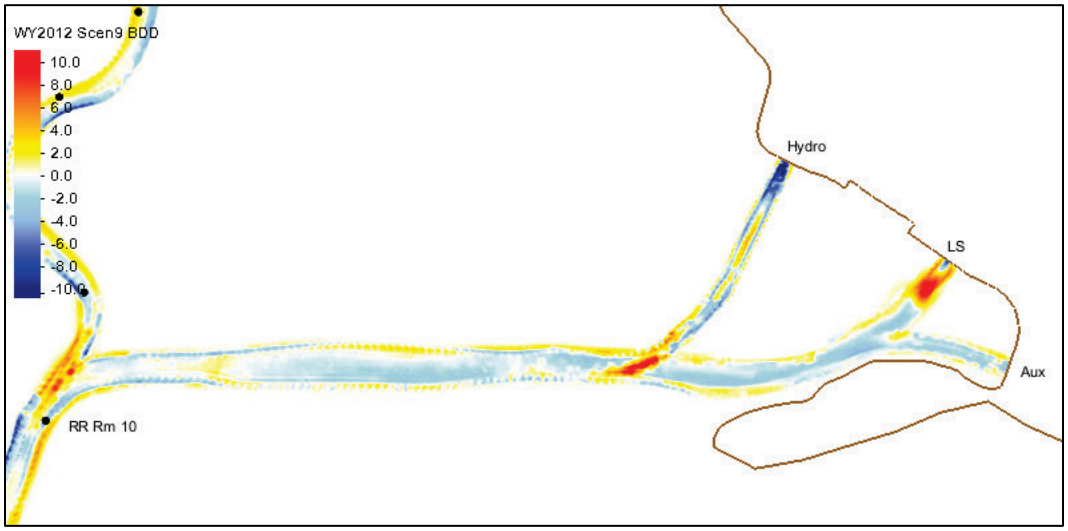


Plate D.76. WY2012 Scenario 9 BDD RR RM 10–Atcha RM 5.

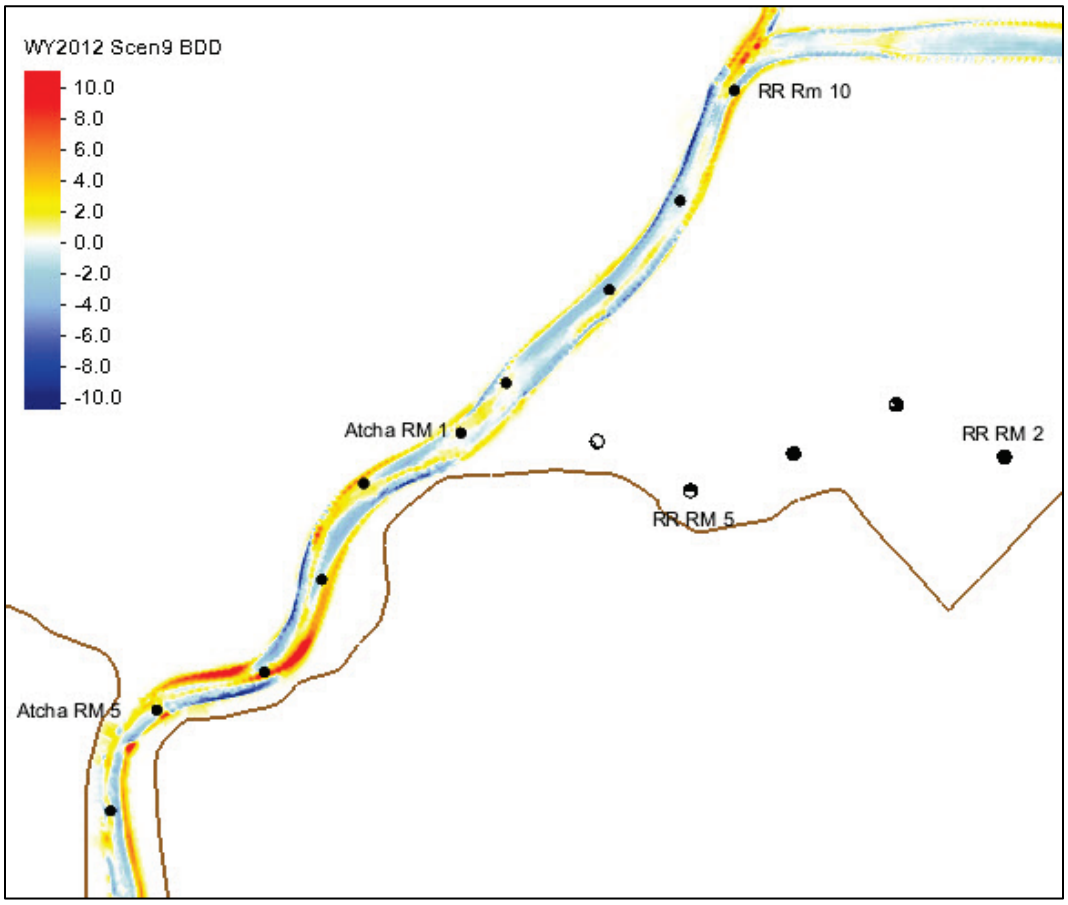


Plate D.77. WY2012 Scenario 9 BDD Atcha RM 5–Atcha RM 15.

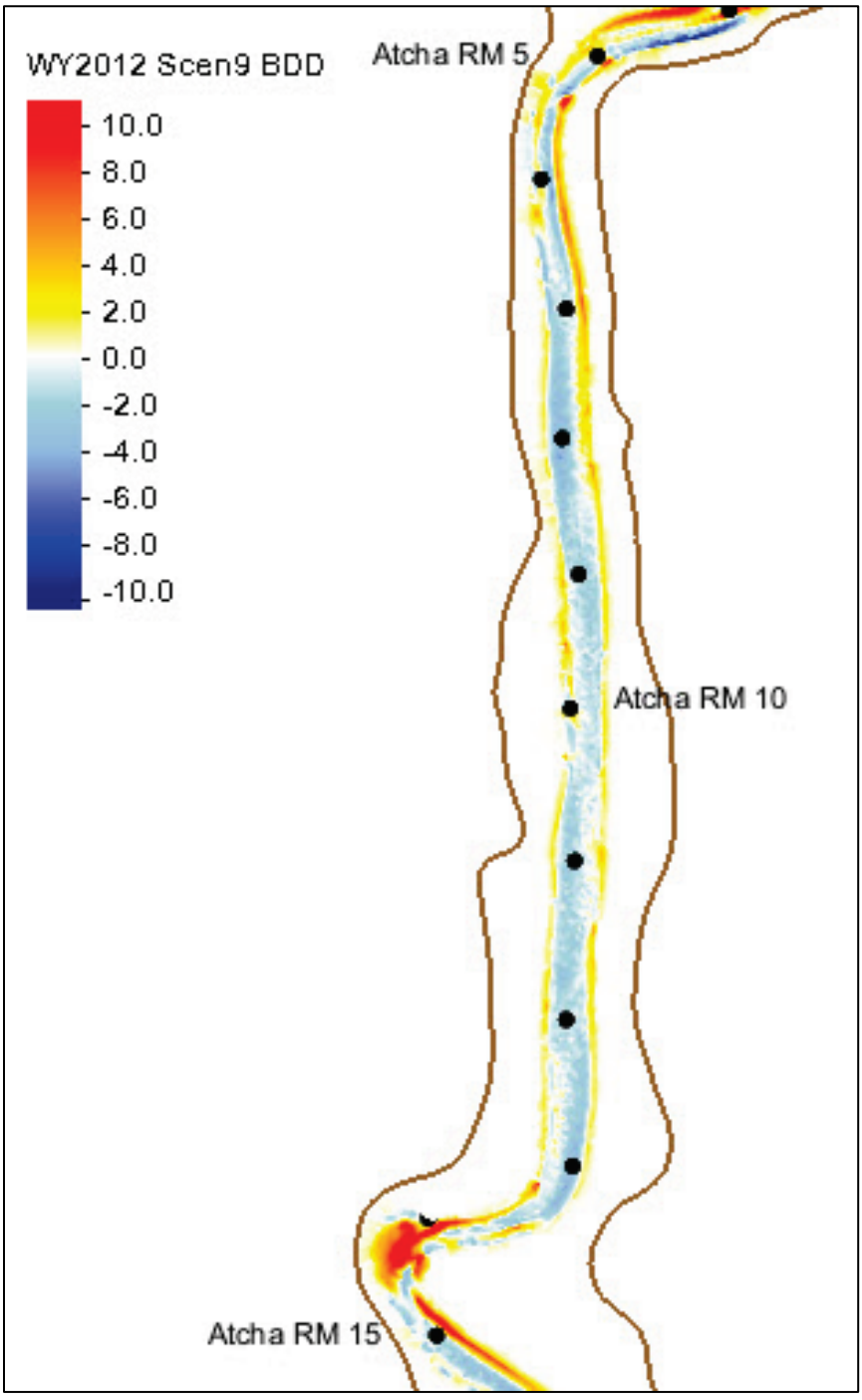
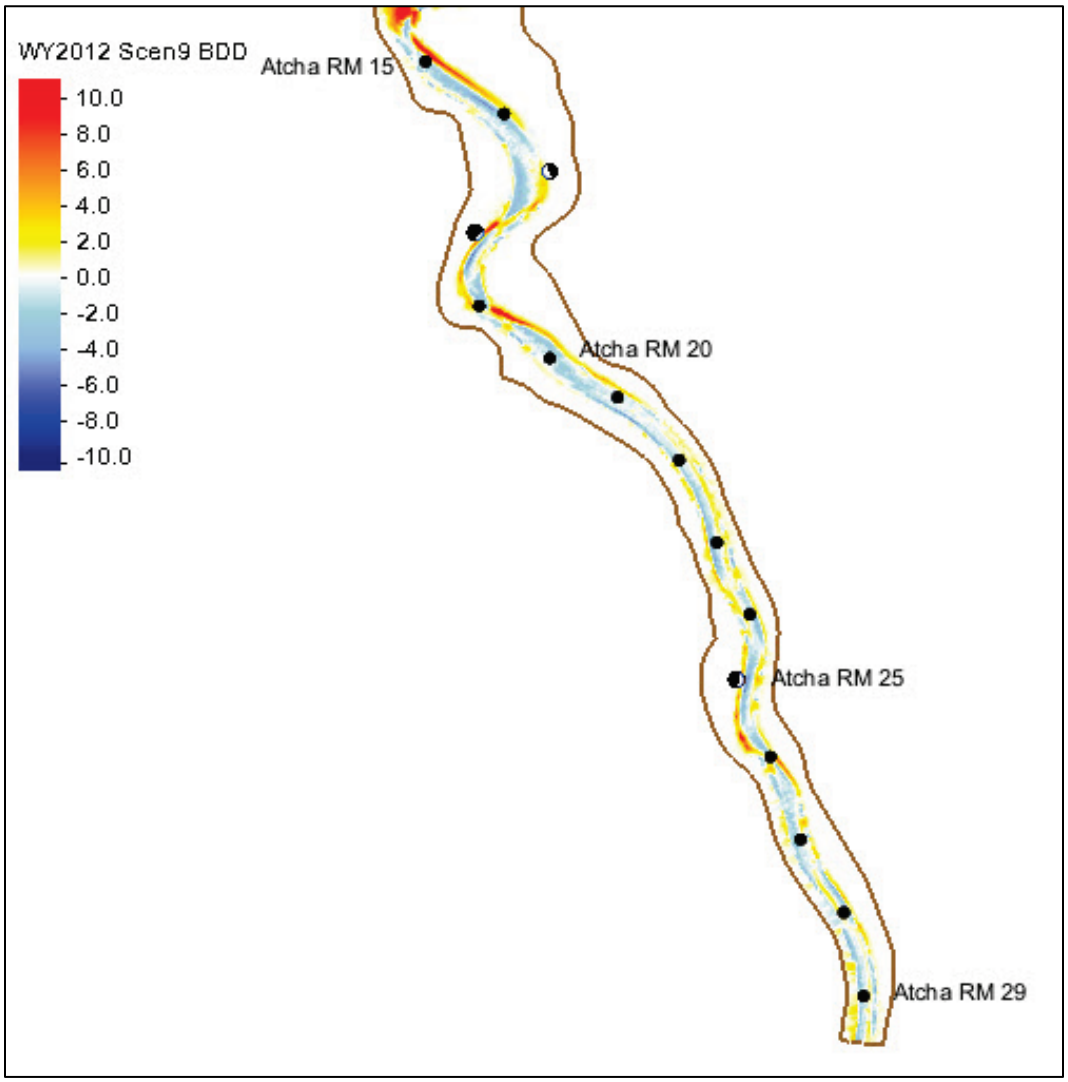


Plate D.78. WY2012 Scenario 9 BDD Atcha RM 15–Atcha RM 29.



D.10 Scenario 10

Plate D.79. WY2012 Scenario 10 BDD RR RM 43–RR RM 30.

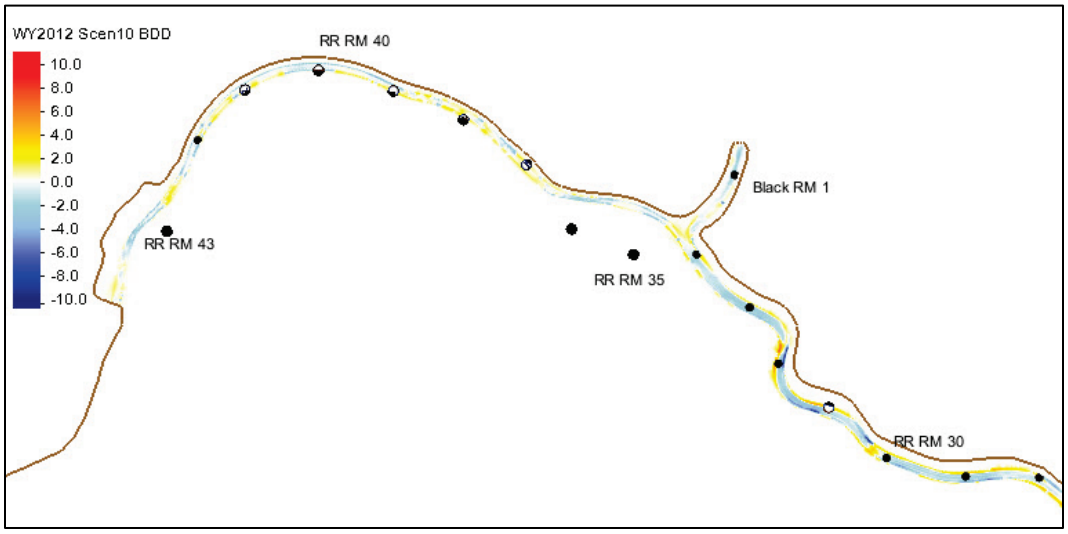


Plate D.80. WY2012 Scenario 10 BDD RR RM 30–RR RM 20.

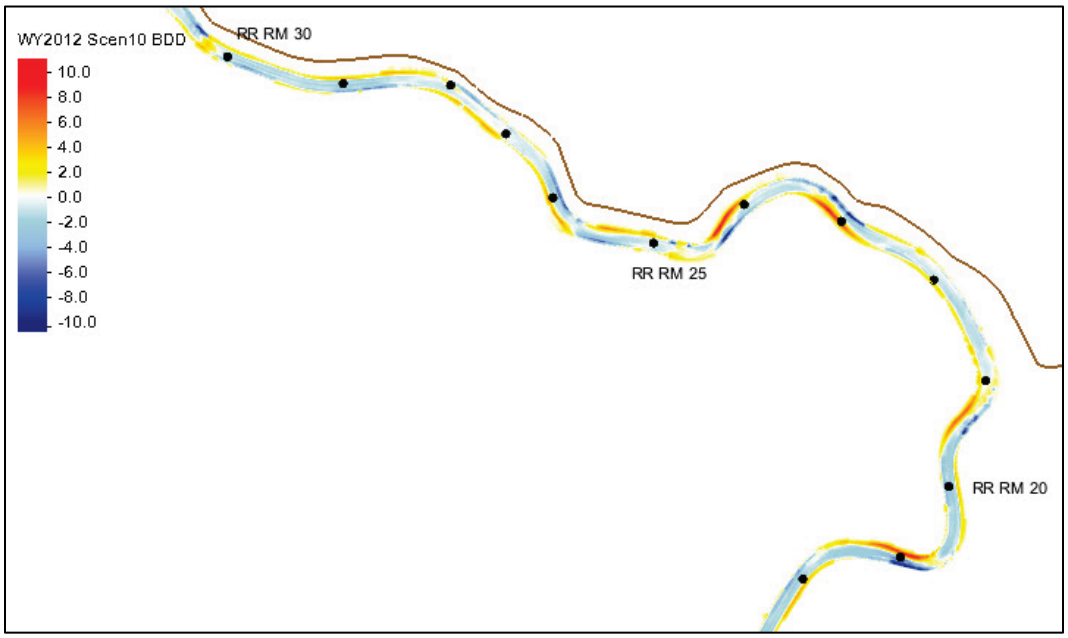


Plate D.81. WY2012 Scenario 10 BDD RR RM 20–RR RM 10 and Outflow Channel.

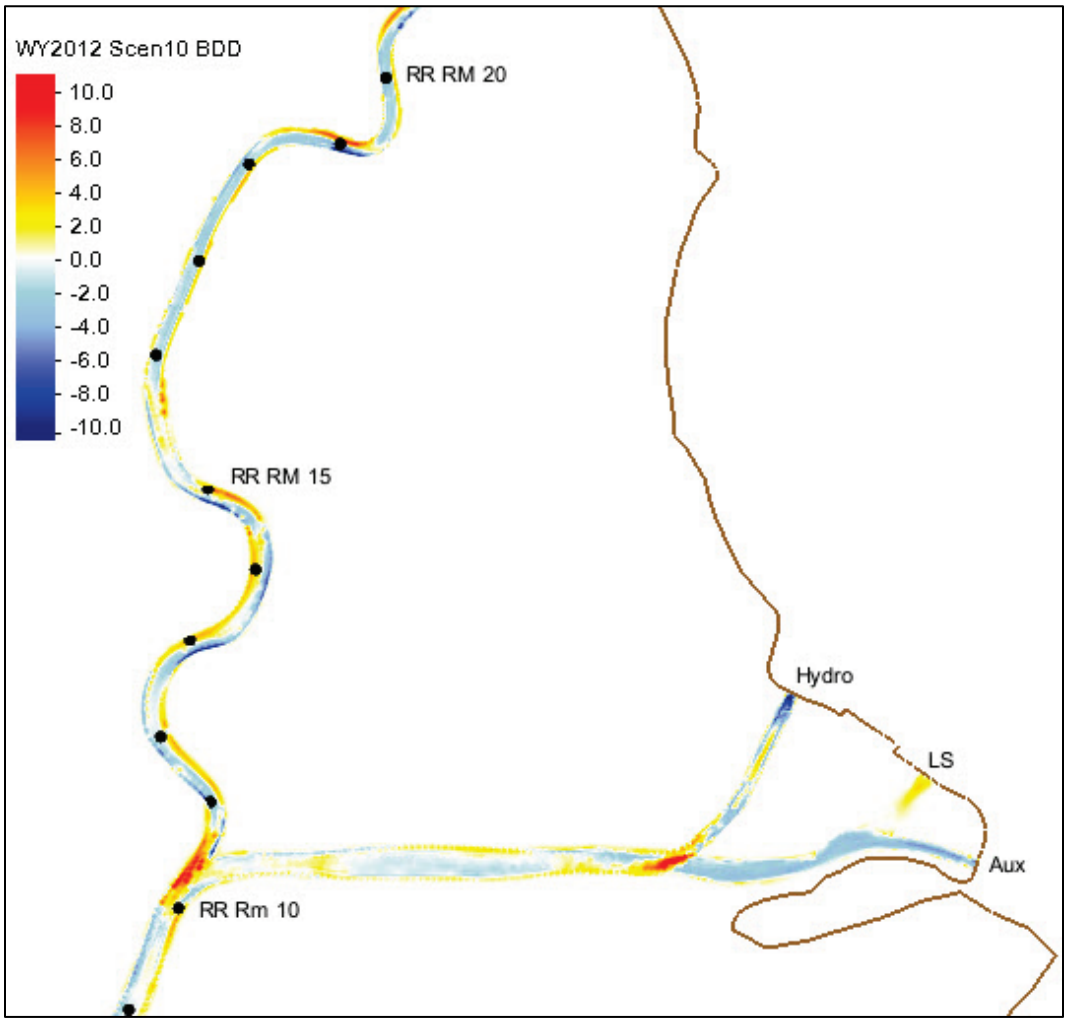


Plate D.82. WY2012 Scenario 10 BDD Outflow Channel.

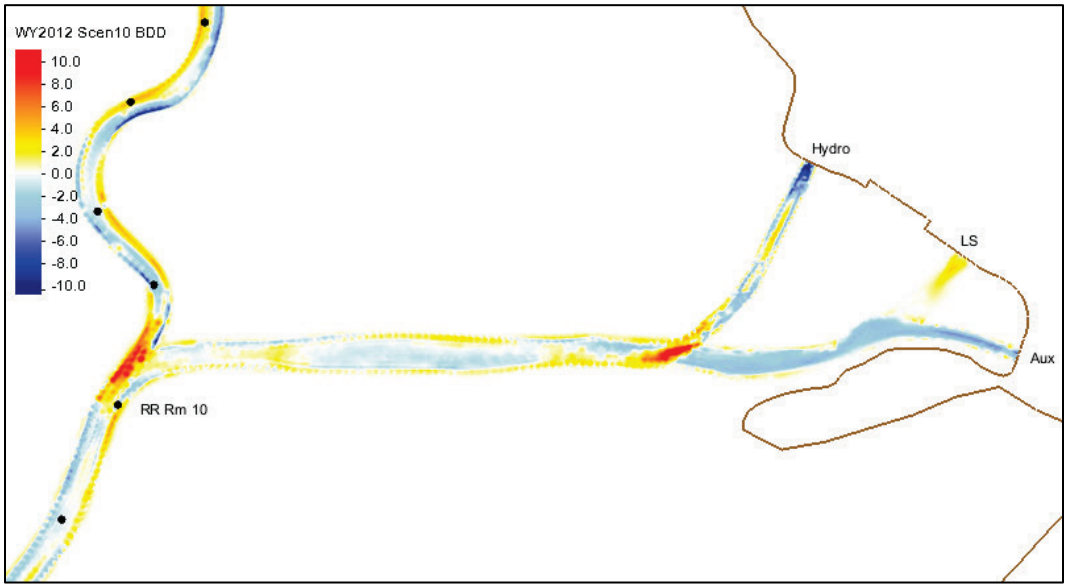


Plate D.83. WY2012 Scenario 10 BDD RR RM 10–Atcha RM 5.

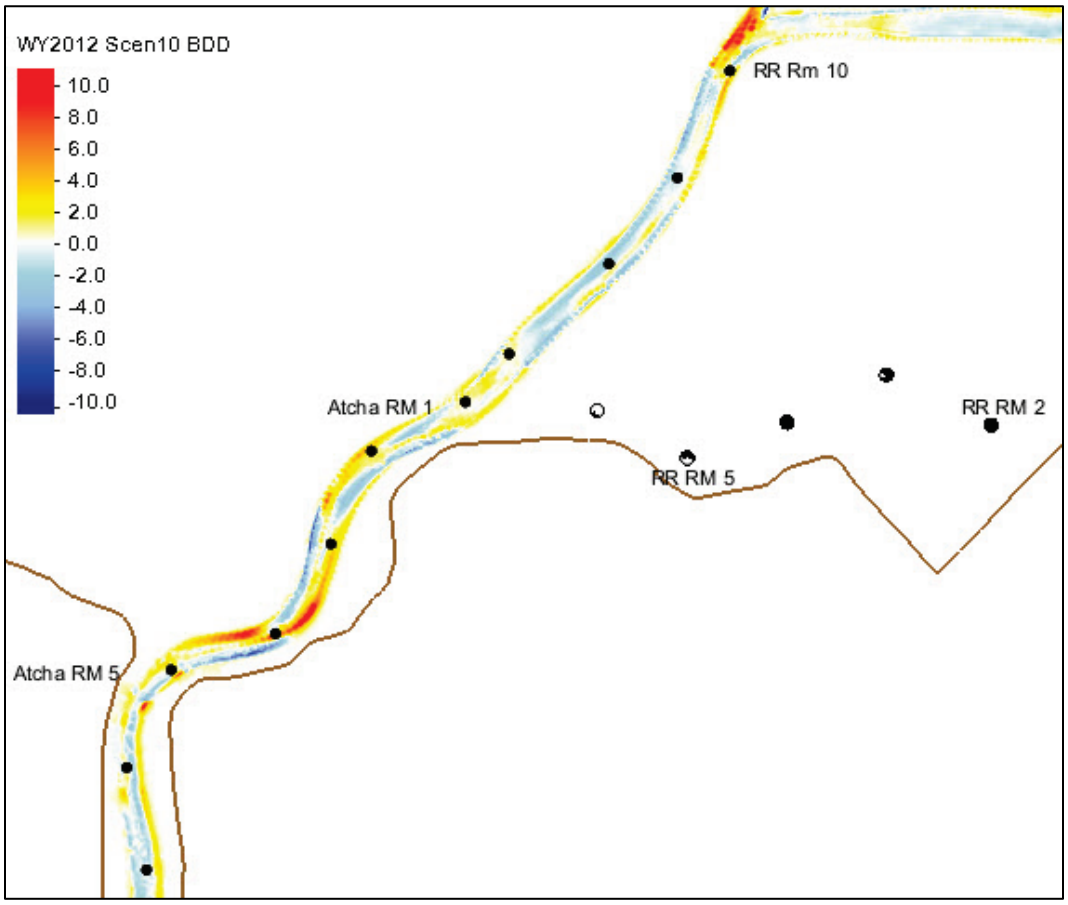


Plate D.84. WY2012 Scenario 10 BDD Atcha RM 5–Atcha RM 15.

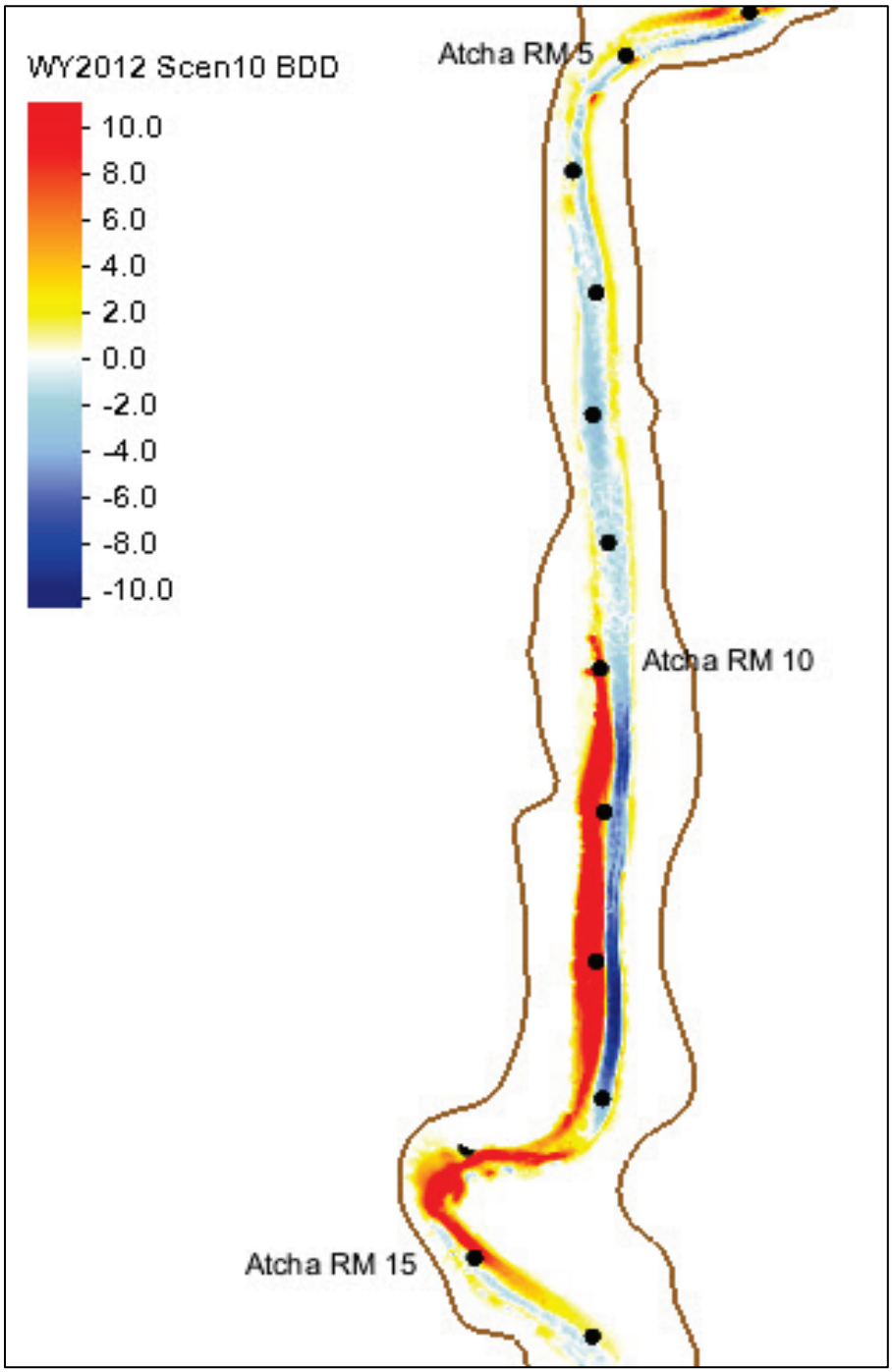
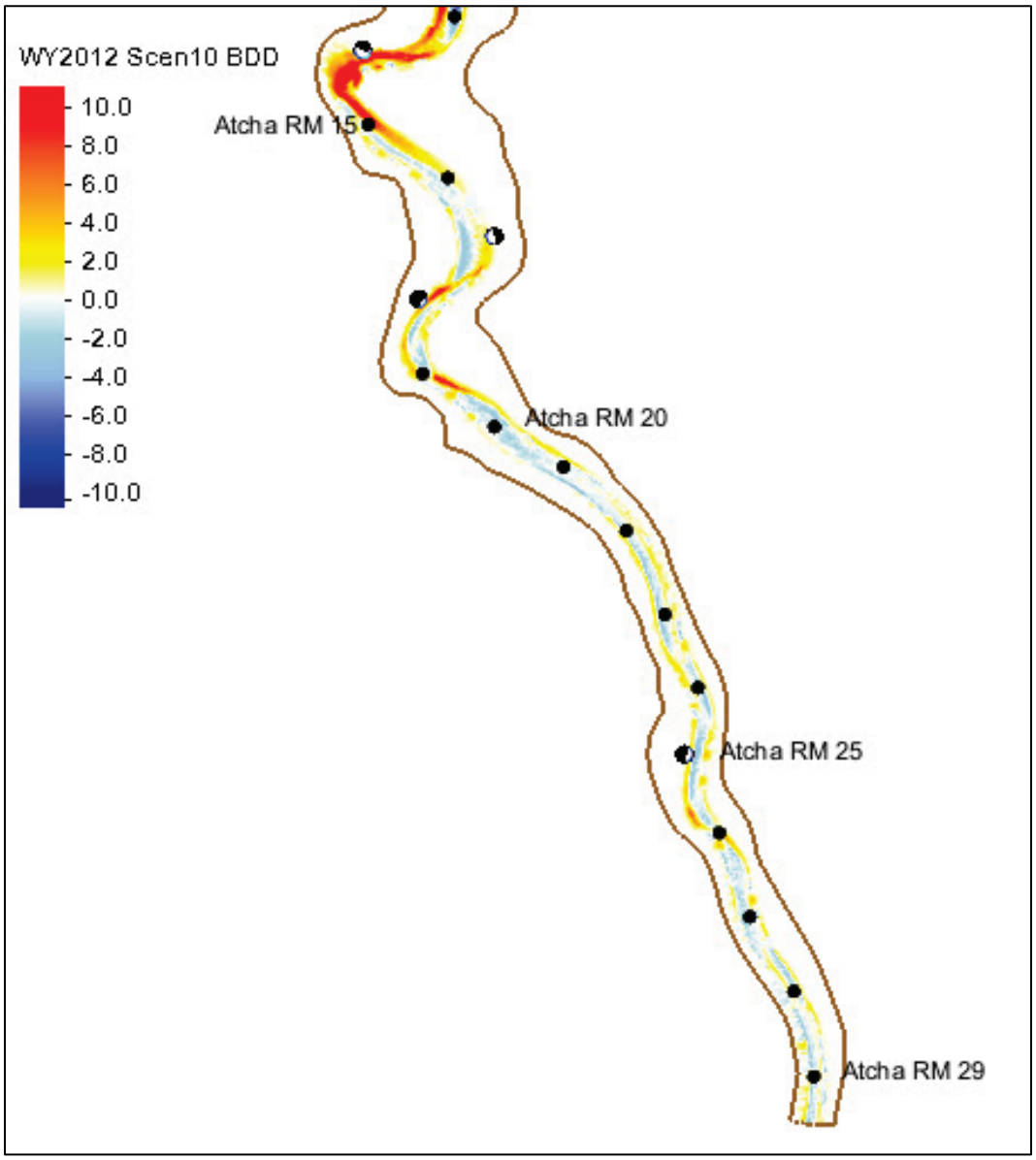


Plate D.85. WY2012 Scenario 10 BDD Atcha RM 15–Atcha RM 29.



D.11 Dredging Scenario 11–14

D.11.1 Scenario 11

Plate D.86. WY2012 Scenario 11 BDD RR RM 43–RR RM 30.

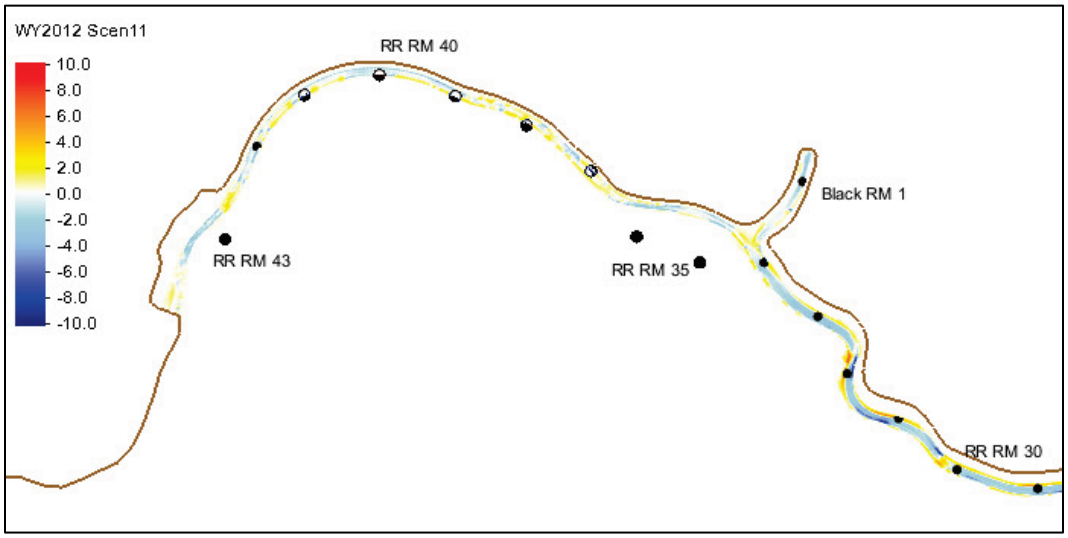


Plate D.87. WY2012 Scenario 11 BDD RR RM 30–RR RM 20.

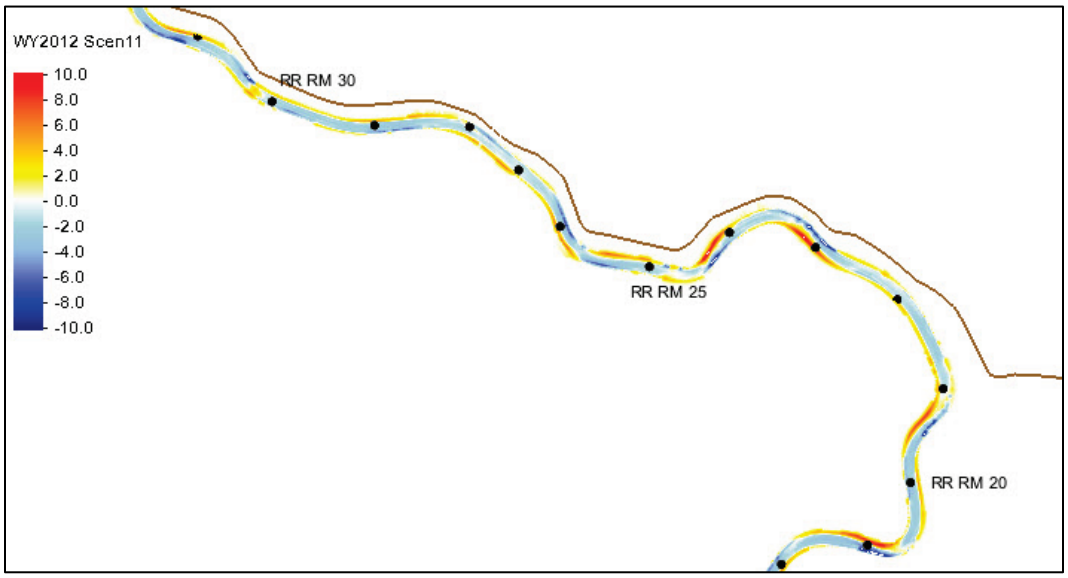


Plate D.88. WY2012 Scenario 11 BDD RR RM 20–RR RM 10.

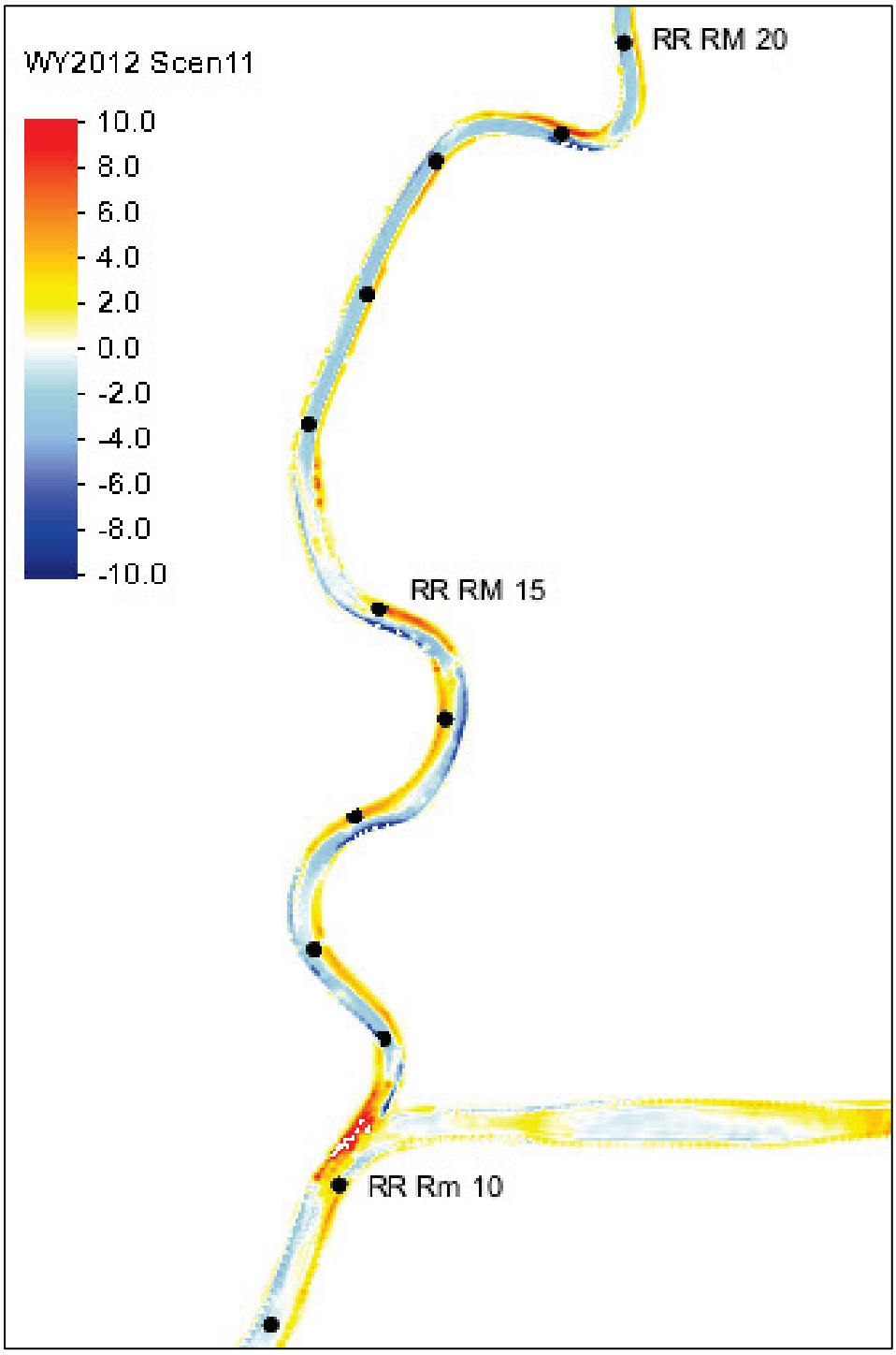


Plate D.89. WY2012 Scenario 11 BDD Outflow Channel.

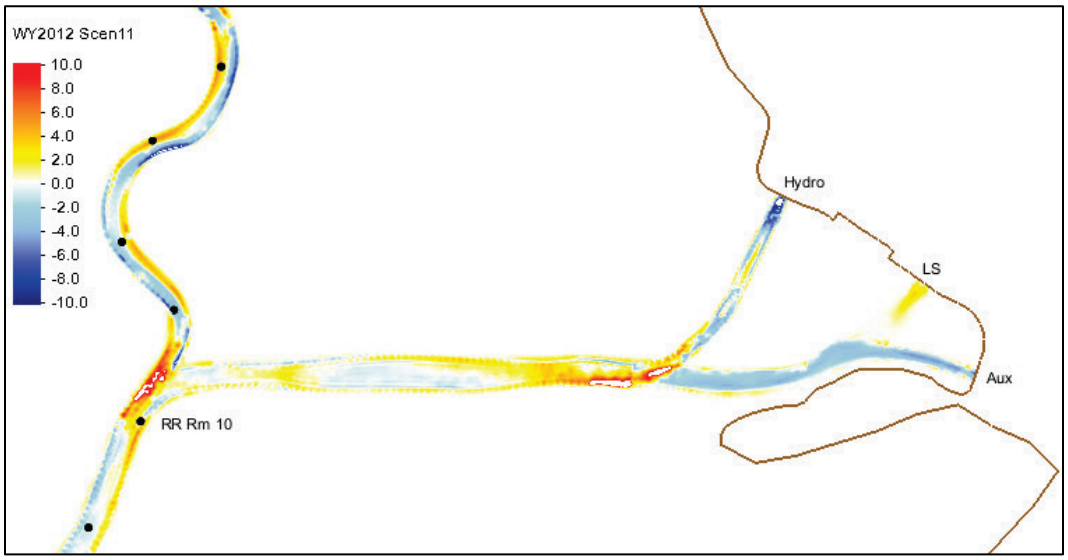


Plate D.90. WY2012 Scenario 11 BDD RR RM 10–Atcha RM 5.

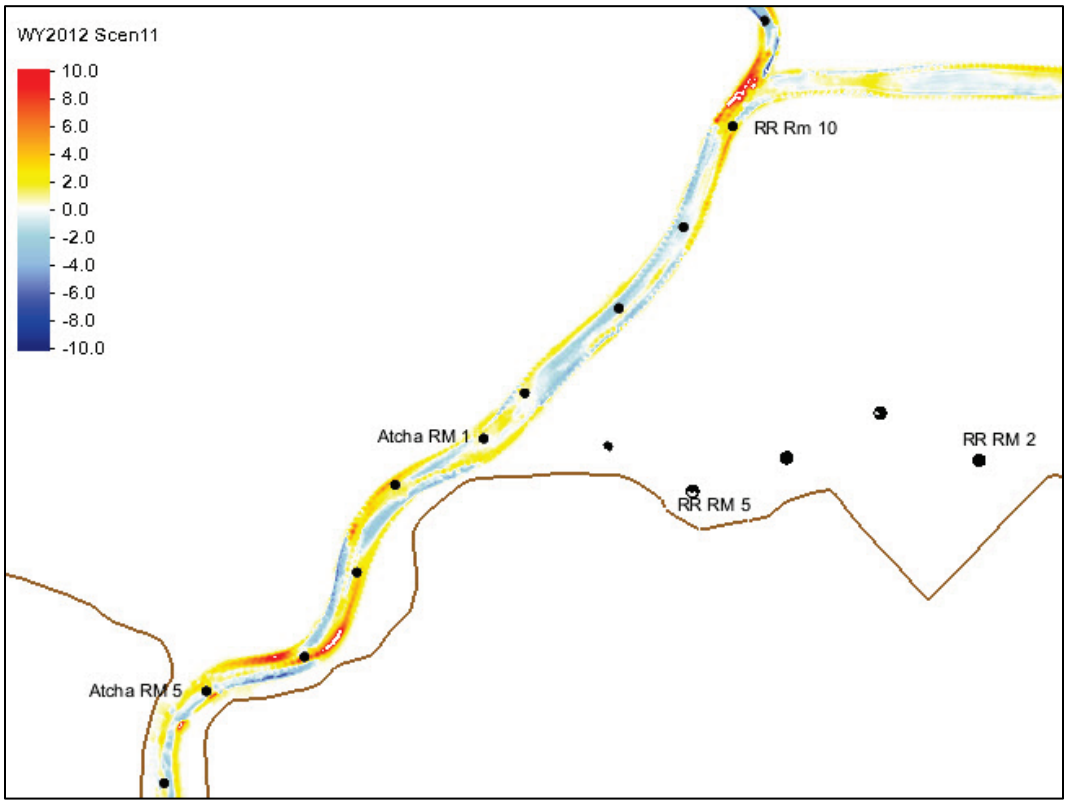


Plate D.91. WY2012 Scenario 11 BDD Atcha RM 5–Atcha RM 15.

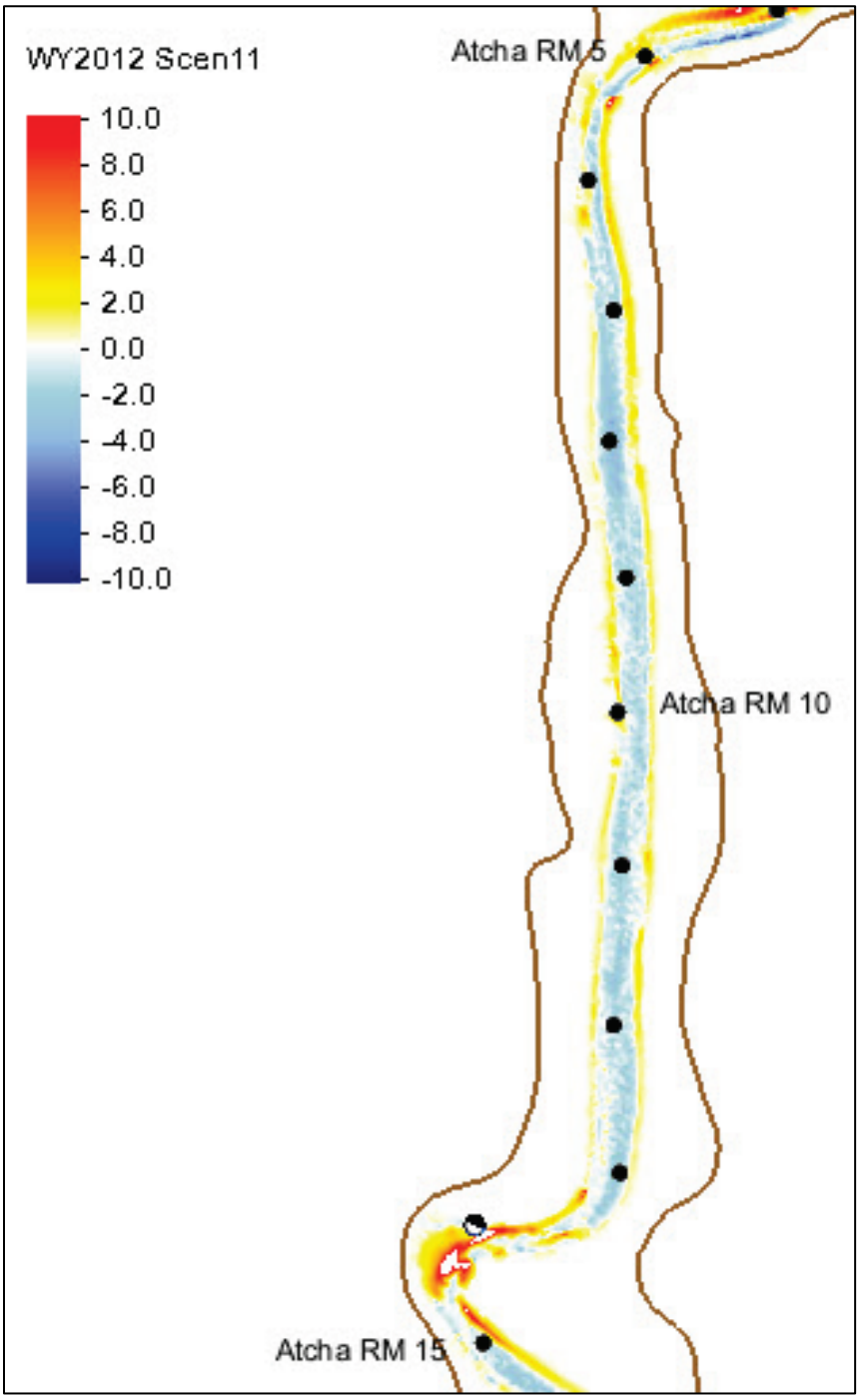
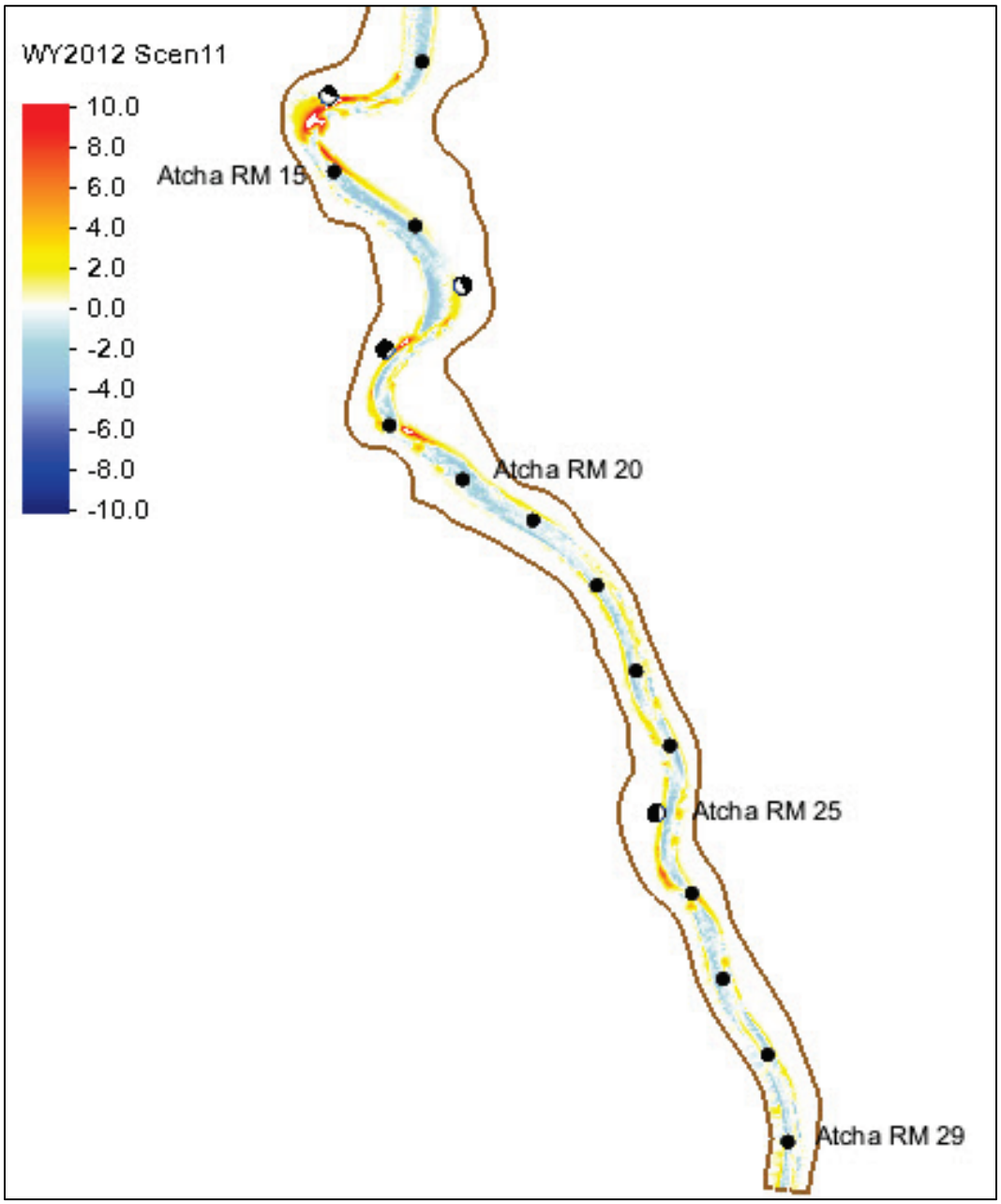


Plate D.92. WY2012 Scenario 11 BDD Atcha RM 15–Atcha RM 29.



D.11.2 Scenario 12

Plate D.93. WY2012 Scenario 12 BDD RR RM 43–RR RM 30.

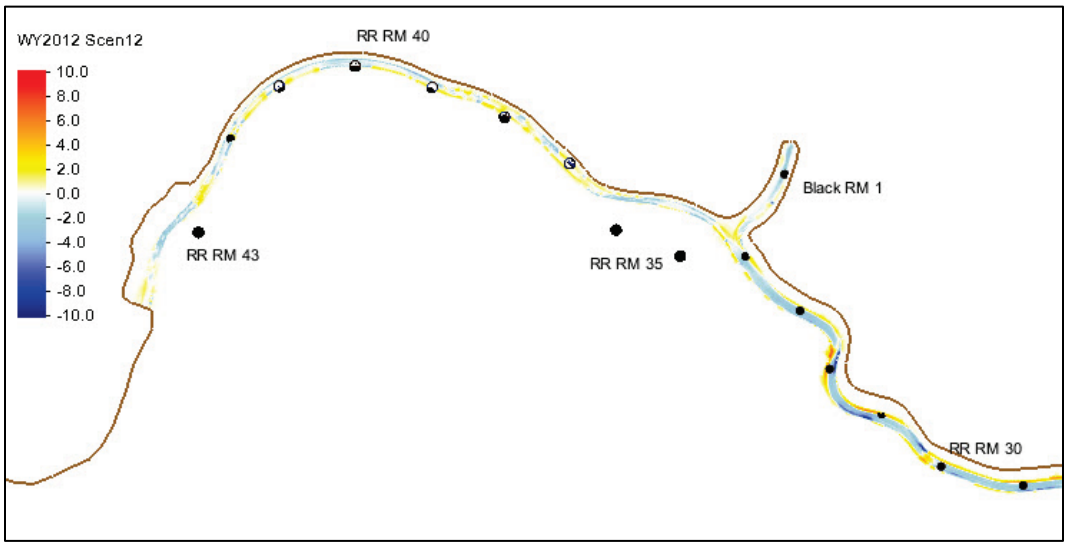


Plate D.94. WY2012 Scenario 12 BDD RR RM 30–RR RM 20.

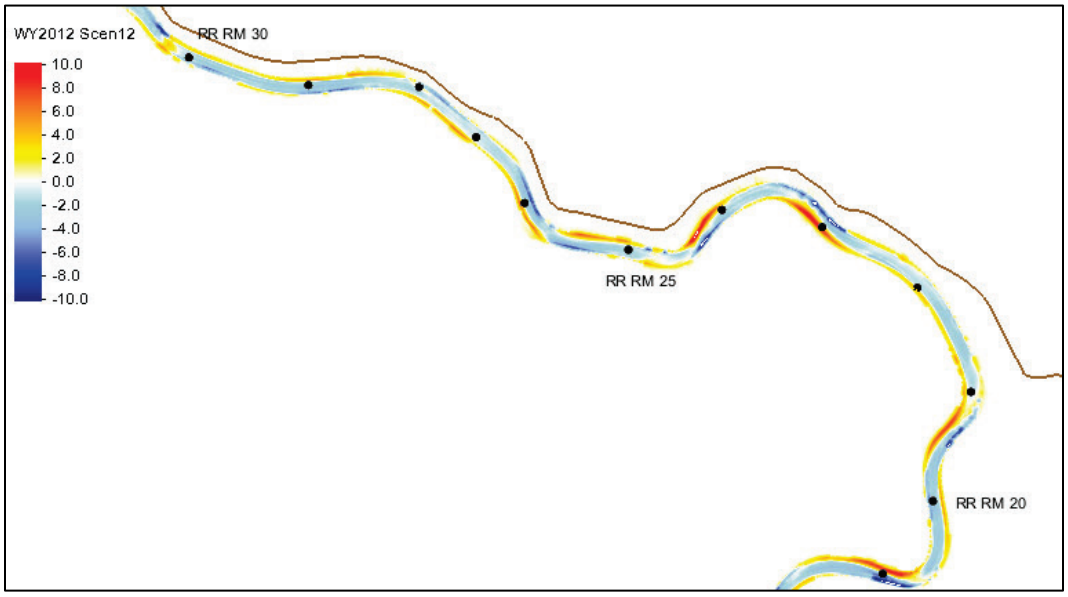


Plate D.95. WY2012 Scenario 12 BDD RR RM 20–RR RM 10.

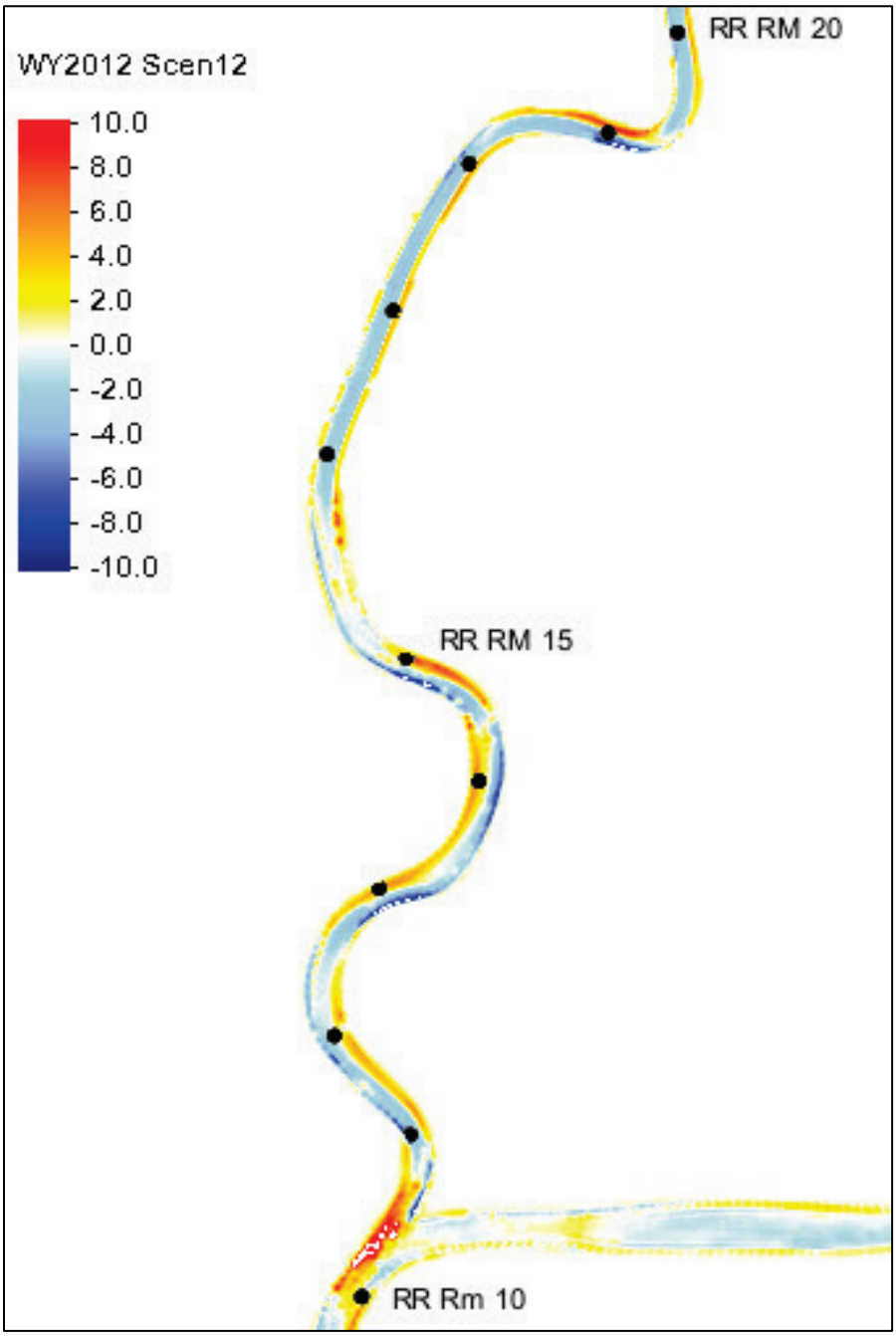


Plate D.96. WY2012 Scenario 12 BDD Outflow Channel.

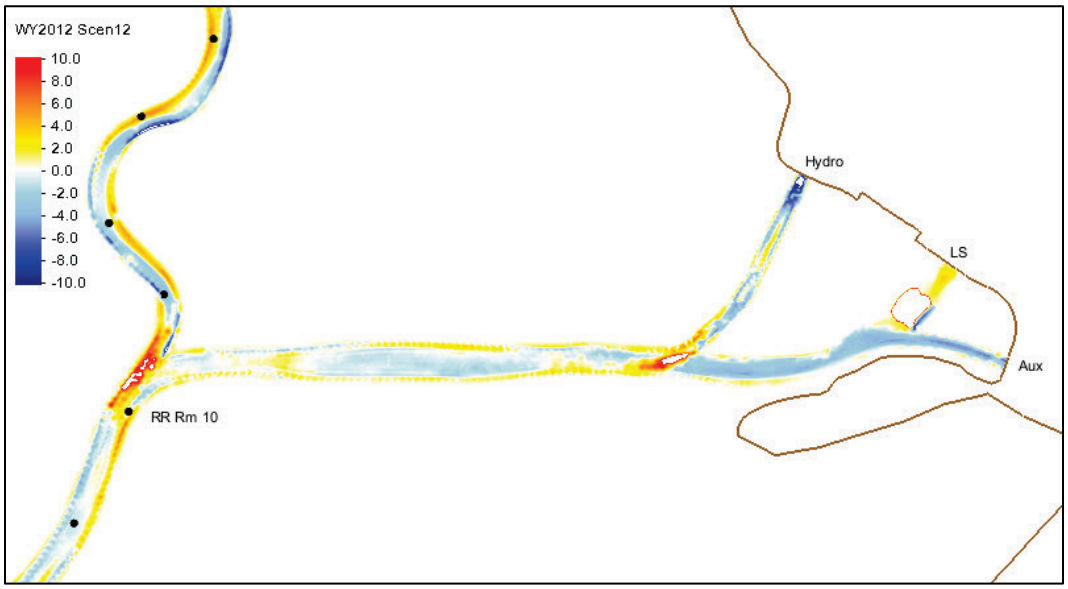


Plate D.97. WY2012 Scenario 12 BDD RR RM 10–Atcha RM 5.

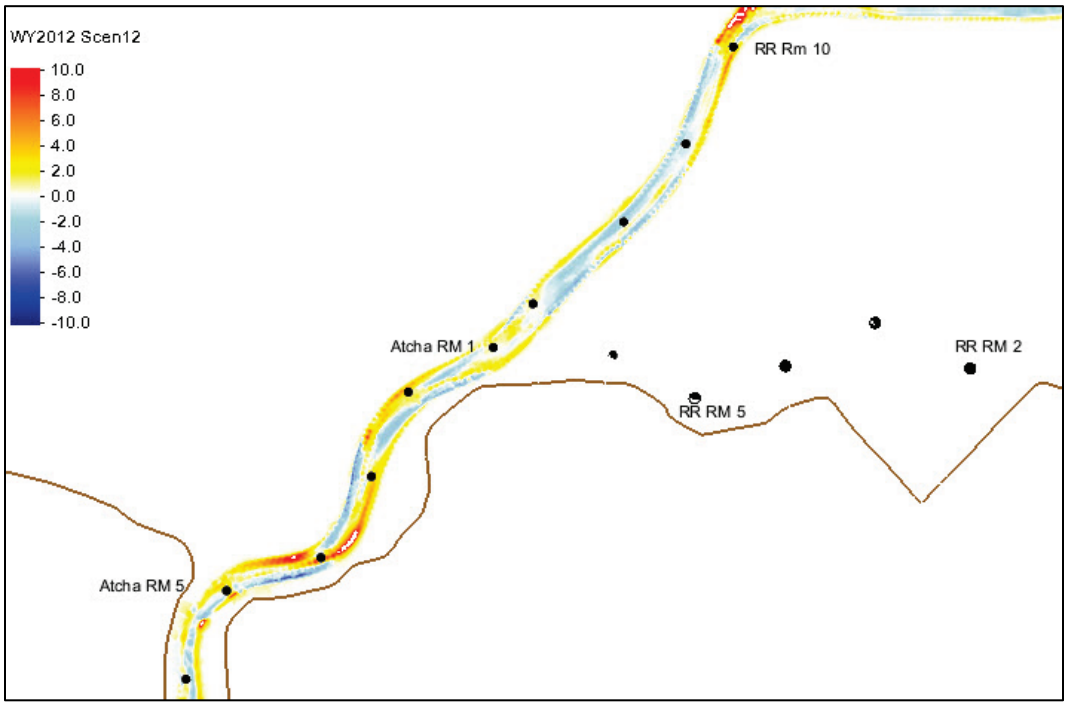


Plate D.98. WY2012 Scenario 12 BDD Atcha RM 5–Atcha RM 15.

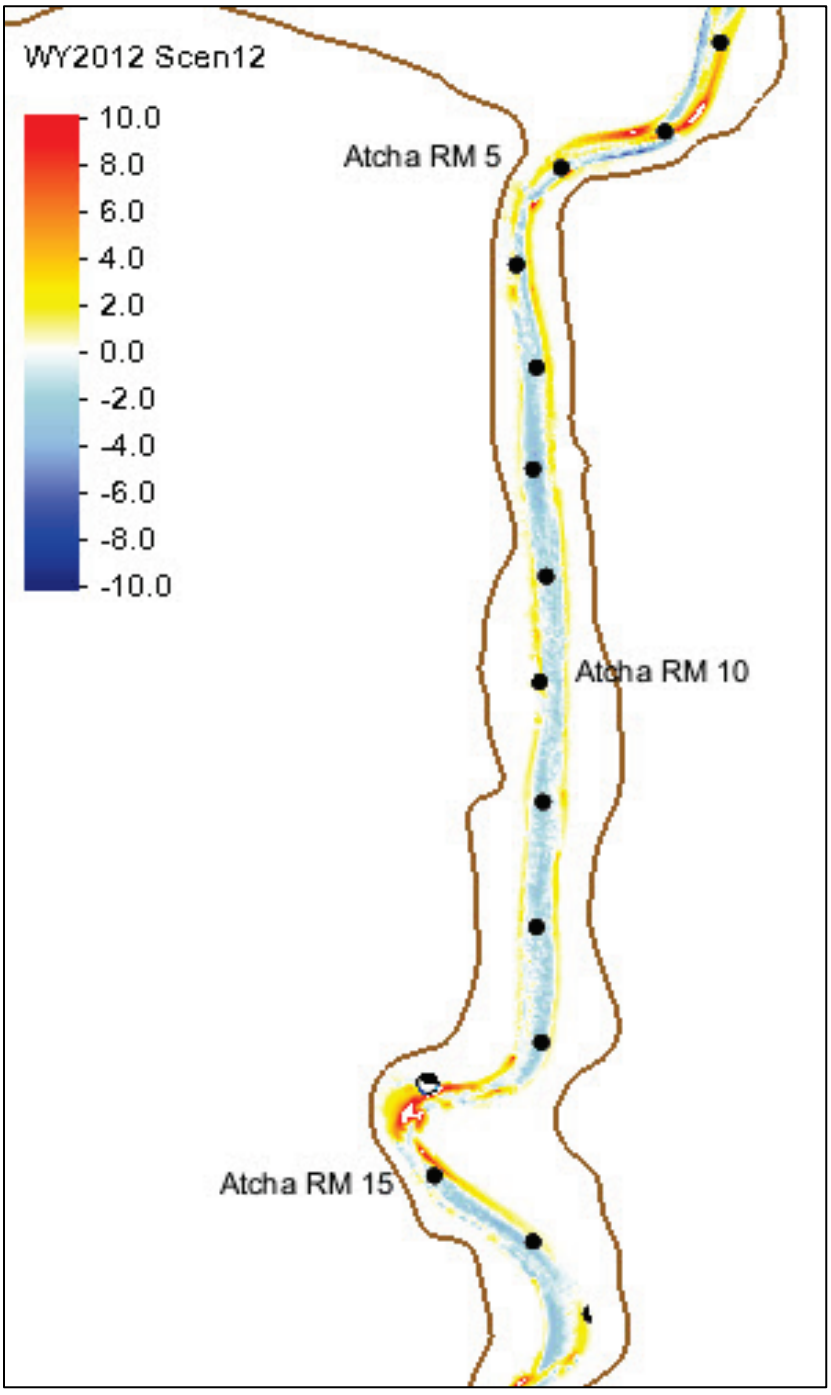
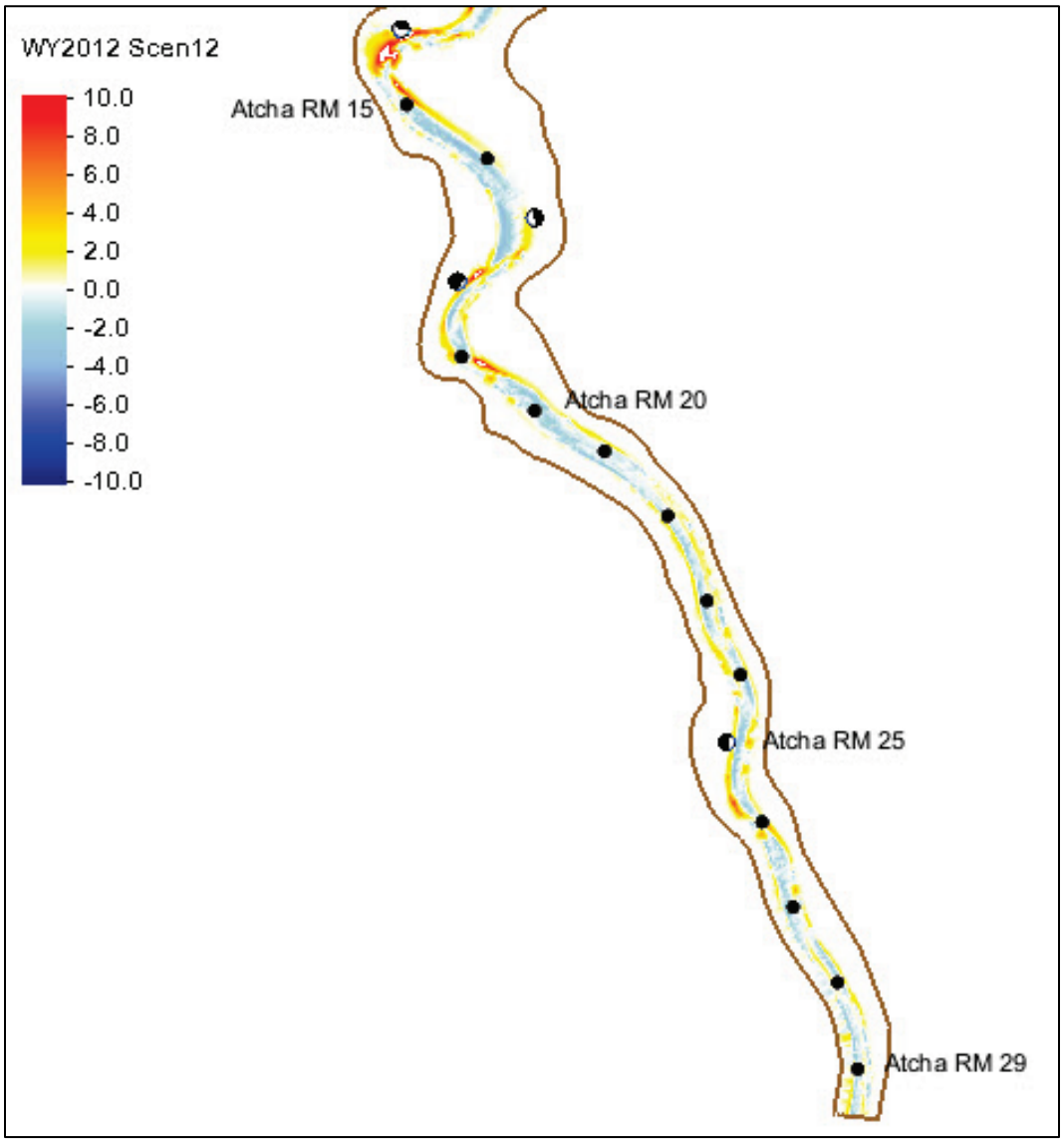


Plate D.99. WY2012 Scenario 12 BDD Atcha RM 15–Atcha RM 29.



D.11.3 Scenario 13

Plate D.100. WY2012 Scenario 13 BDD RR RM 43–RR RM 30.

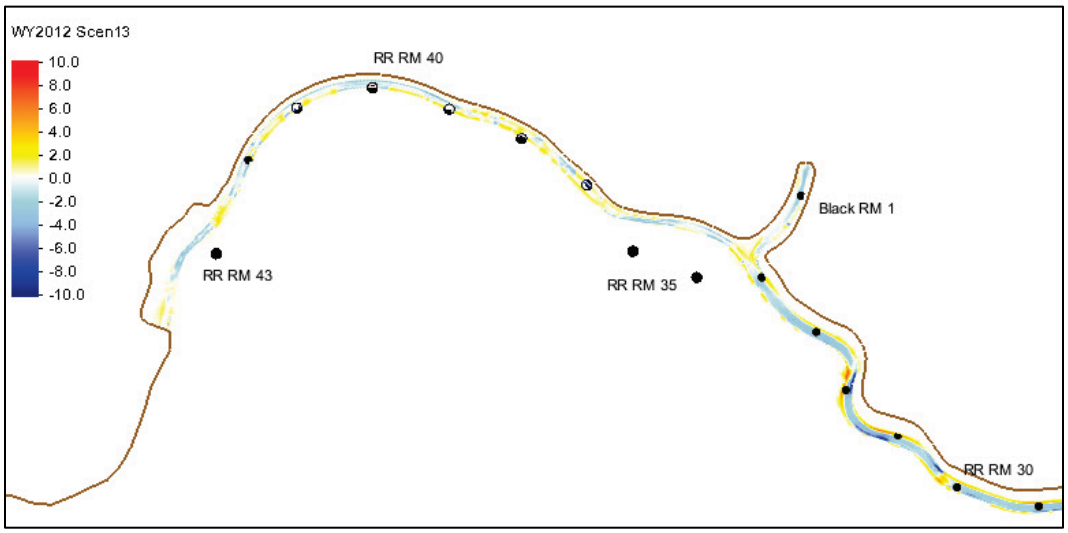


Plate D.101. WY2012 Scenario 13 BDD RR RM 30–RR RM 20.

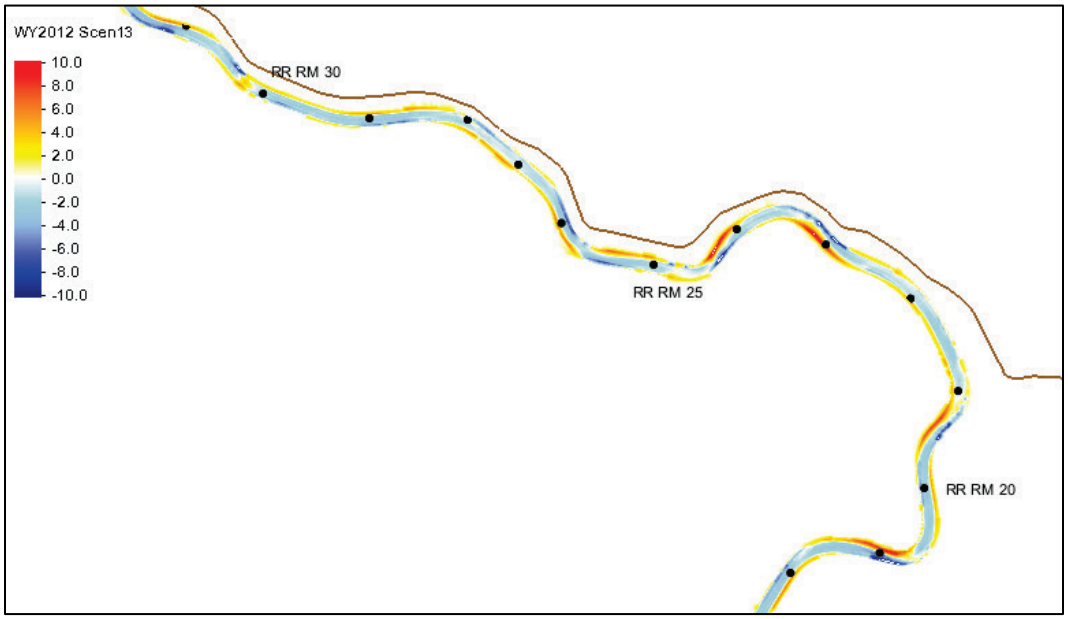


Plate D.102. WY2012 Scenario 13 BDD RR RM 20–RR RM 10.

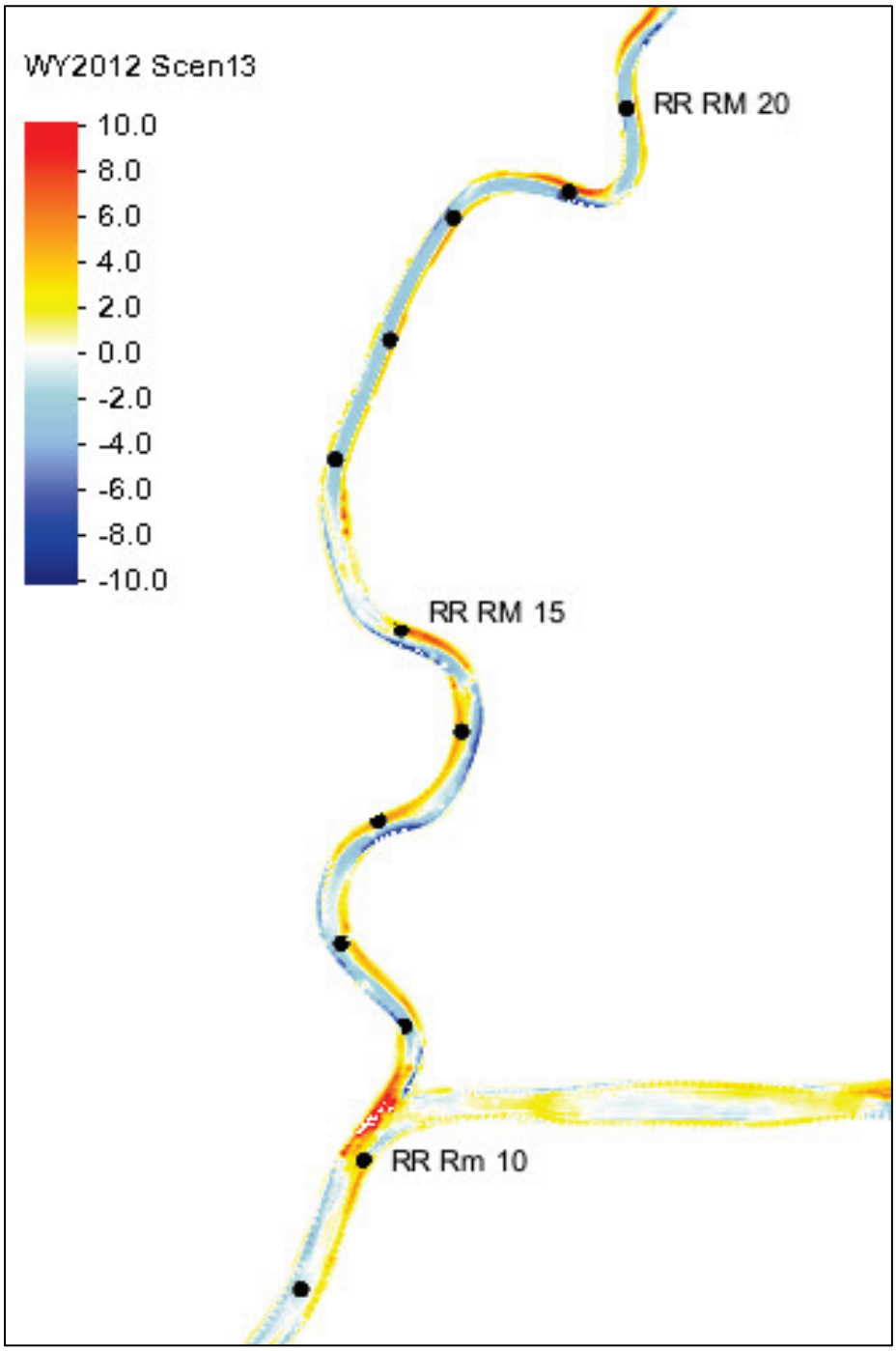


Plate D.103. WY2012 Scenario 13 BDD Outflow Channel.

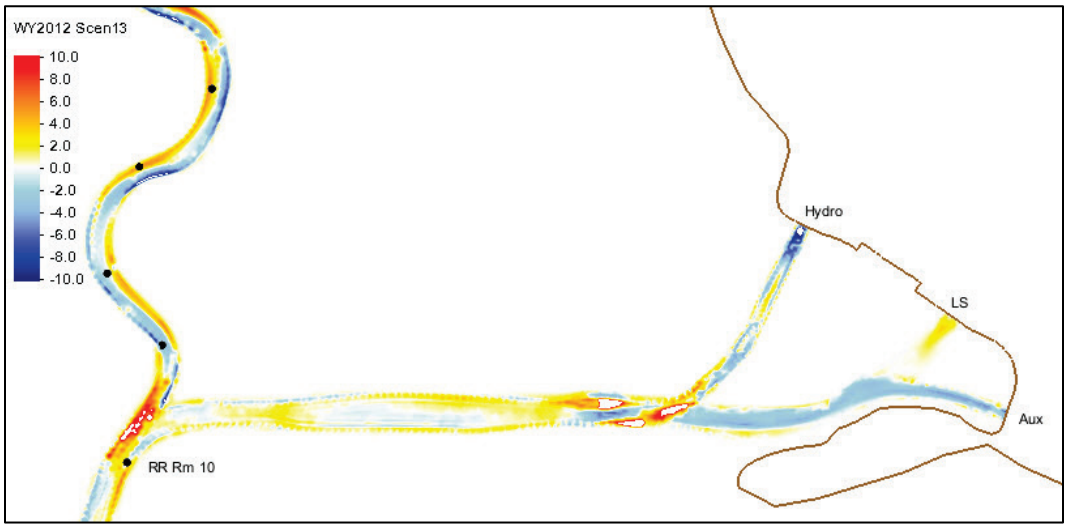


Plate D.104. WY2012 Scenario 13 BDD RR RM 10–Atcha RM 5.

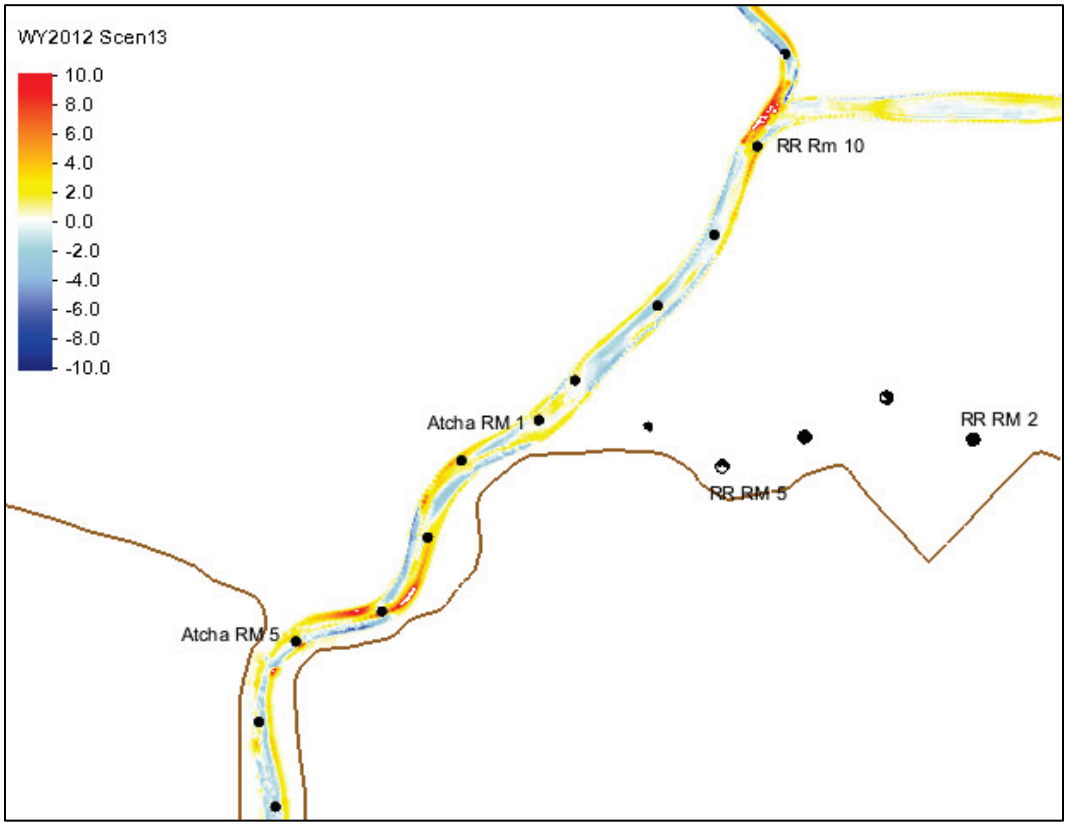


Plate D.105. WY2012 Scenario 13 BDD Atcha RM 5–Atcha RM 15.

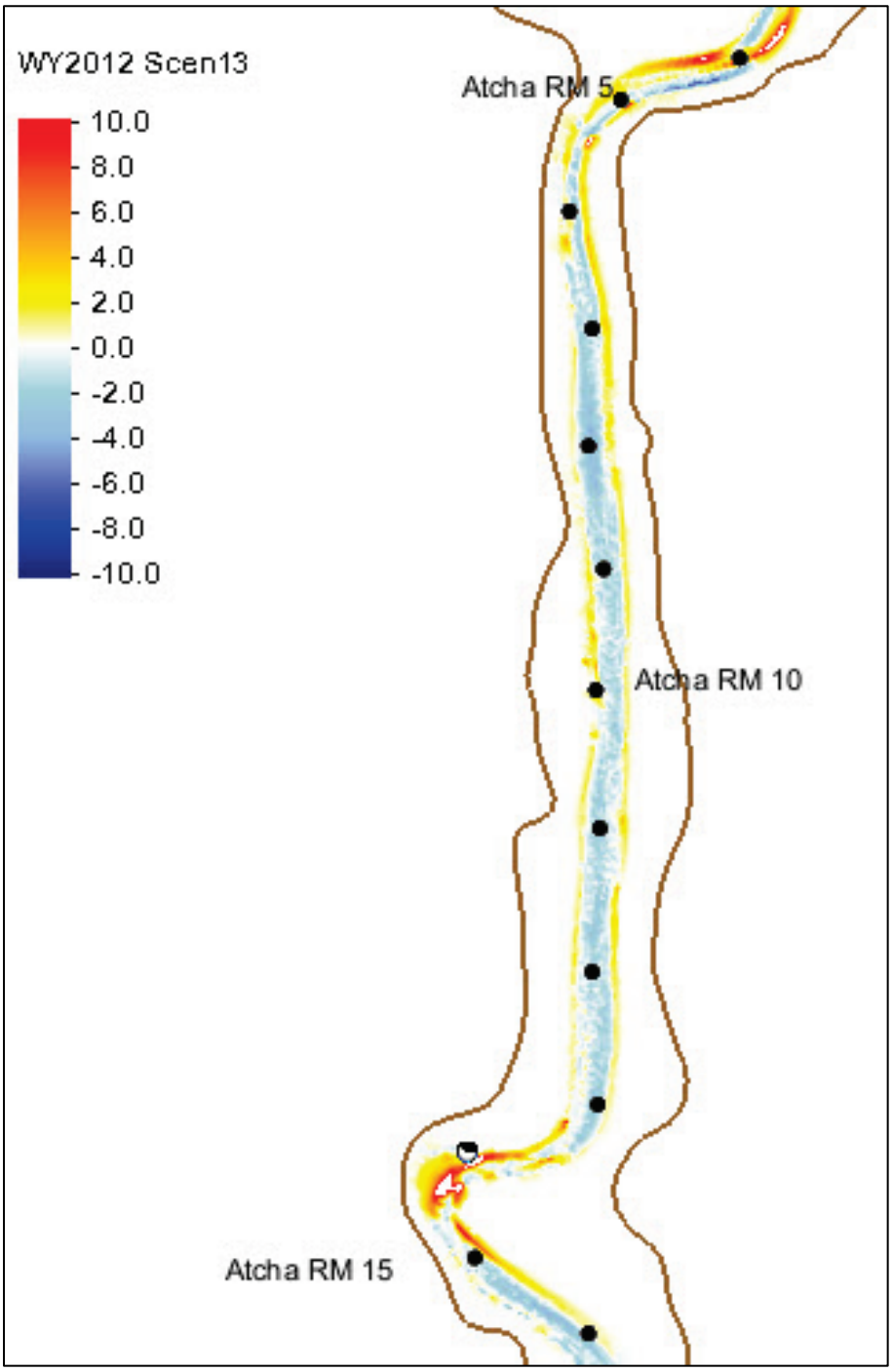
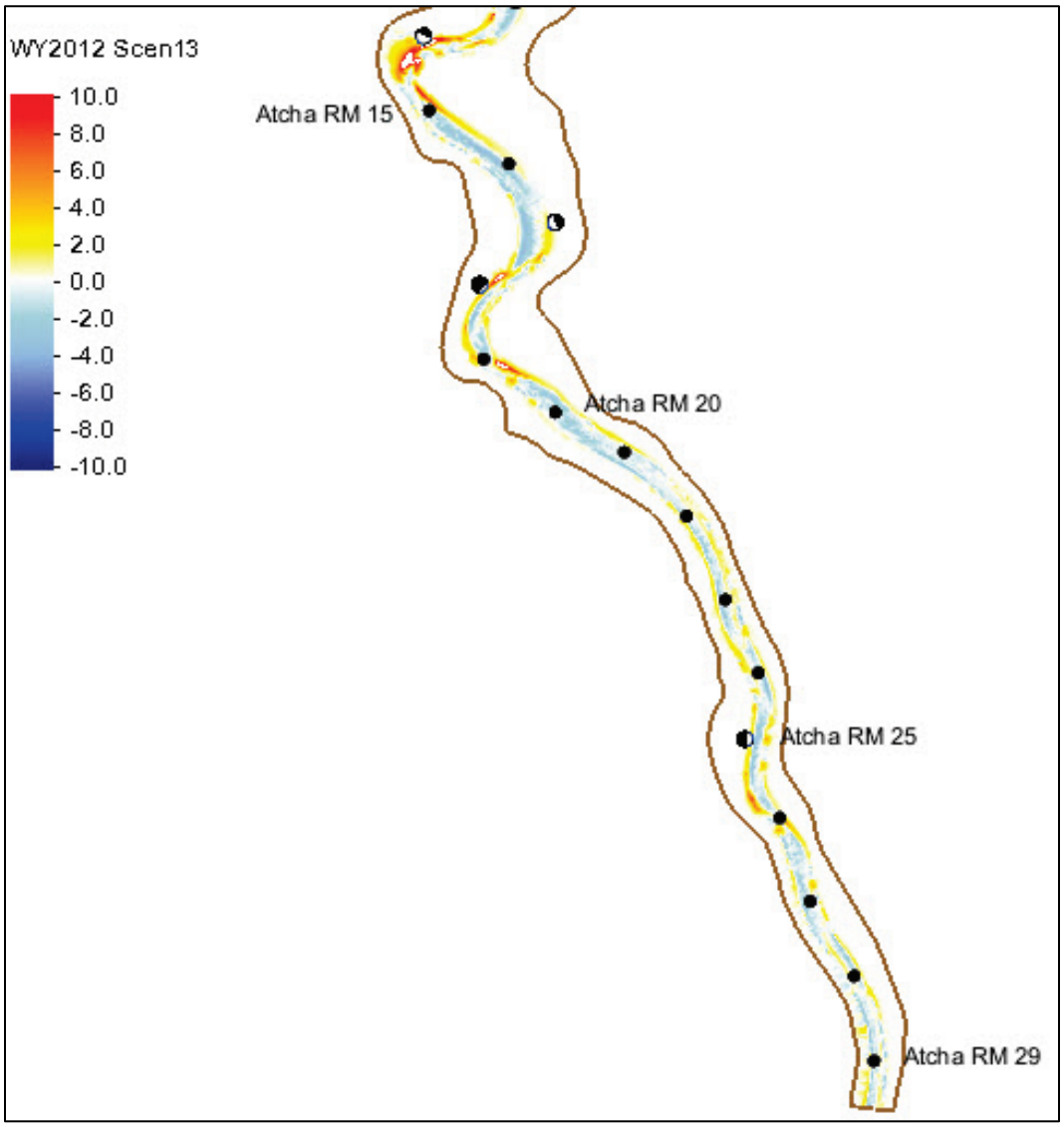


Plate D.106. WY2012 Scenario 13 BDD Atcha RM 15–Atcha RM 29.



D.11.4 Scenario 14

Plate D.107. WY2012 Scenario 14 BDD RR RM 43–RR RM 30.

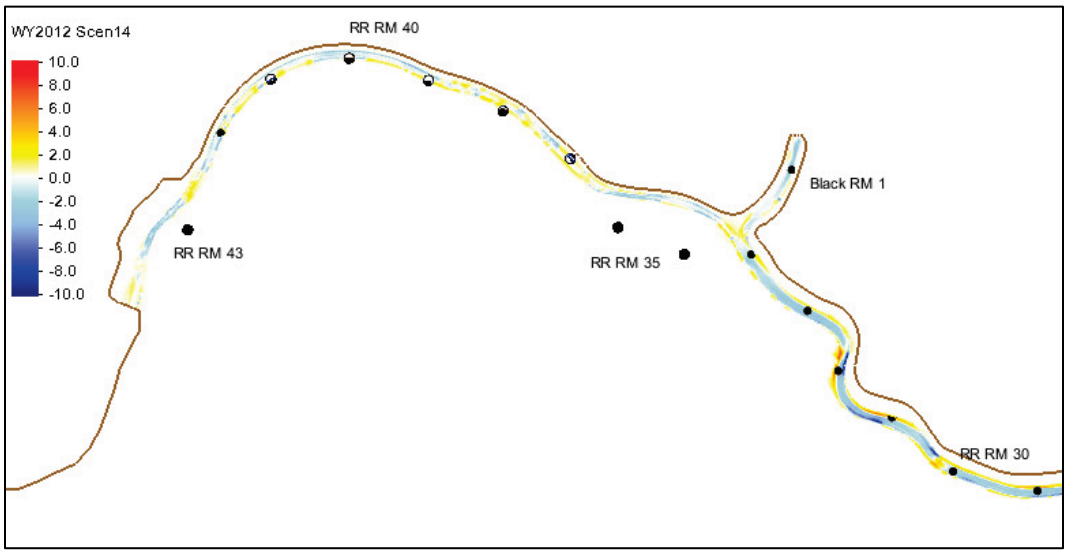


Plate D.108. WY2012 Scenario 14 BDD RR RM 30–RR RM 20.

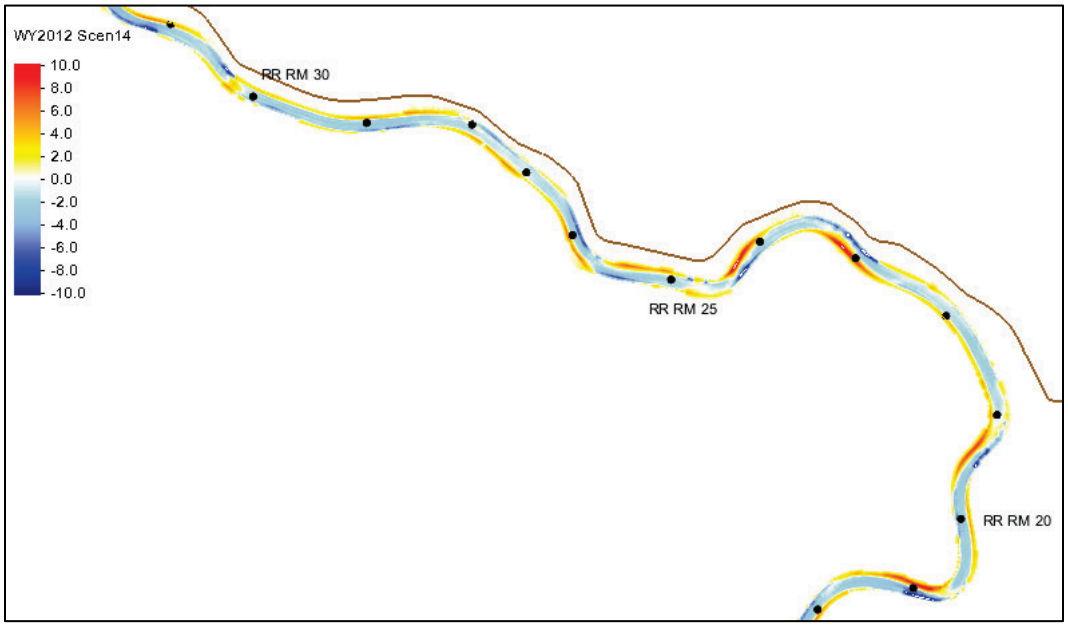


Plate D.109. WY2012 Scenario 14 BDD RR RM 20–RR RM 10.

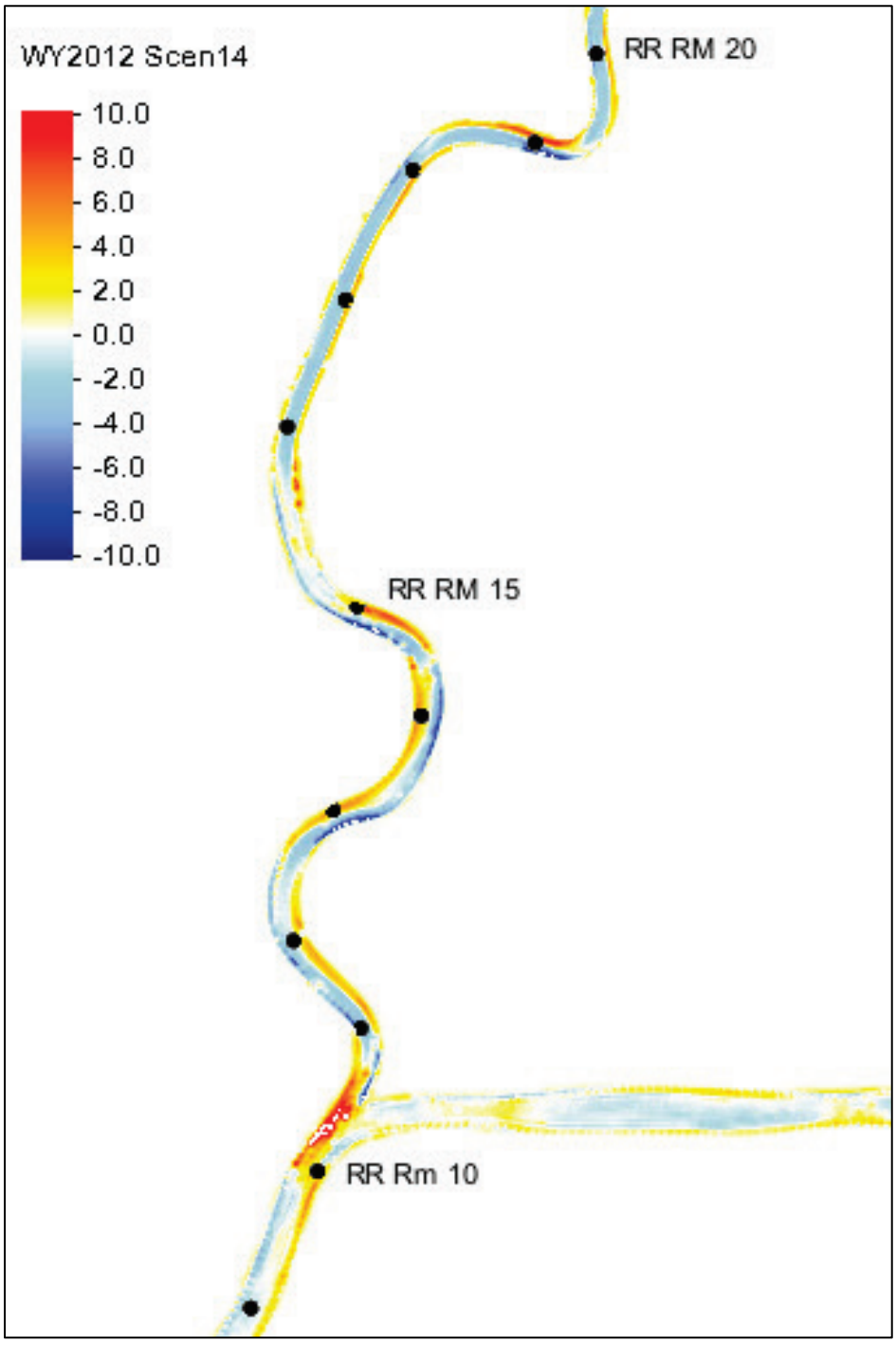


Plate D.110. WY2012 Scenario 14 BDD Outflow Channel.

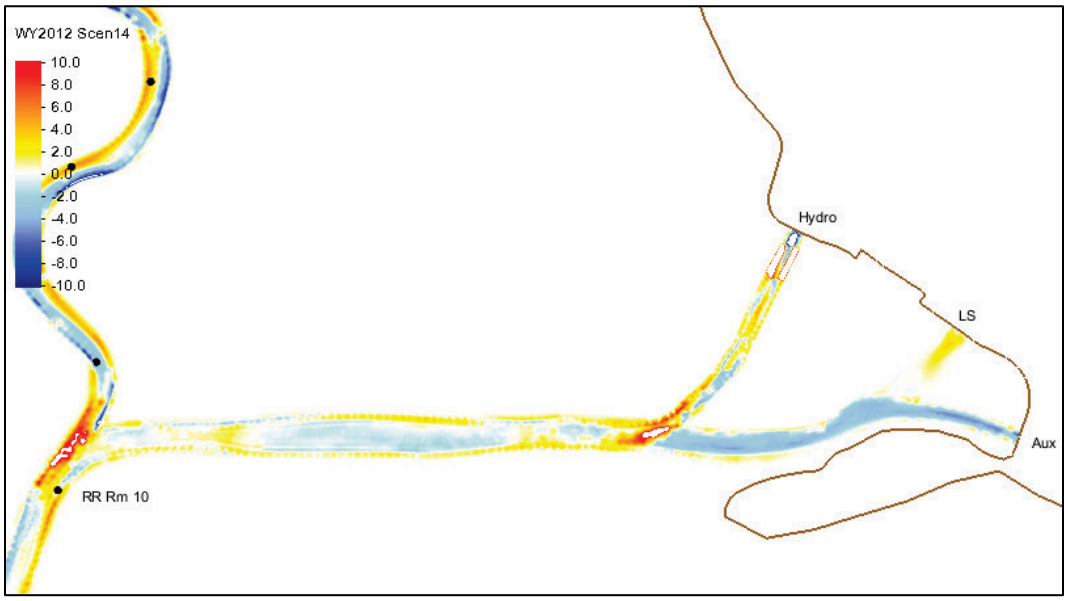


Plate D.111. WY2012 Scenario 14 BDD RR RM 10–Atcha RM 5.

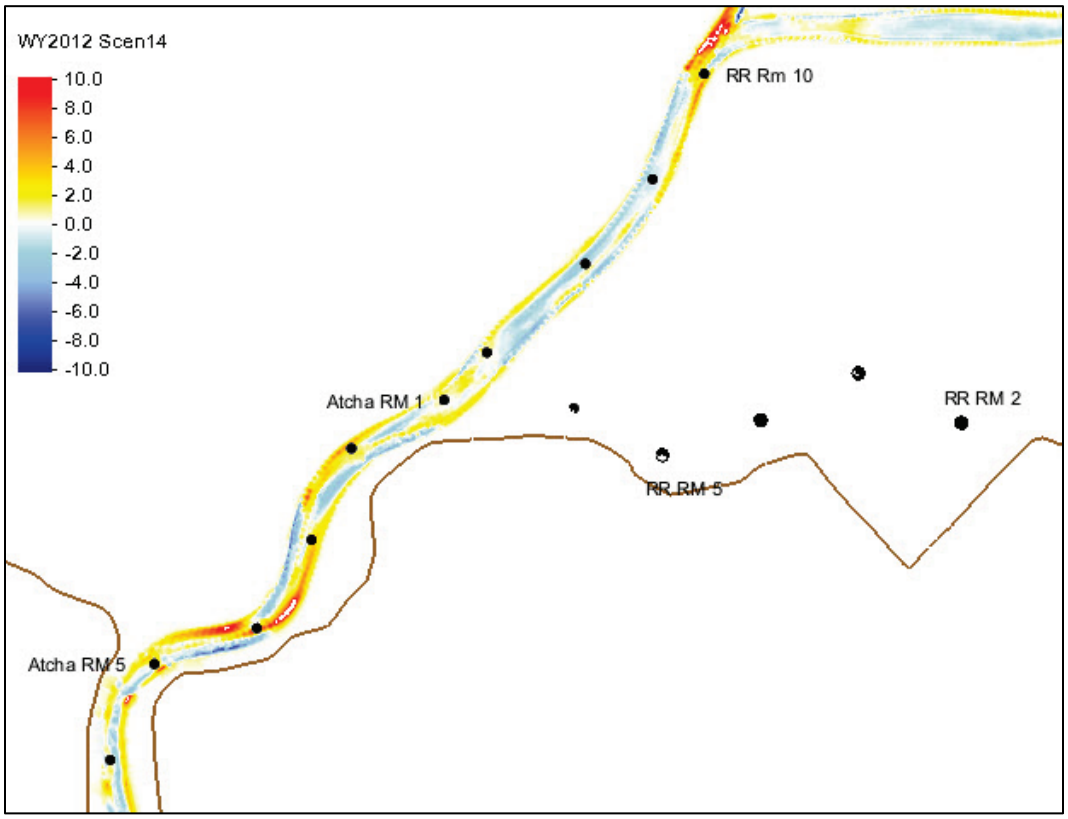


Plate D.112. WY2012 Scenario 14 BDD Atcha RM 5–Atcha RM 15.

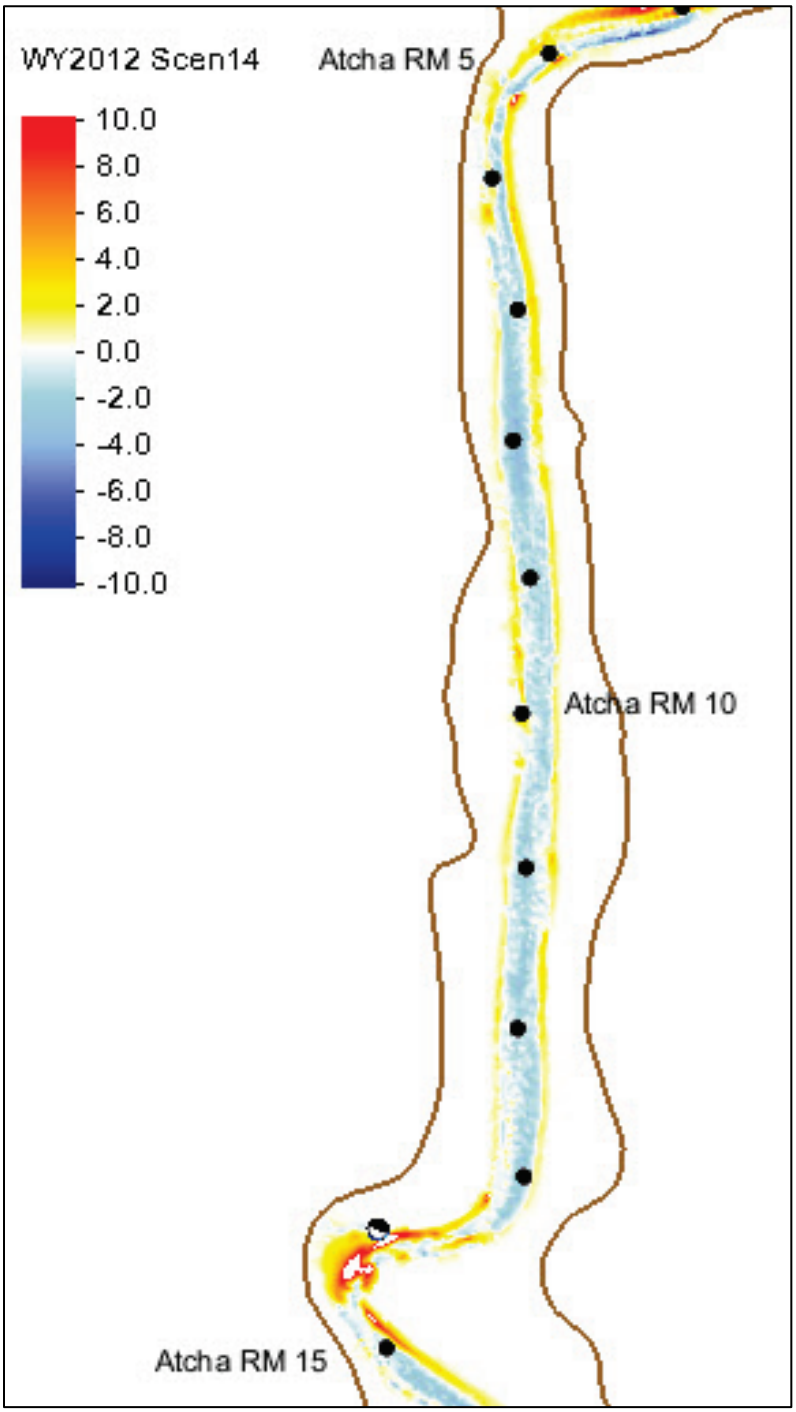
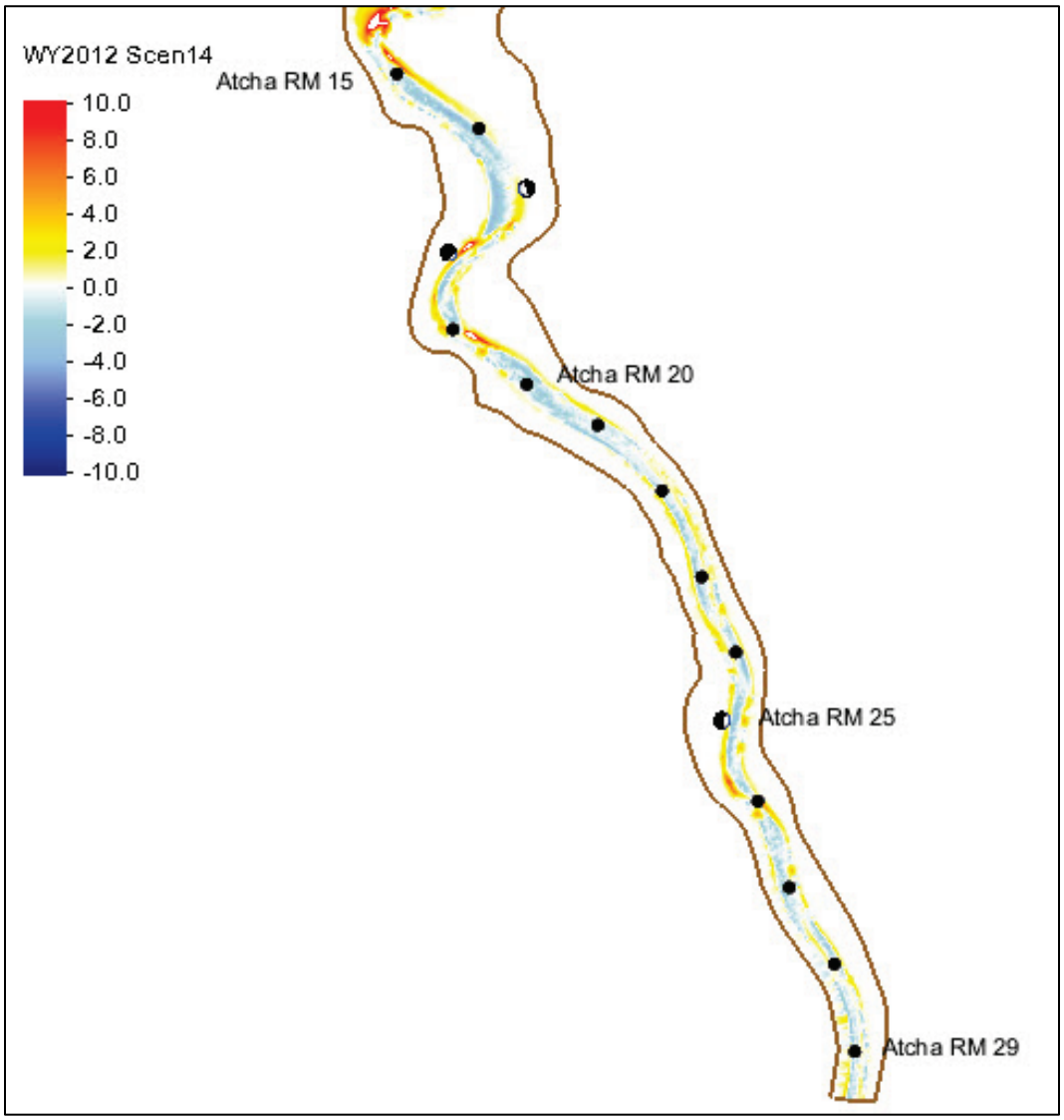


Plate D.113. WY2012 Scenario 14 BDD Atcha RM 15–Atcha RM 29.



D.12 Structure Options

D.12.1 Scenario 19

Plate D.114. WY2012 Scenario 19 BDD RR RM 43–RR RM 30.

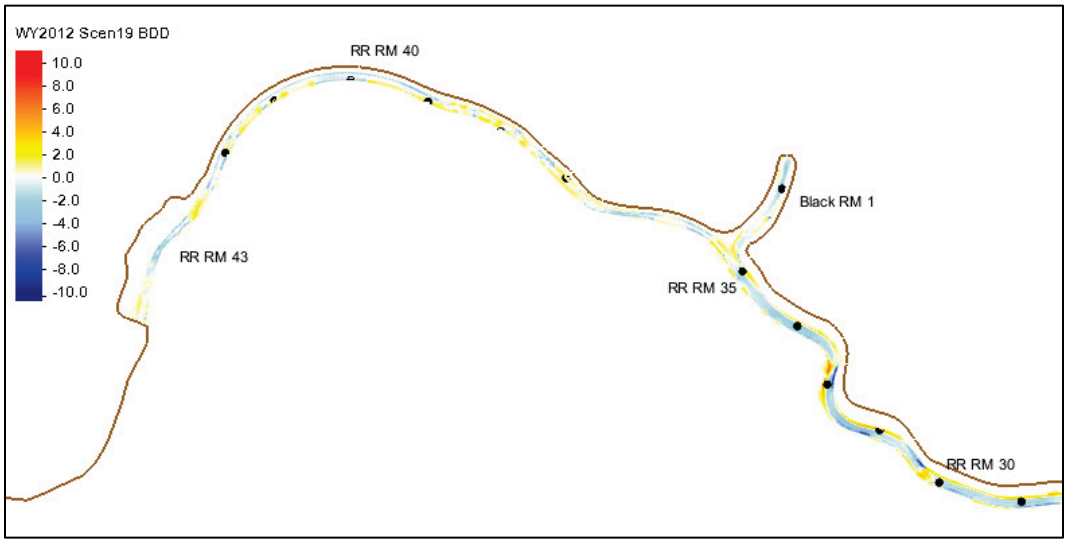


Plate D.115. WY2012 Scenario 19 BDD RR RM 30–RR RM 20.

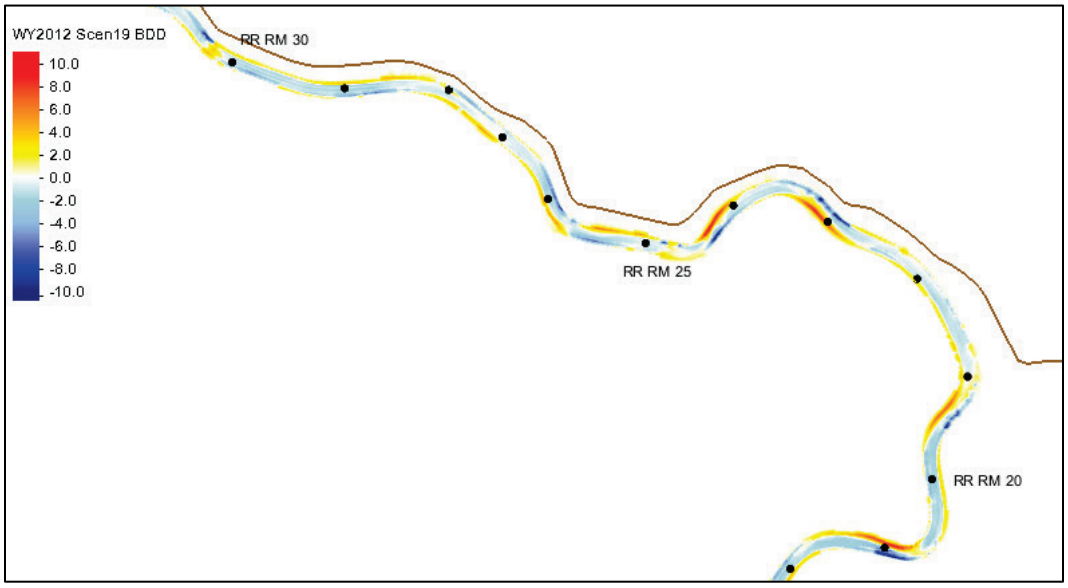


Plate D.116. WY2012 Scenario 19 BDD RR RM 20–RR RM 10 and Outflow Channel.

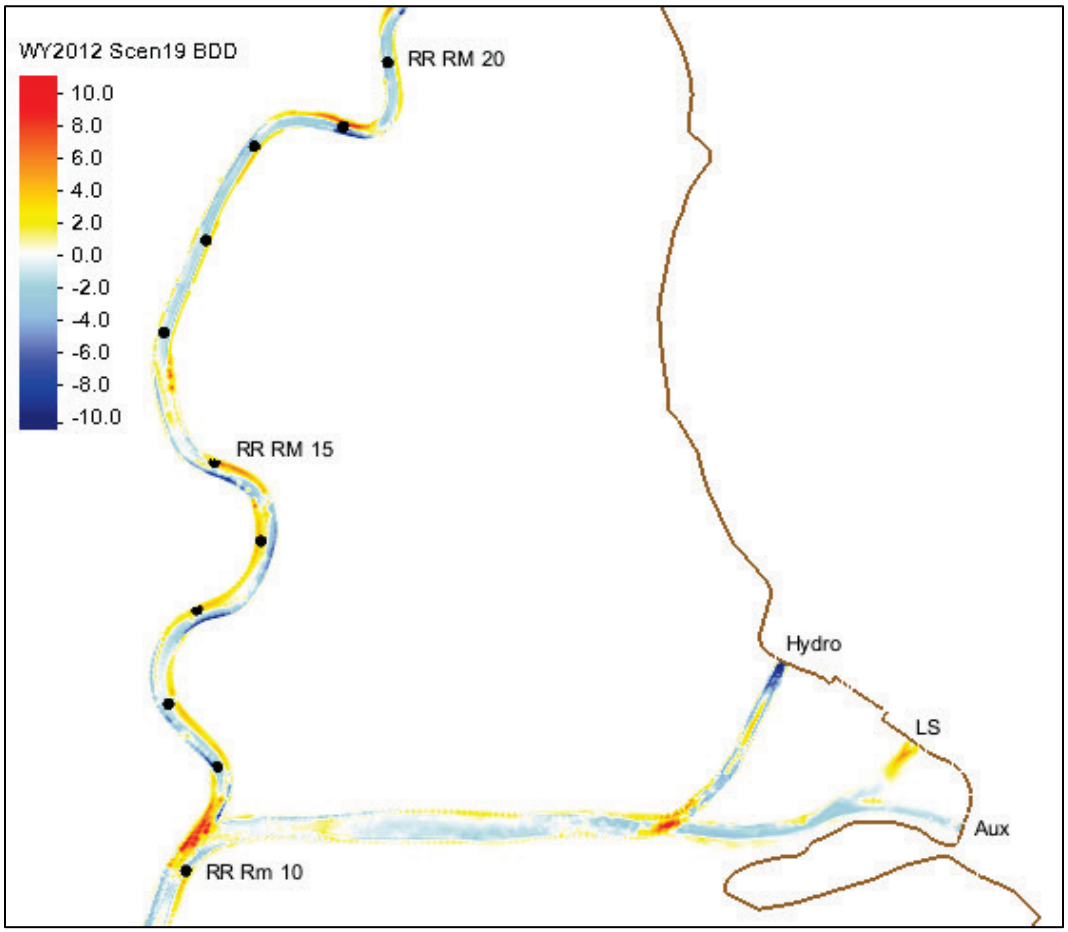


Plate D.117. WY2012 Scenario 19 BDD Outflow Channel.

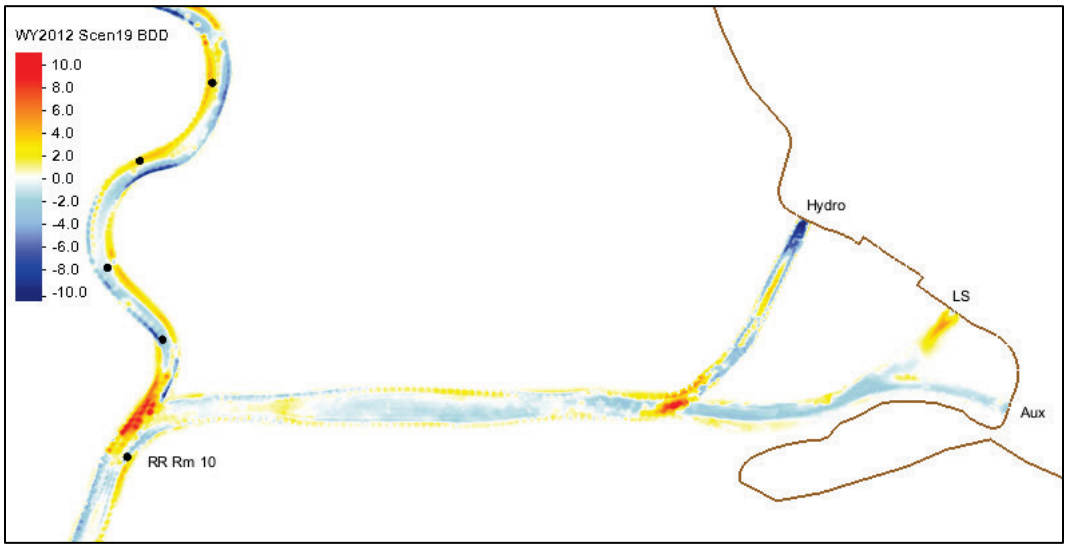


Plate D.118. WY2012 Scenario 19 BDD RR RM 10–Atcha RM 5.

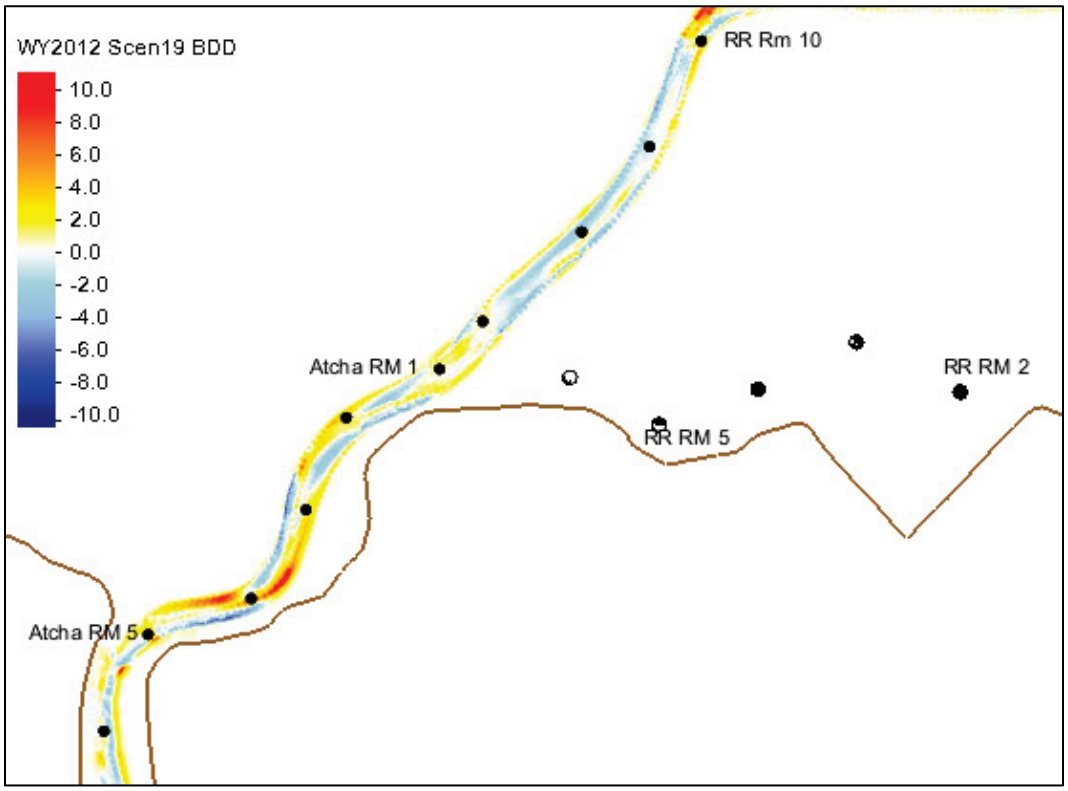


Plate D.119. WY2012 Scenario 19 BDD Atcha RM 5–Atcha RM 15.

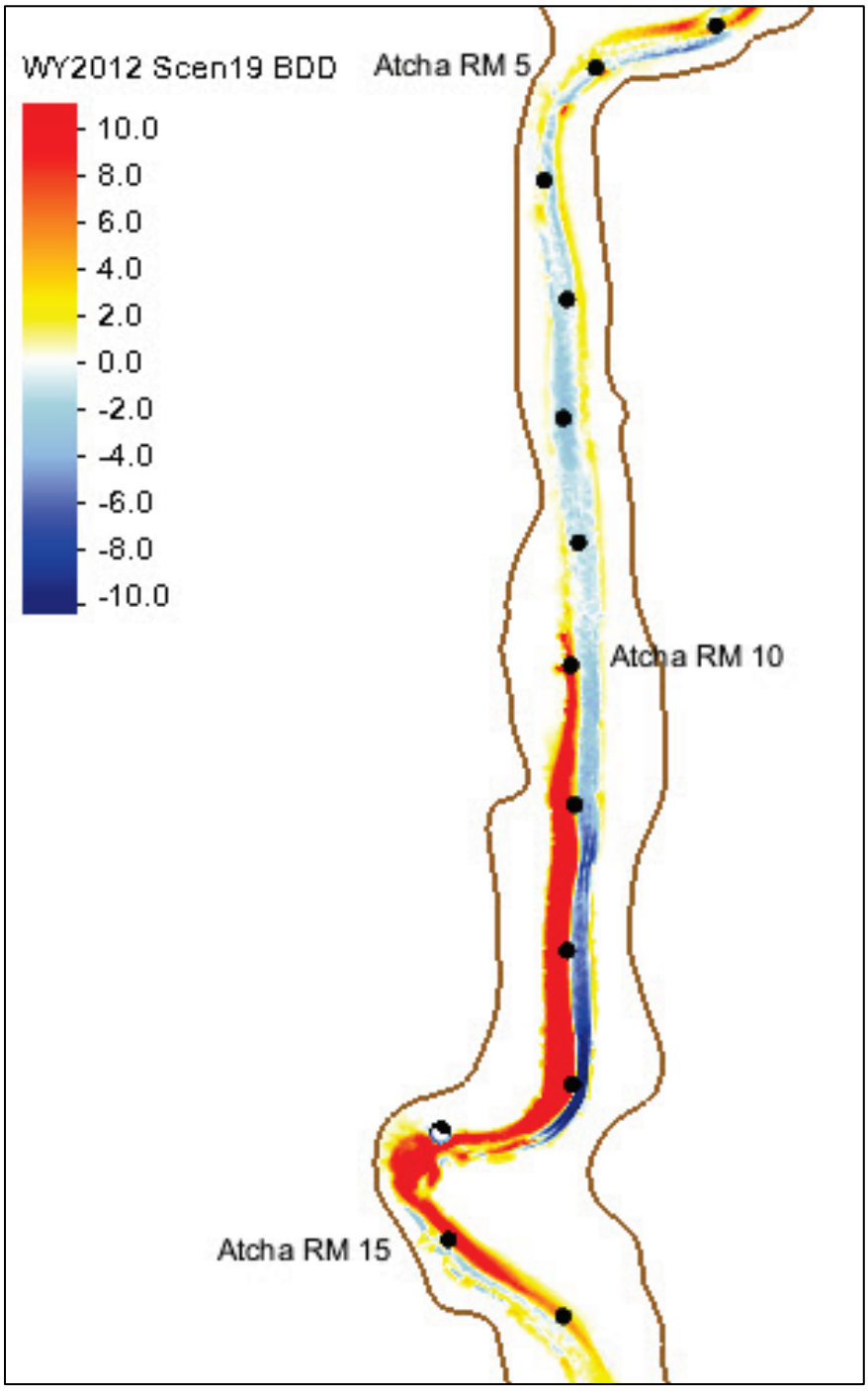
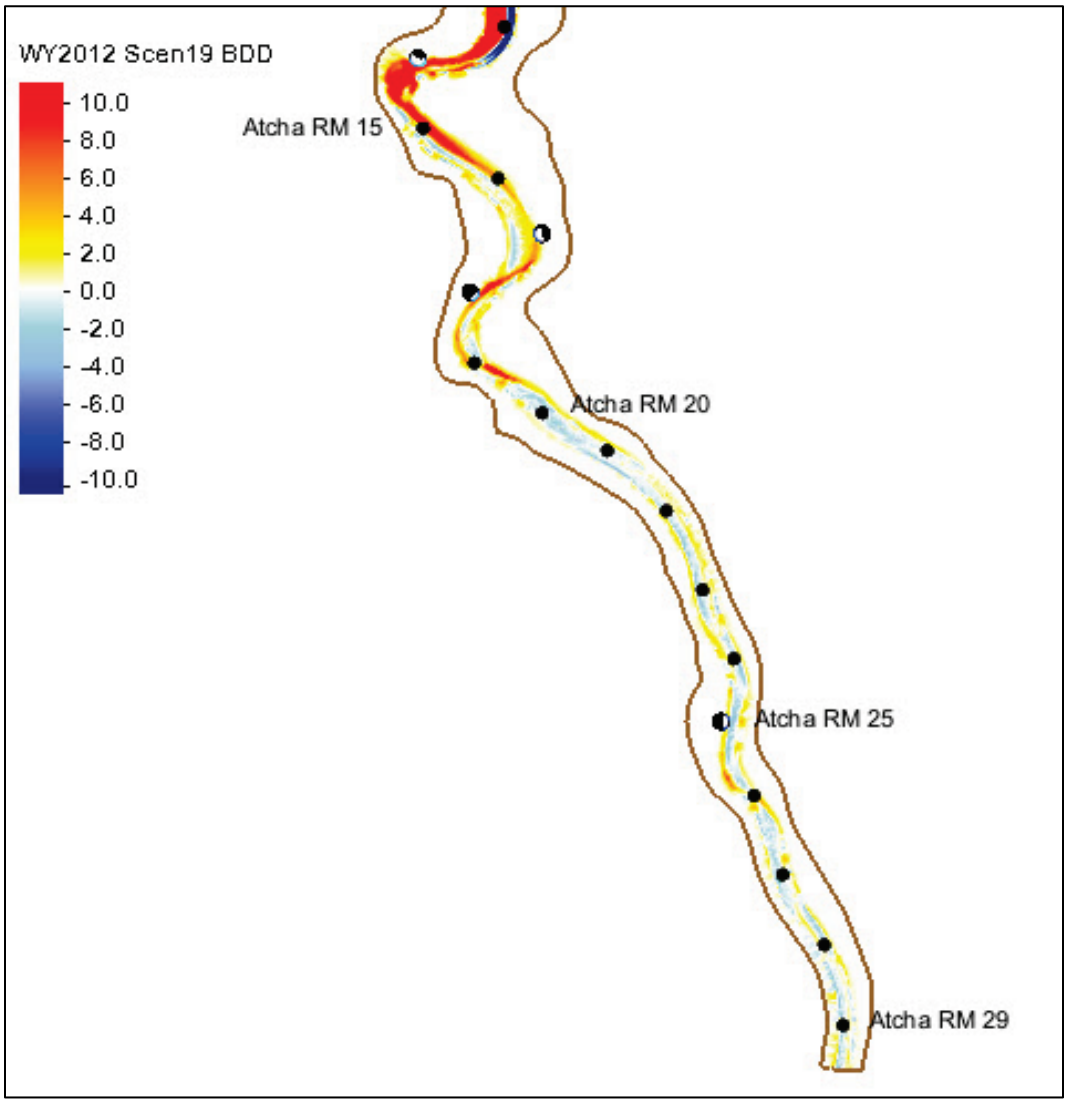


Plate D.120. WY2012 Scenario 19 BDD Atcha RM 15–Atcha RM 29.



D.12.2 Scenario 20

Plate D.121. WY2012 Scenario 20 BDD RR RM 43–RR RM 30.

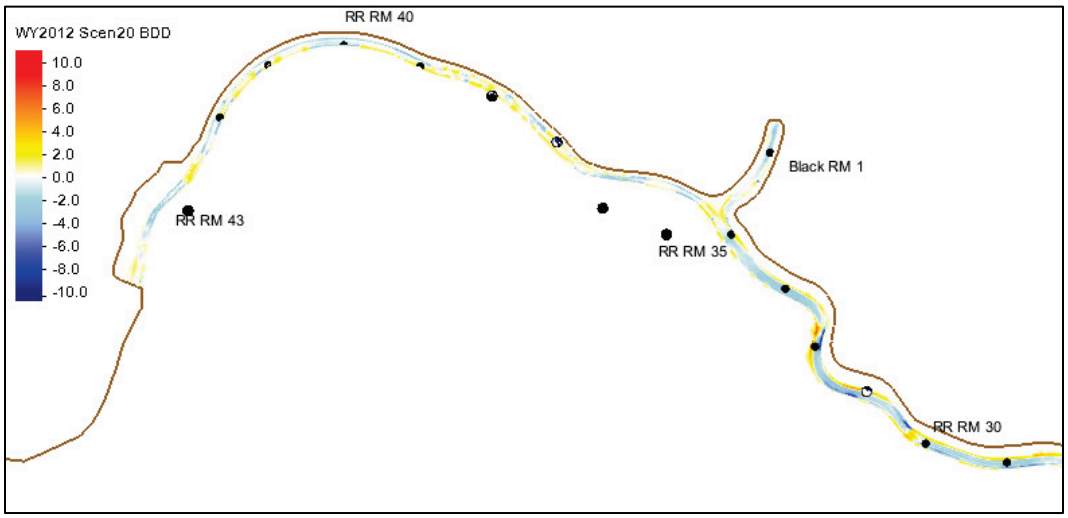


Plate D.122. WY2012 Scenario 20 BDD RR RM 30–RR RM 20.

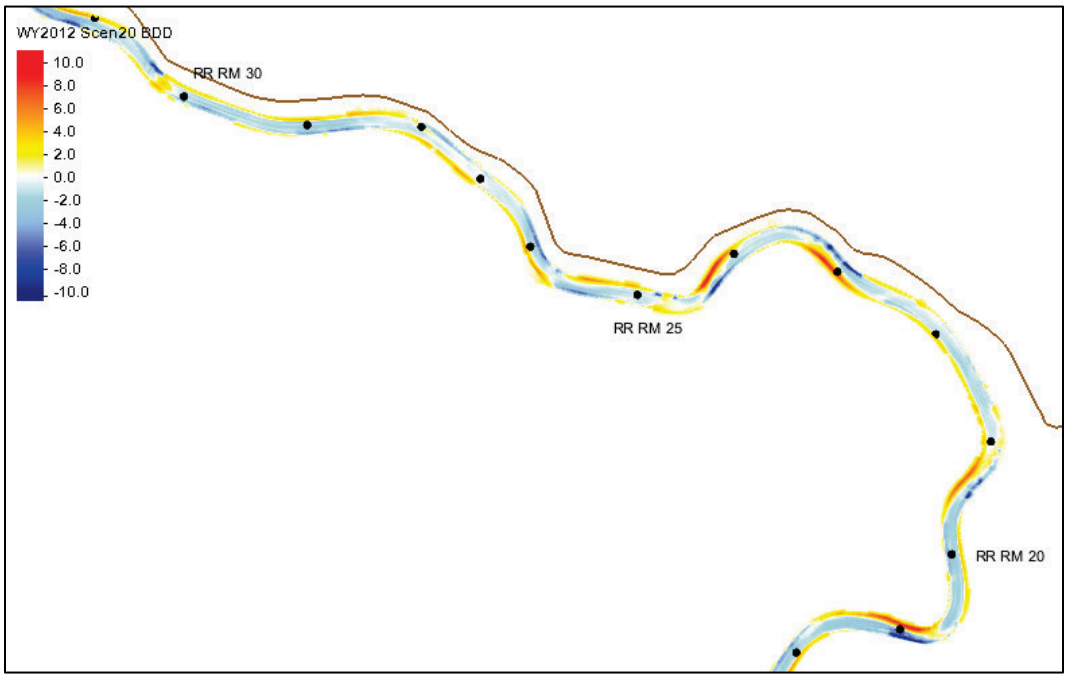


Plate D.123. WY2012 Scenario 20 BDD RR RM 20–RR RM 10 and Outflow Channel.

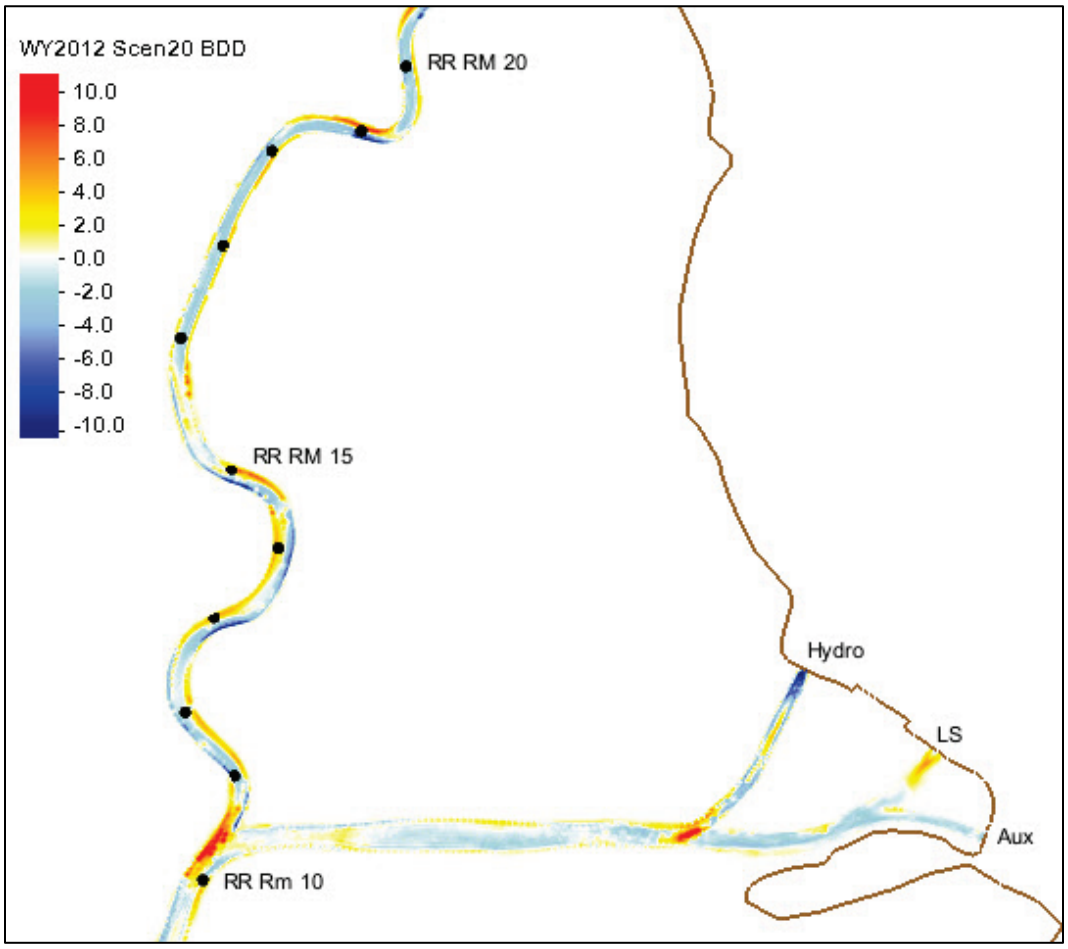


Plate D.124. WY2012 Scenario 20 BDD Outflow Channel.

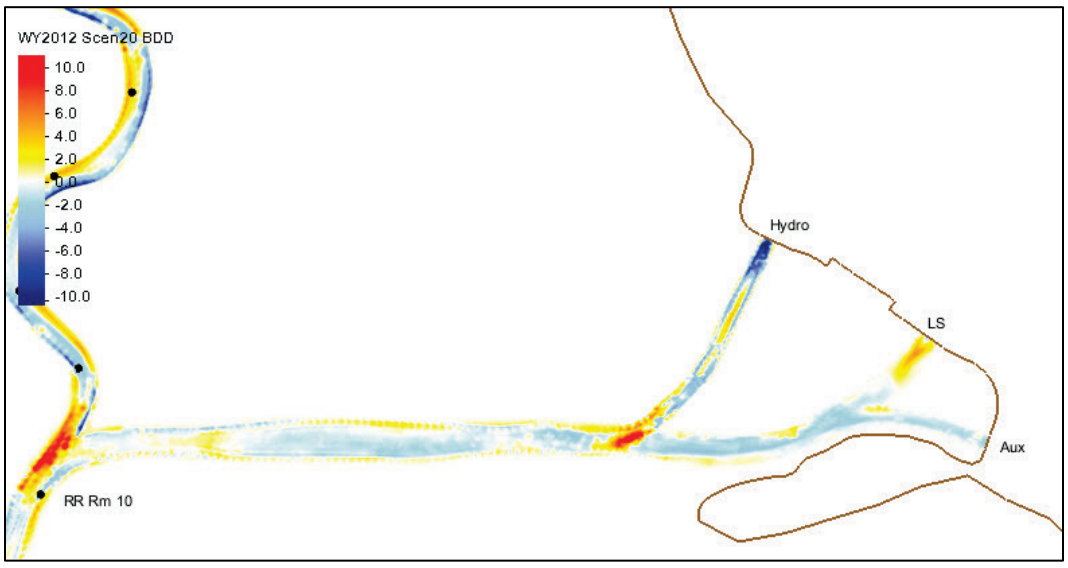


Plate D.125. WY2012 Scenario 20 BDD RR RM 10–Atcha RM 5.

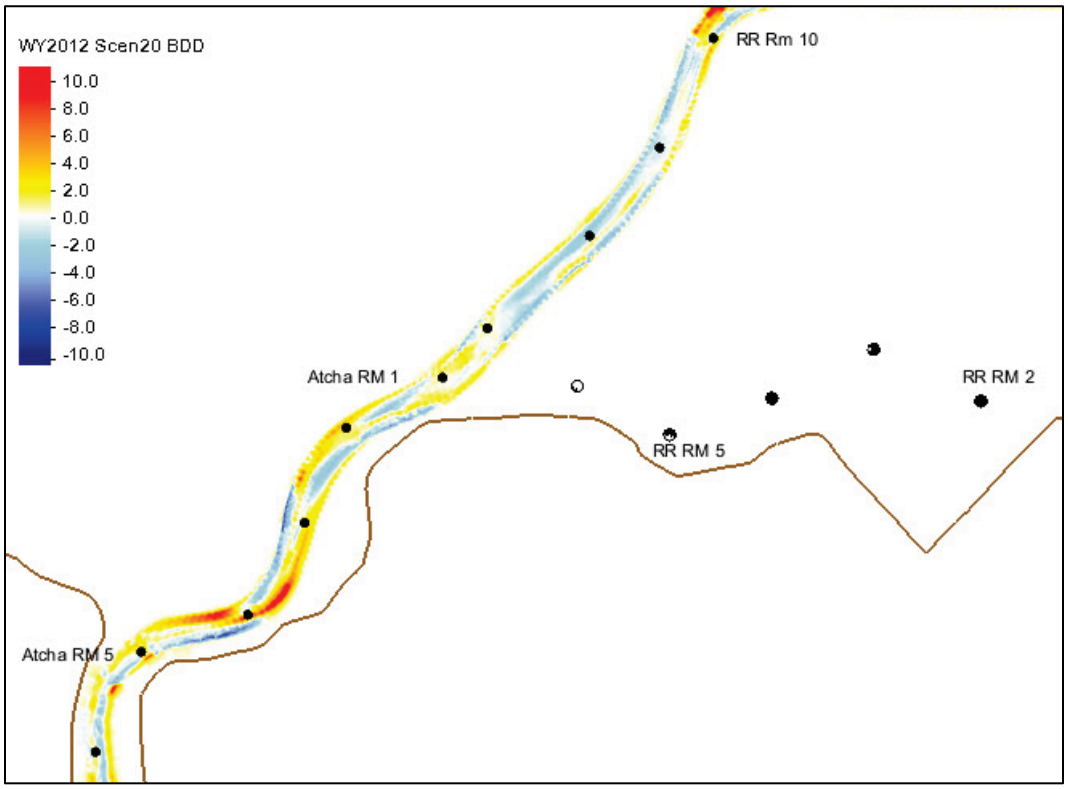


Plate D.126. WY2012 Scenario 20 BDD Atcha RM 5–Atcha RM 15.

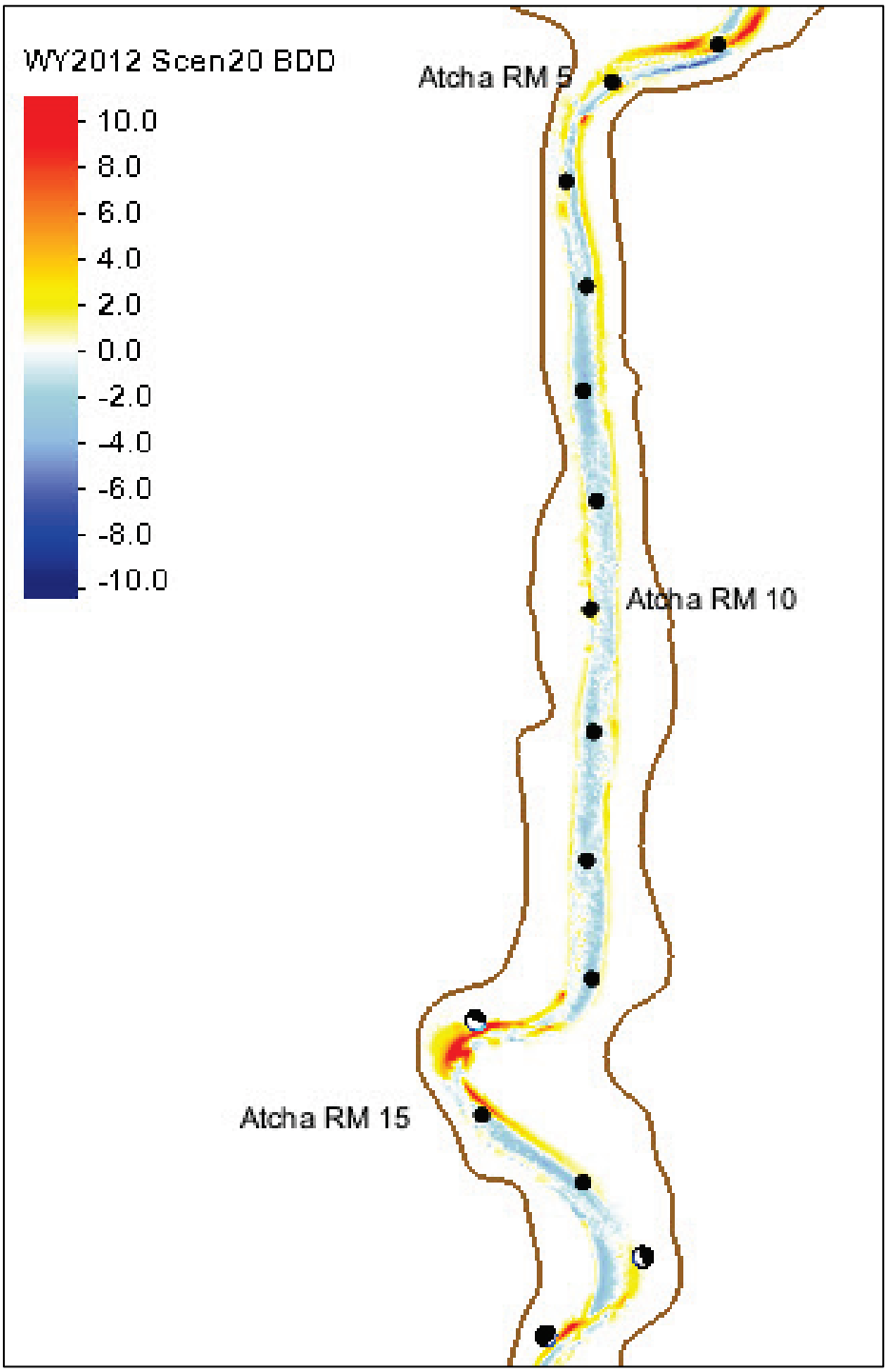
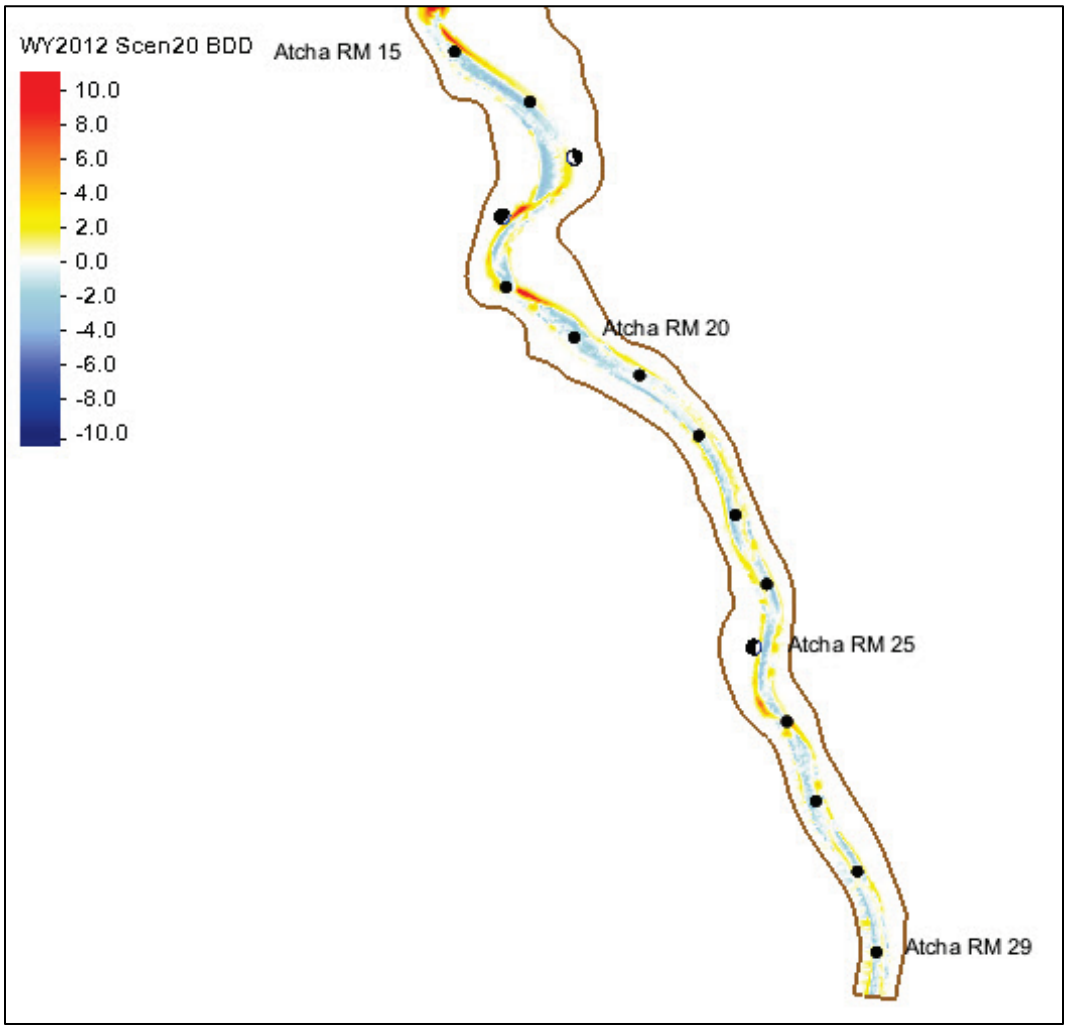


Plate D.127. WY2012 Scenario 20 BDD Atcha RM 15–Atcha RM 29.



Appendix E: WY2012 BSVC

E.1 Material 1 Base Run and Scenarios 3–10

Plate E.1. Material legend.

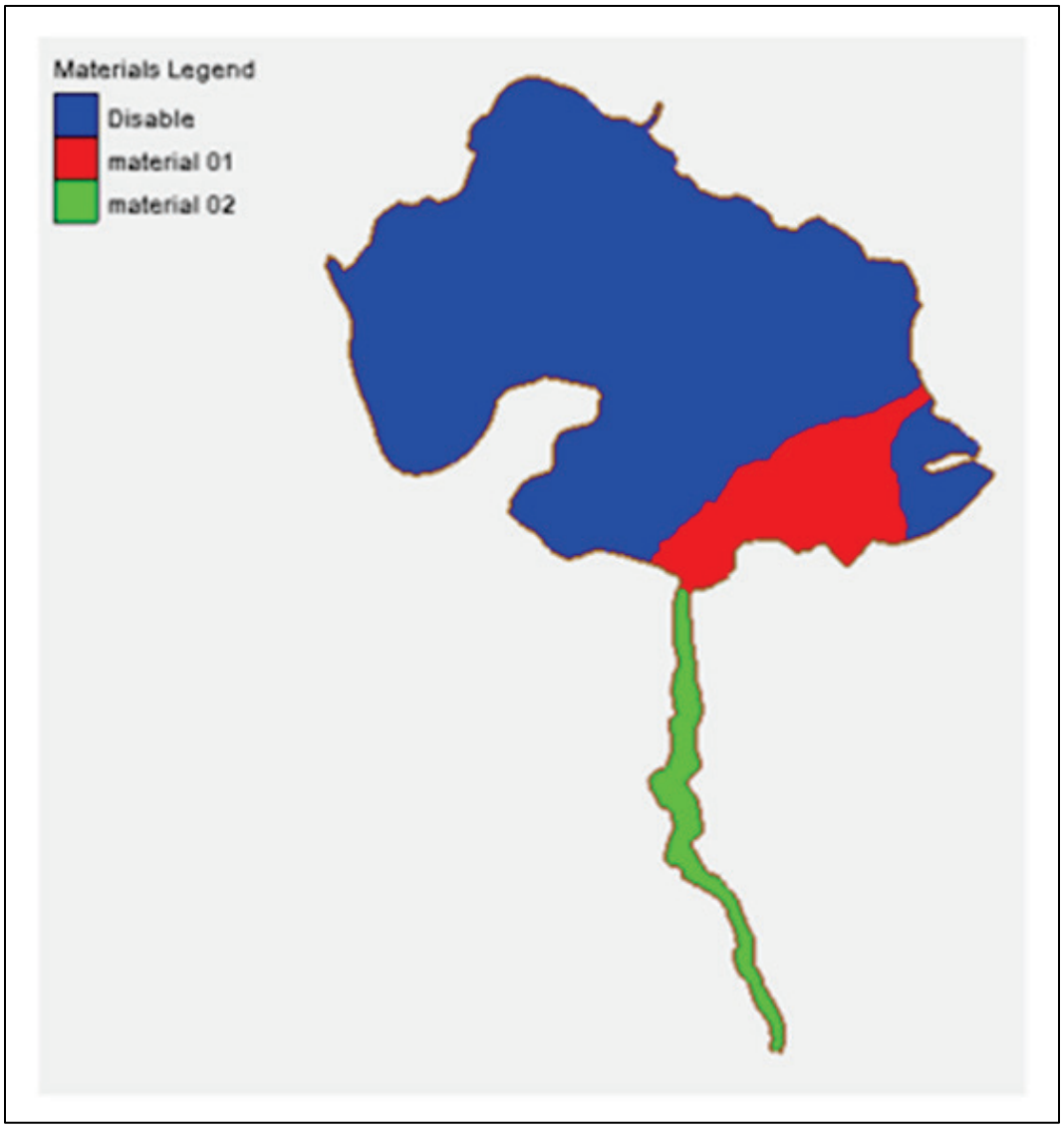


Plate E.2. Material 1 WY2012 Base Run time versus sediment volume change/Simmesport discharge.

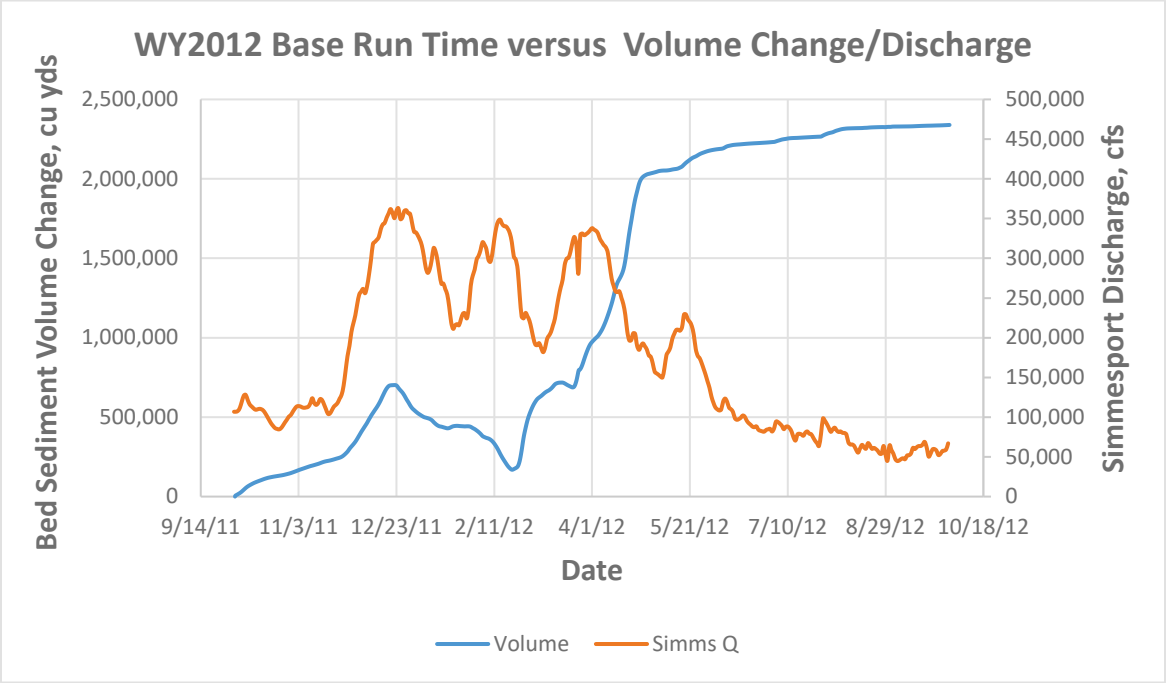


Plate E.3. Material 1 WY2012 Scenario 3 time versus sediment volume change/Simmesport discharge.

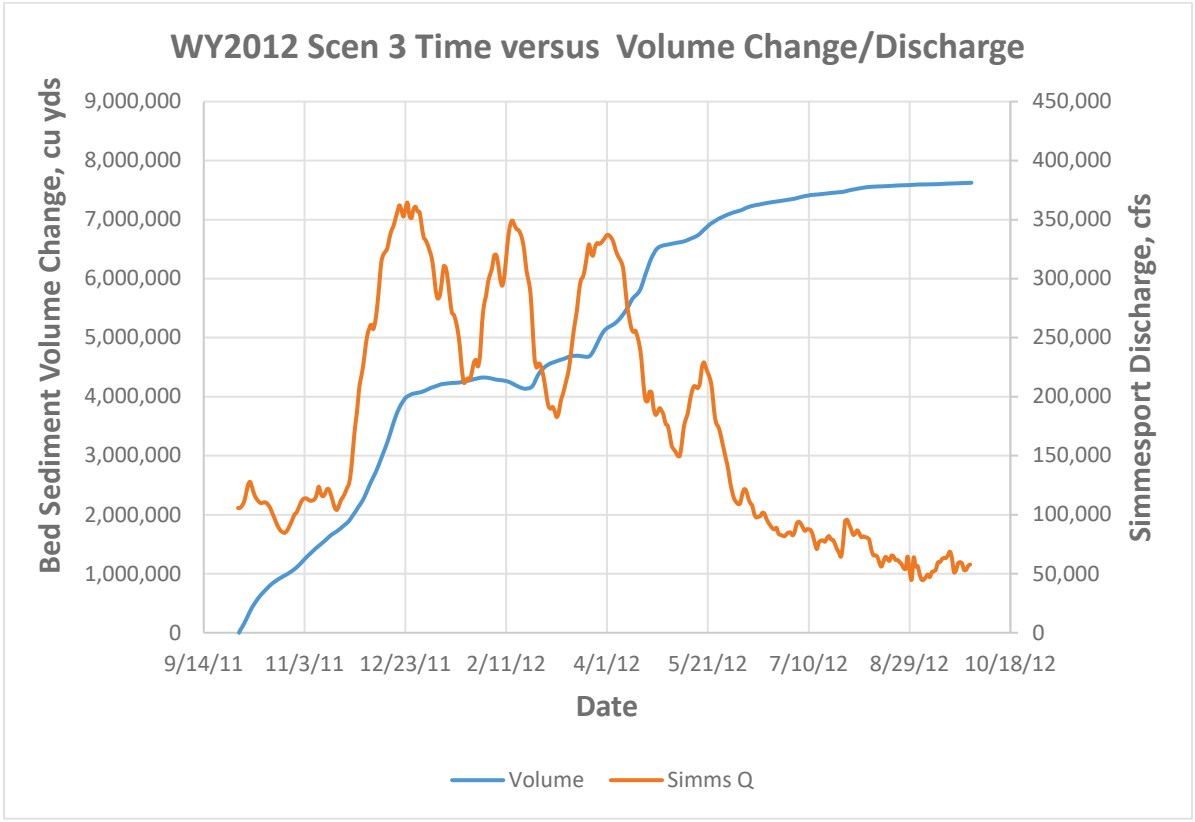


Plate E.4. Material 1 WY2012 Scenario 4 time versus sediment volume change/Simmesport discharge.

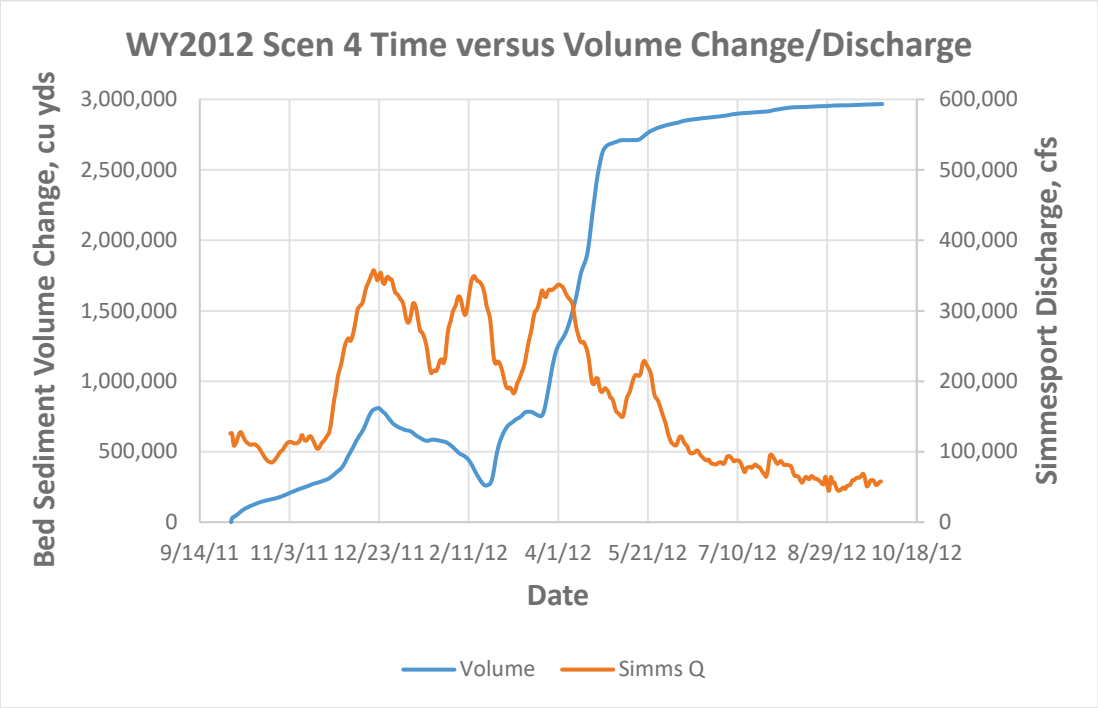


Plate E.5. Material 1 WY2012 Scenario 5 time versus sediment volume change/Simmesport discharge.

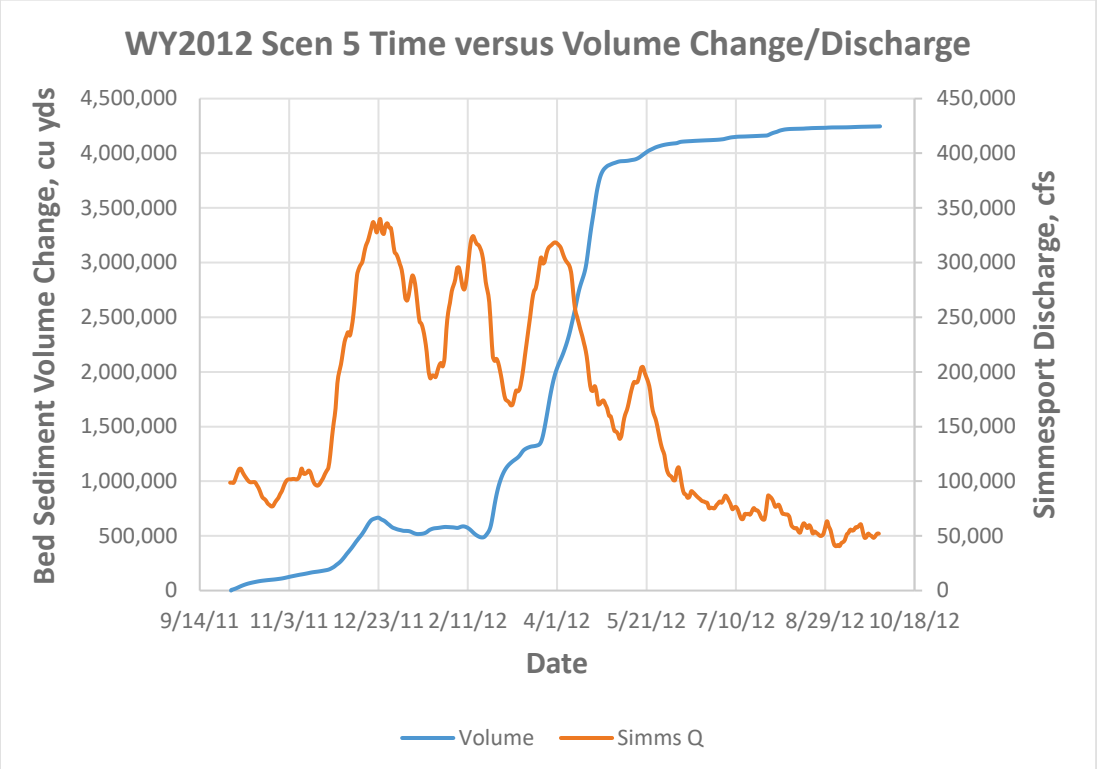


Plate E.6. Material 1 WY2012 Scenario 6 time versus sediment volume change/Simmesport discharge.

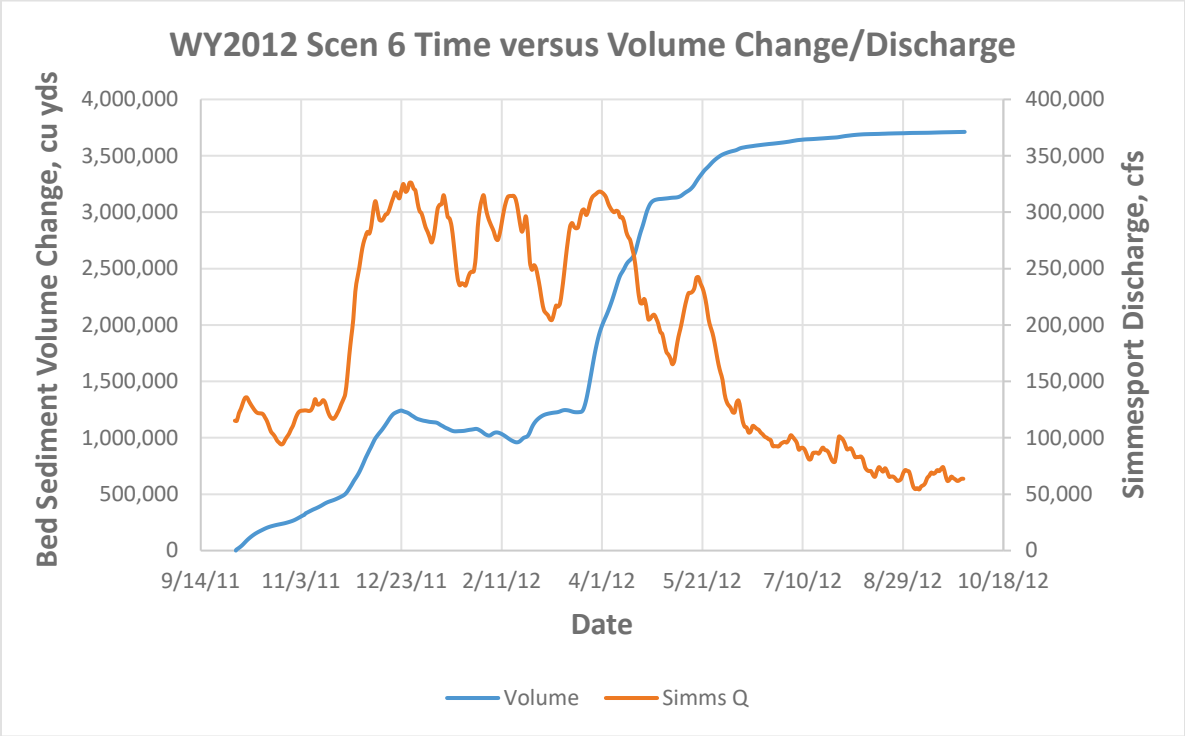


Plate E.7. Material 1 WY2012 Scenario 7 time versus sediment volume change/Simmesport discharge.

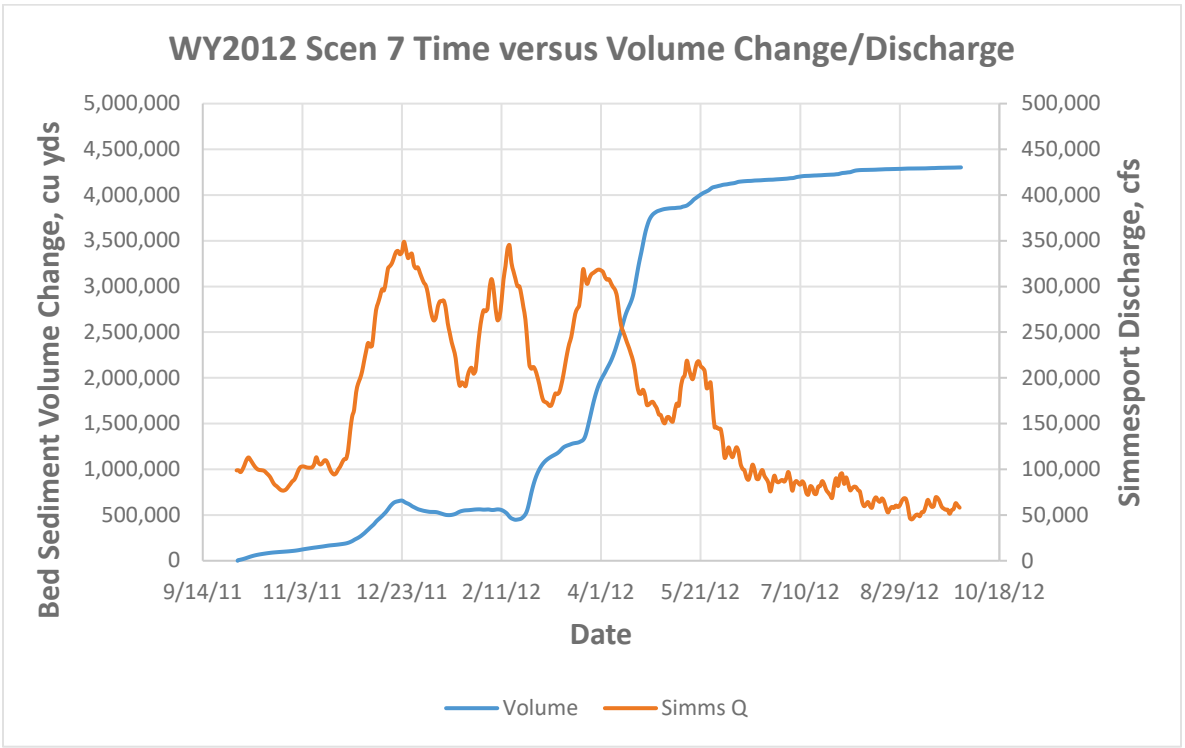


Plate E.8. Material 1 WY2012 Scenario 8a time versus sediment volume change/Simmesport discharge.

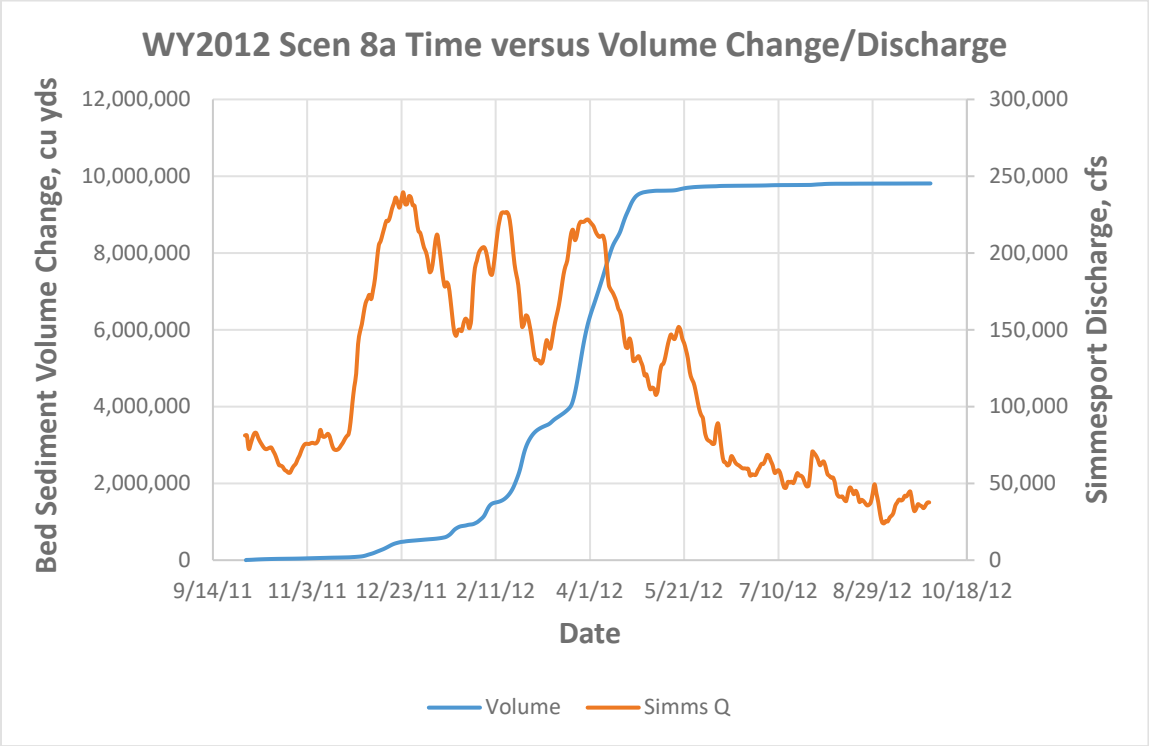


Plate E.9. Material 1 WY2012 Scenario 8b time versus sediment volume change/Simmesport discharge.

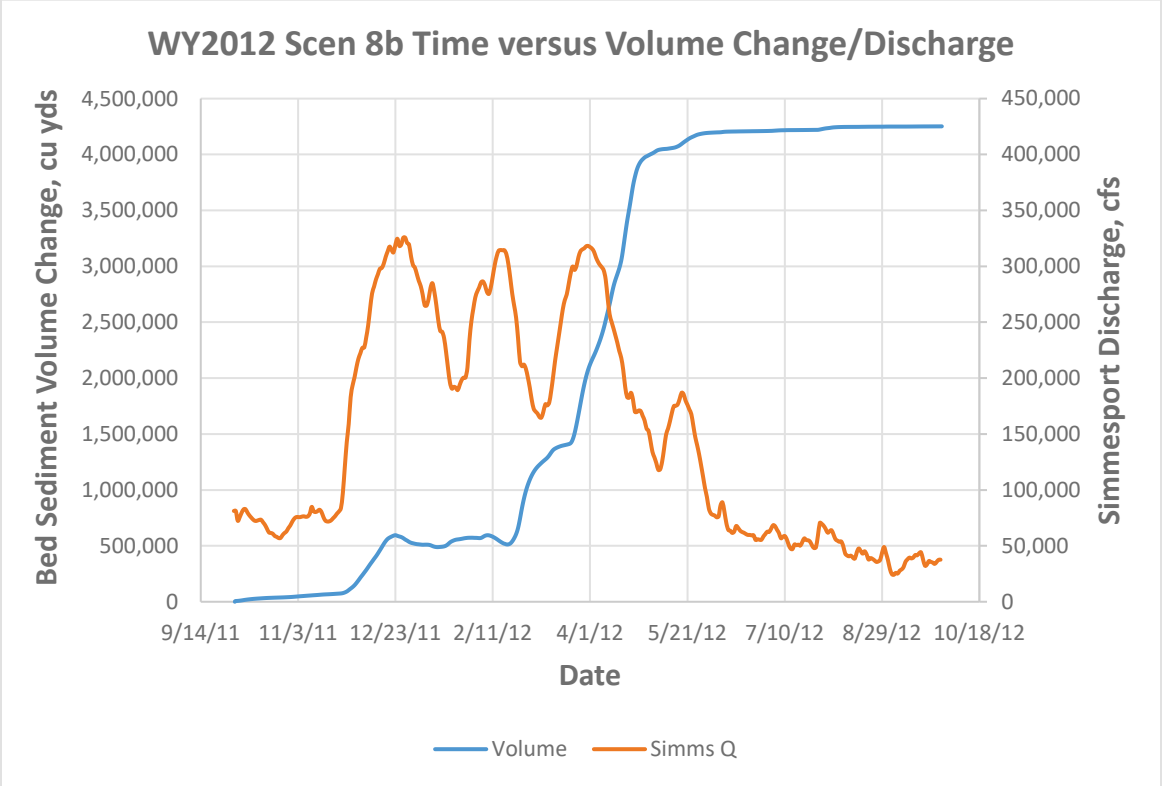


Plate E.10. Material 1 WY2012 Scenario 9 time versus sediment volume change/Simmesport discharge.

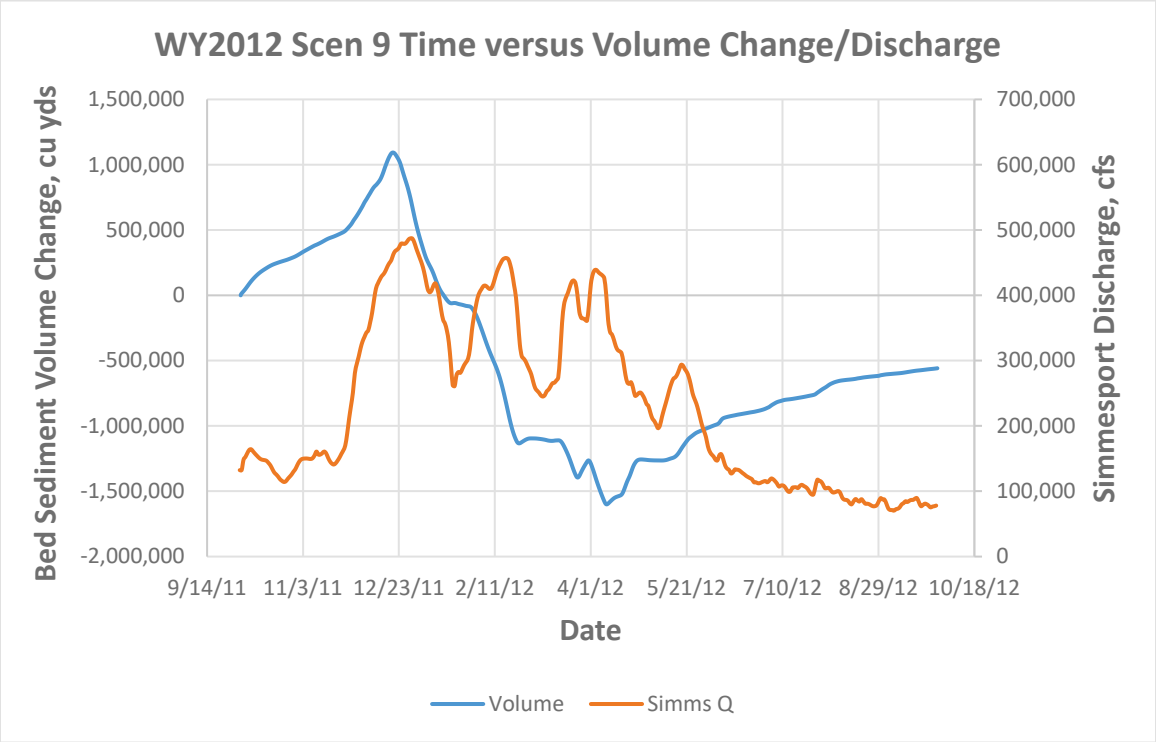


Plate E.11. Material 1 WY2012 Scenario 10 time versus sediment volume change/Simmesport discharge.

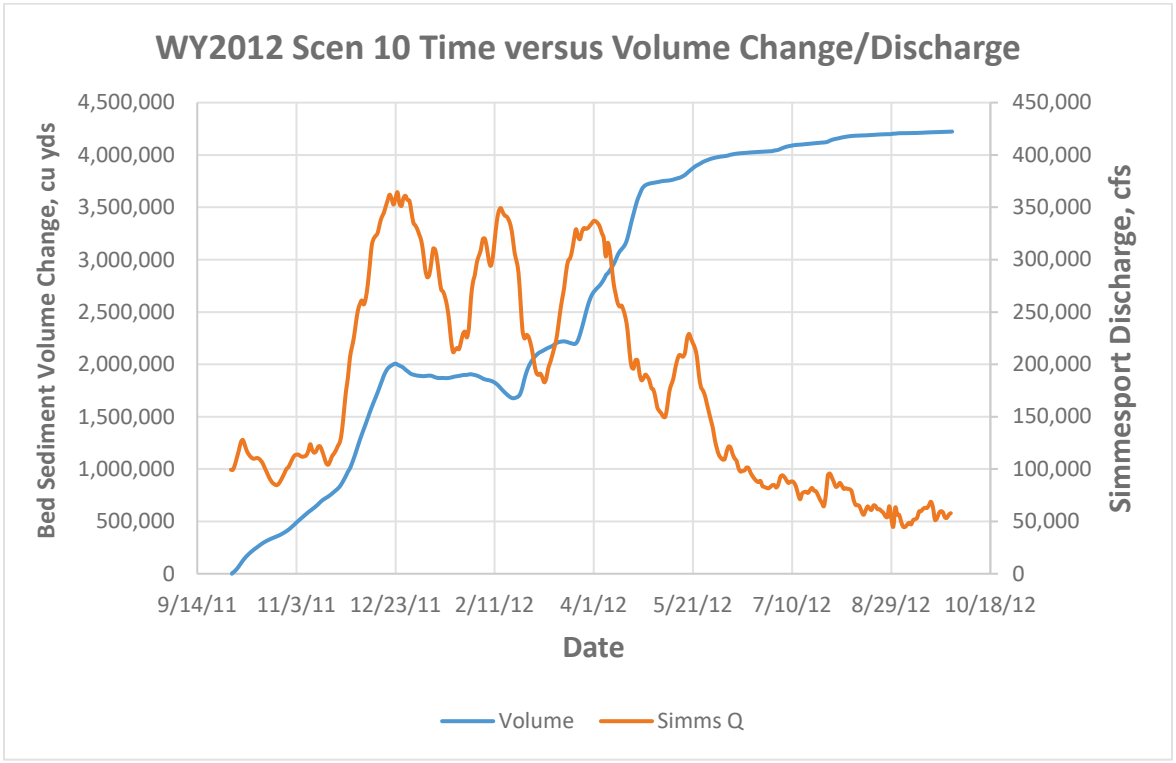
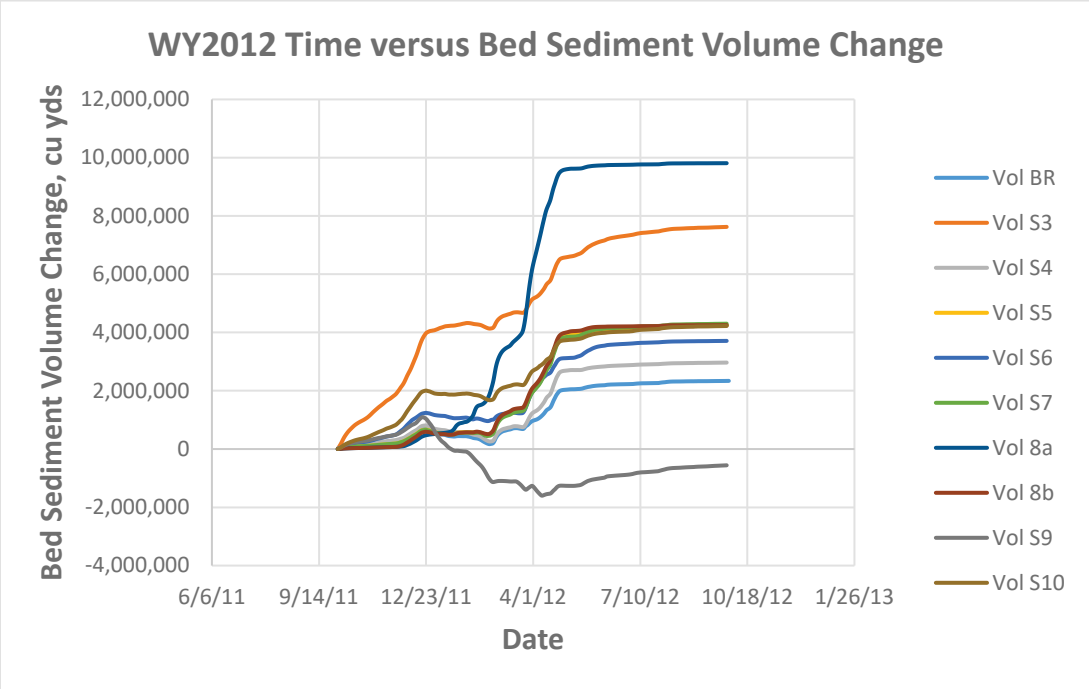


Plate E.12. Material 1 WY2012 Base Run and Scenarios 3–10 time versus sediment volume change.



E.2 Material 2 Base Run and Scenarios 3–10

Plate E.13. Material 2 Simmesport to Melville.

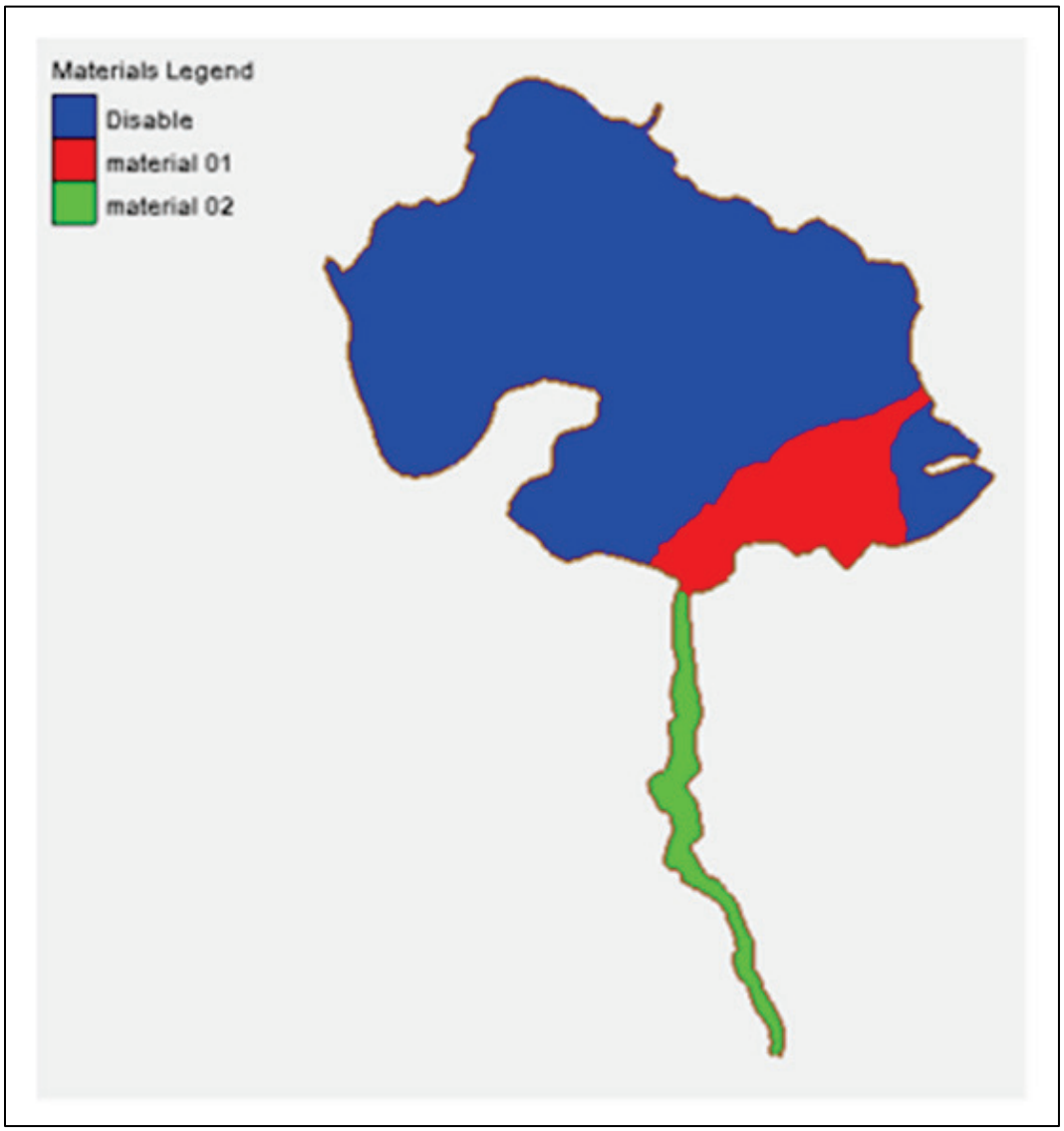


Plate E.14. Material 2 WY2012 Base Run time versus sediment volume change/Simmesport discharge.

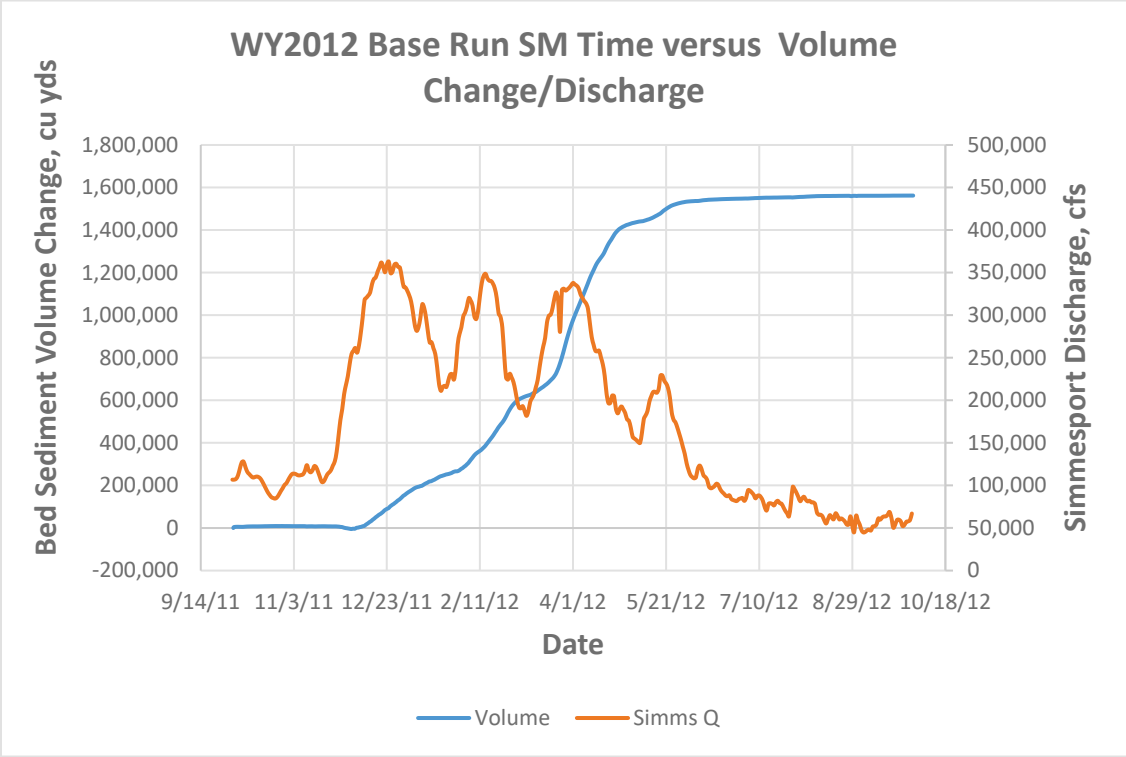


Plate E.15. Material 2 WY2012 Scenario 3 time versus sediment volume change/Simmesport discharge.

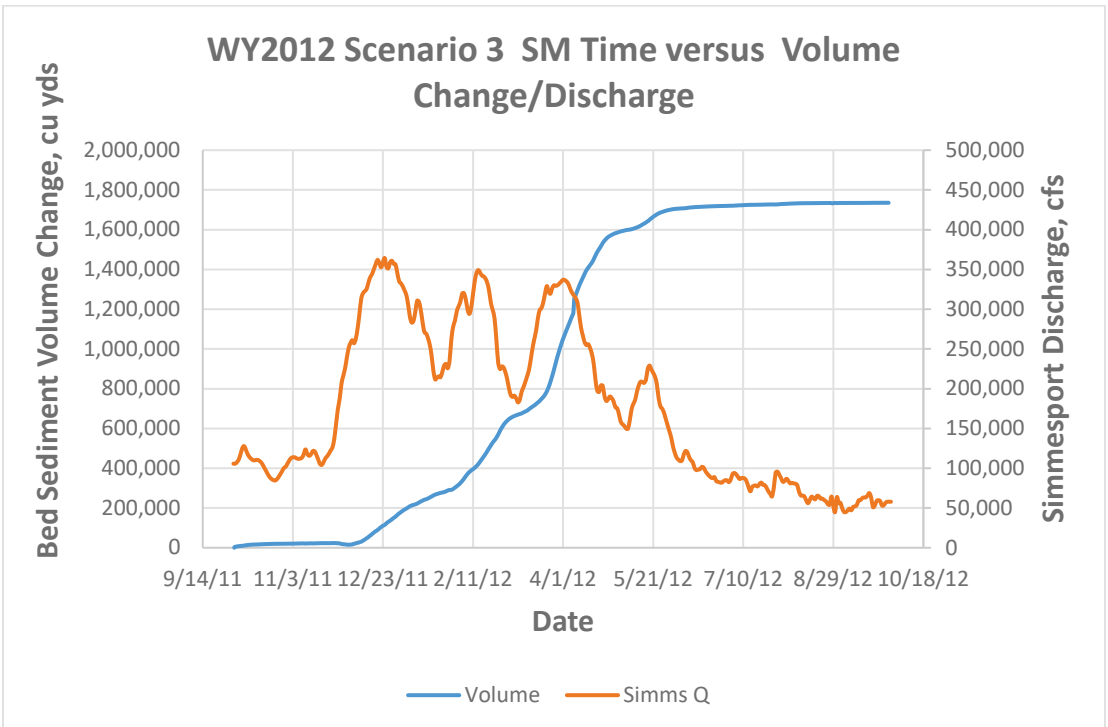


Plate E.16. Material 2 WY2012 Scenario 4 time versus sediment volume change/Simmesport discharge.

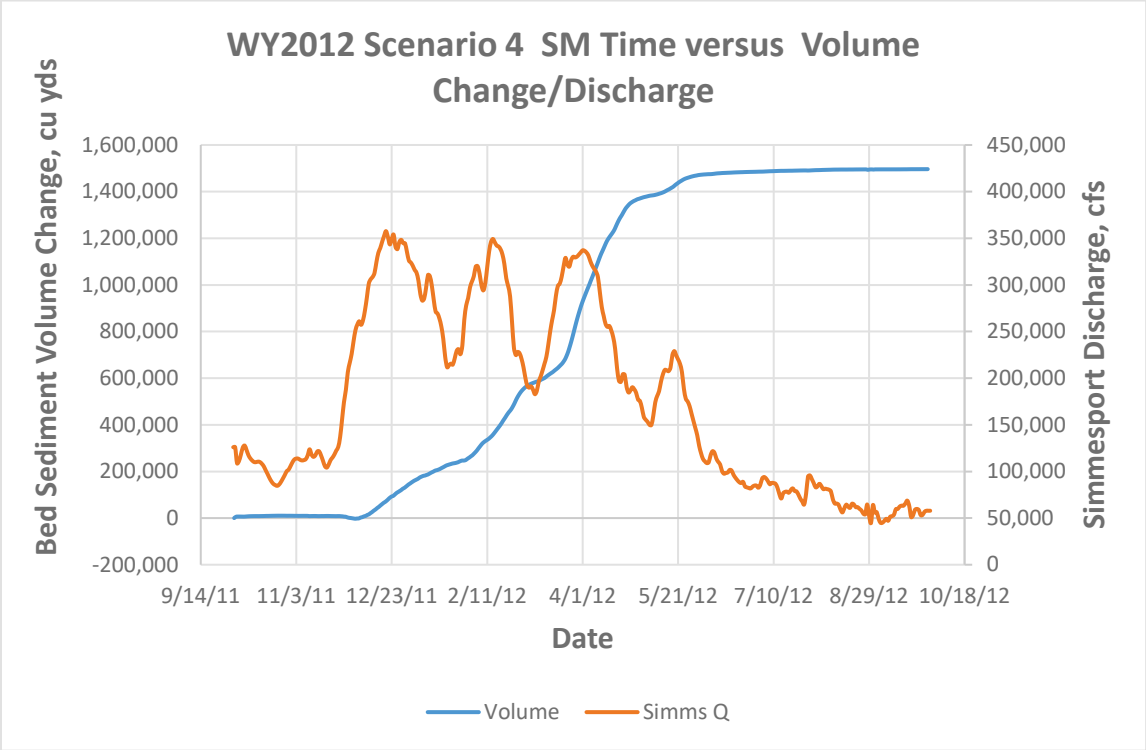


Plate E.17. Material 2 WY2012 Scenario 5 time versus sediment volume change/Simmesport discharge.

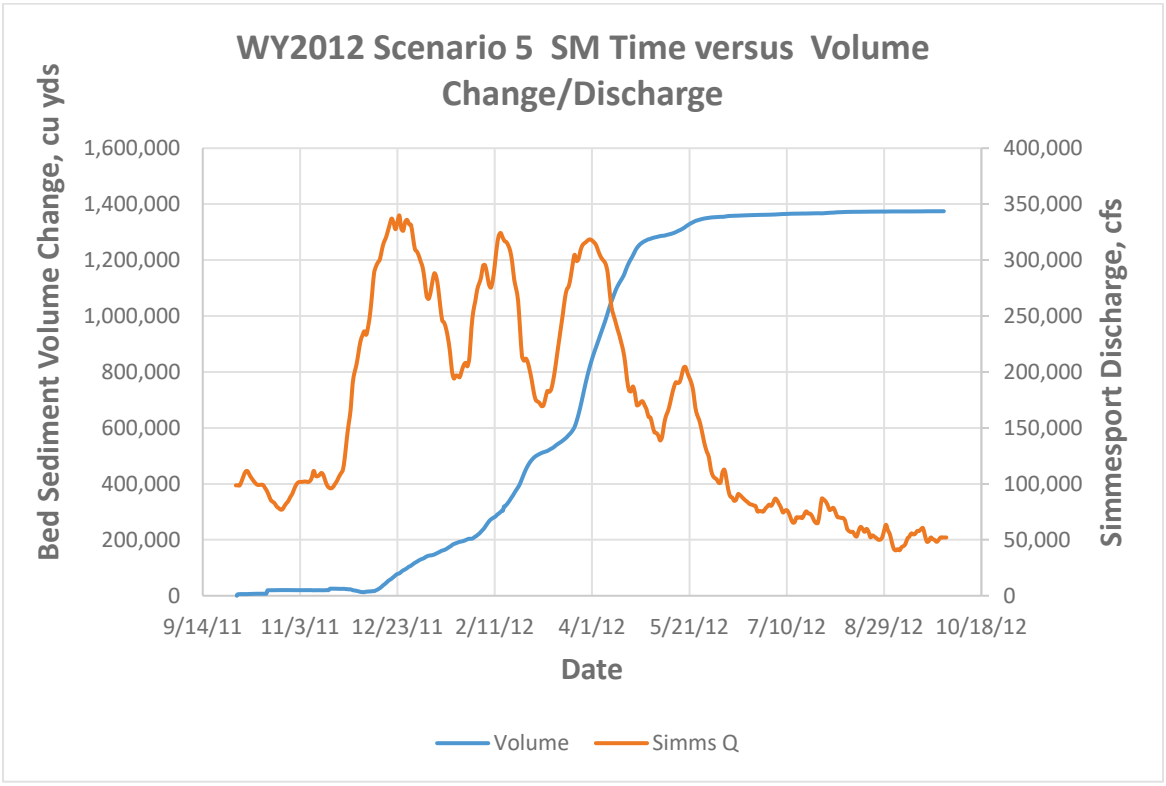


Plate E.18. Material 2 WY2012 Scenario 6 time versus sediment volume change/Simmesport discharge.

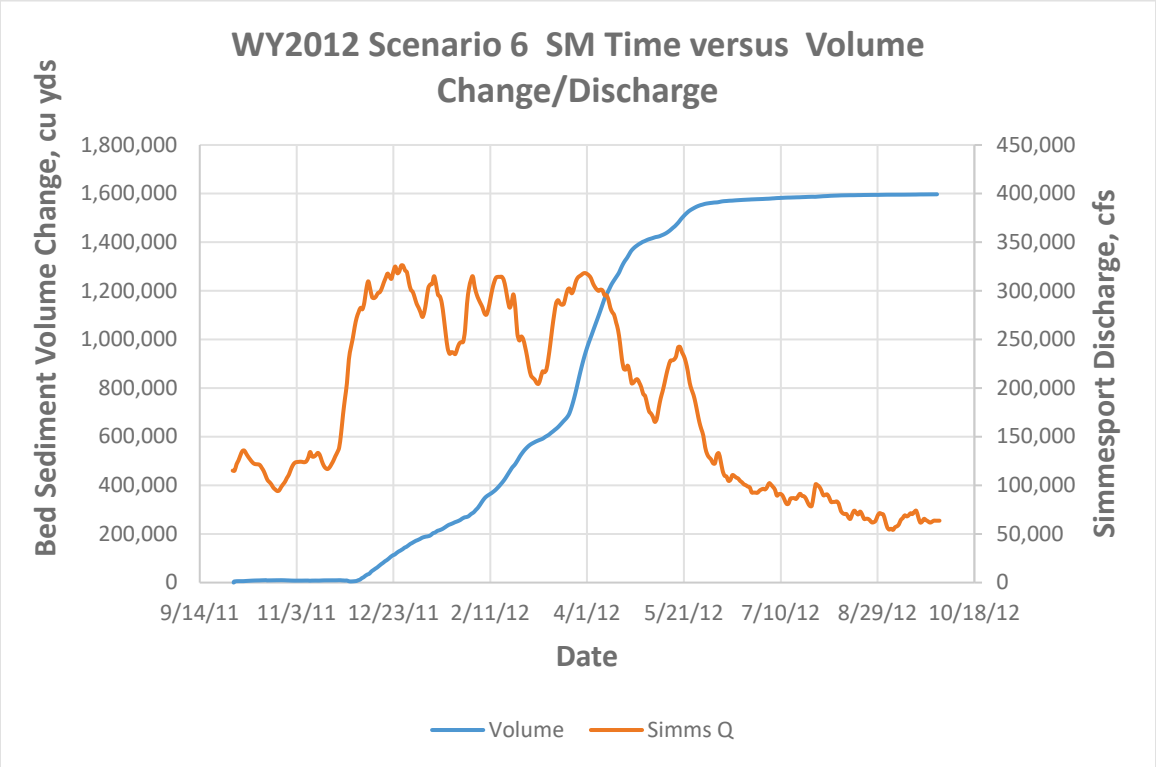


Plate E.19. Material 2 WY2012 Scenario 7 time versus sediment volume change/Simmesport discharge.

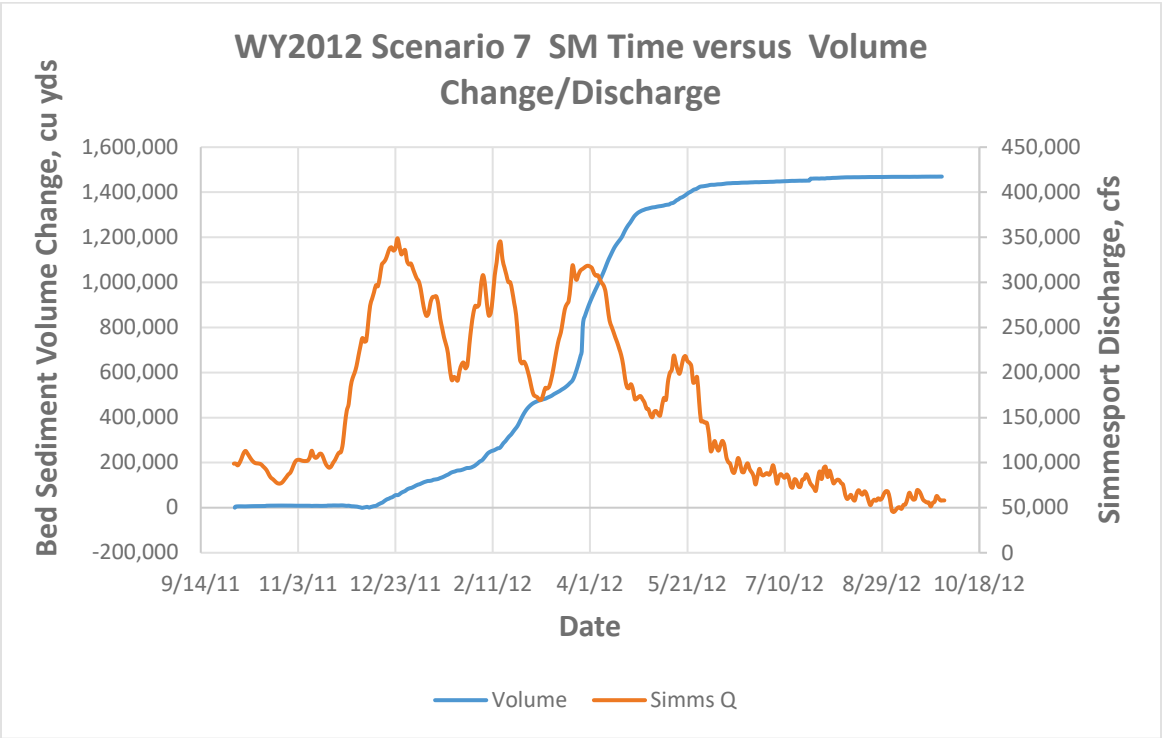


Plate E.20. Material 2 WY2012 Scenario 8a time versus sediment volume change/Simmesport discharge.

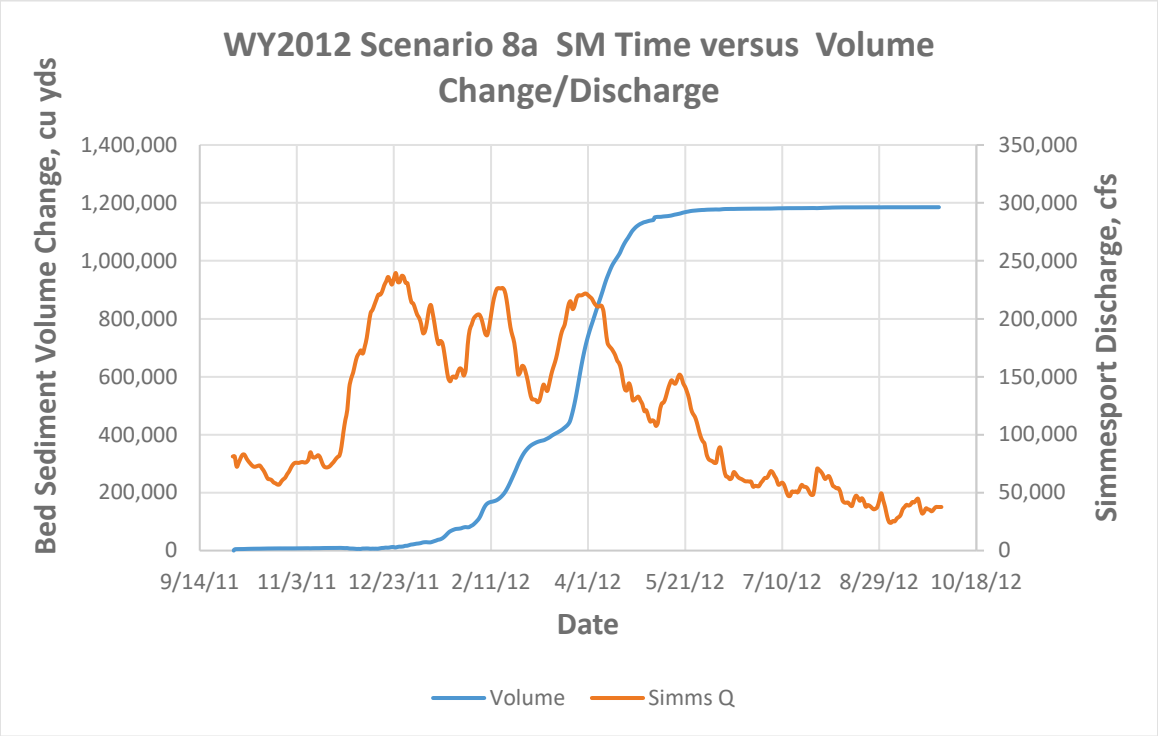


Plate E.21. Material 2 WY2012 Scenario 8b time versus sediment volume change/Simmesport discharge.

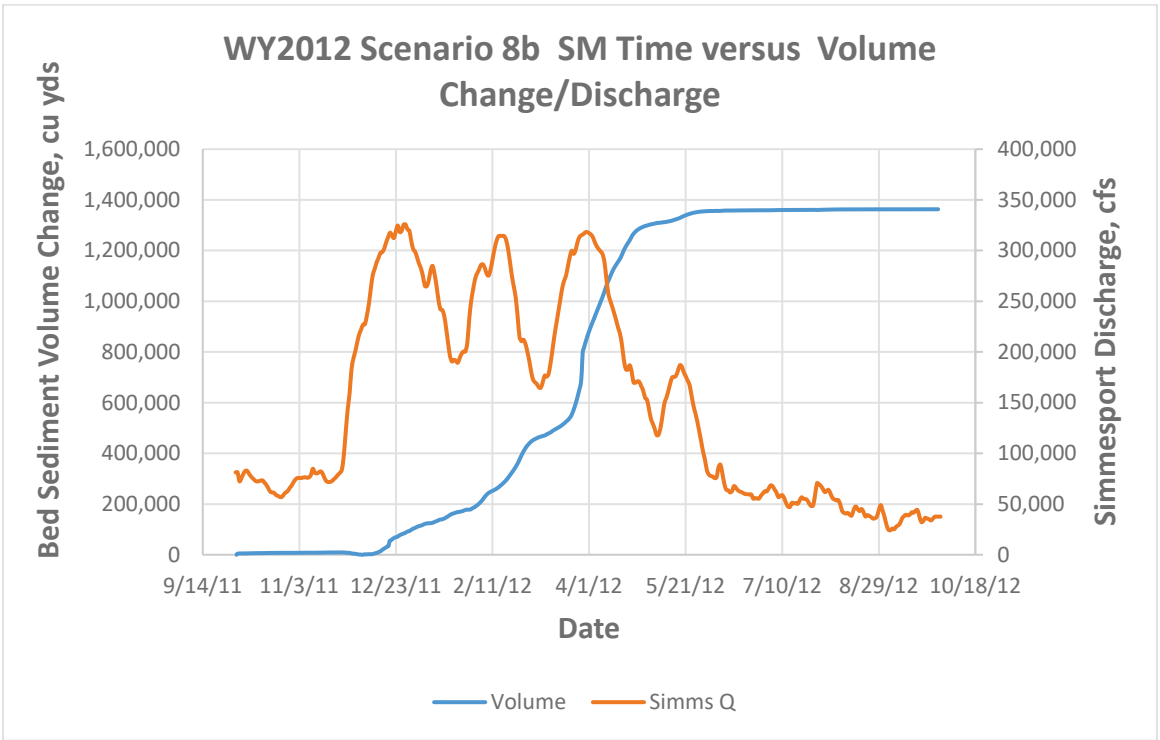


Plate E.22. Material 2 WY2012 Scenario 9 time versus sediment volume change/Simmesport discharge.

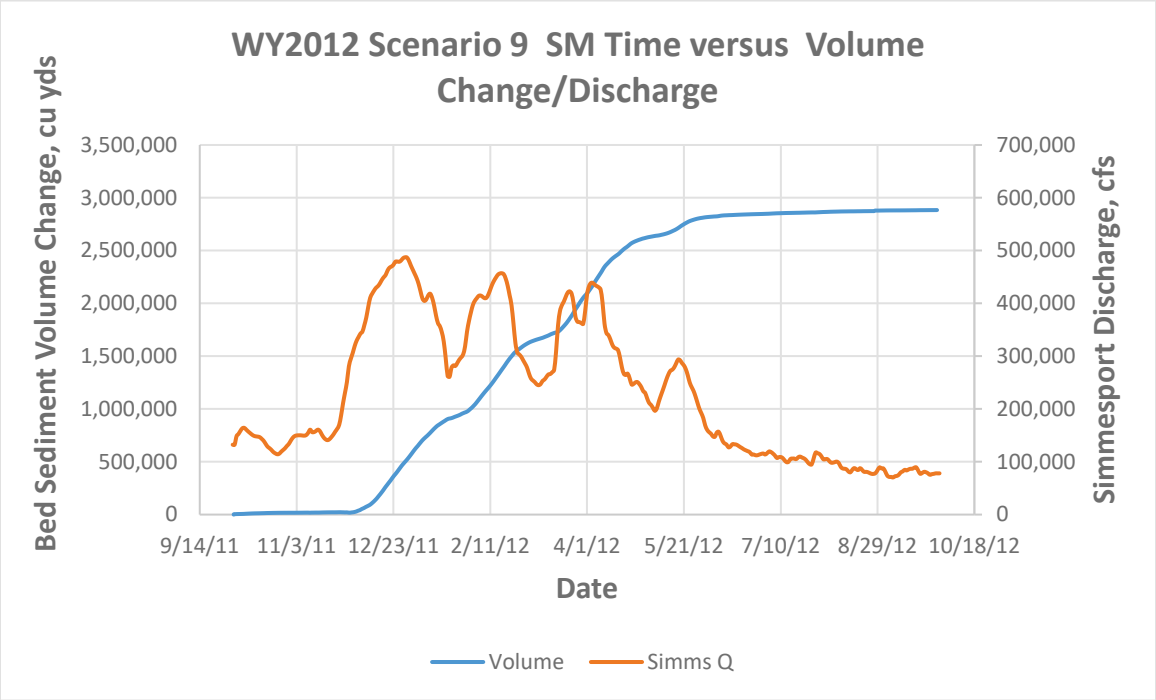


Plate E.23. Material 2 WY2012 Scenario 10 time versus sediment volume change/Simmesport discharge.

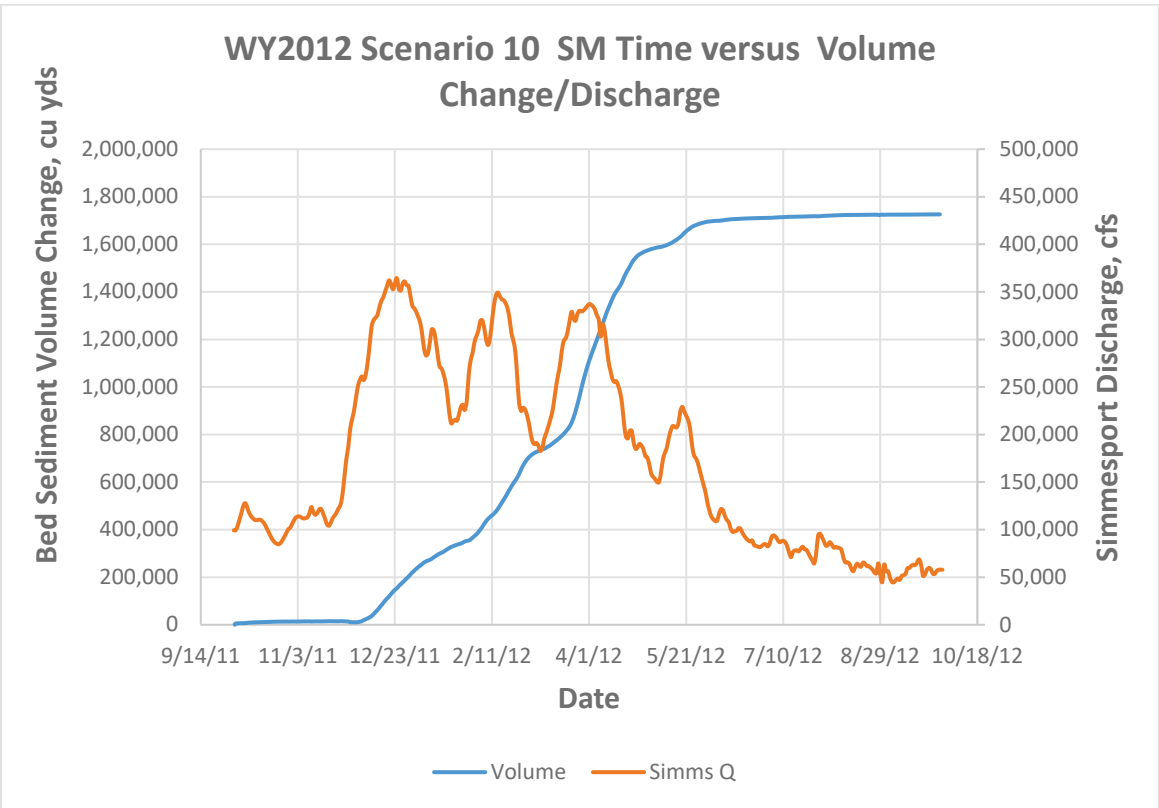
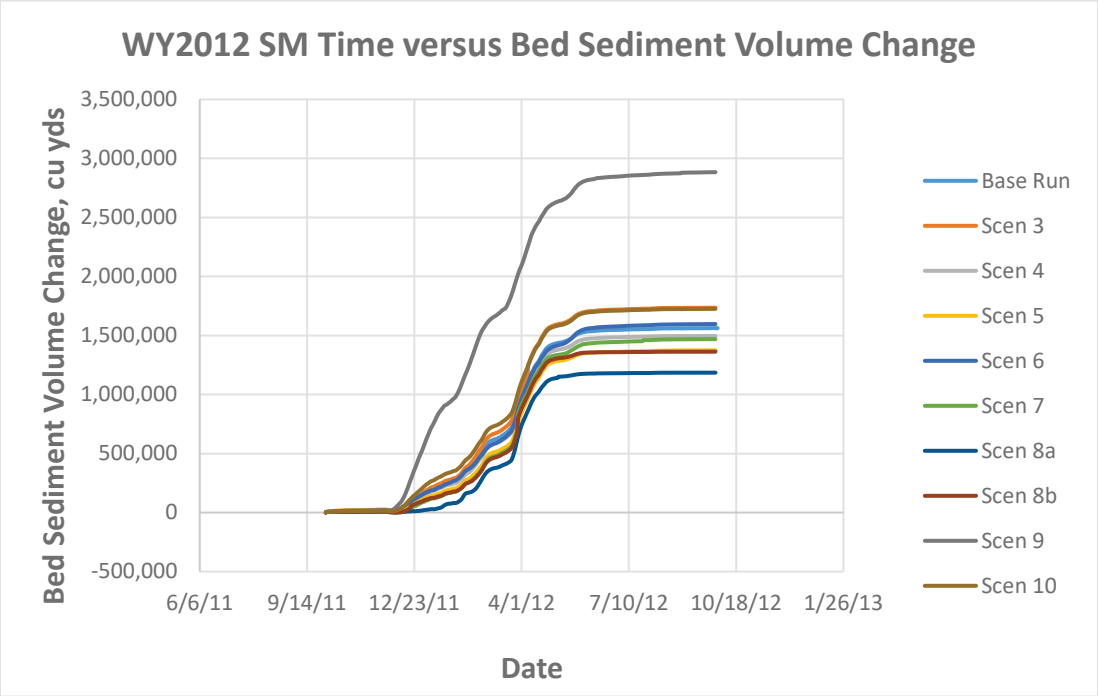


Plate E.24. Material 2 WY2012 Base Run and Scenarios 3–10 time versus sediment volume change.



E.3 Material 1 Dredge Placement Scenarios 11–14

Plate E.25. Material 1 Dredge Displacement Scenarios 11–14.

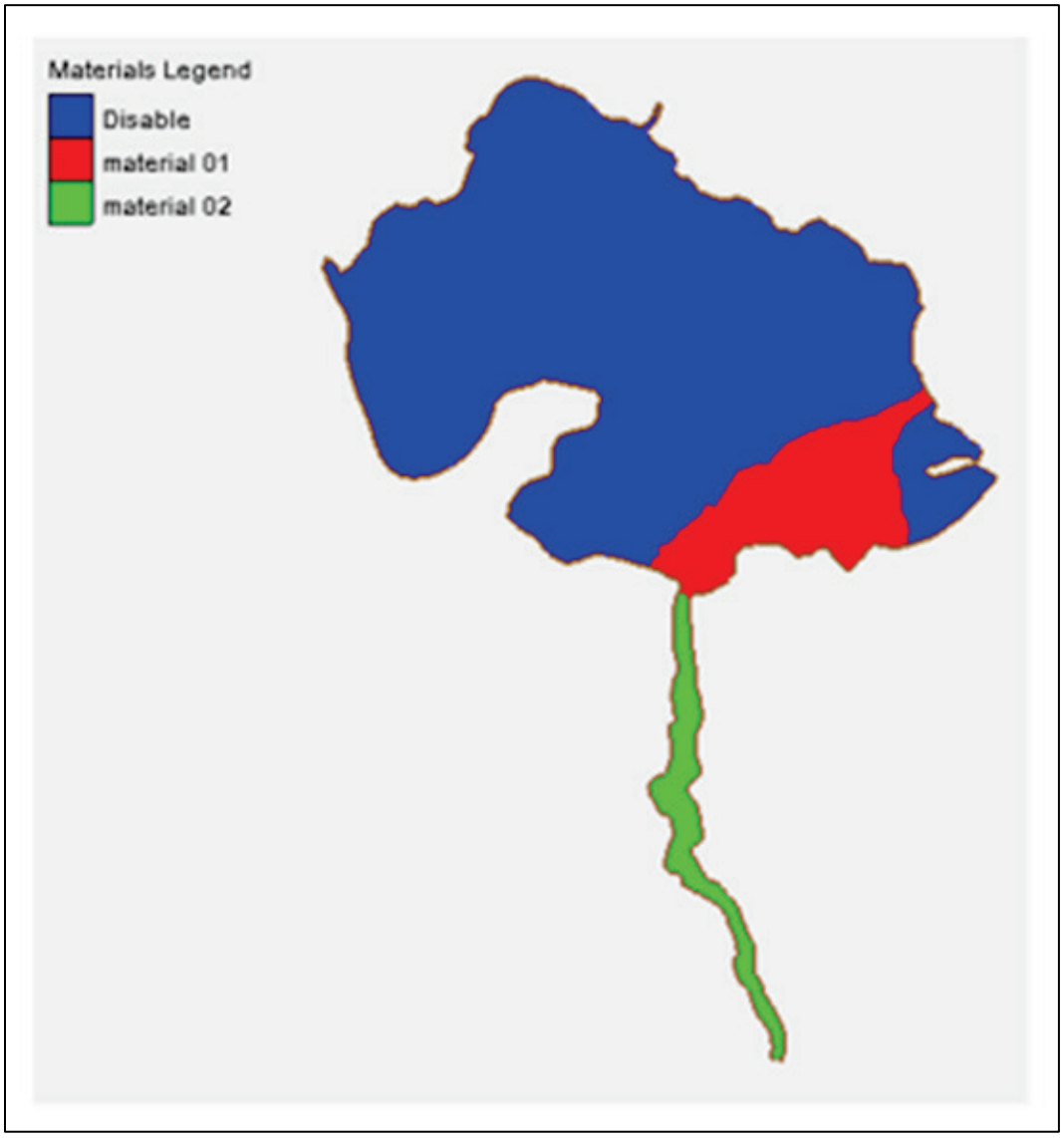


Plate E.26. Material 1 WY2012 Scenario 11 time versus sediment volume change/Simmesport discharge.

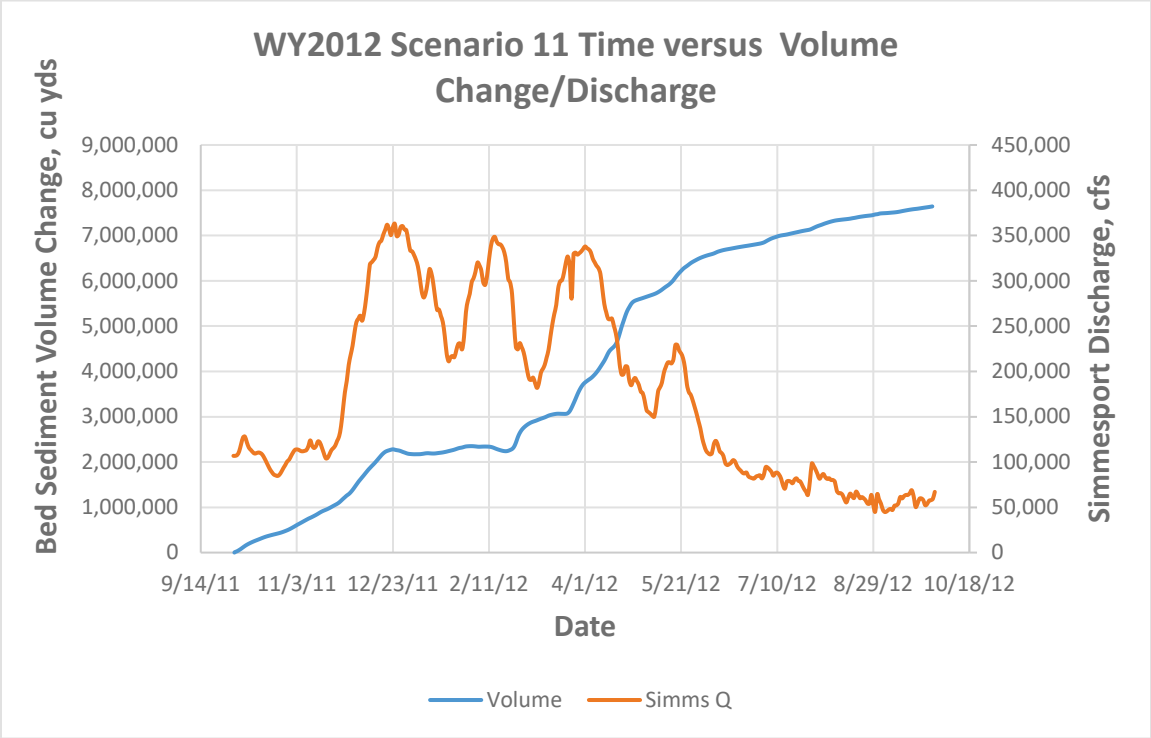


Plate E.27. Material 1 WY2012 Scenario 12 time versus sediment volume change/Simmesport discharge.

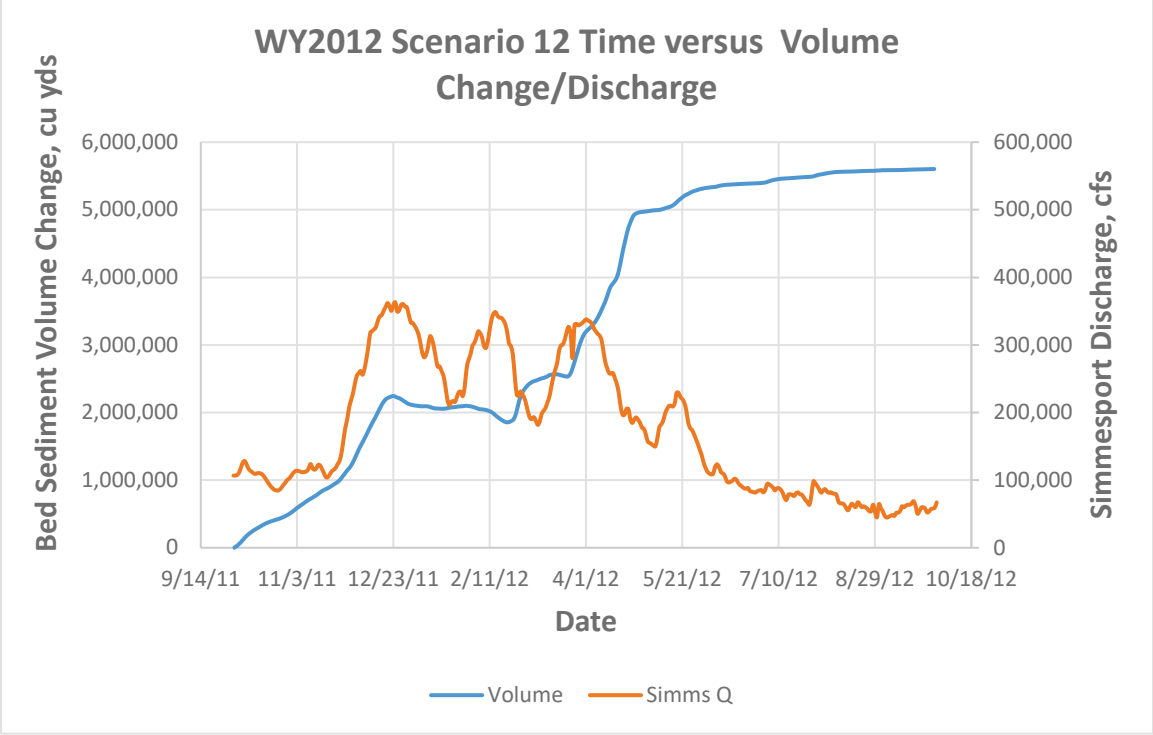


Plate E.28. Material 1 WY2012 Scenario 13 time versus sediment volume change/Simmesport discharge.

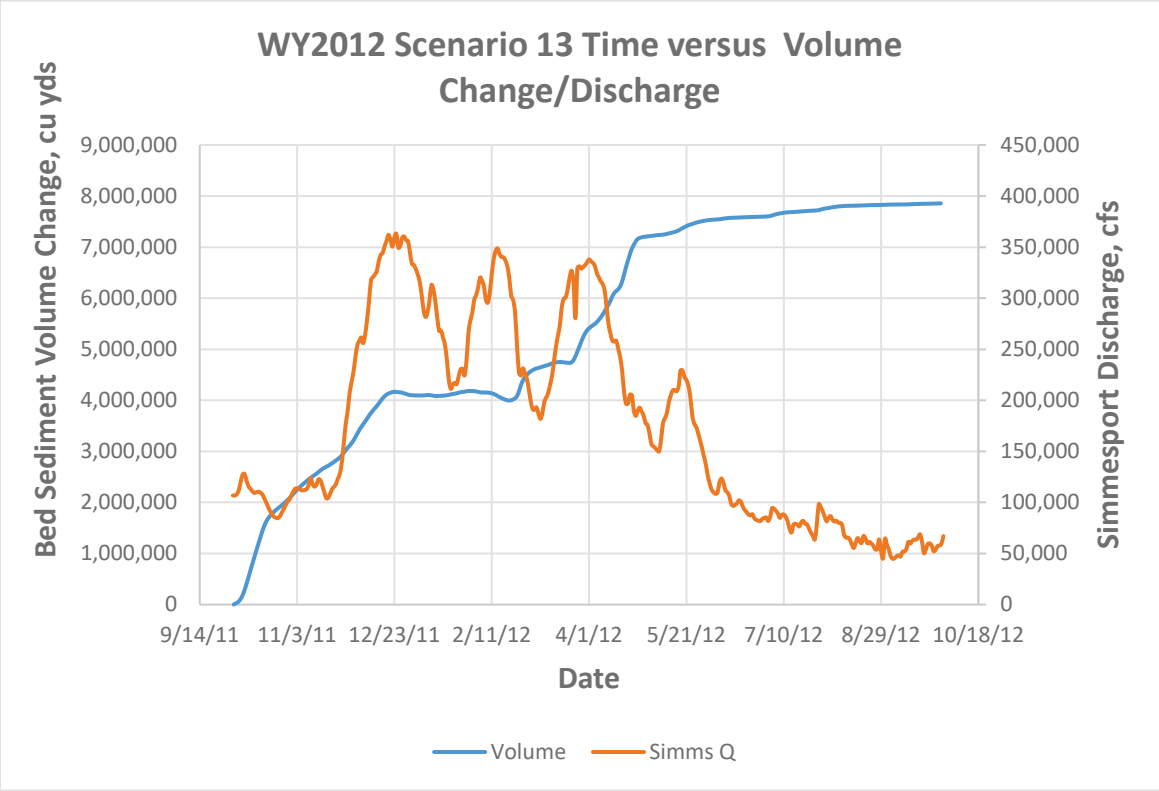


Plate E.29. Material 1 WY2012 Scenario 14 time versus sediment volume change/Simmesport discharge.

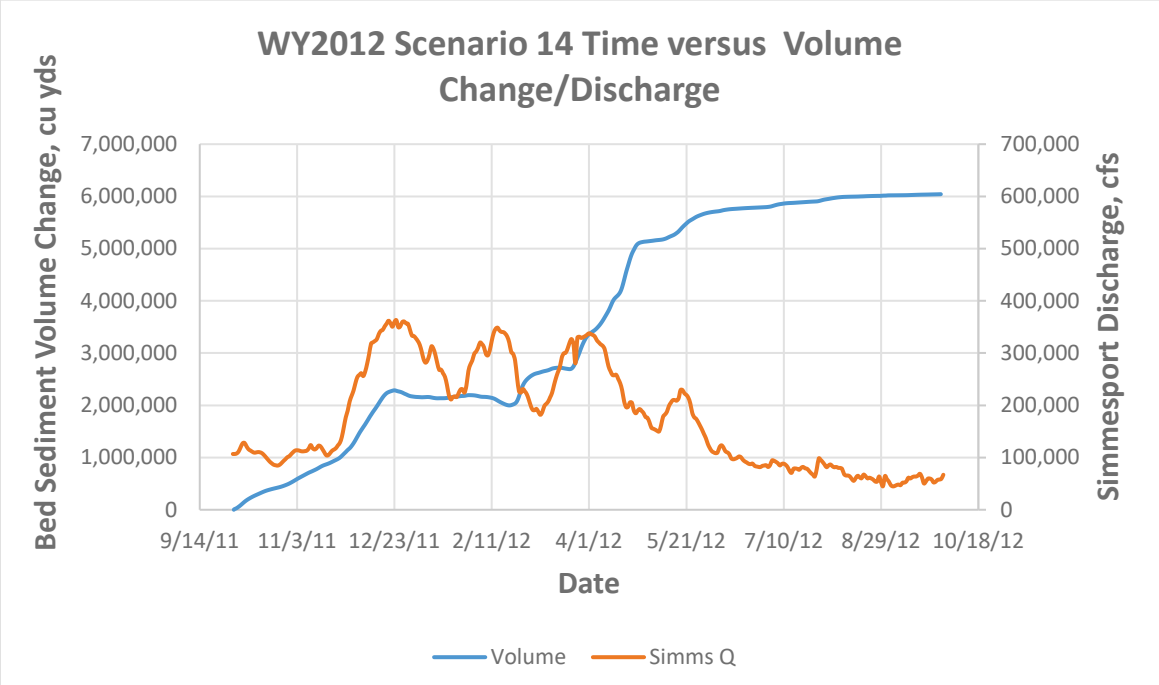
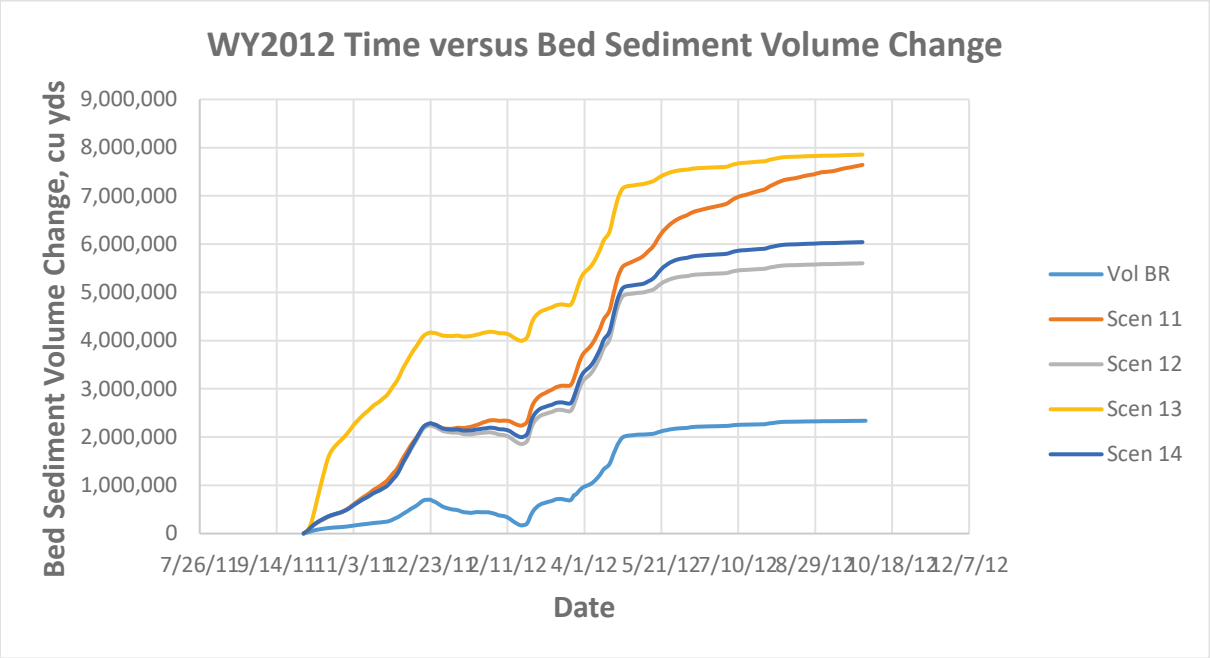


Plate E.30. Material 1 WY2012 Base Run and Scenarios 11–14 time versus sediment volume change.



E.4 Material 2 Dredge Placement Scenarios 11–14

Plate E.31. Material 2 dredge placement scenarios.

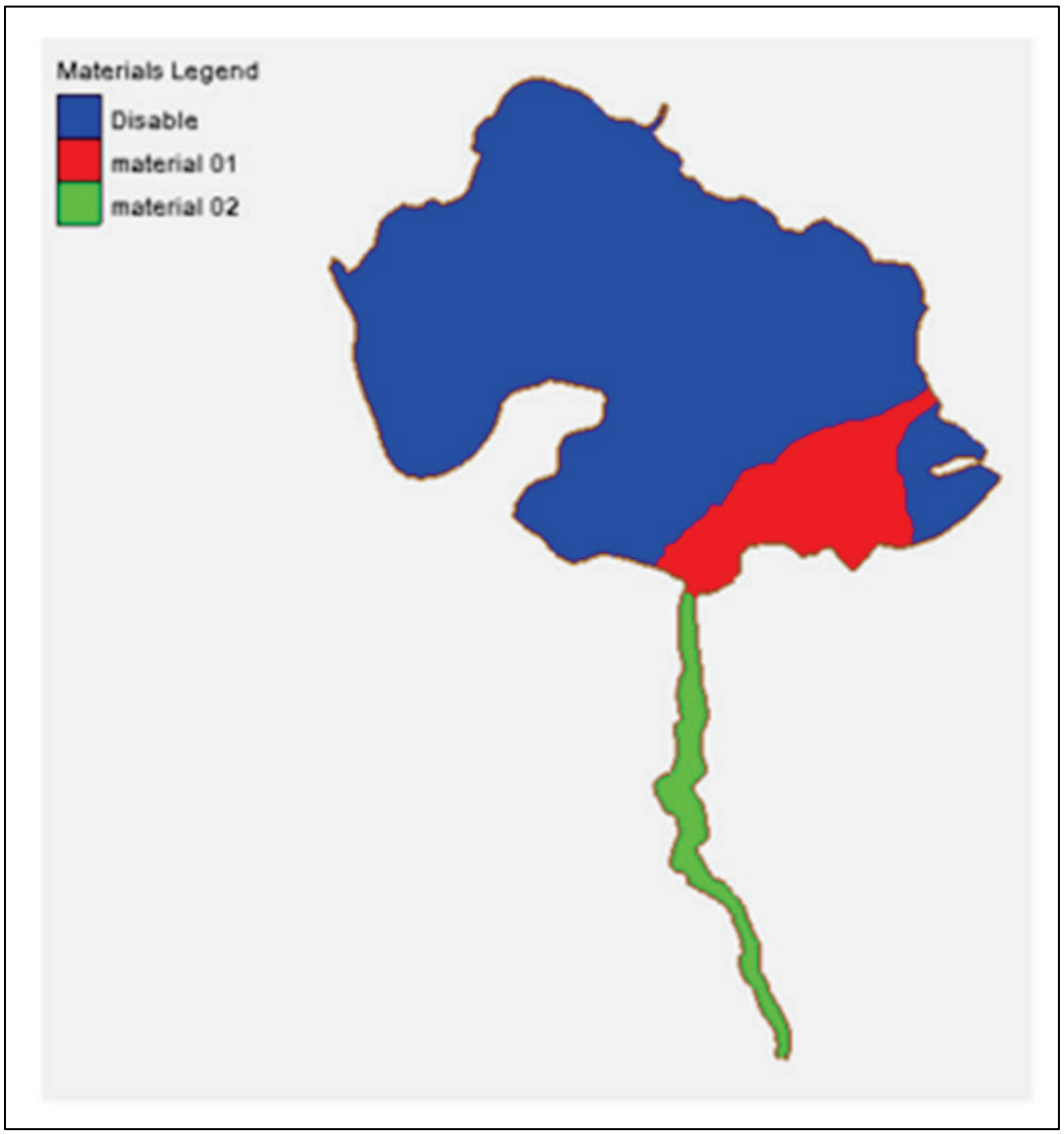


Plate E.32. Material 2 WY2012 Scenario 11 time versus sediment volume change/Simmesport discharge.

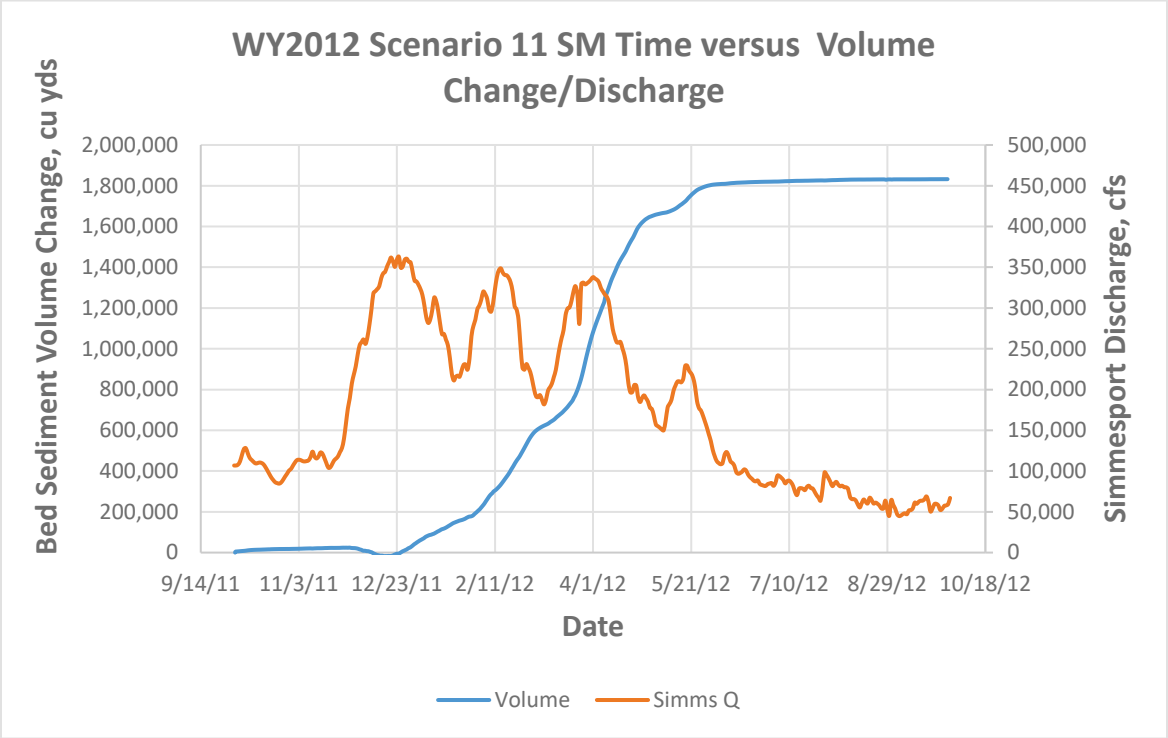


Plate E.33. Material 2 WY2012 Scenario 12 time versus sediment volume change/Simmesport discharge.

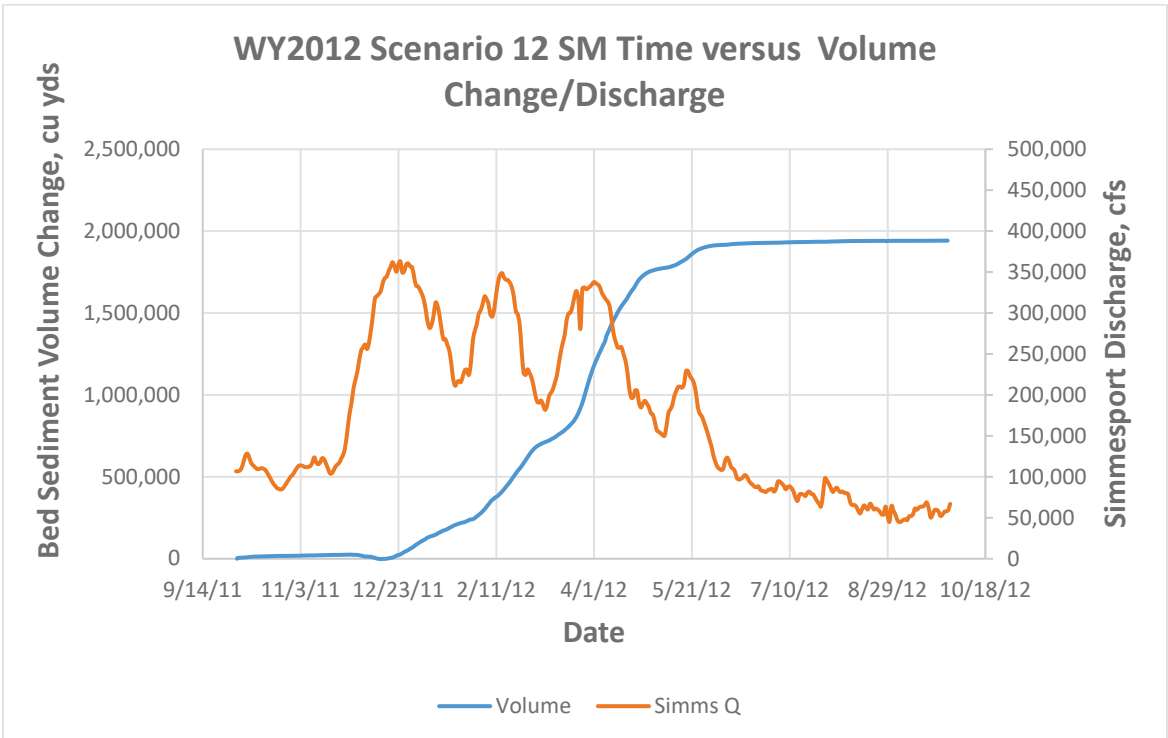


Plate E.34. Material 2 WY2012 Scenario 13 time versus sediment volume change/Simmesport discharge.

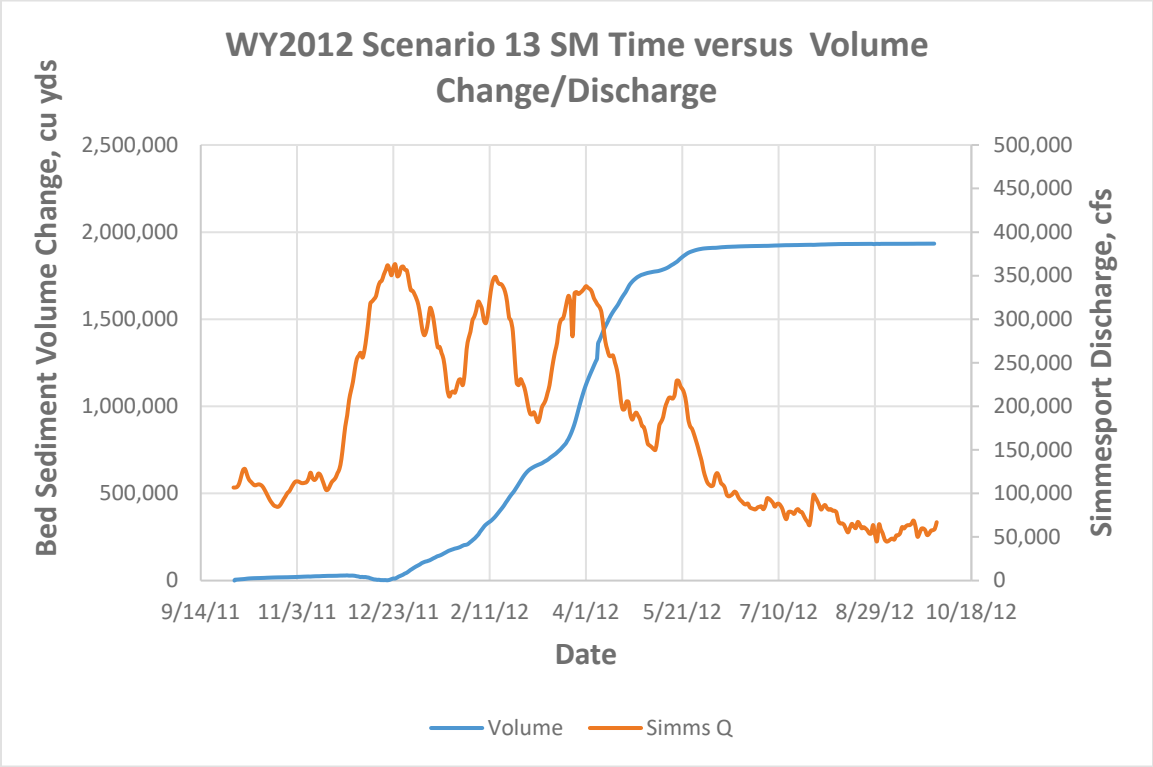


Plate E.35. Material 2 WY2012 Scenario 14 time versus sediment volume change/Simmesport discharge.

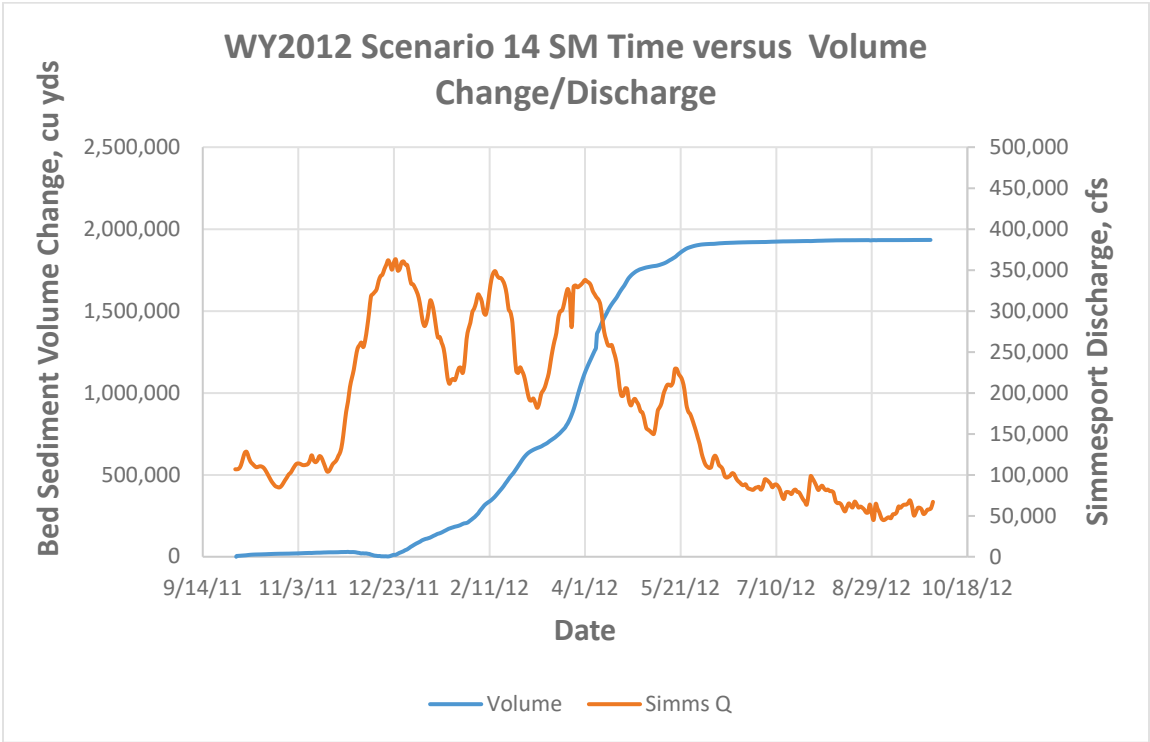
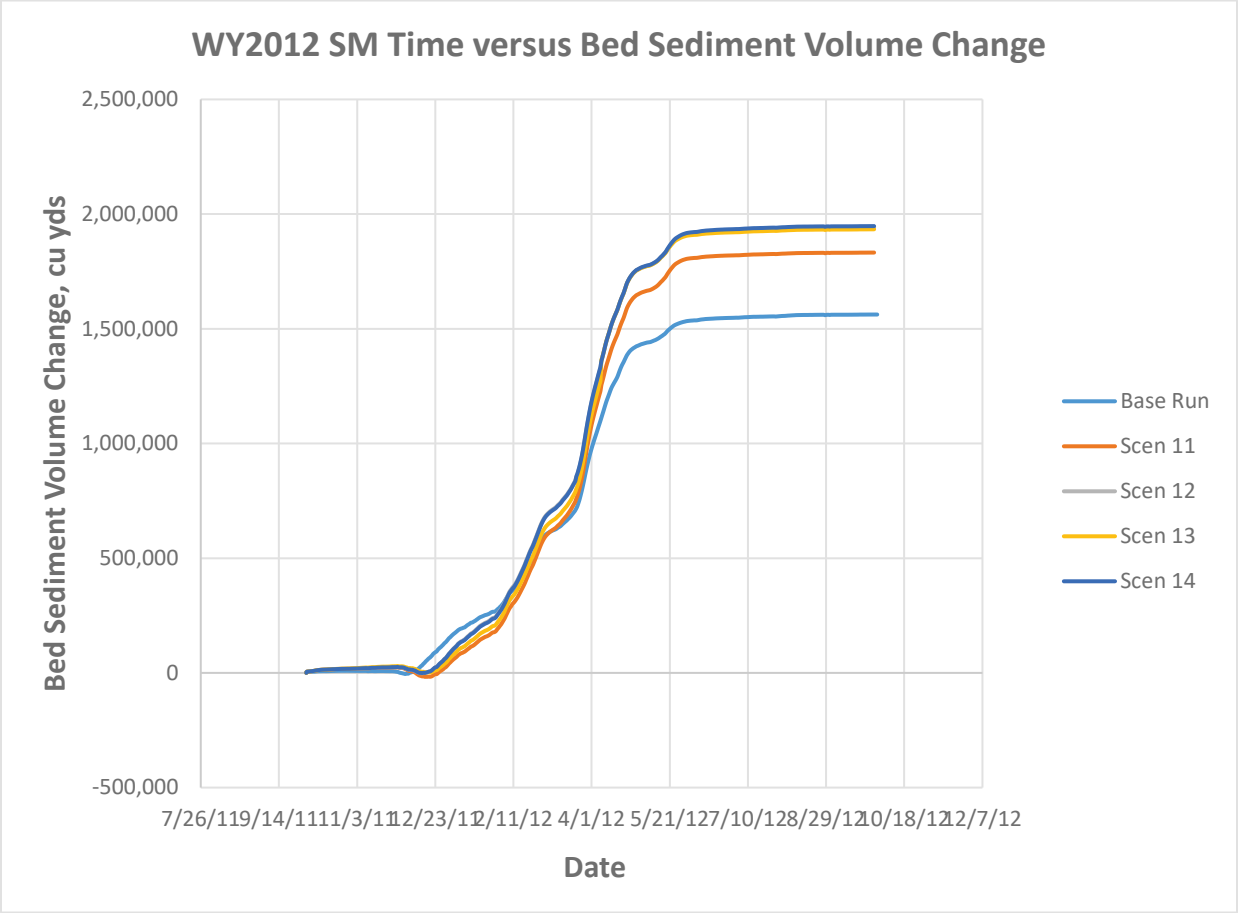


Plate E.36. Material 2 WY2012 Base Run and Scenarios 11–14 time versus sediment volume change.



E.5 Material 1 Structure Options Scenarios 19 and 20

Plate E.37. Material 1 structure options.

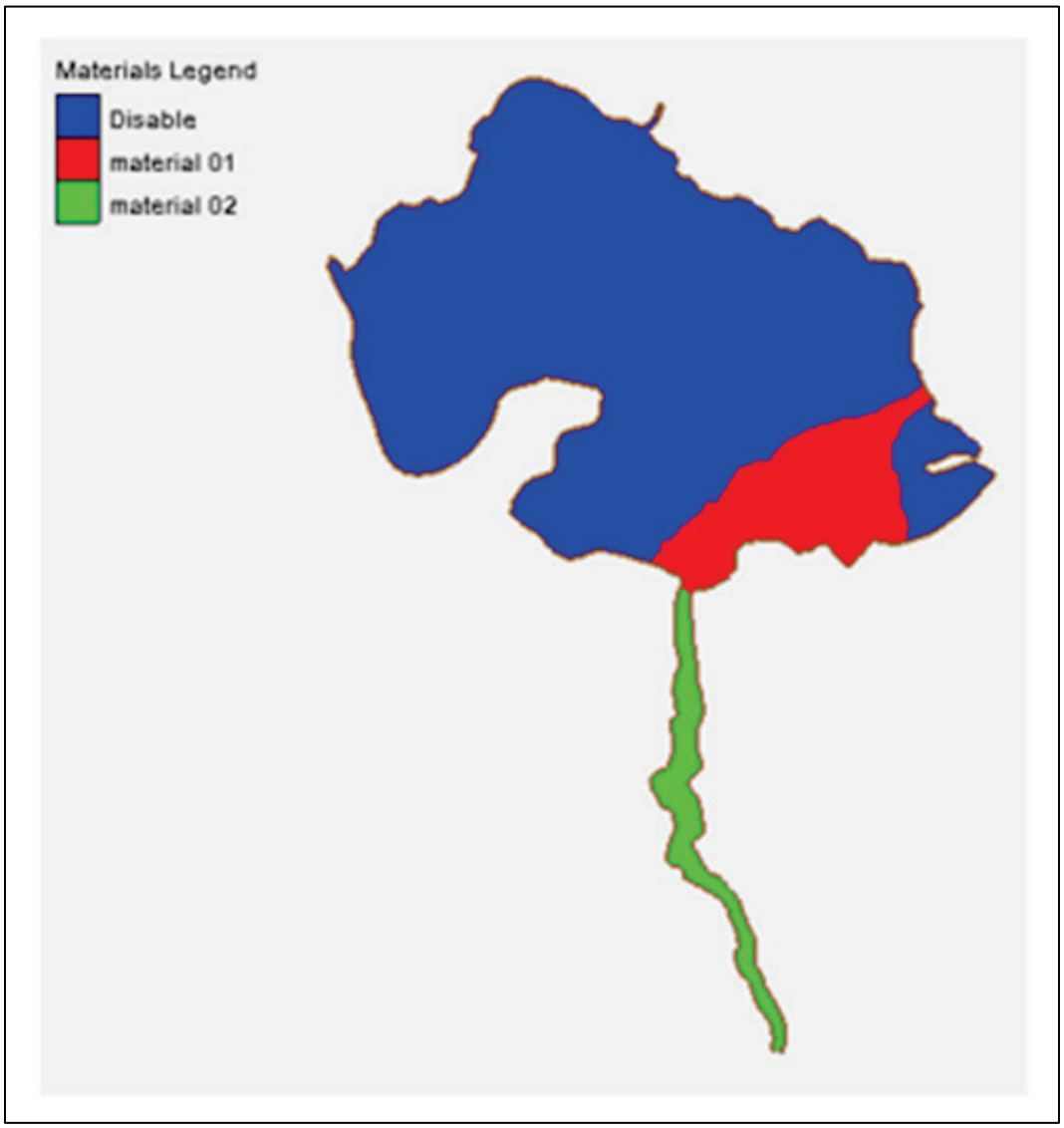


Plate E.38. Material 1 WY2012 Scenario 19 time versus sediment volume change/Simmesport discharge.

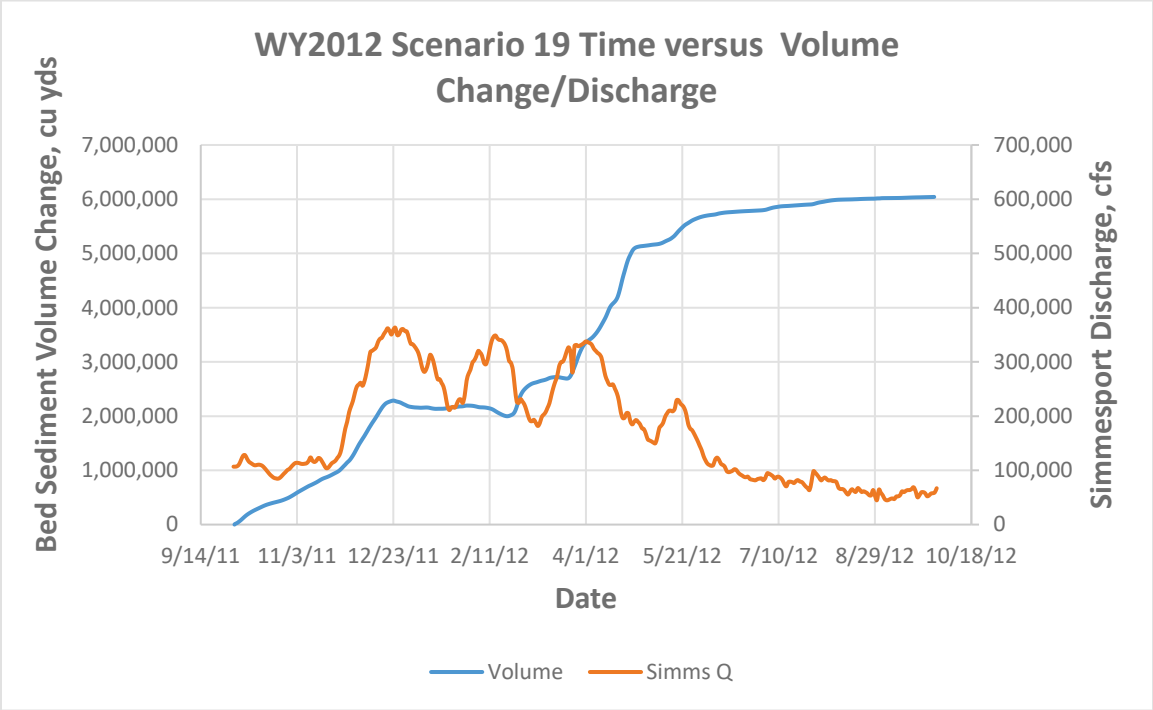


Plate E.39. Material 1 WY2012 Scenario 20 time versus sediment volume change/Simmesport discharge.

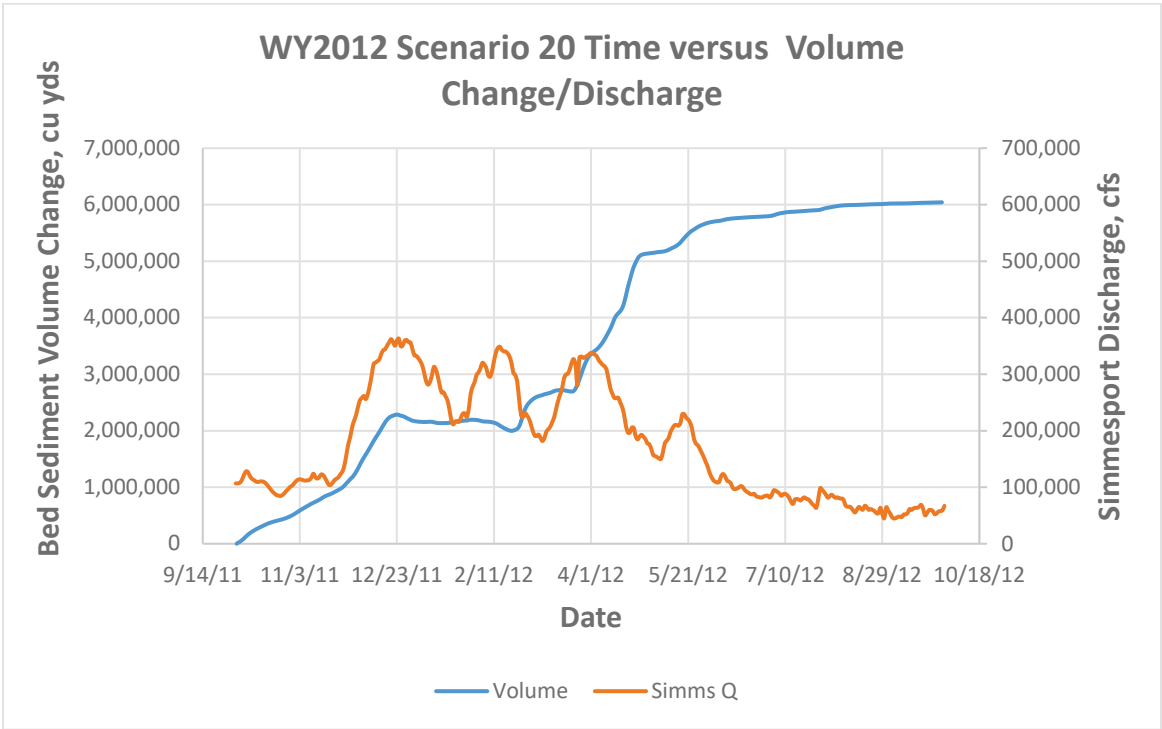
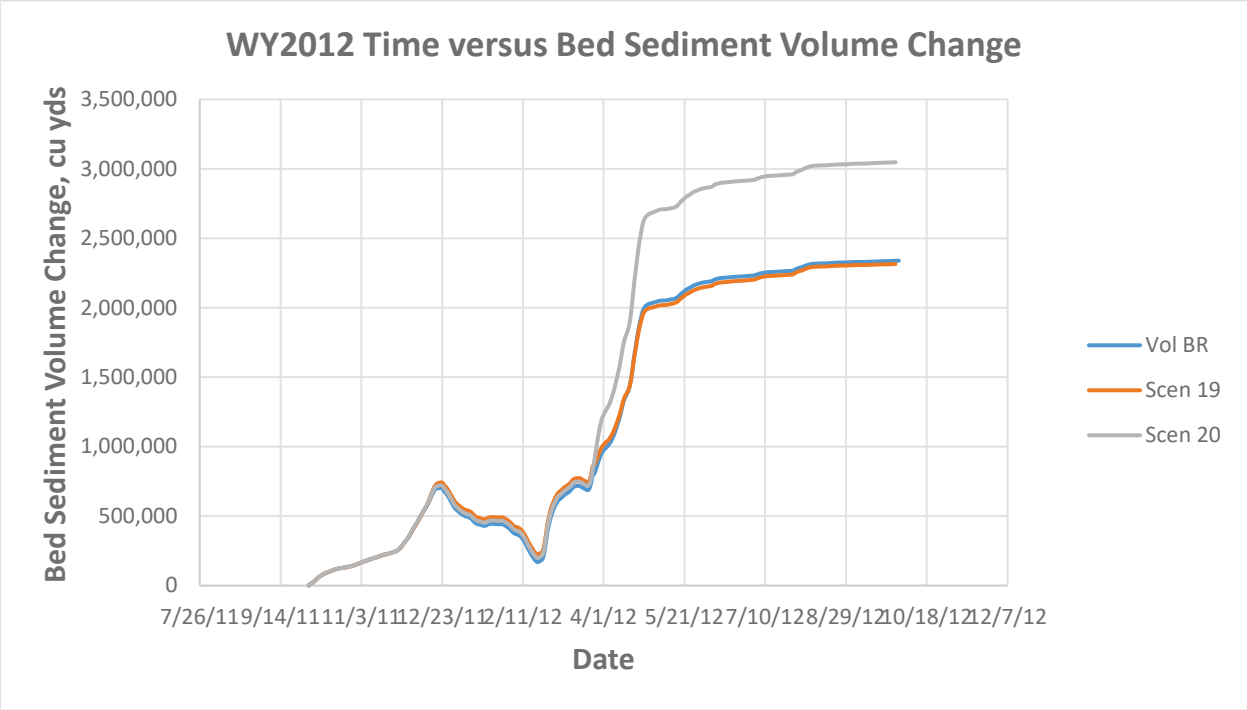


Plate E.40. Material 1 WY2012 Base Run, Scenario 19 and 20 time versus sediment volume change.



E.6 Material 2 Structure Options Scenarios 19 and 20

Plate E.41. Material 2 structure options.

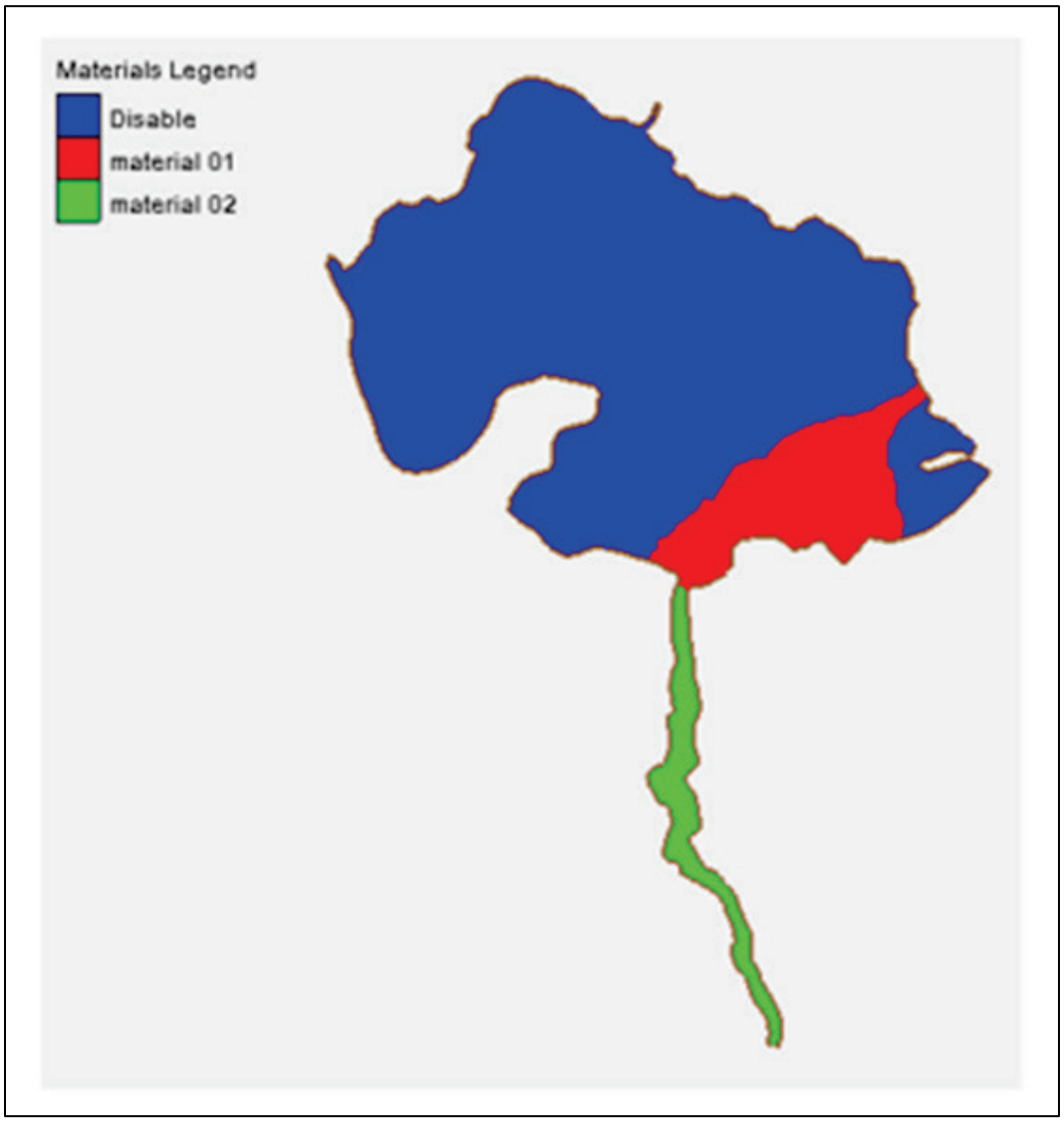


Plate E.42. Material 2 WY2012 Scenario 19 time versus sediment volume change/Simmesport discharge.

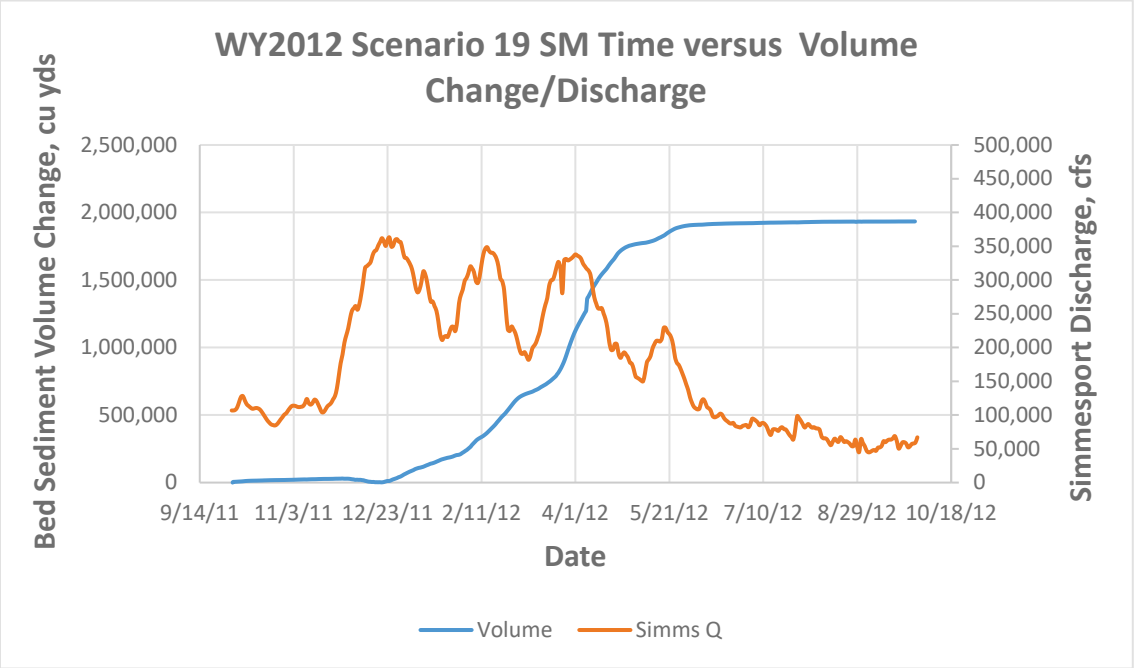


Plate E.43. Material 2 WY2012 Scenario 20 time versus sediment volume change/Simmesport discharge.

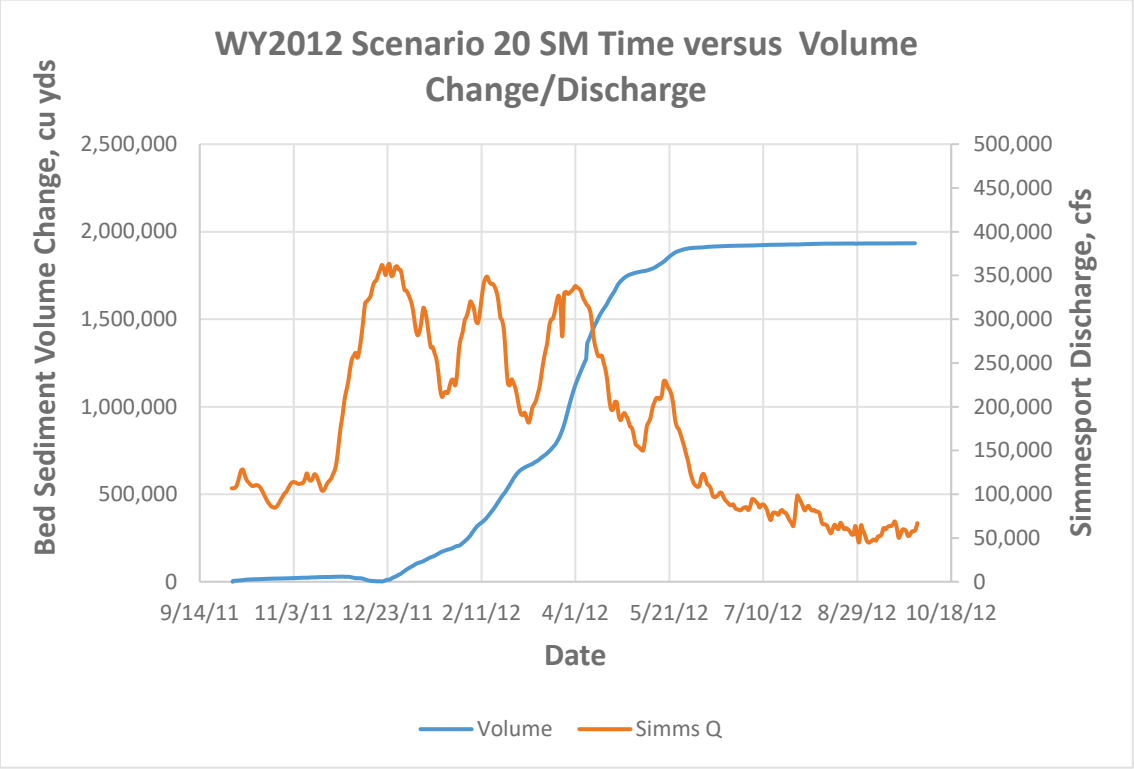
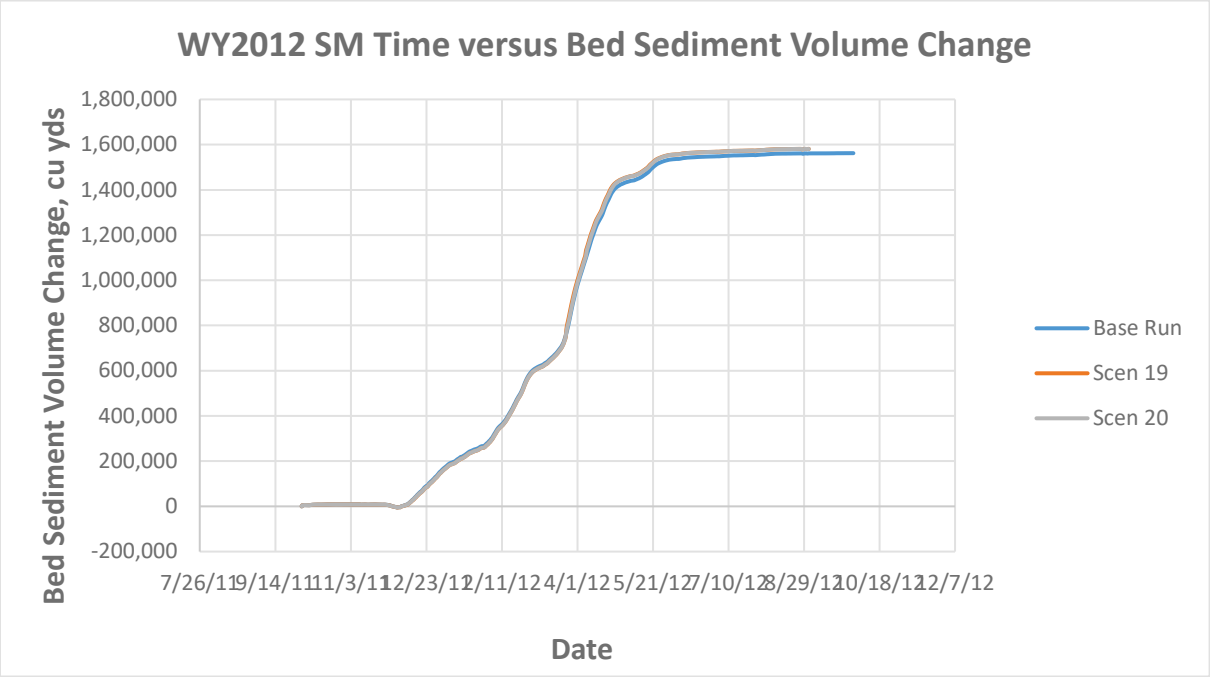


Plate E.44. Material 2 WY2012 Base Run, Scenario 19 and 20 time versus sediment volume change.



Appendix F: WY2013 Bed Displacement Data

The BDD presented in this appendix are screen captures of the Surface Modeling System (SMS) software used to visualize the bed transformation for the last time step of WY2013. The legend is in meters and is color-coded to visualize the sediment transport trends over the whole water year.

F.1 Base Run

Plate F.1. WY2013 Base Run BDD RR RM 43–RR RM 39.

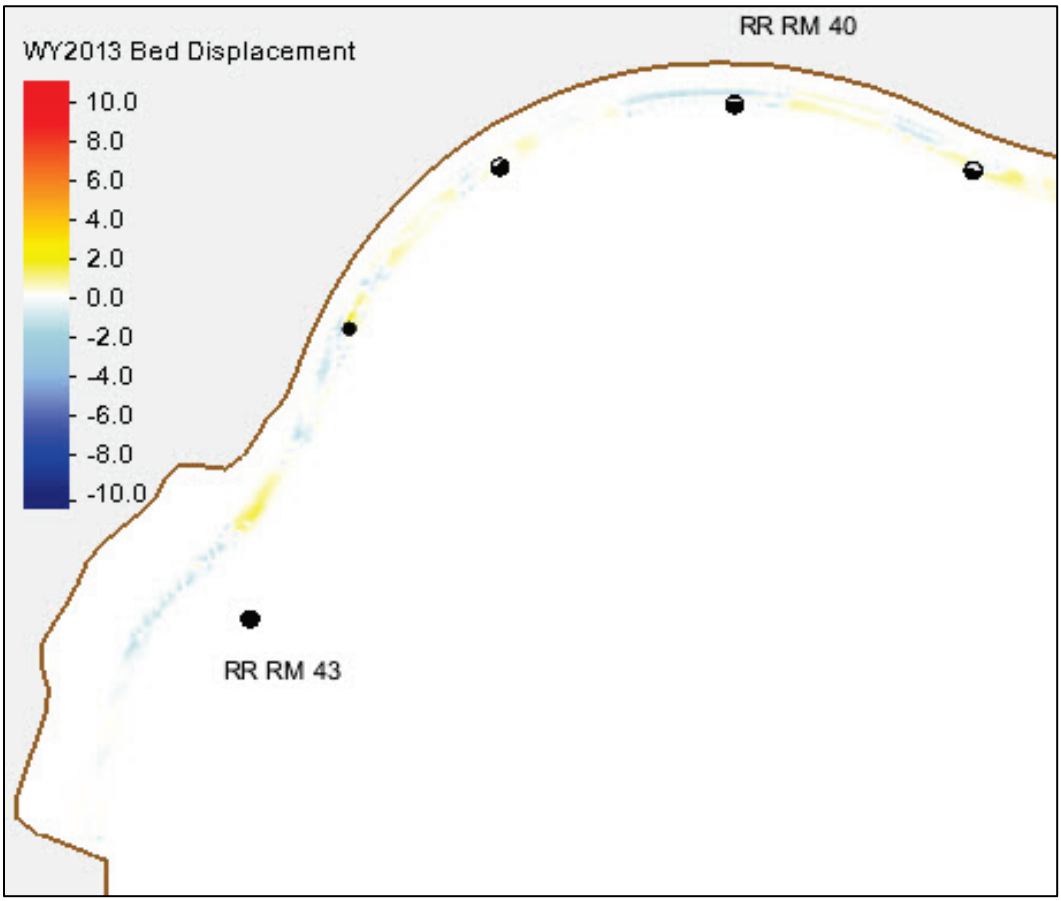


Plate F.2. WY2013 Base Run BDD RR RM 40–RR RM 35.

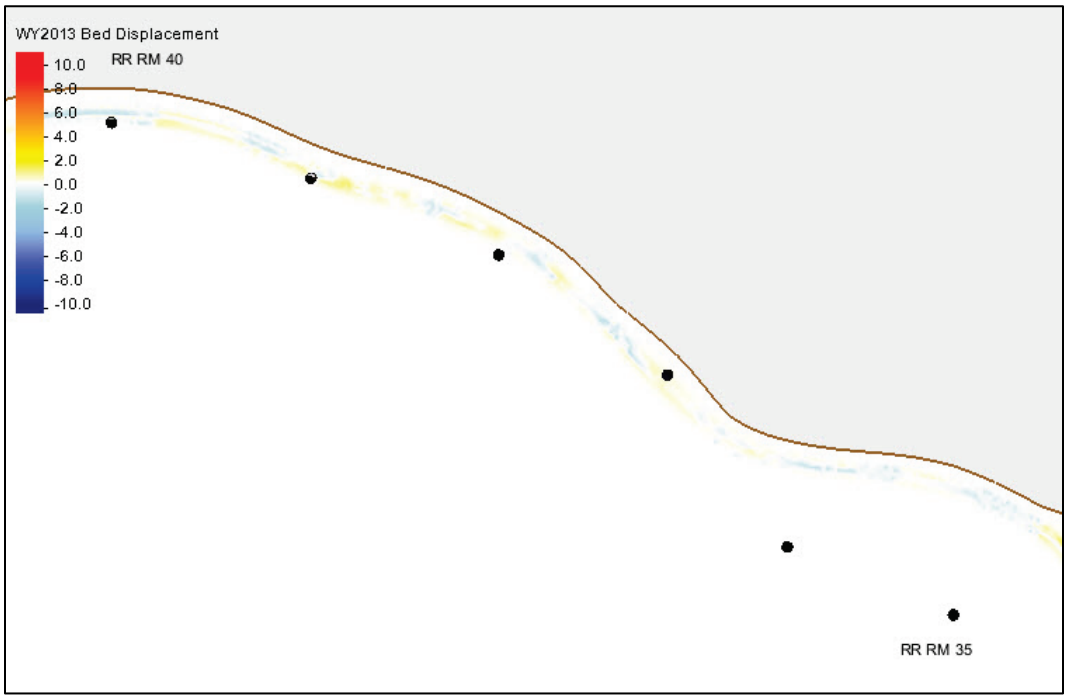


Plate F.3. WY2013 Base Run BDD RR RM 35–RR RM 30.

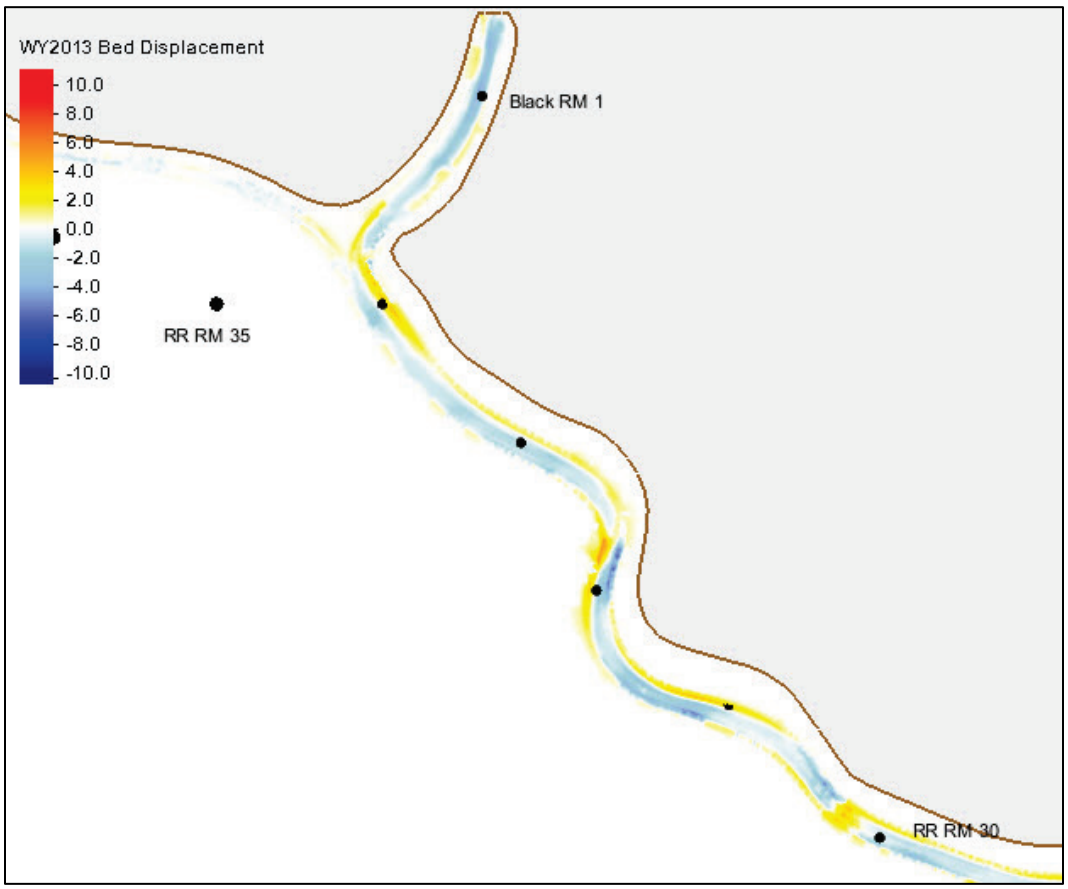


Plate F.4. WY2013 Base Run BDD RR RM 30–RR RM 25.

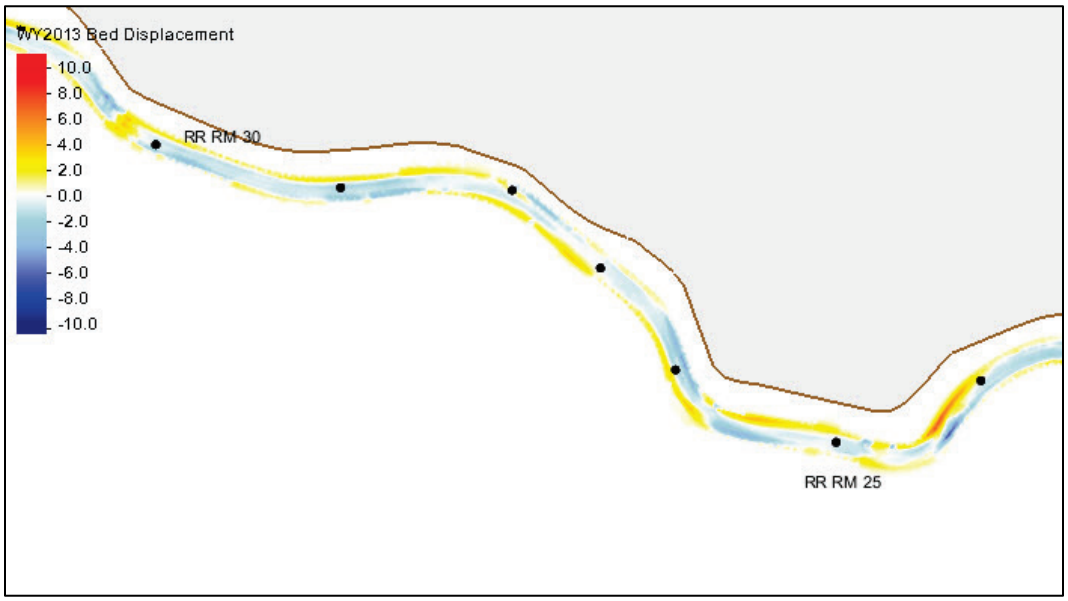


Plate F.5. WY2013 Base Run BDD RR RM 25–RR RM 20.

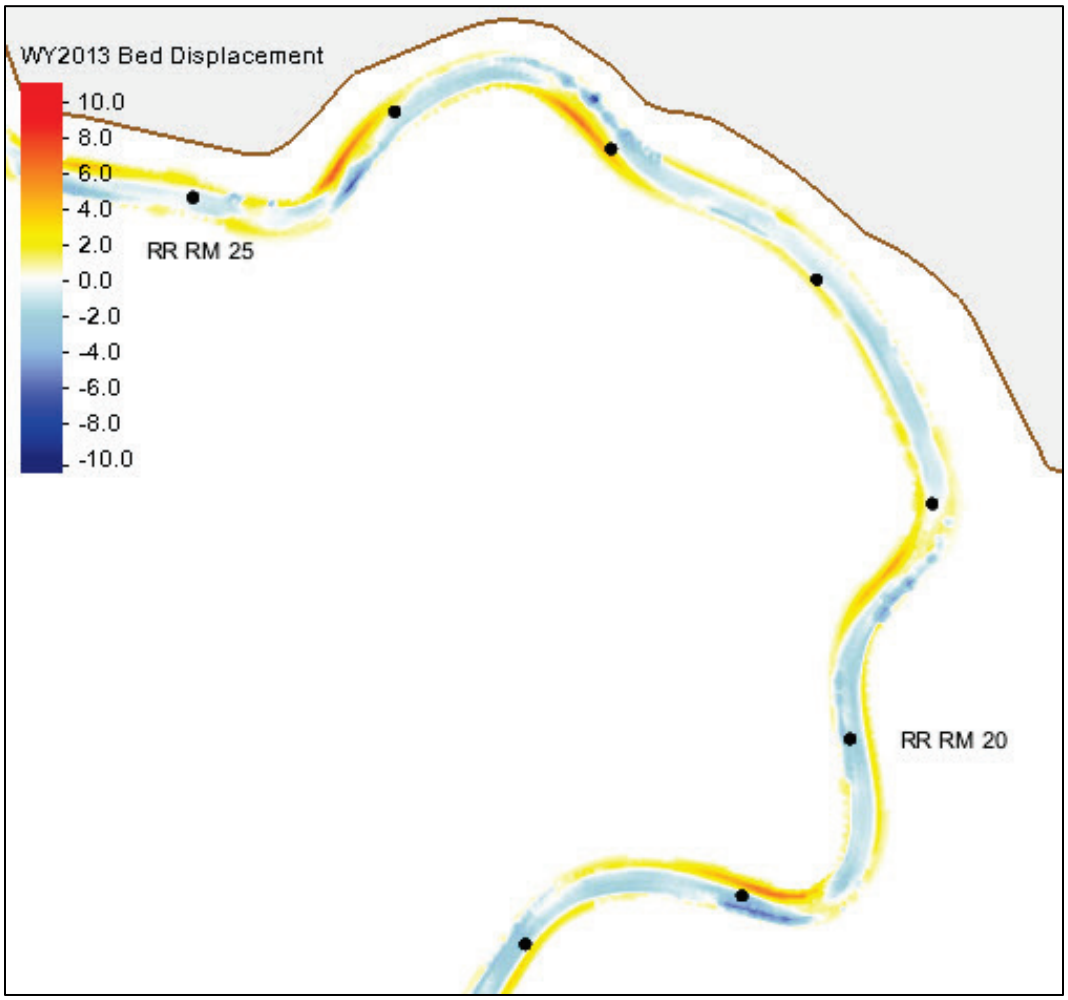


Plate F.6. WY2013 Base Run BDD RR RM 20–RR RM 15.

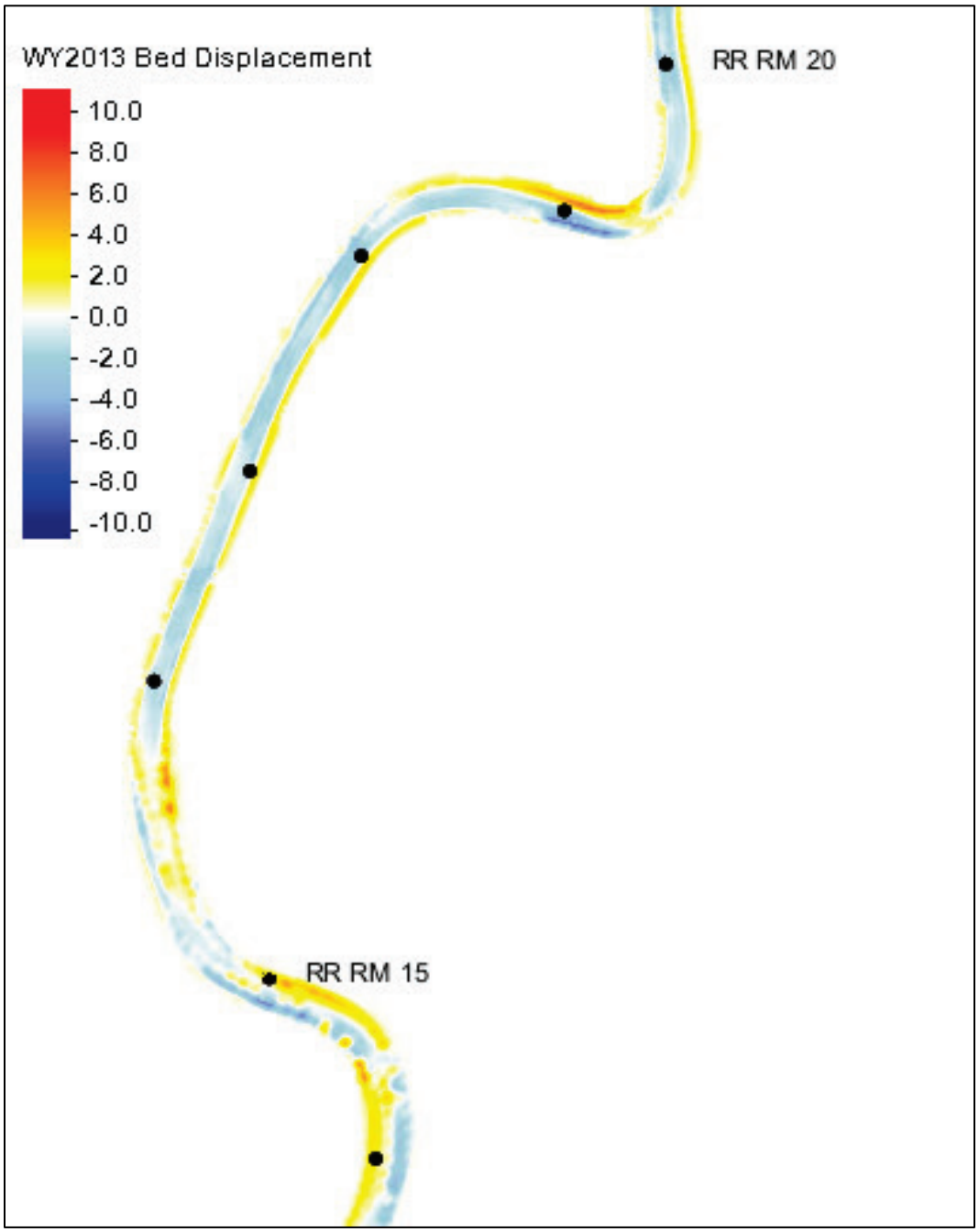


Plate F.7. WY2013 Base Run BDD RR RM 15–RR RM 10 and Outflow Channel.

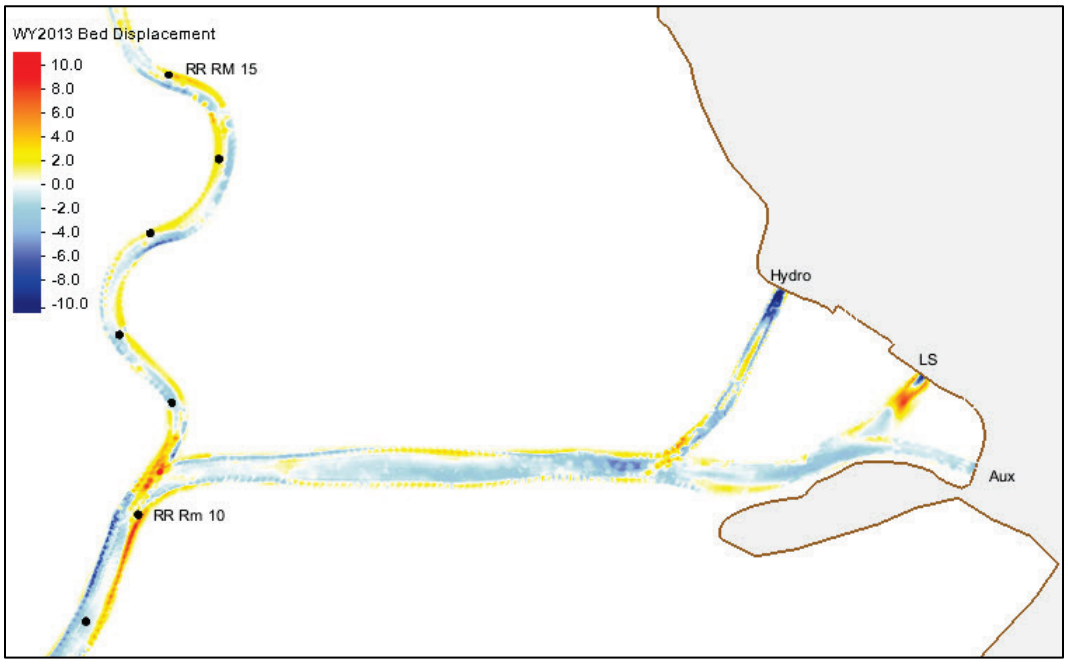


Plate F.8. WY2013 Base Run BDD Outflow Channel.

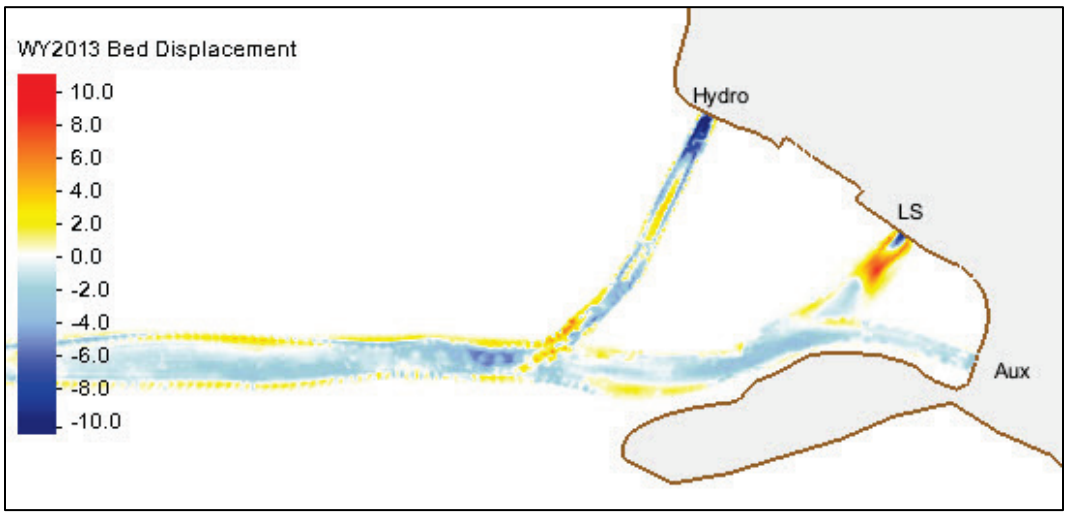


Plate F.9. WY2013 Base Run BDD RR RM 10–Atcha RM 1.

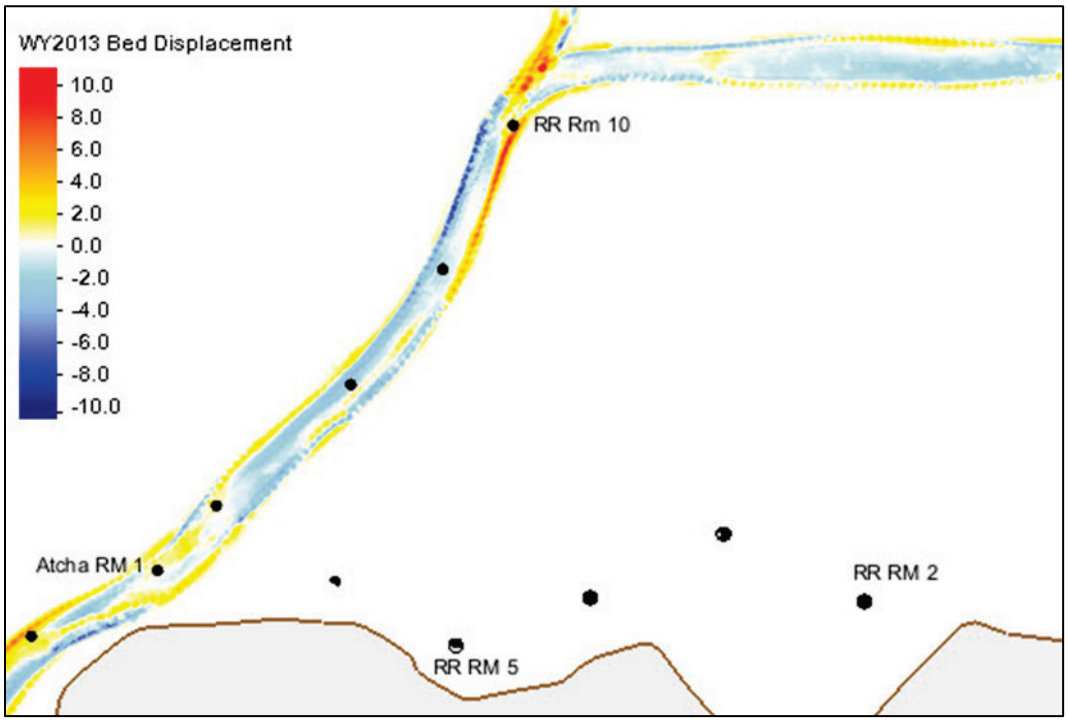


Plate F.10. WY2013 Base Run BDD Atcha RM 1–Atcha RM 5.

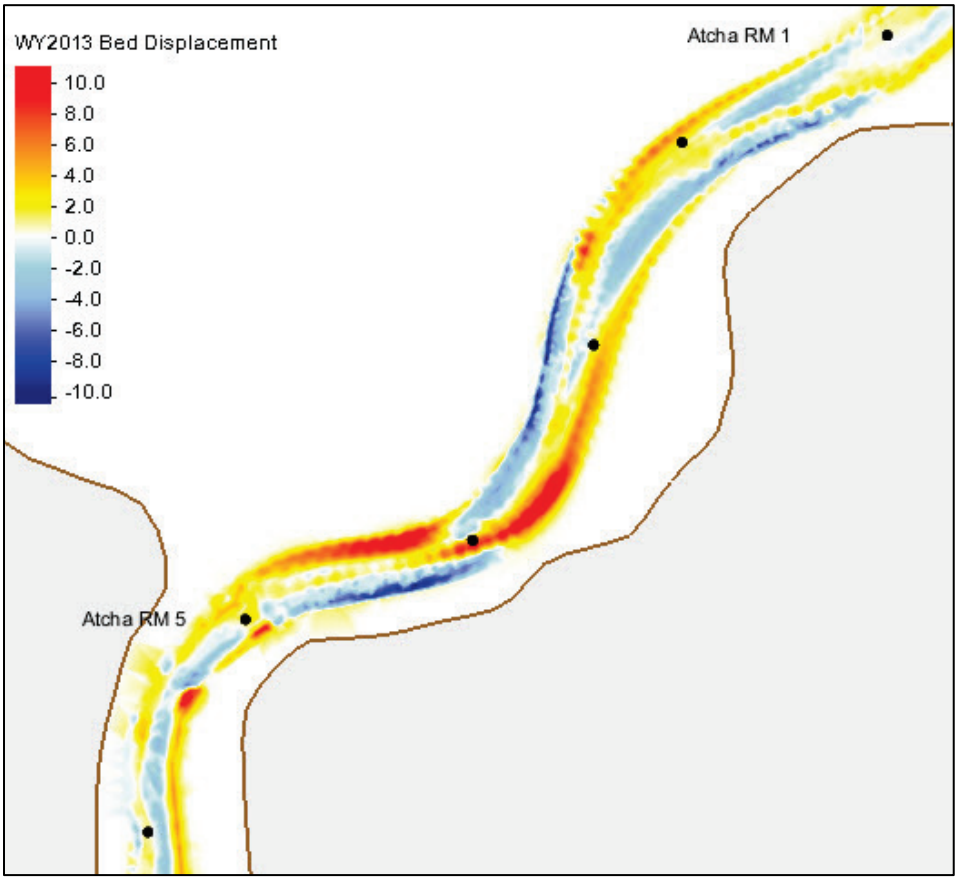


Plate F.11. WY2013 Base Run BDD Atcha RM 5–Atcha RM 10.

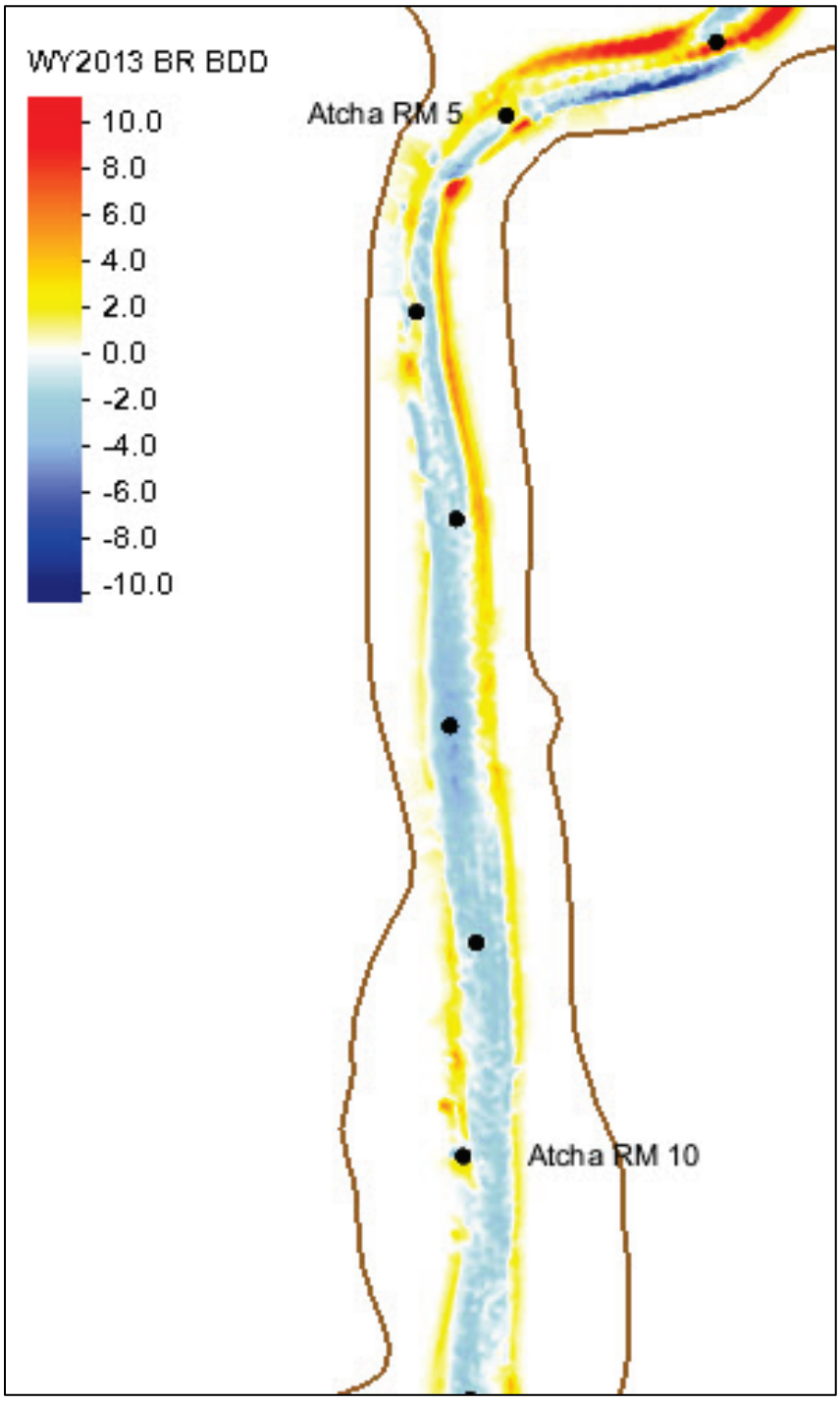


Plate F.12. WY2013 Base Run BDD Atcha RM 10–Atcha RM 15.

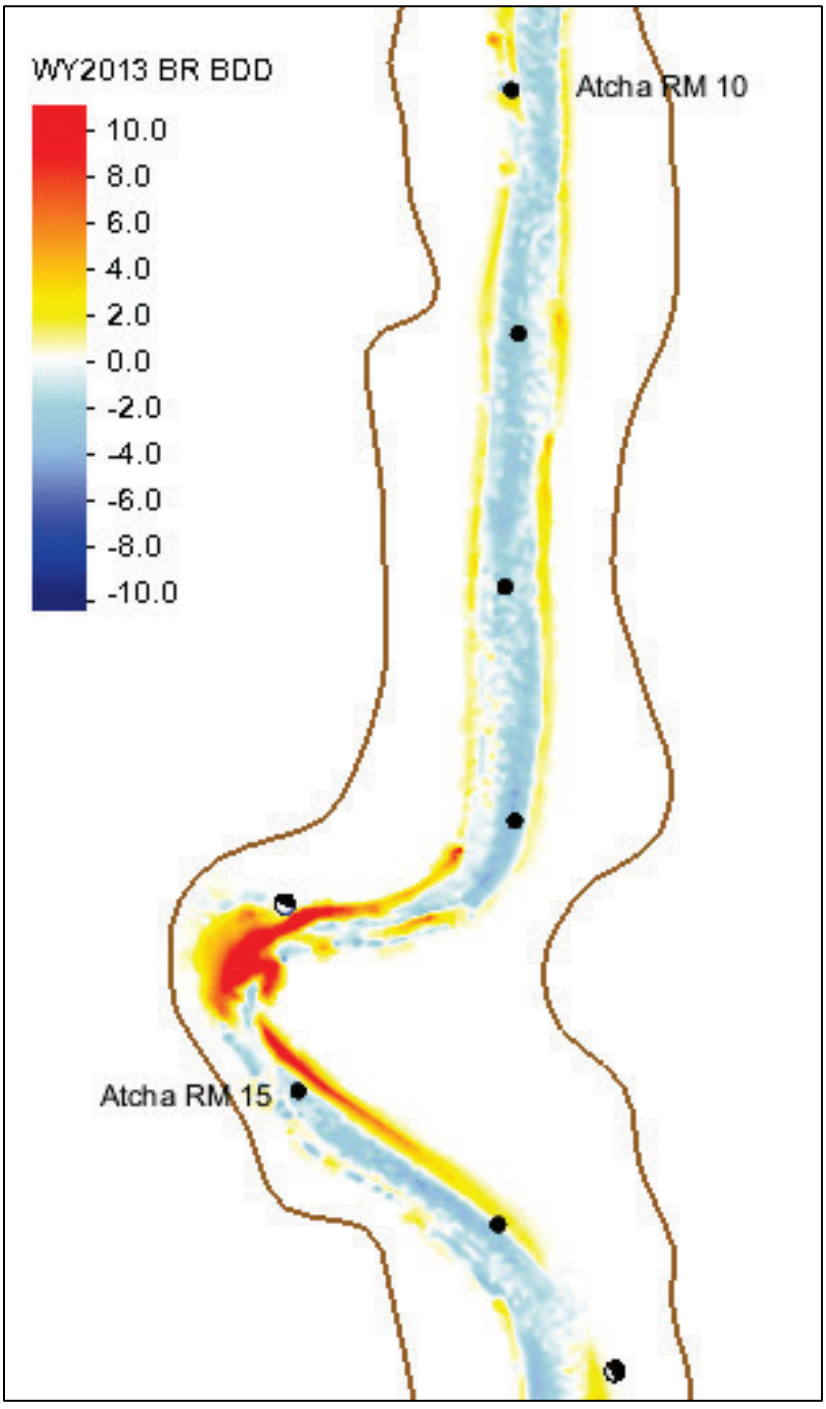


Plate F.13. WY2013 Base Run BDD Atcha RM 15–Atcha RM 20.

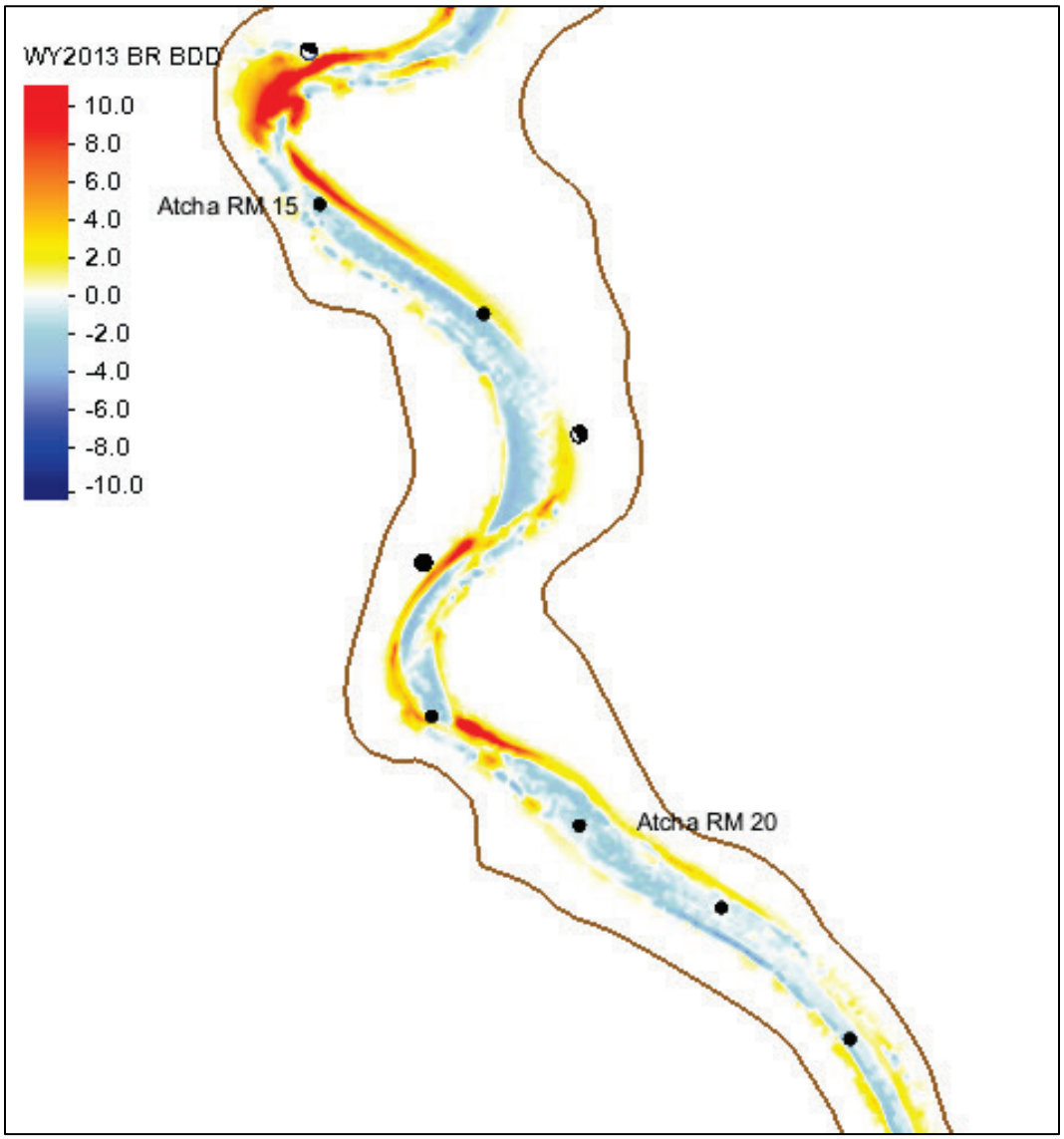


Plate F.14. WY2013 Base Run BDD Atcha RM 20–Atcha RM 25.

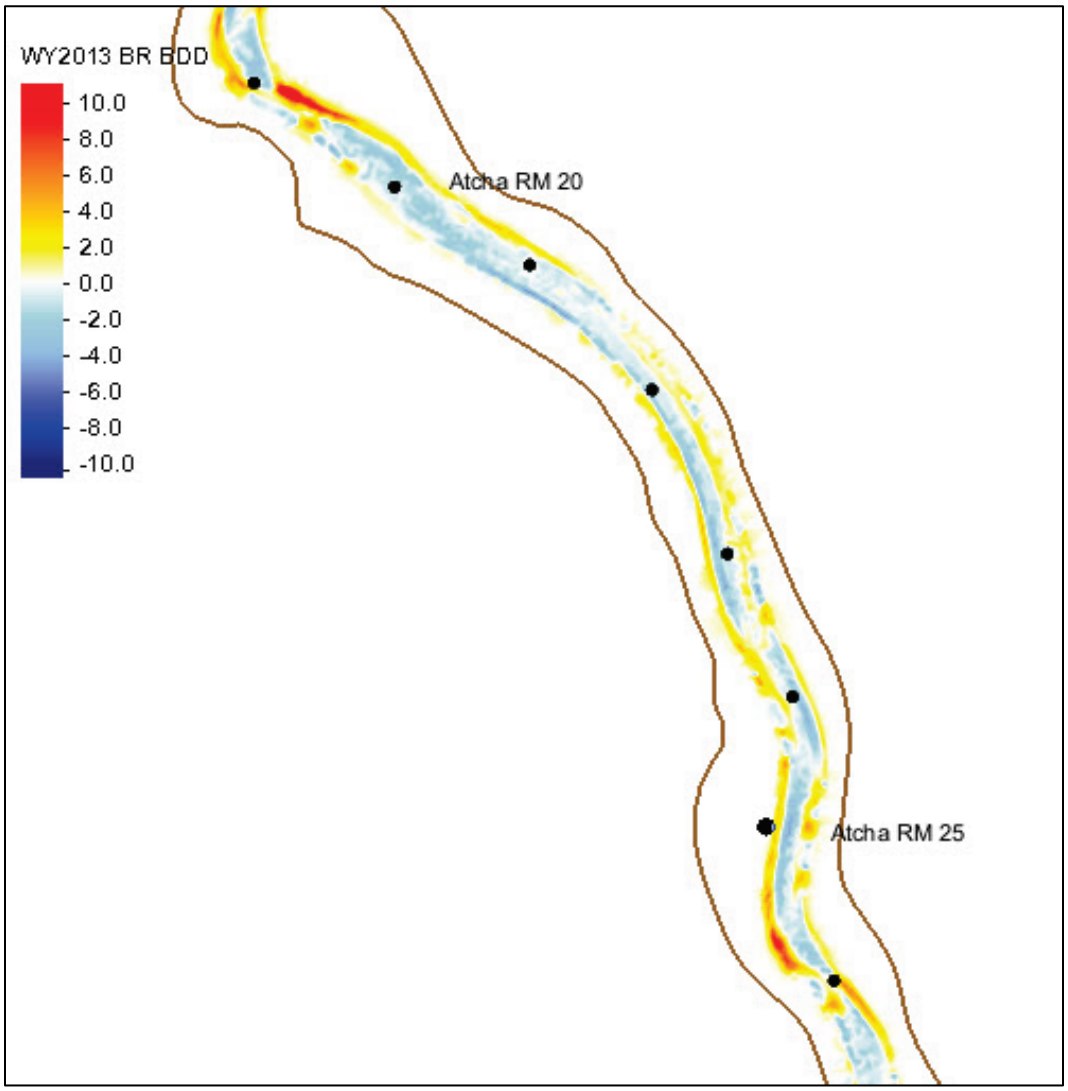
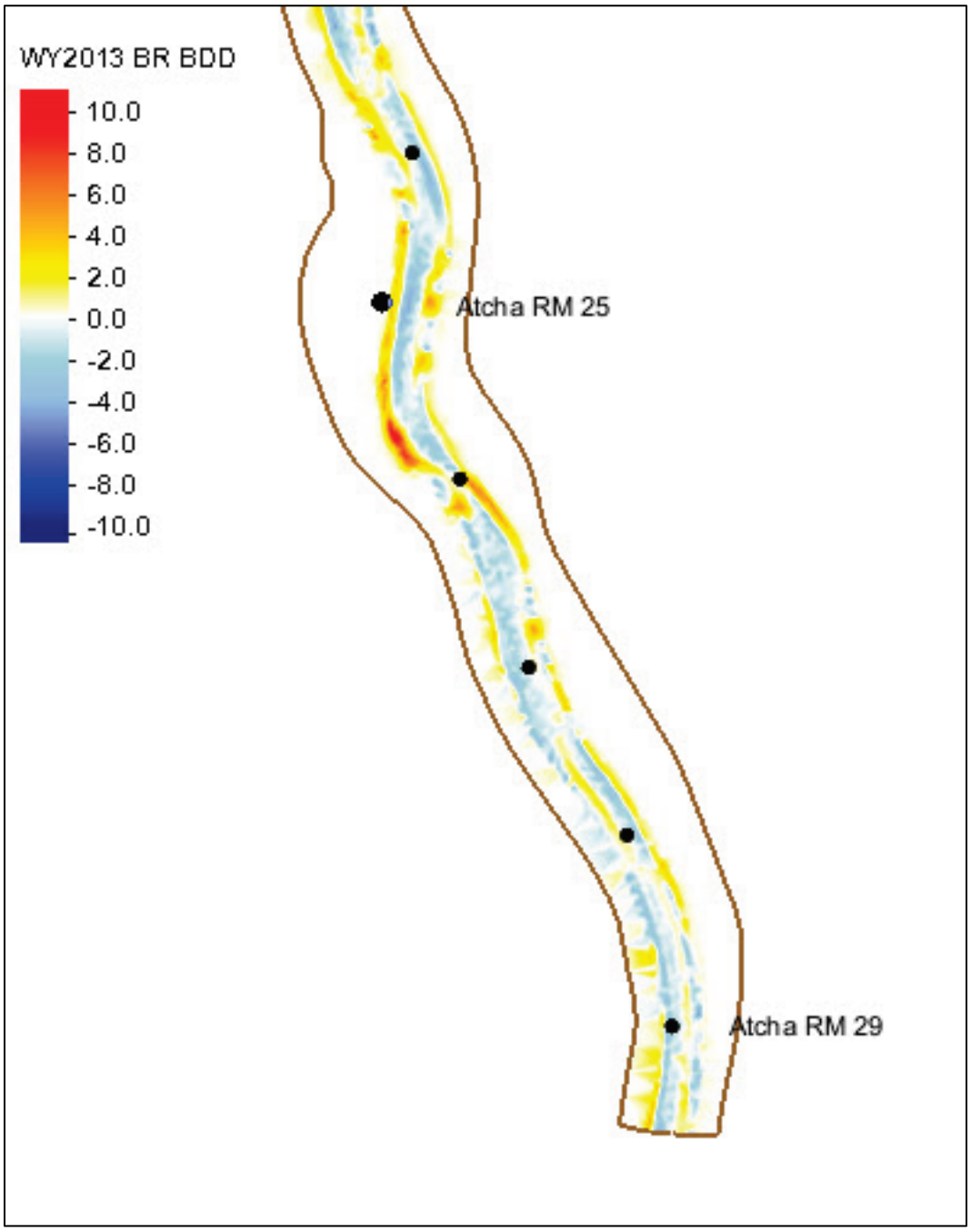


Plate F.15. WY2013 Base Run BDD Atcha RM 25–Atcha RM 29.



F.2 Scenario 3

Plate F.16. WY2013 Scenario 3 BDD RR RM 43–RR RM 39.

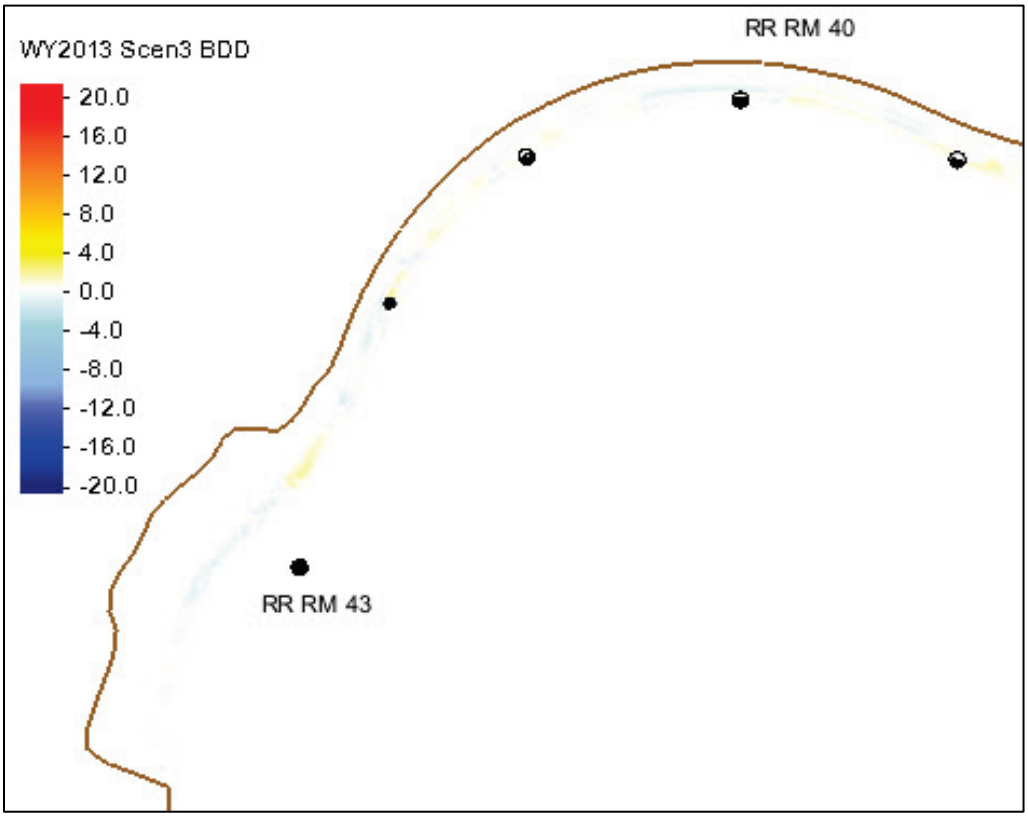


Plate F.17. WY2013 Scenario 3 BDD RR RM 40–RR RM 32.

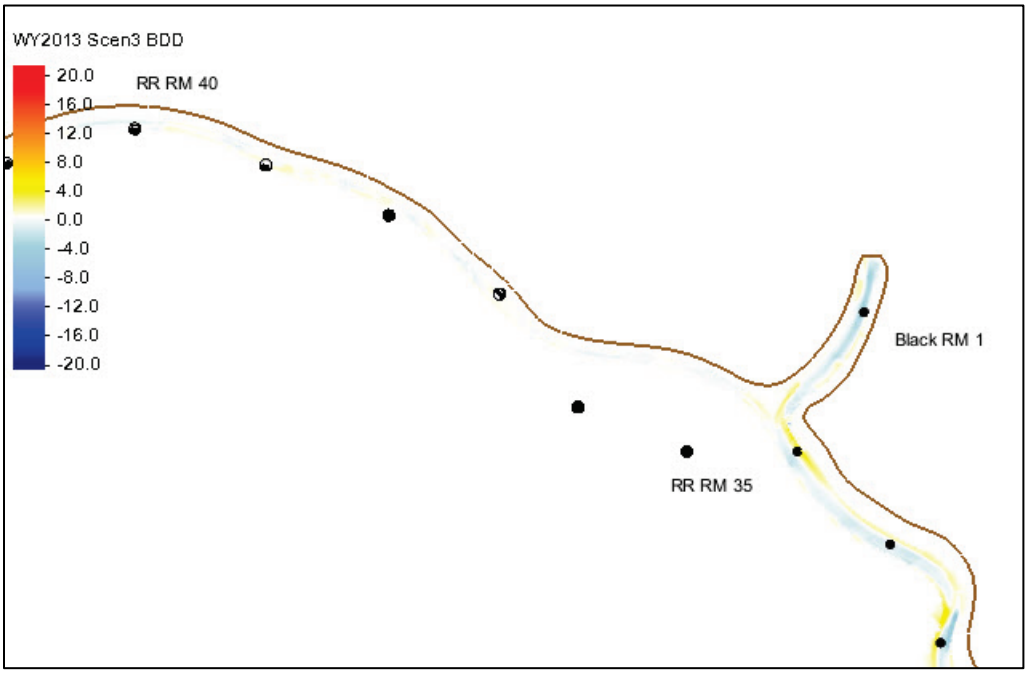


Plate F.18. WY2013 Scenario 3 BDD RR RM 35–RR RM 30.

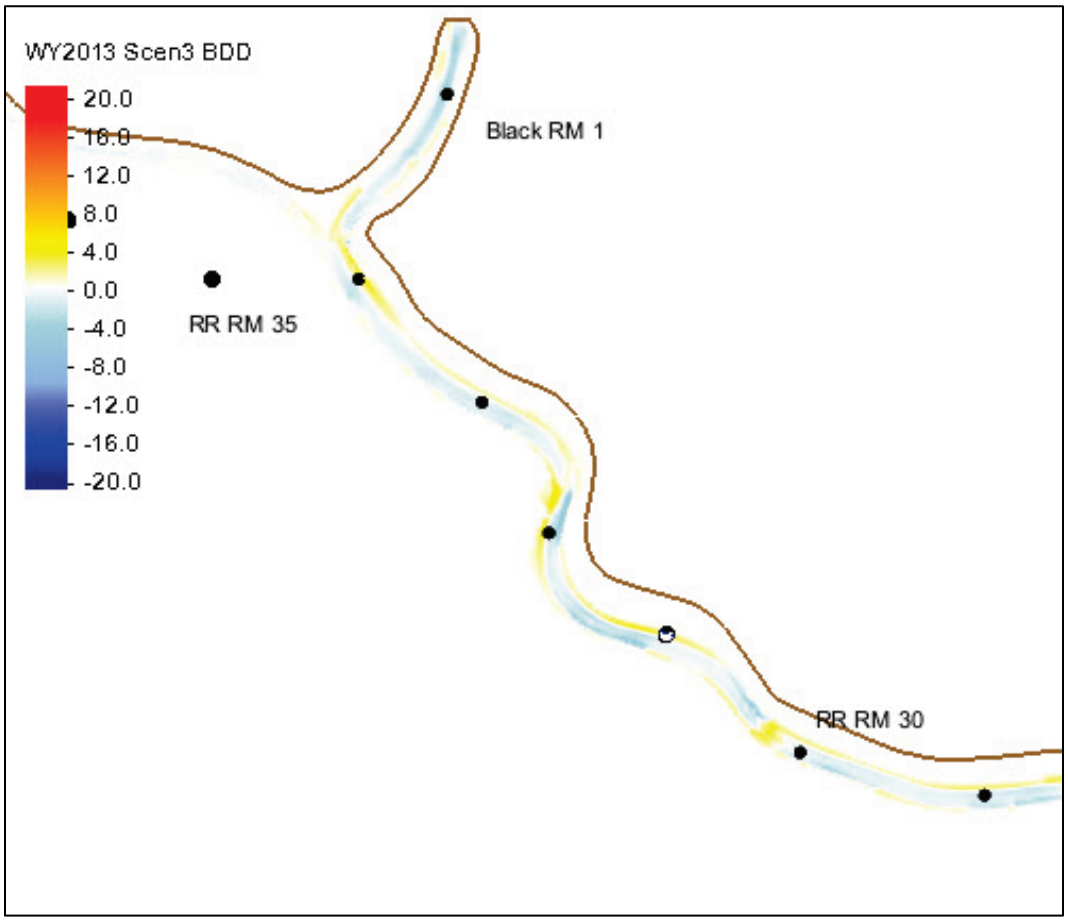


Plate F.19. WY2013 Scenario 3 BDD RR RM 30–RR RM 25.

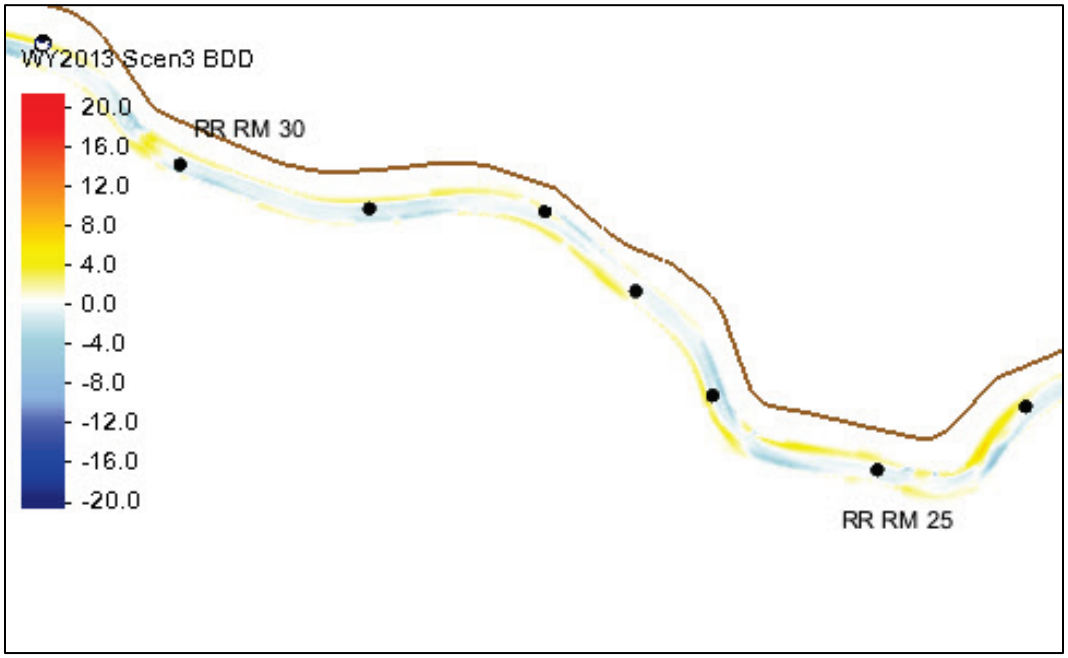


Plate F.20. WY2013 Scenario 3 Displacement Data RR RM 25–RR RM 20.

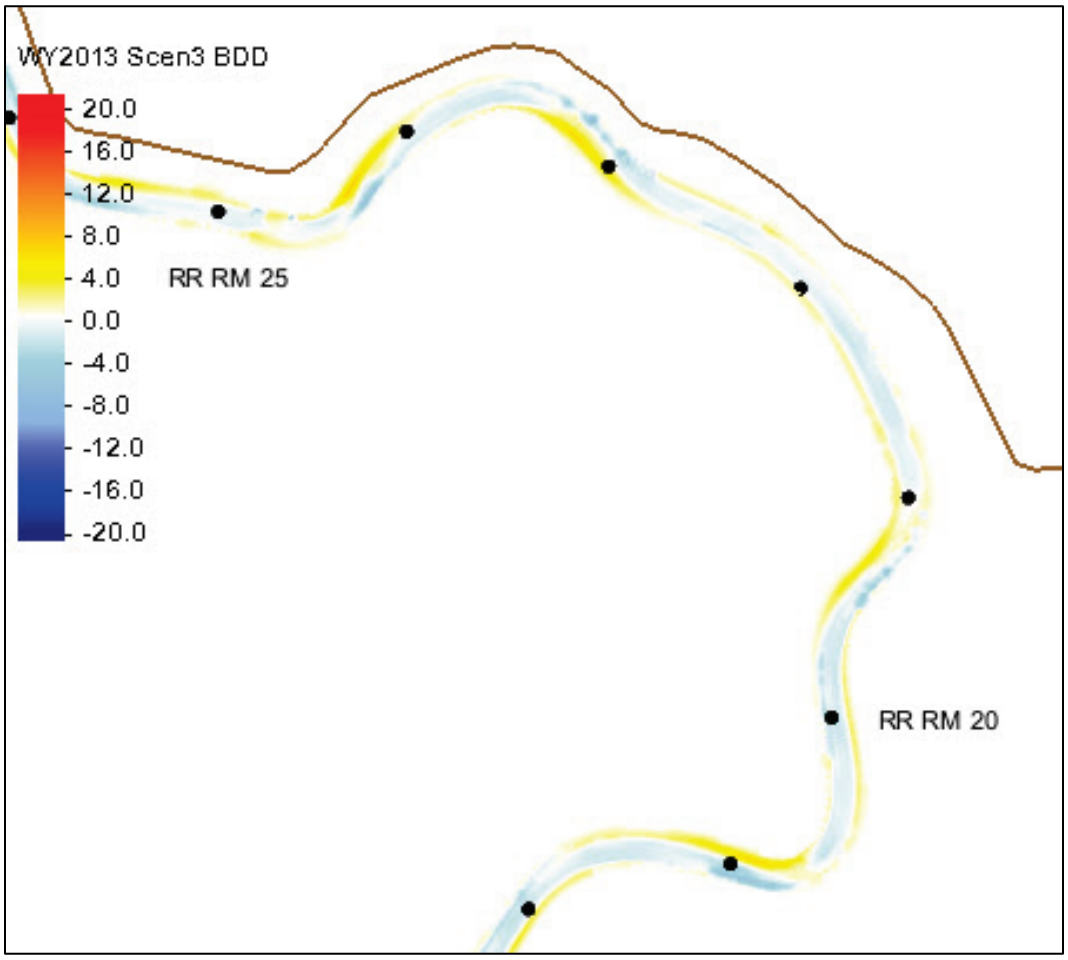


Plate F.21. WY2013 Scenario 3 BDD RR RM 20–RR RM 15.

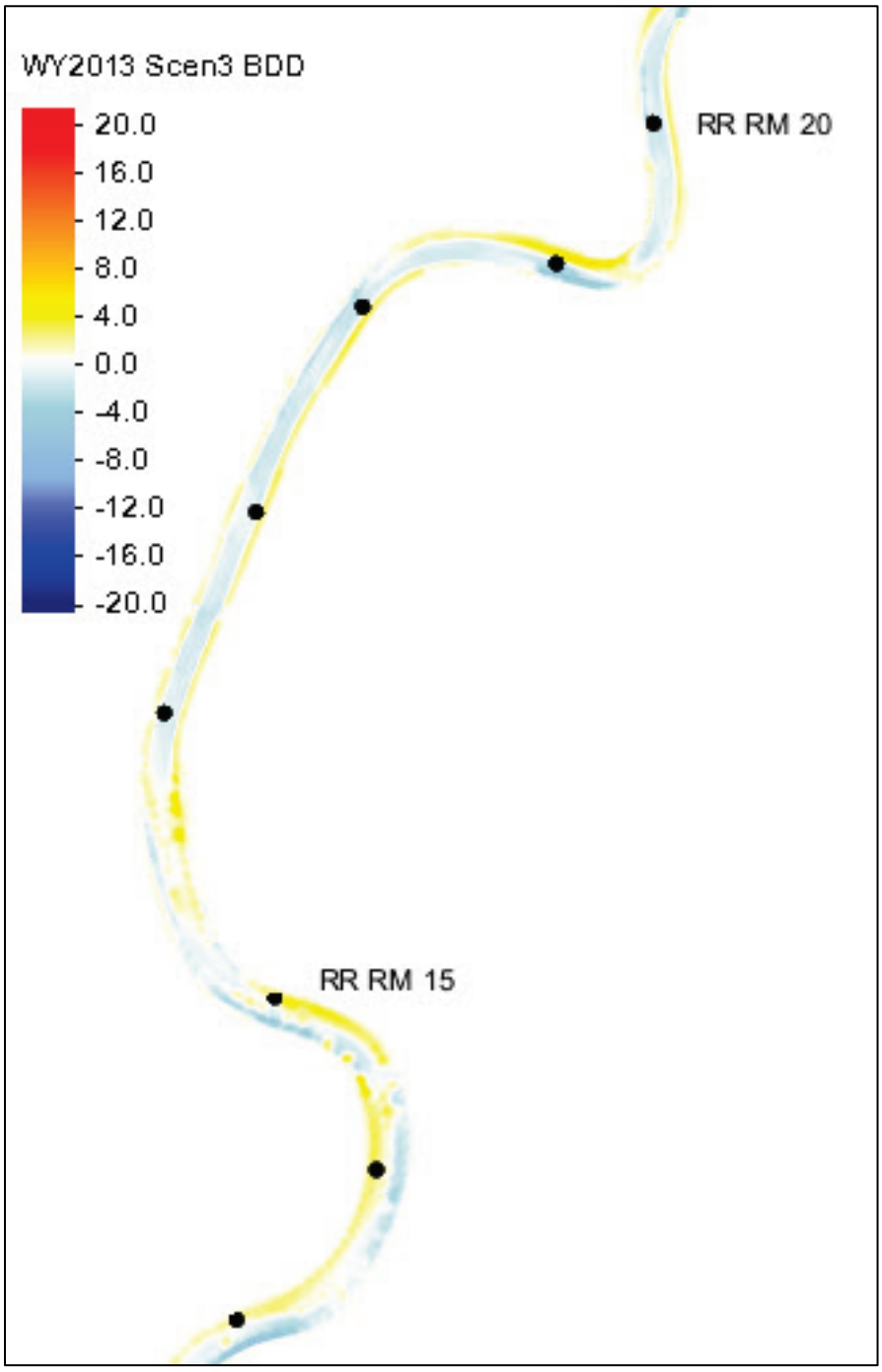


Plate F.22. WY2013 Scenario 3 BDD RR RM 15–RR RM 10 and Outflow Channel.

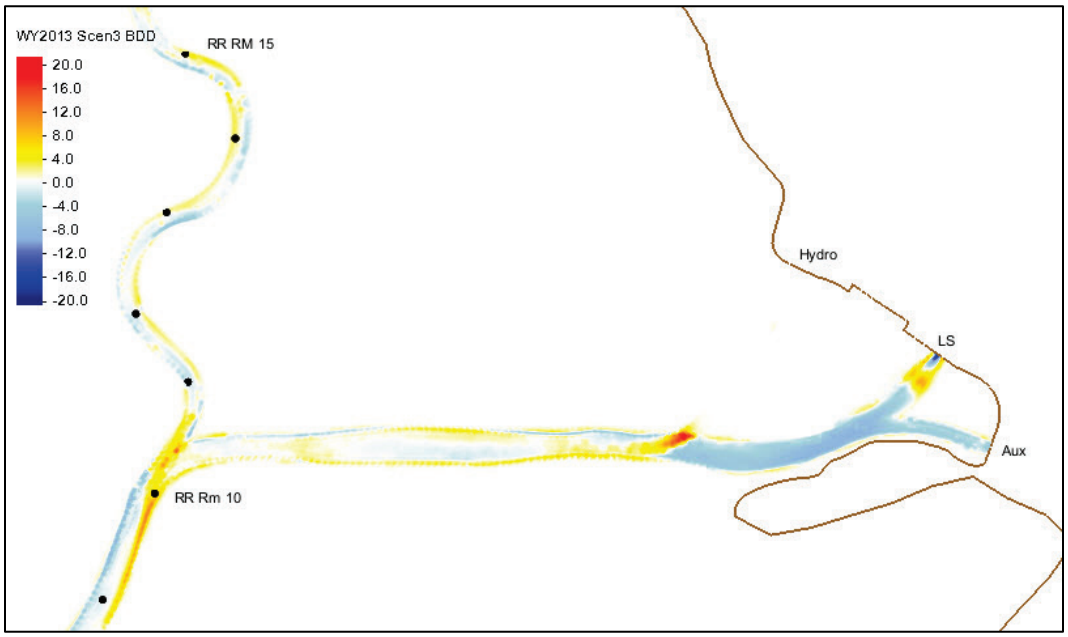


Plate F.23. WY2013 Scenario 3 BDD RR RM 10–Atcha RM 1.

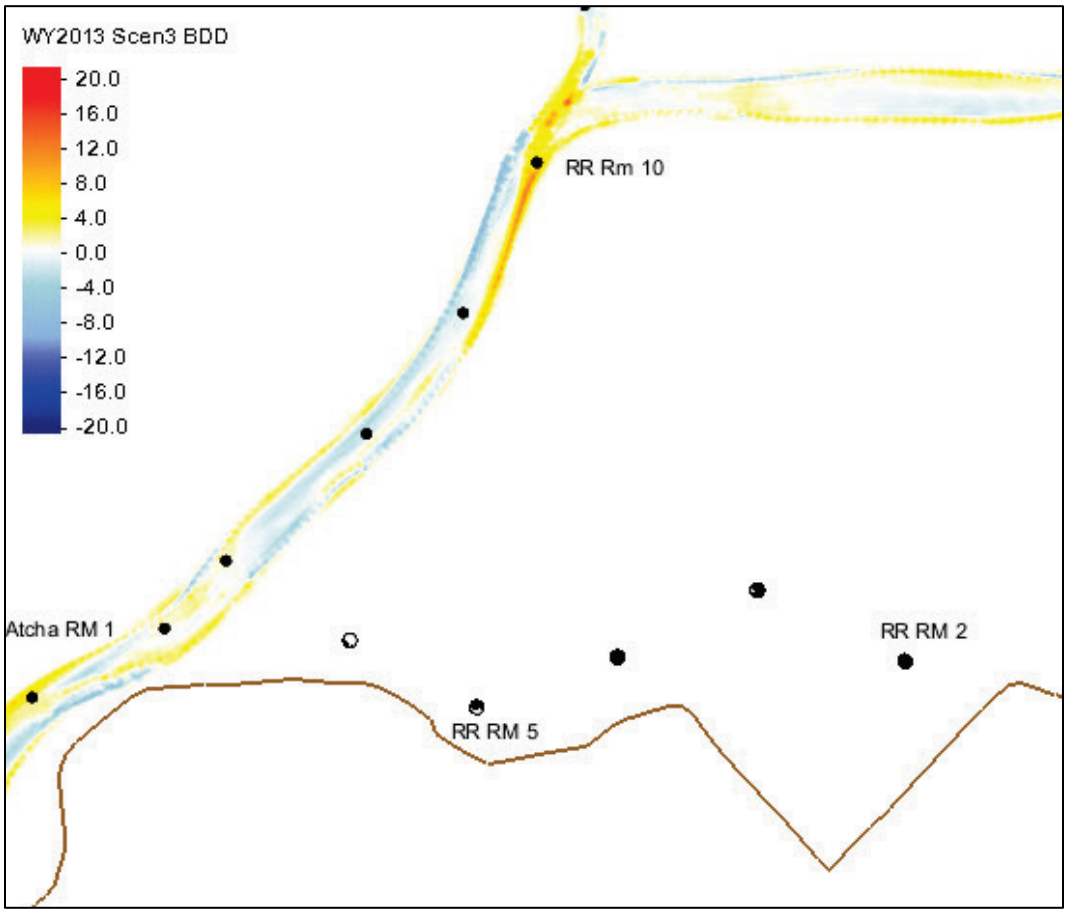


Plate F.24. WY2013 Scenario 3 BDD Atcha RM 1–Atcha RM 7.

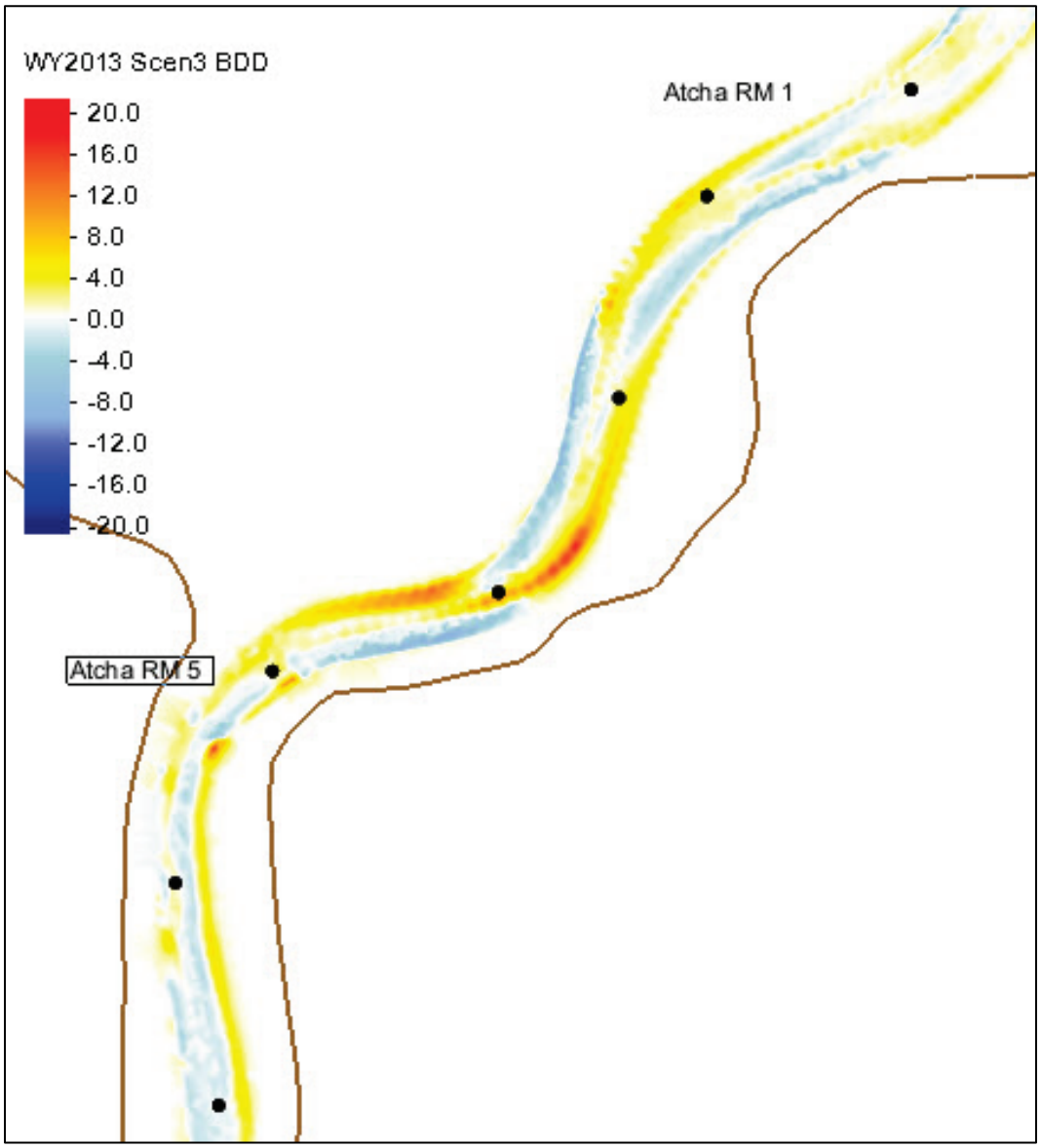


Plate F.25. WY2013 Base Scenario 3 Displacement Data Atcha RM 5–Atcha RM 10.

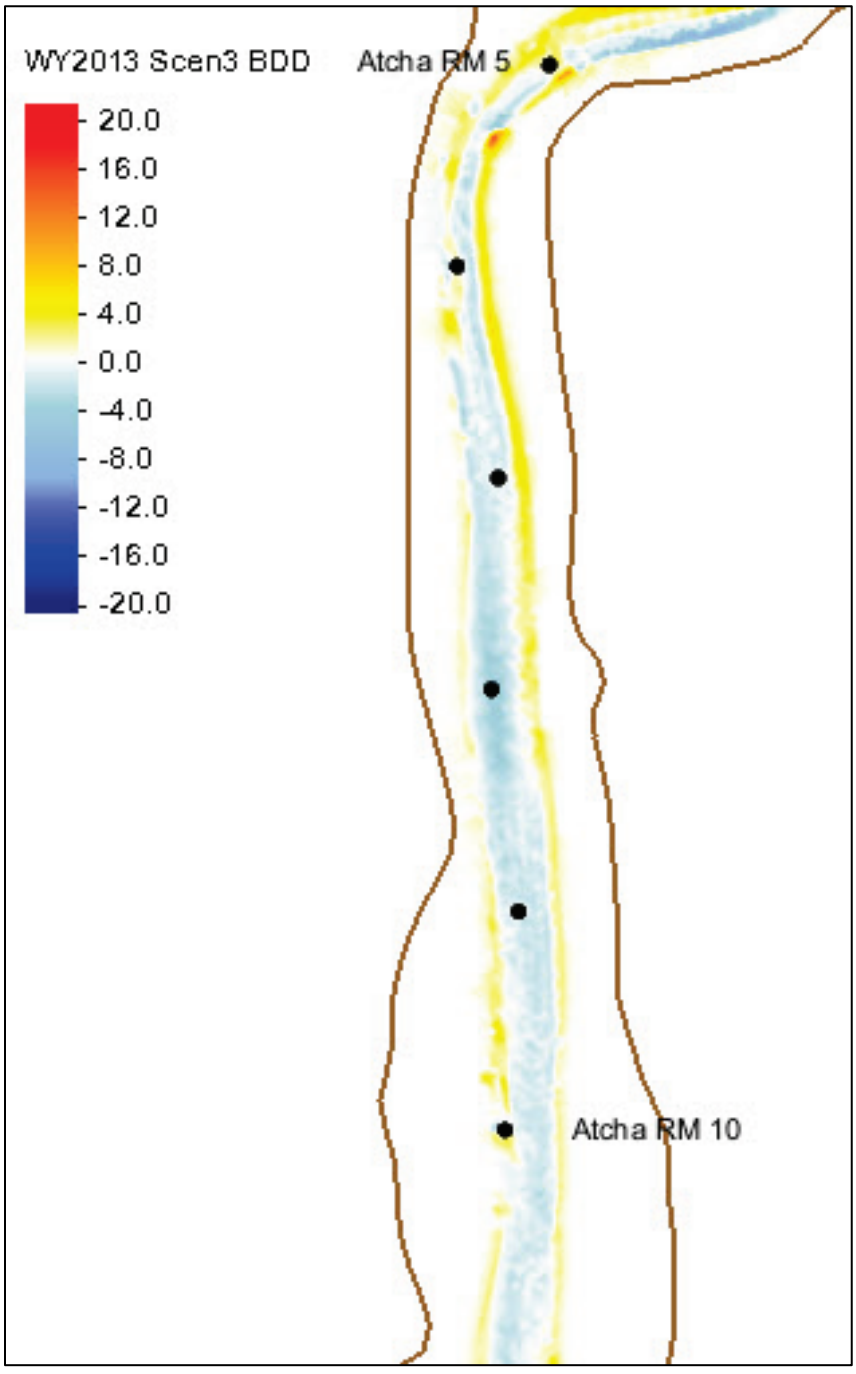


Plate F.26. WY2013 Scenario 3 BDD Atcha RM 10–Atcha RM 15.

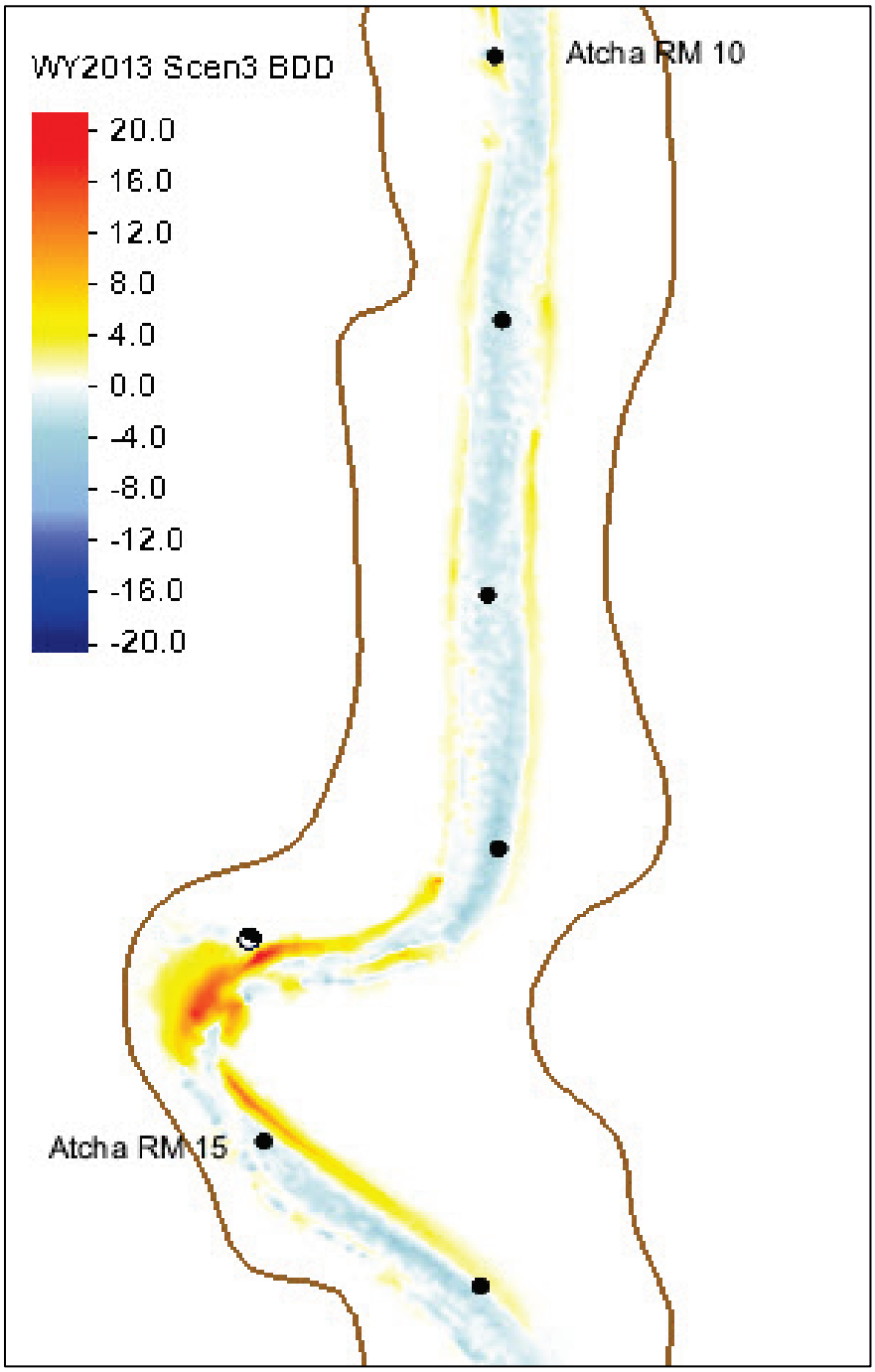


Plate F.27. WY2013 Scenario 3 BDD Atcha RM 15–Atcha RM 20.

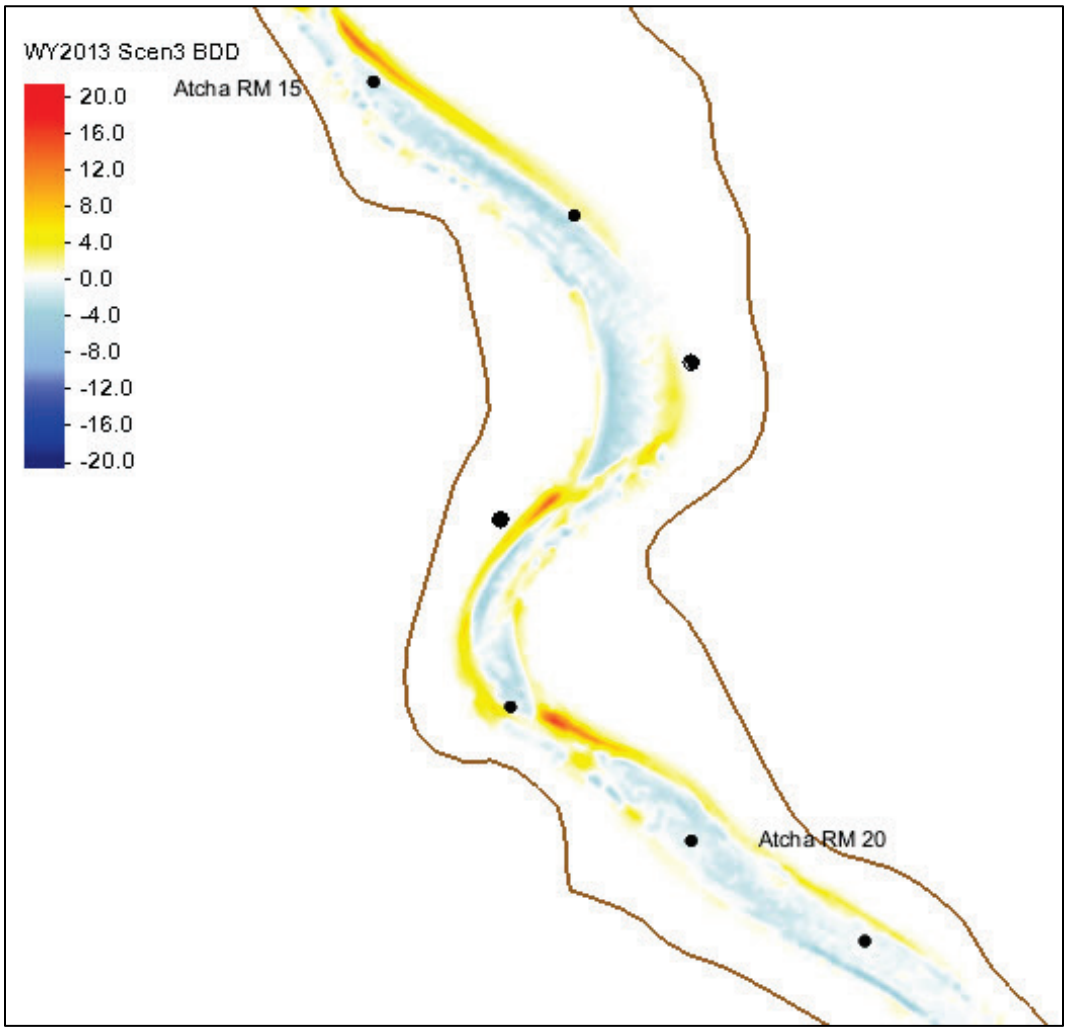


Plate F.28. WY2013 Scenario 3 BDD Atcha RM 20–Atcha RM 25.

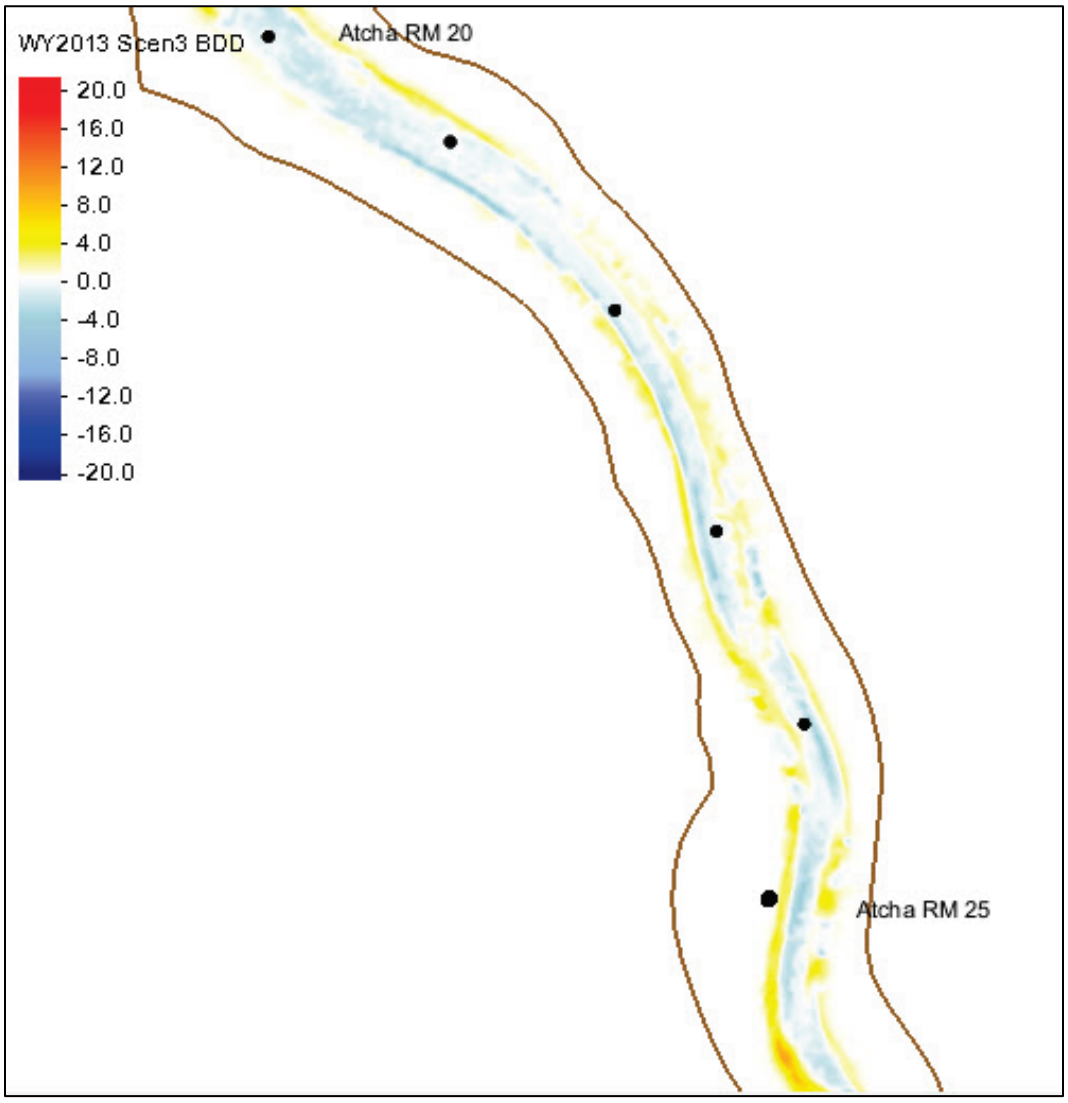
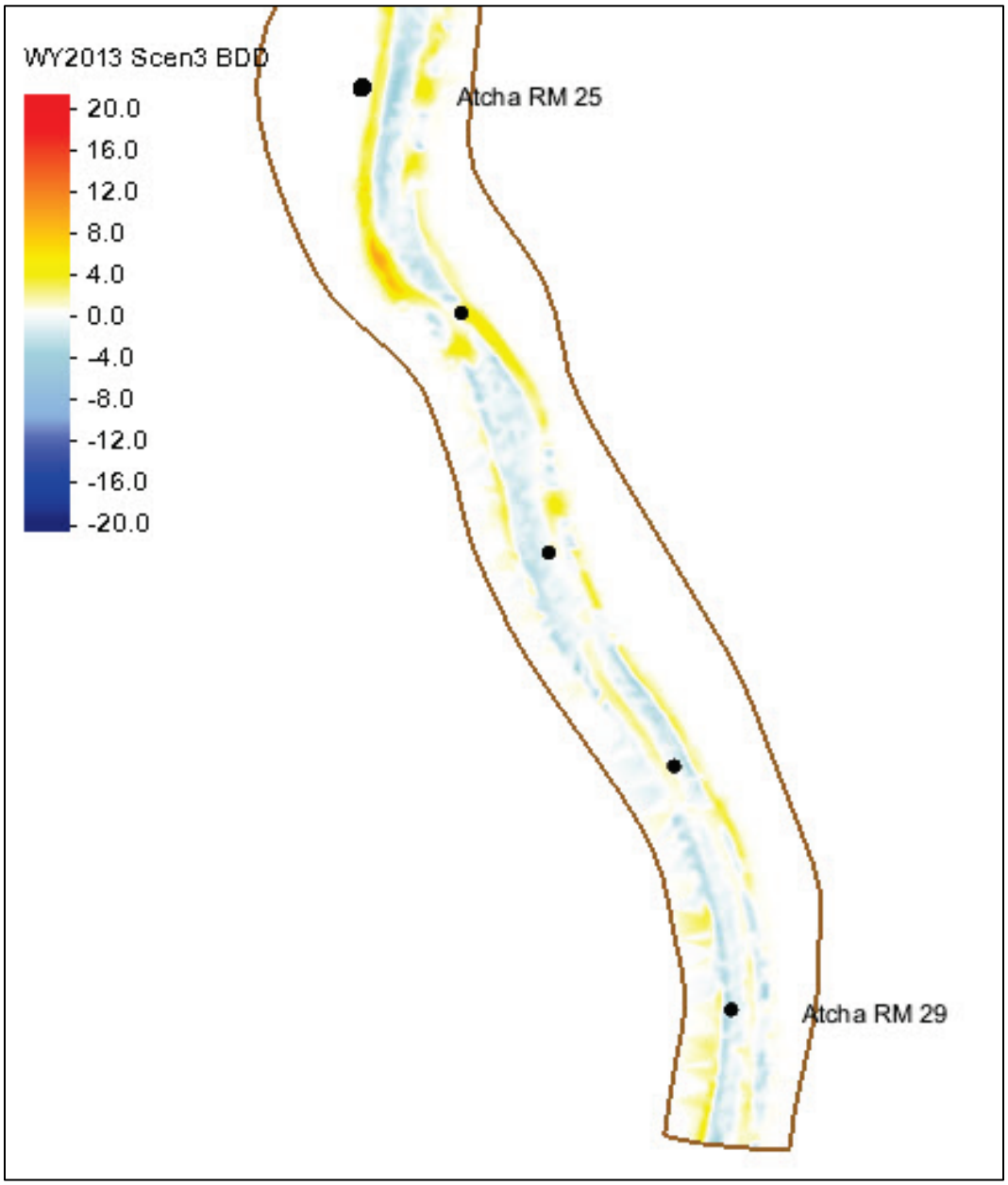


Plate F.29. WY2013 Scenario 3 BDD Atcha RM 25–Atcha RM 29.



F.3 Scenario 4

Plate F.30. WY2013 Scenario 4 BDD RR RM 43–RR RM 30.

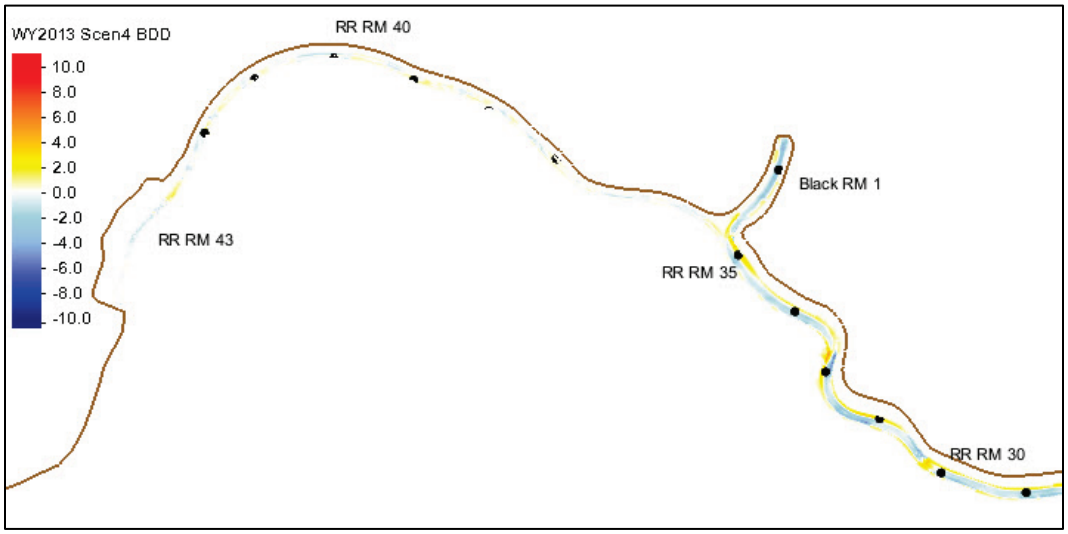


Plate F.31. WY2013 Scenario 4 BDD RR RM 30–RR RM 20.

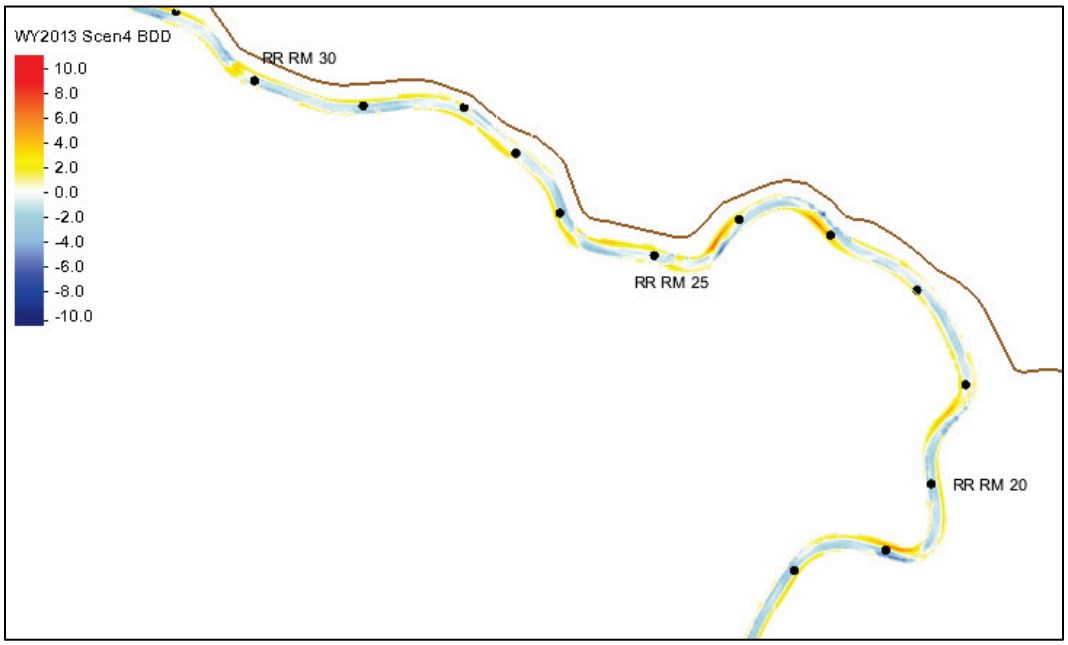


Plate F.32. WY2013 Scenario 4 BDD RR RM 20–RR RM 10 and Outflow Channel.

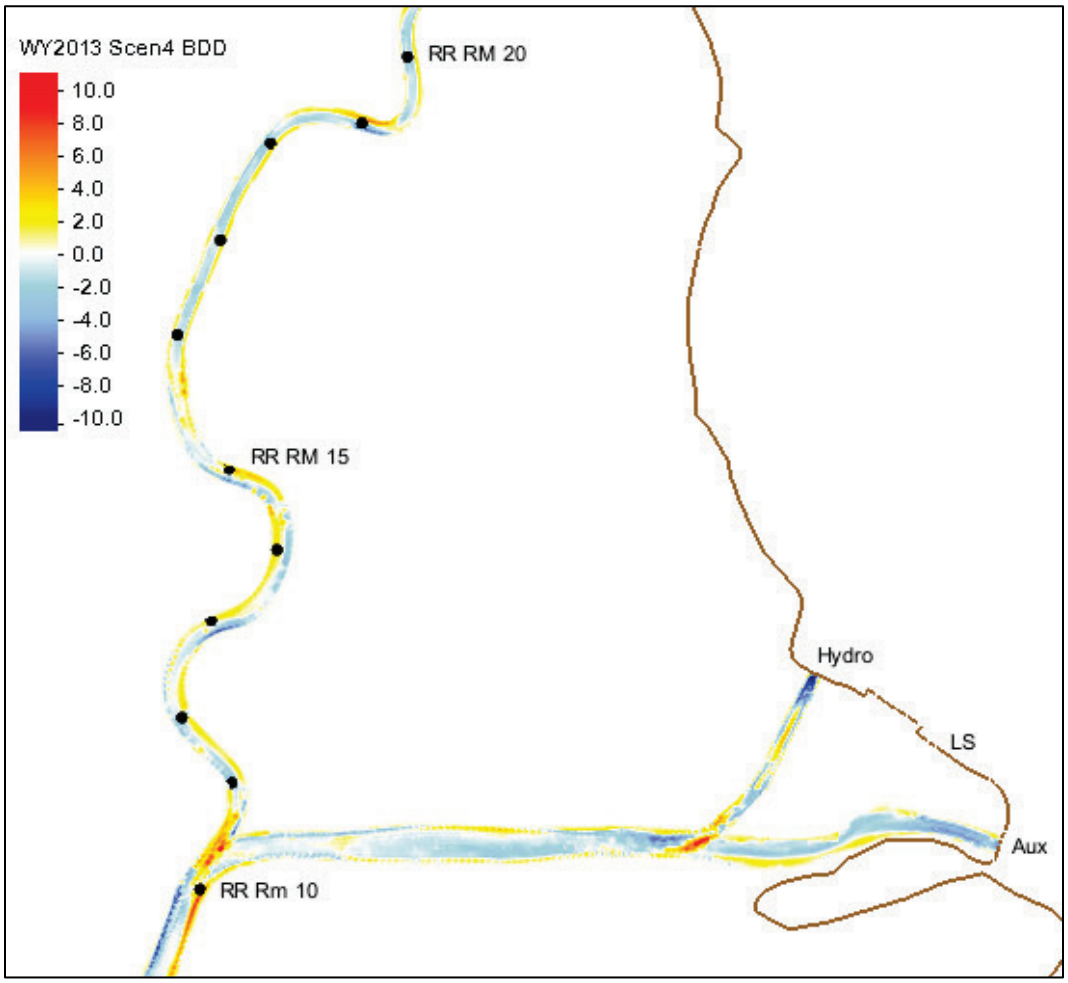


Plate F.33. WY2013 Scenario 4 BDD Outflow Channel.

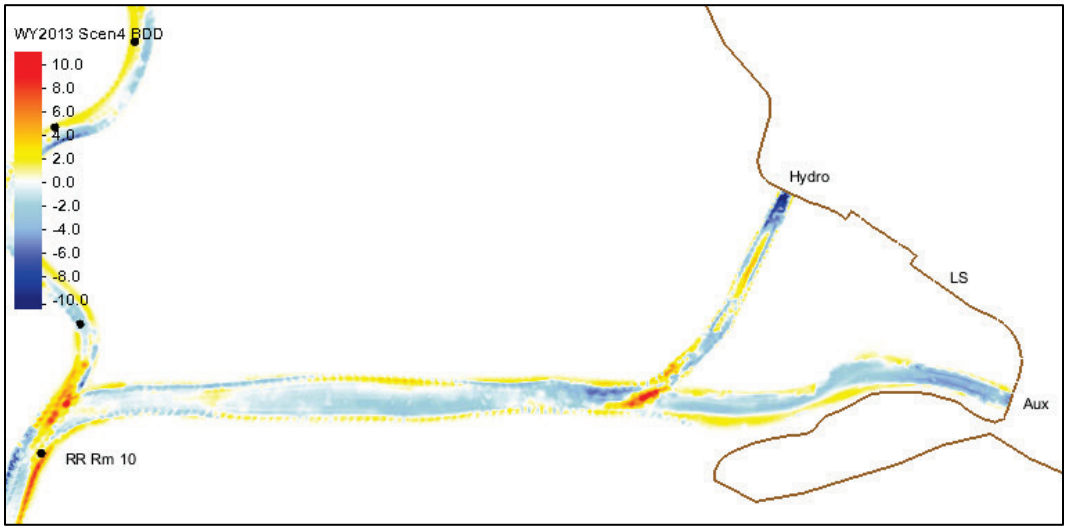


Plate F.34. WY2013 Scenario 4 BDD RR RM 10–Atcha RM 5.

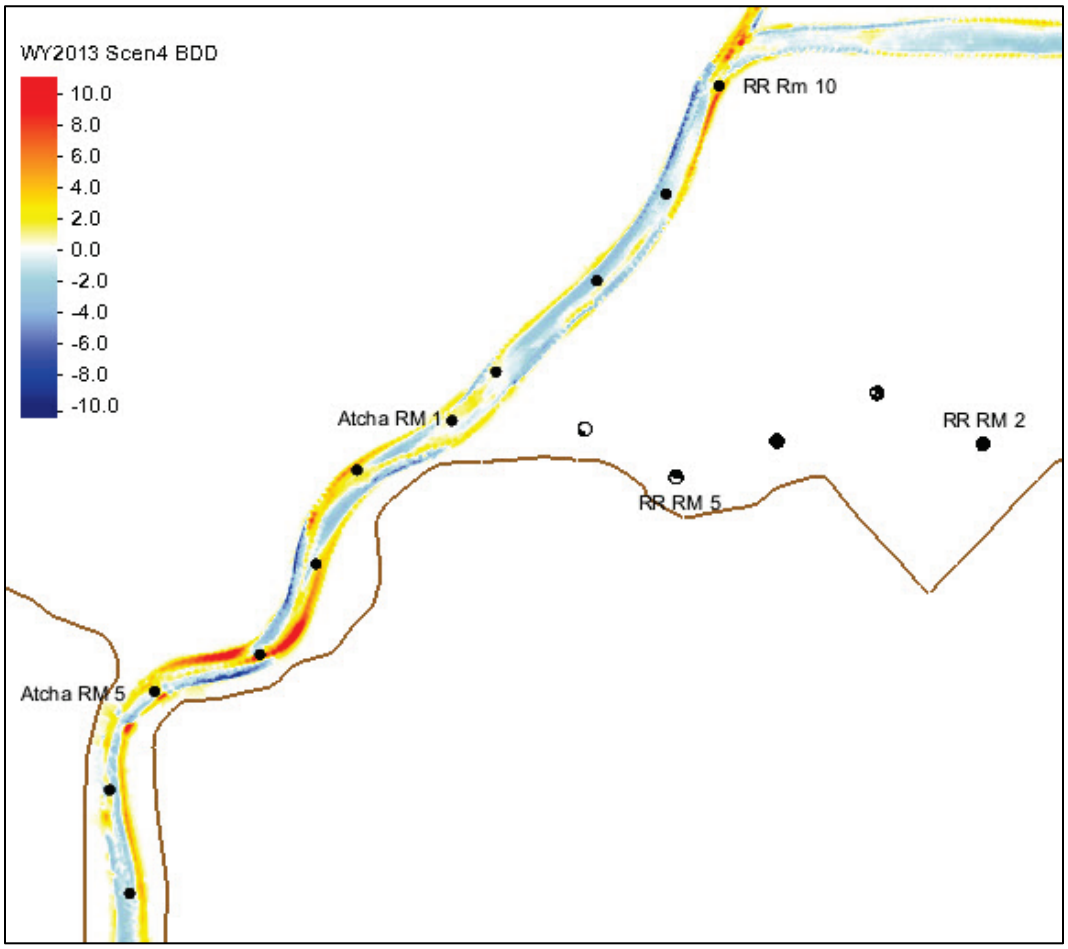


Plate F.35. WY2013 Scenario 4 BDD Atcha RM 5–Atcha RM 15.

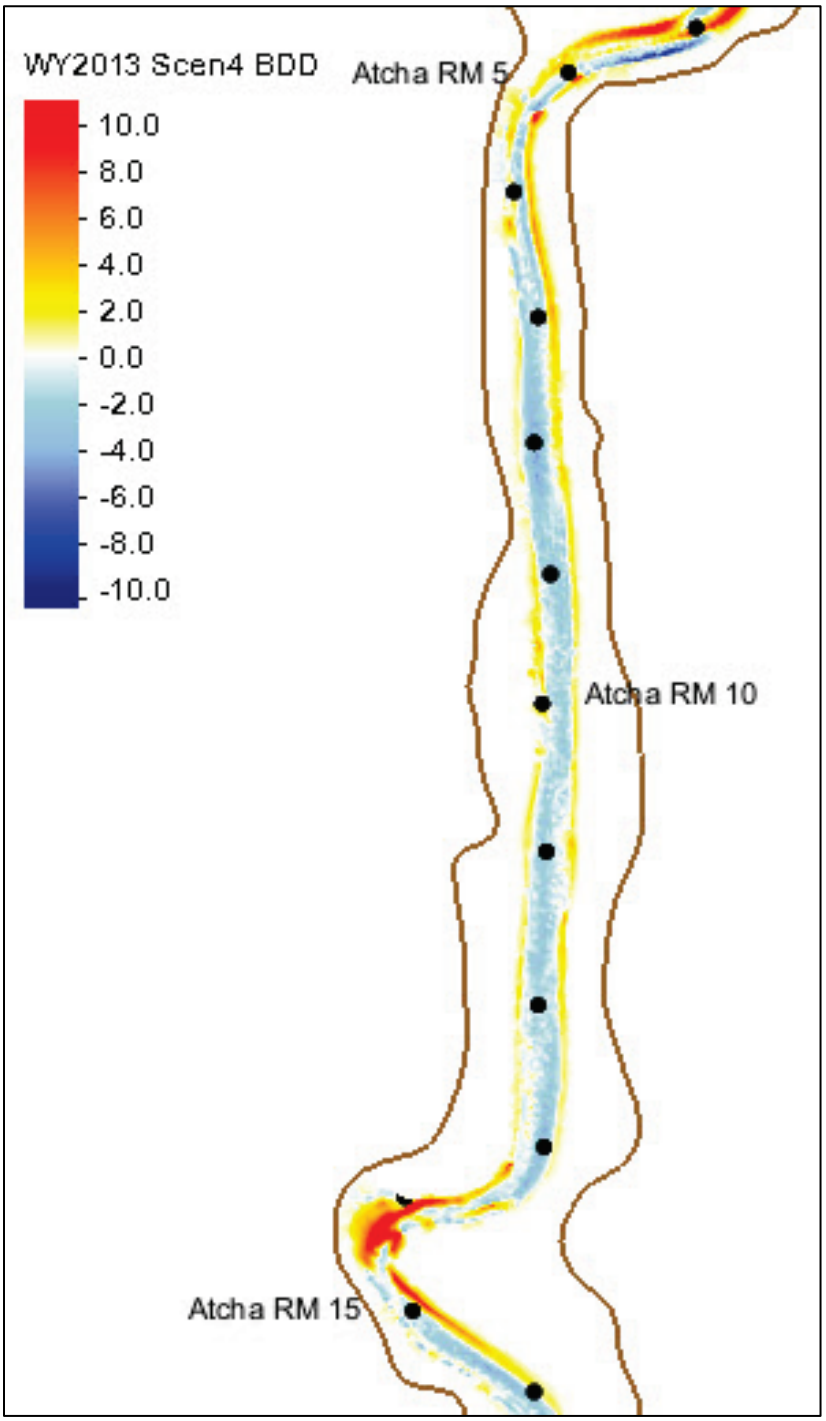
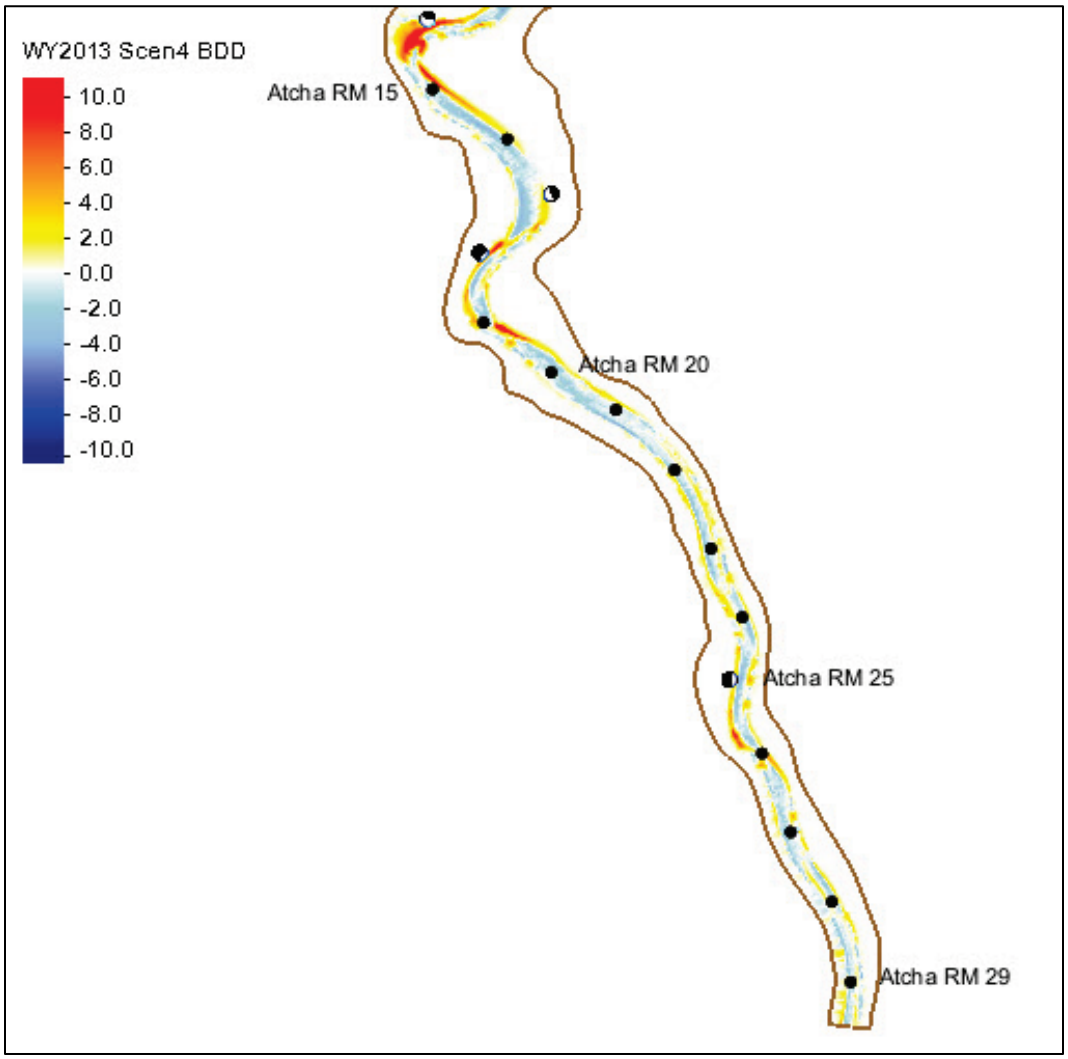


Plate F.36. WY2013 Scenario 4 BDD Atcha RM 15–Atcha RM 29.



F.4 Scenario 5

Plate F.37. WY2013 Scenario 5 BDD RR RM 43–RR RM 30.

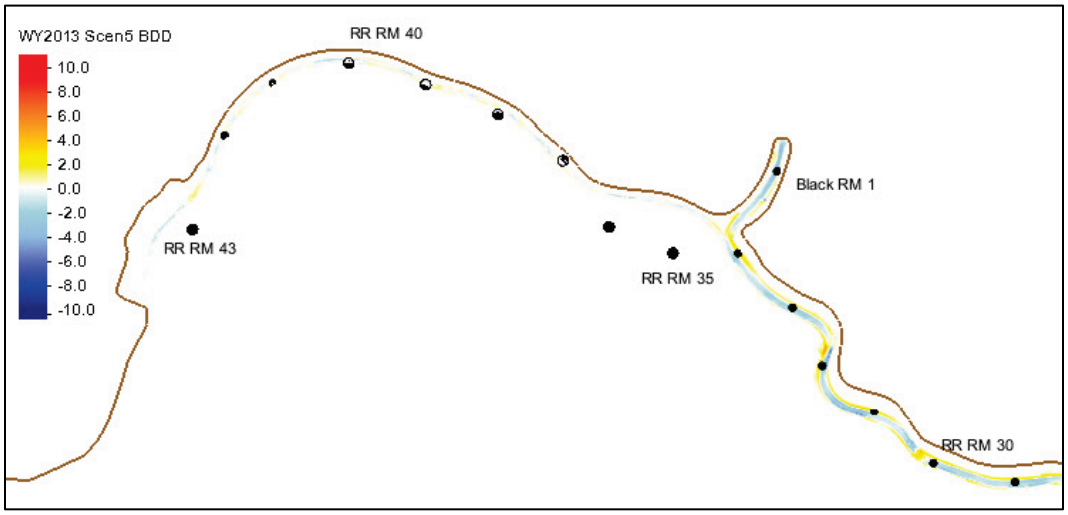


Plate F.38. WY2013 Scenario 5 BDD RR RM 30–RR RM 20.

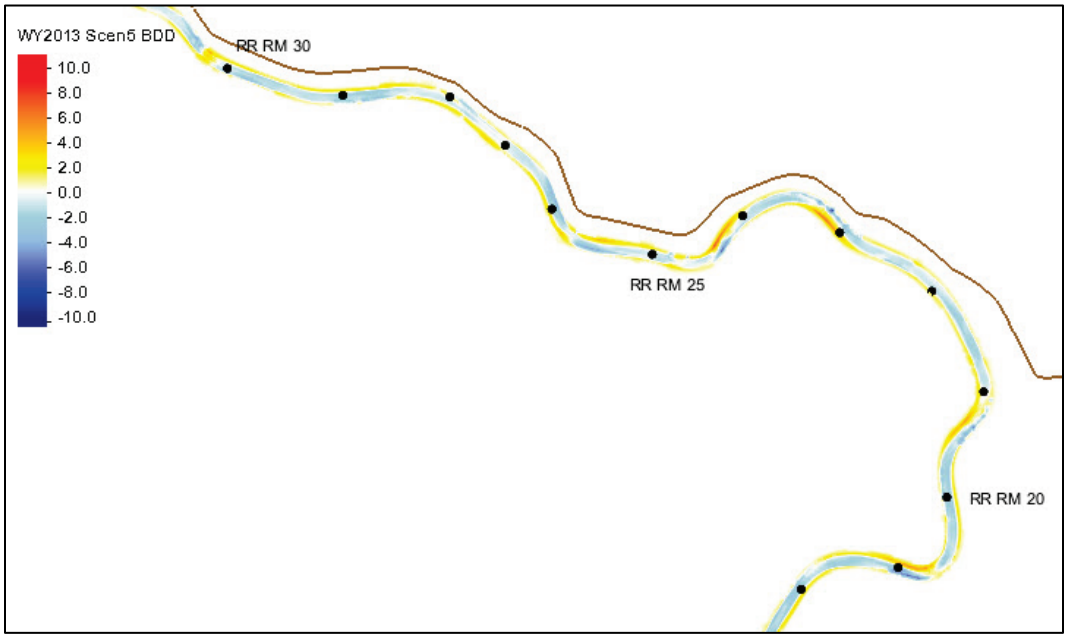


Plate F.39. WY2013 Scenario 5 BDD RR RM 20–RR RM 10 and Outflow Channel.

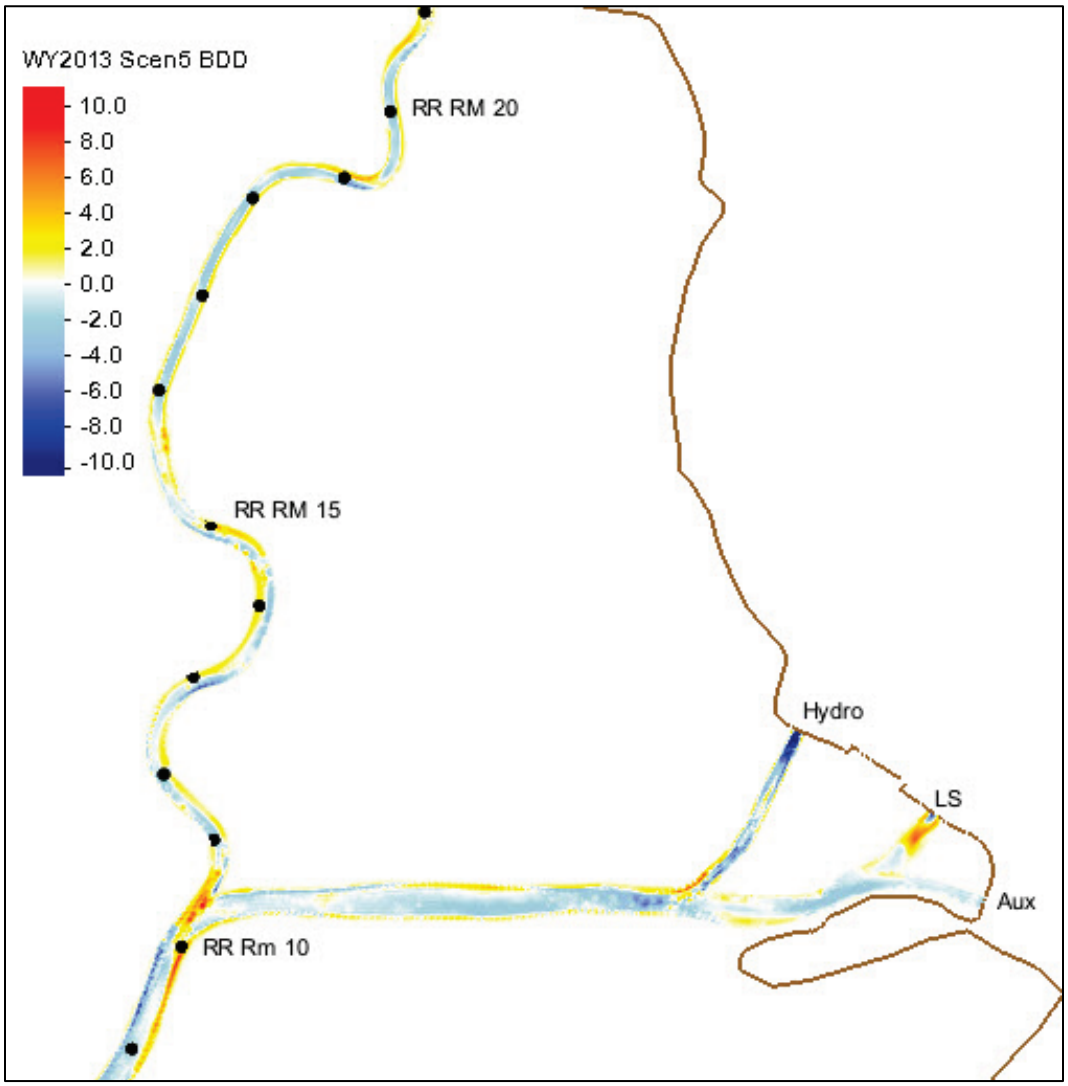


Plate F.40. WY2013 Scenario 5 BDD Outflow Channel.

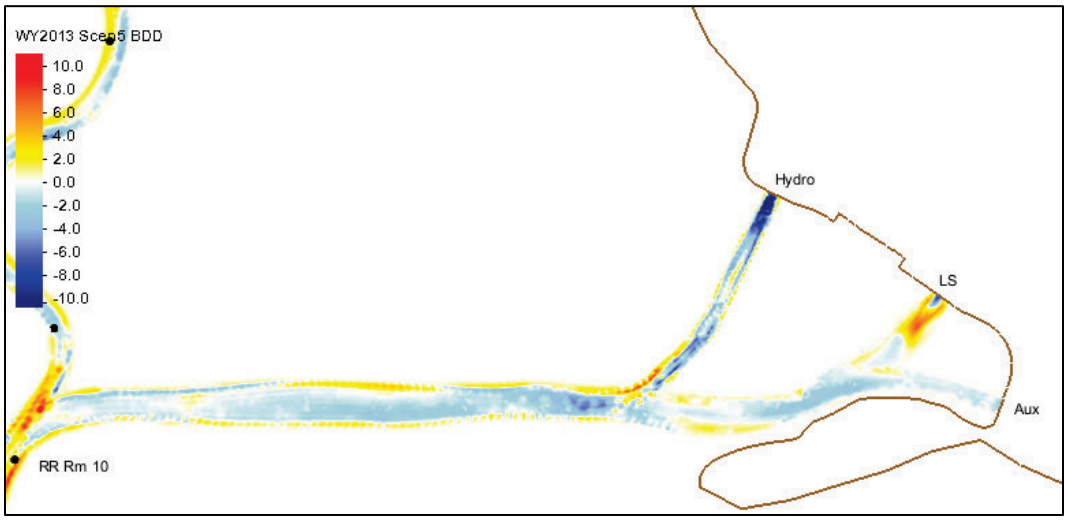


Plate F.41. WY2013 Scenario 5 BDD RR RM 10–Atcha RM 5.

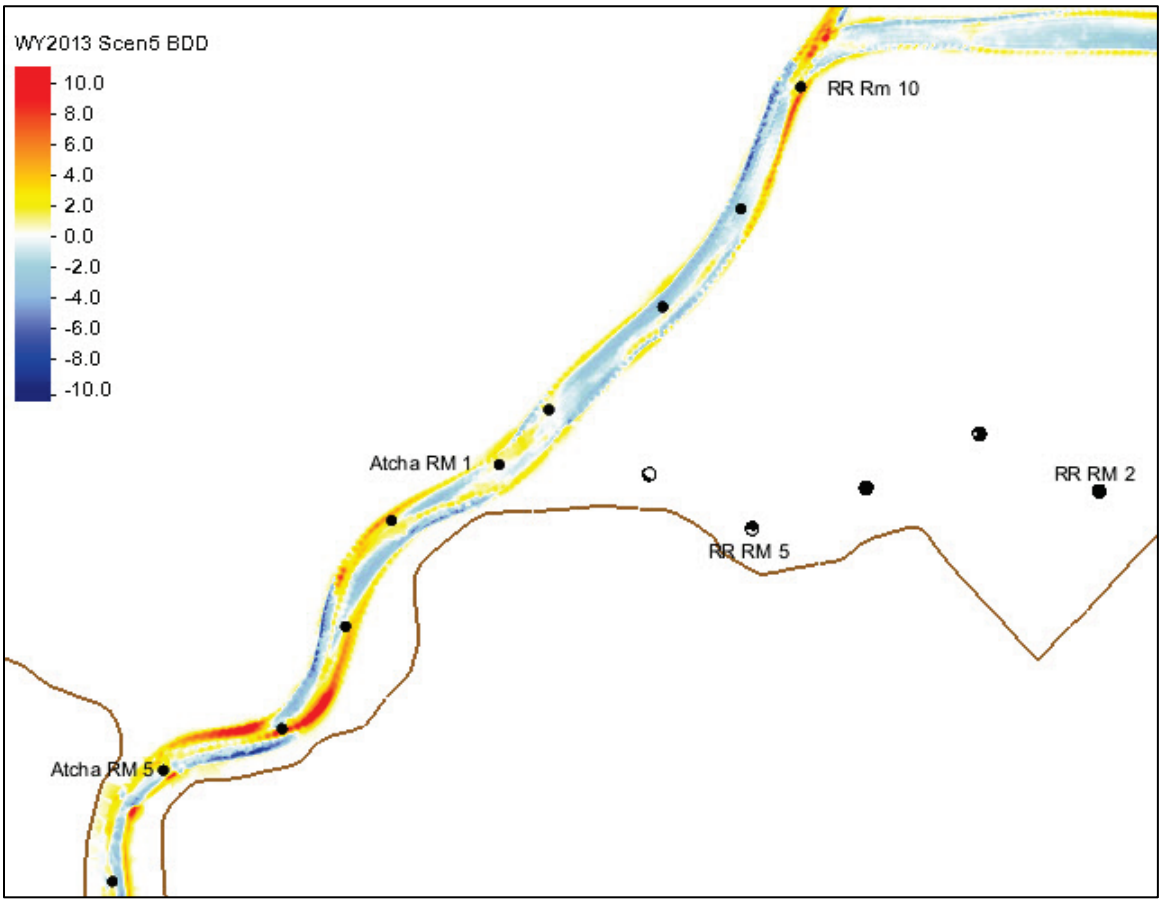


Plate F.42. WY2013 Scenario 5 BDD Atcha RM 5–Atcha RM 15.

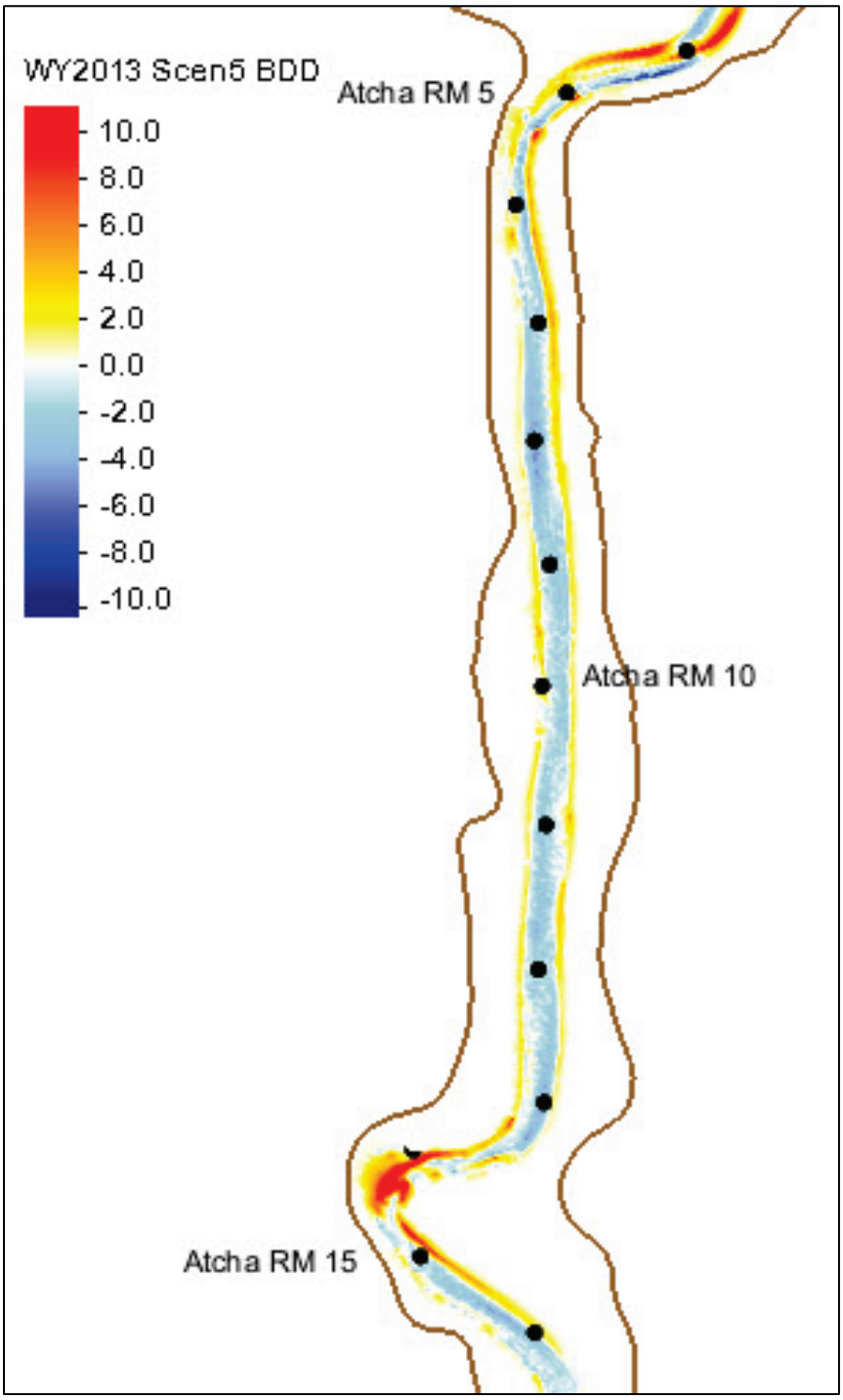
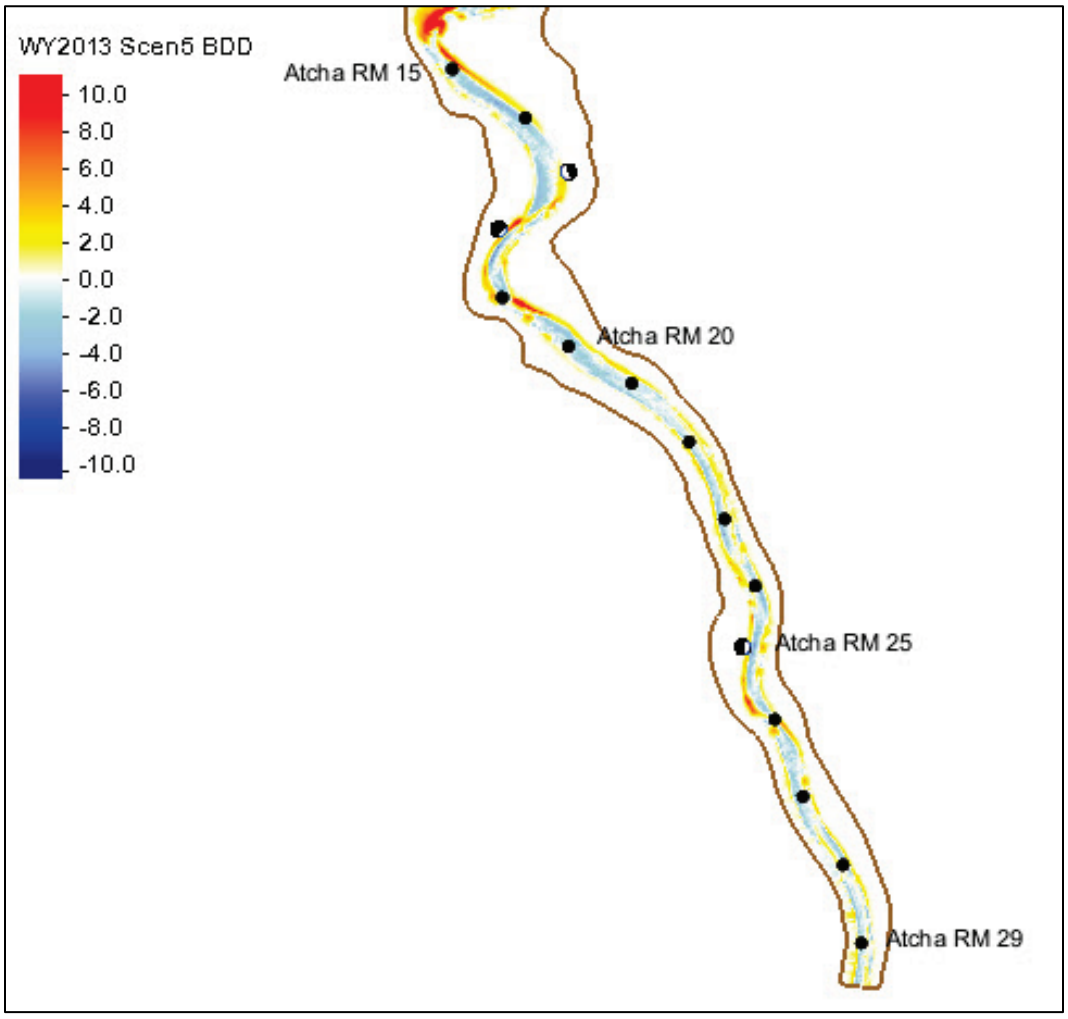


Plate F.43. WY2013 Scenario 5 BDD Atcha RM 15–Atcha RM 29.



F.5 Scenario 6

Plate F.44. WY2013 Scenario 6 BDD RR RM 43–RR RM 30.

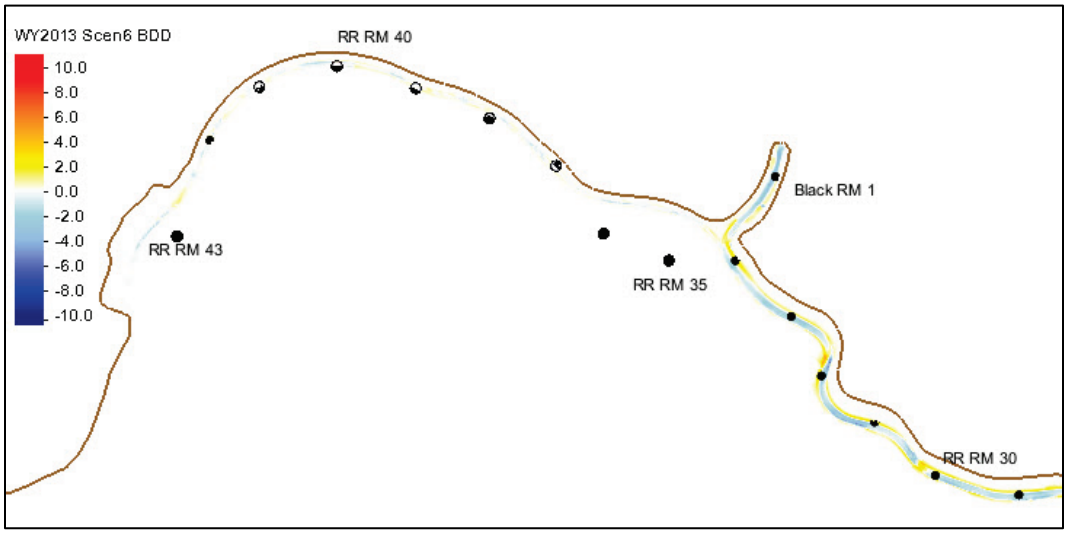


Plate F.45. WY2013 Scenario 6 BDD RR RM 30–RR RM 20.

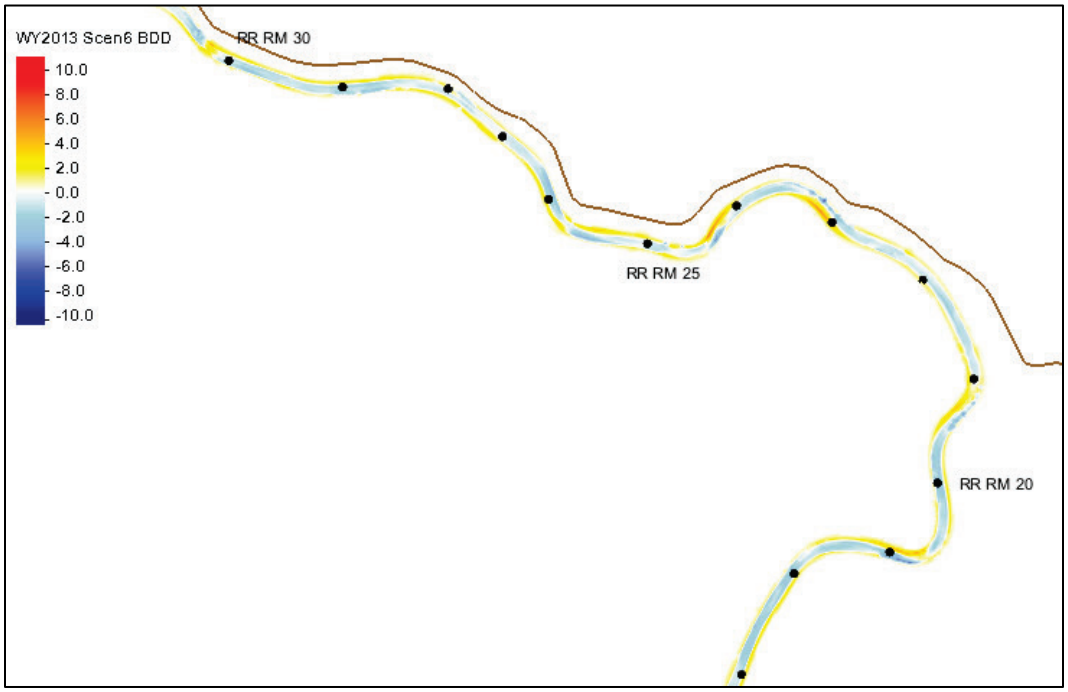


Plate F.46. WY2013 Scenario 6 BDD RR RM 20–RR RM 10 and Outflow Channel.

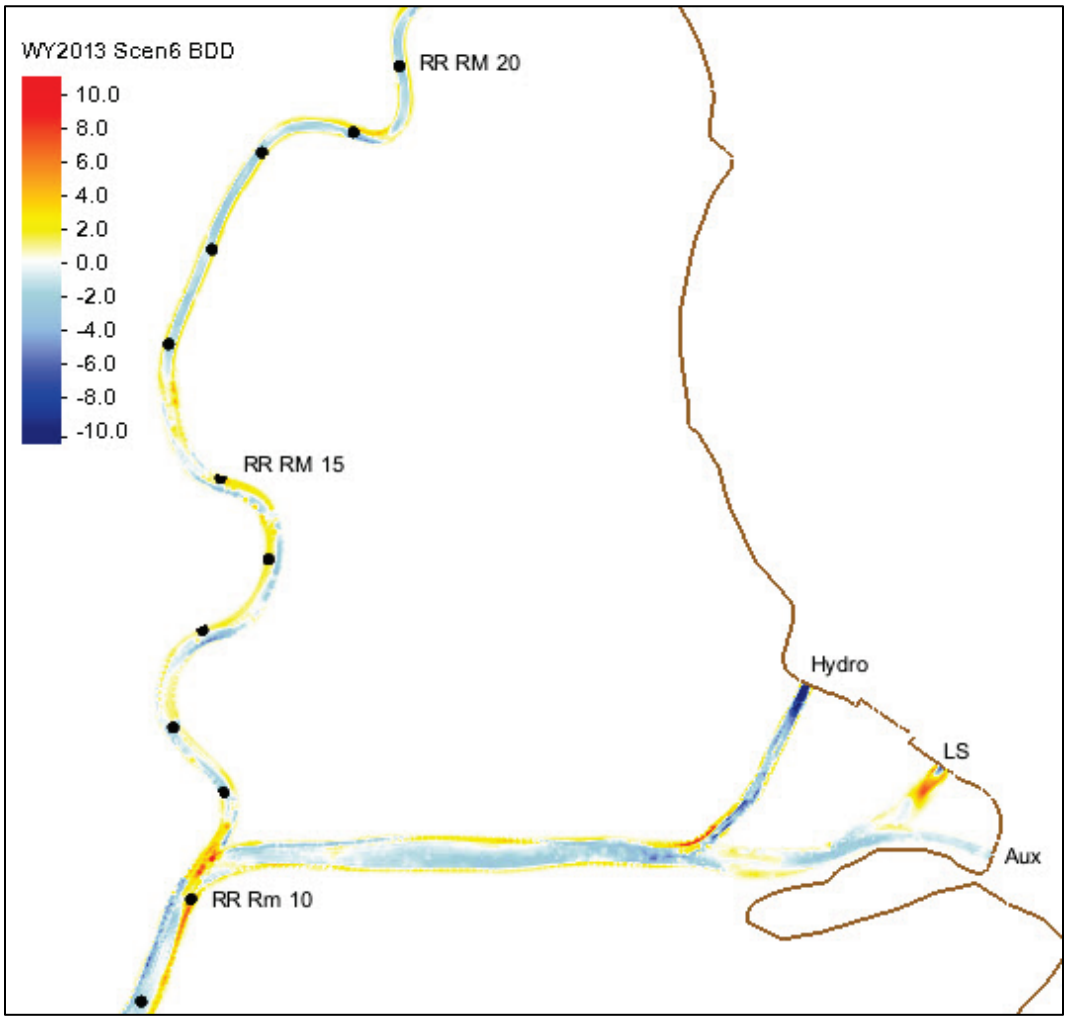


Plate F.47. WY2013 Scenario 6 BDD Outflow Channel.

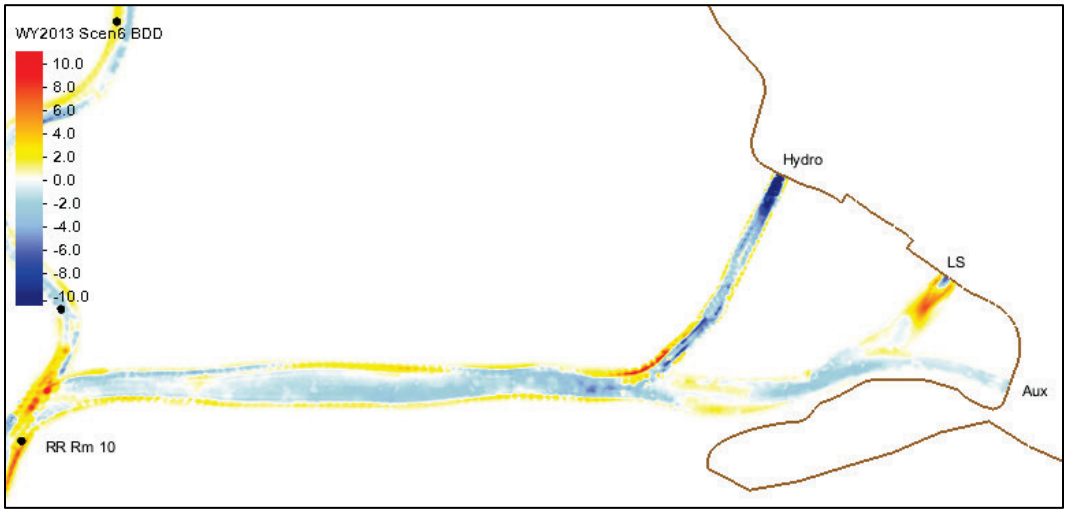


Plate F.48. WY2013 Scenario 6 BDD RR RM 10–Atcha RM 5.

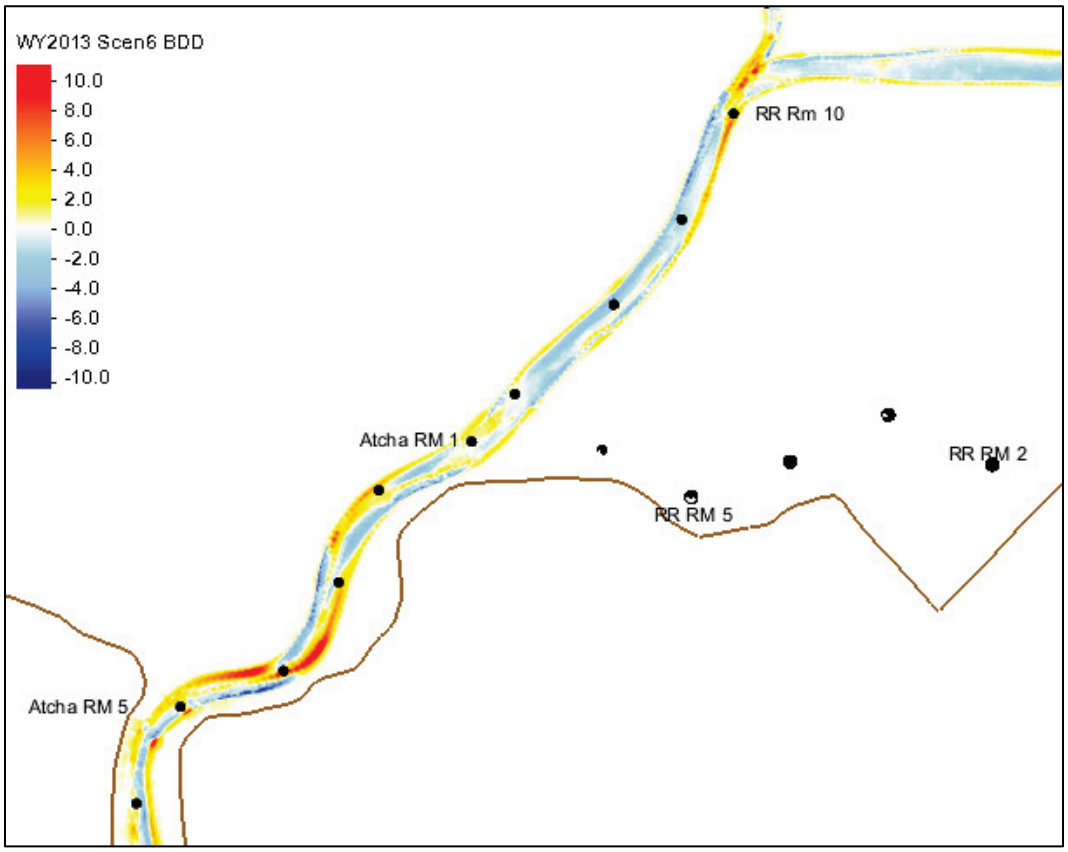


Plate F.49. WY2013 Scenario 6 BDD Atcha RM 5–Atcha RM 15.

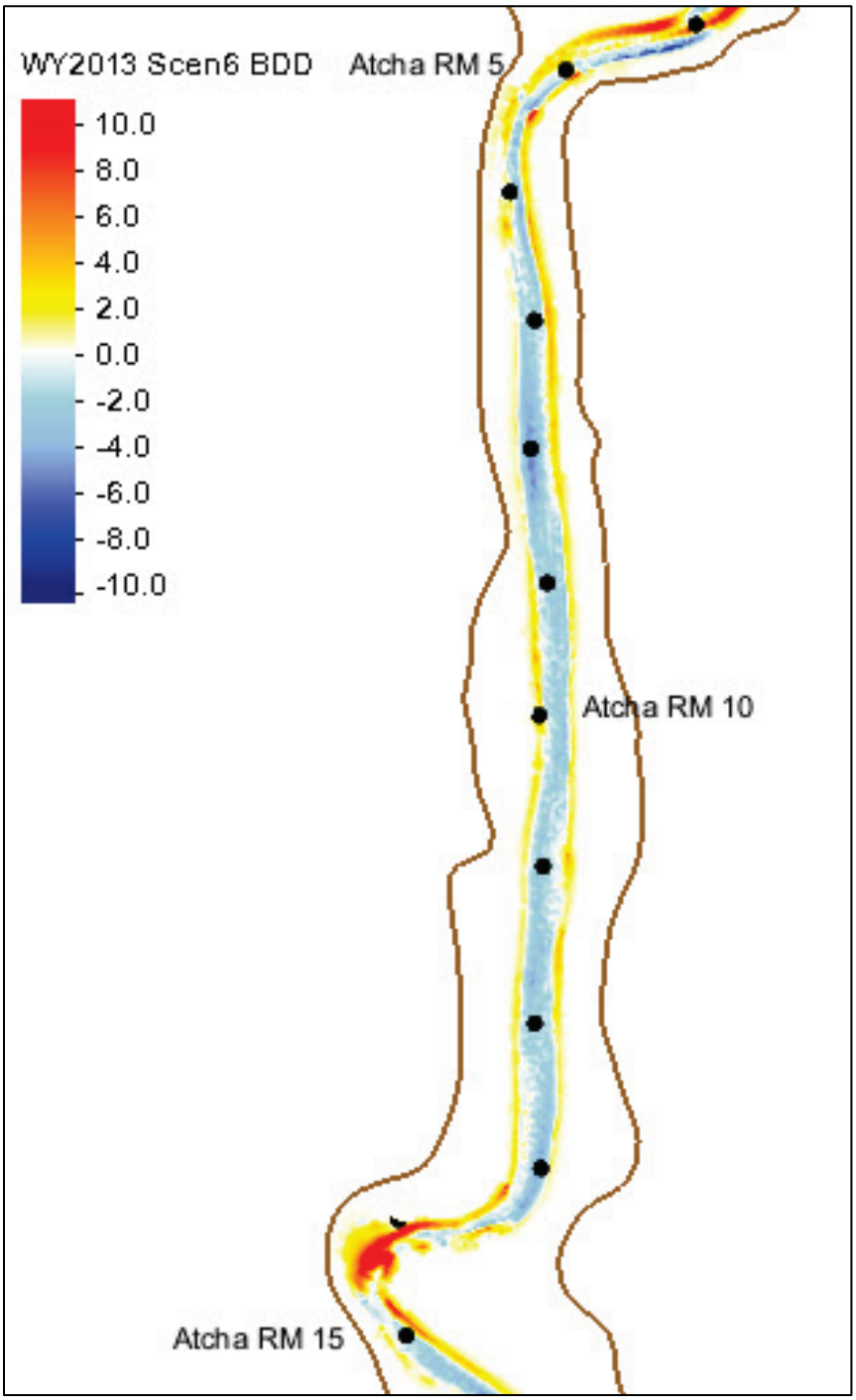
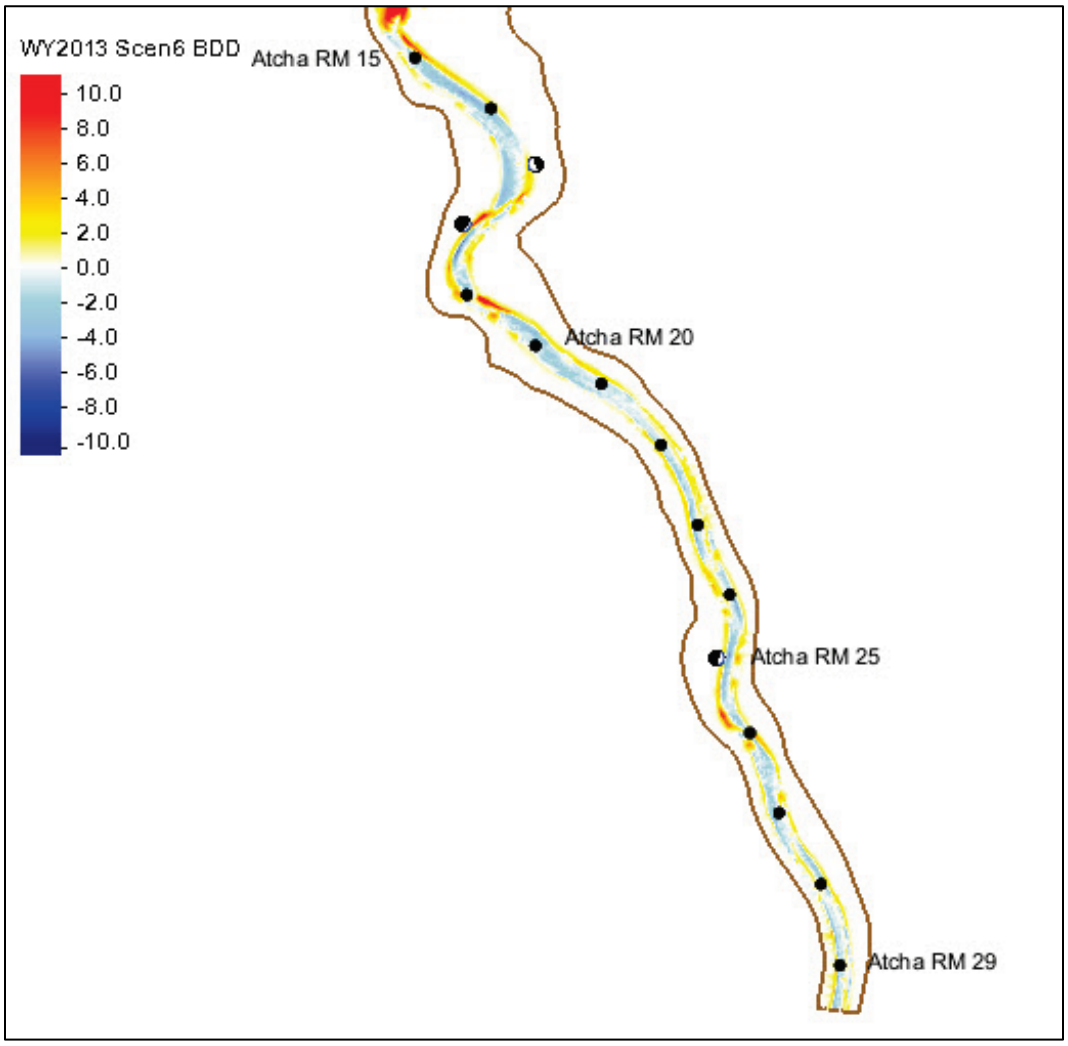


Plate F.50. WY2013 Scenario 6 BDD Atcha RM 15–Atcha RM 29.



F.6 Scenario 7

Plate F.51. WY2013 Scenario 7 BDD RR RM 43–RR RM 30.

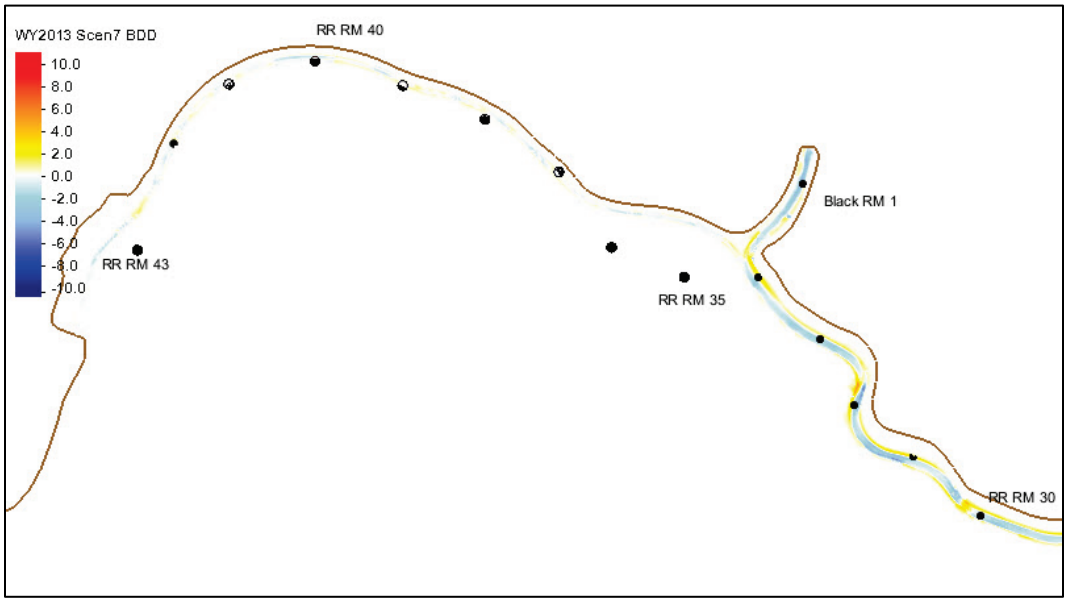


Plate F.52. WY2013 Scenario 7 BDD RR RM 30–RR RM 20.

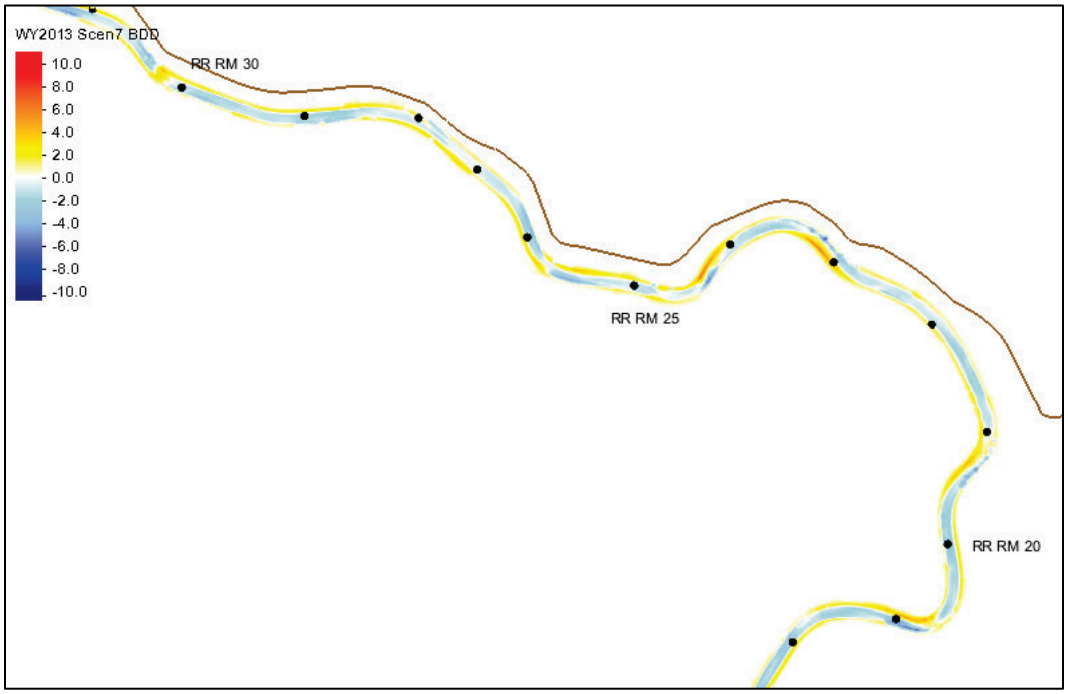


Plate F.53. WY2013 Scenario 7 BDD RR RM 20–RR RM 10 and Outflow Channel.

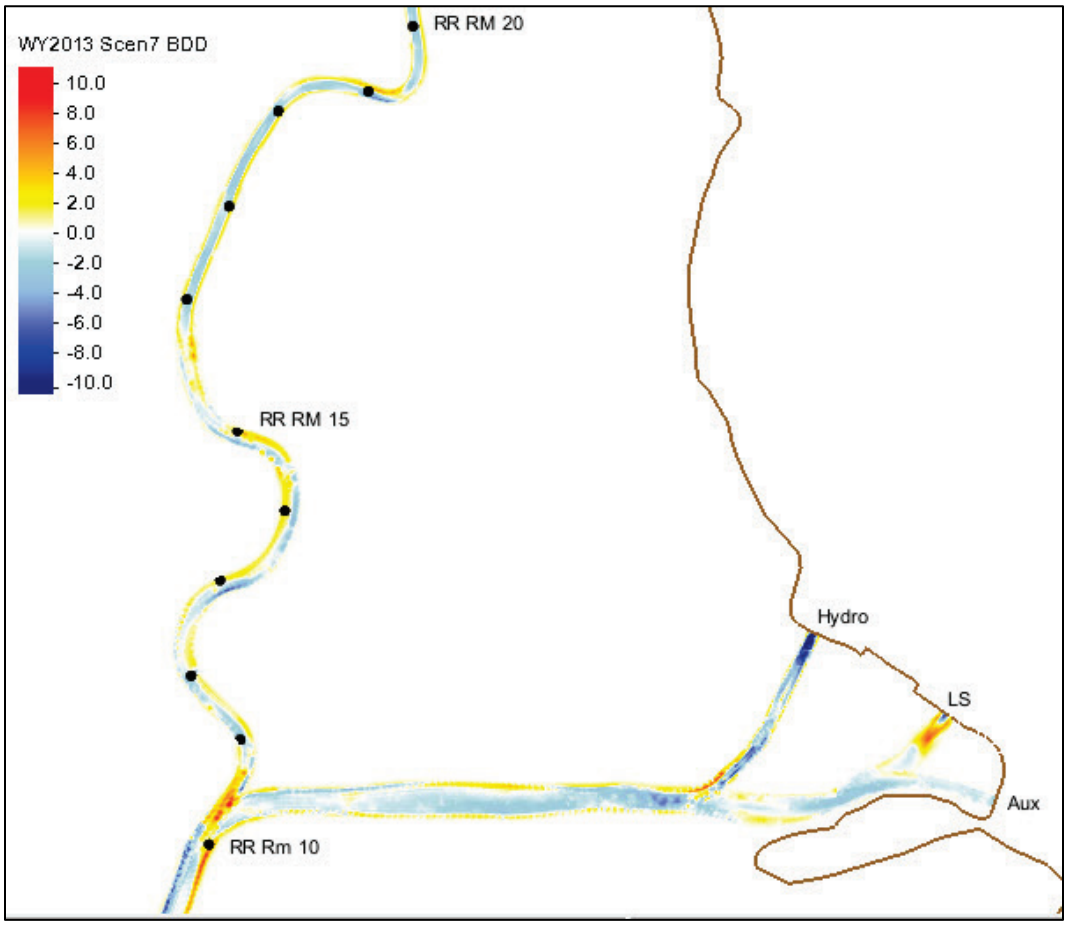


Plate F.54. WY2013 Scenario 7 BDD Outflow Channel.

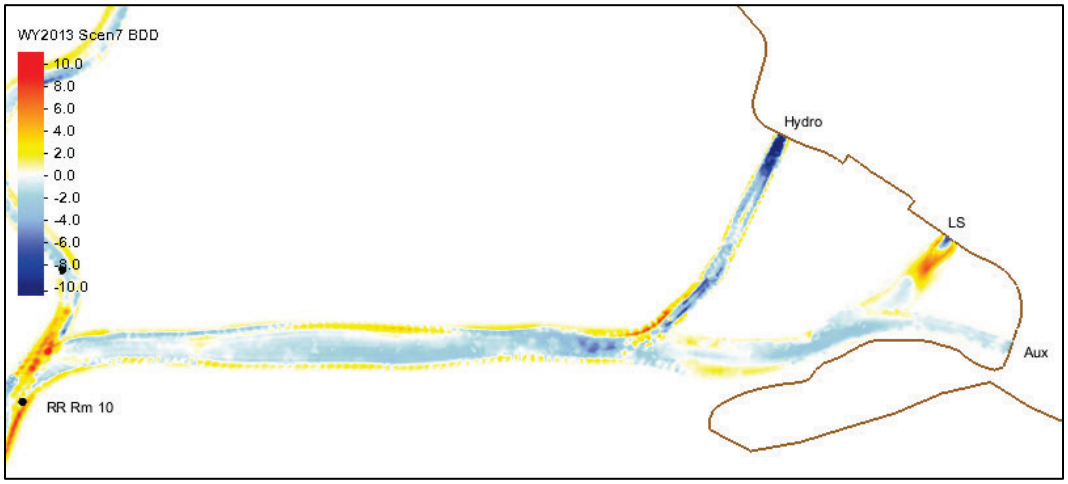


Plate F.55. WY2013 Scenario 7 BDD RR RM 10–Atcha RM 5.

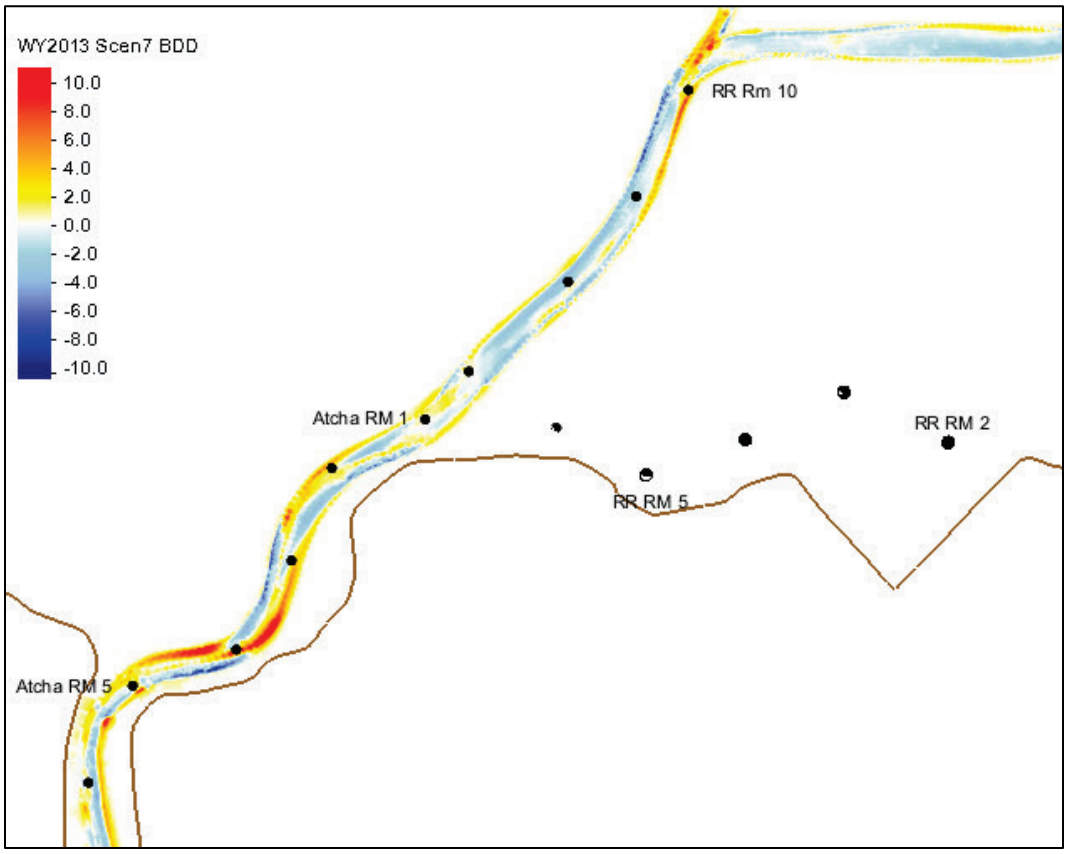


Plate F.56. WY2013 Scenario 7 BDD Atcha RM 5–Atcha RM 15.

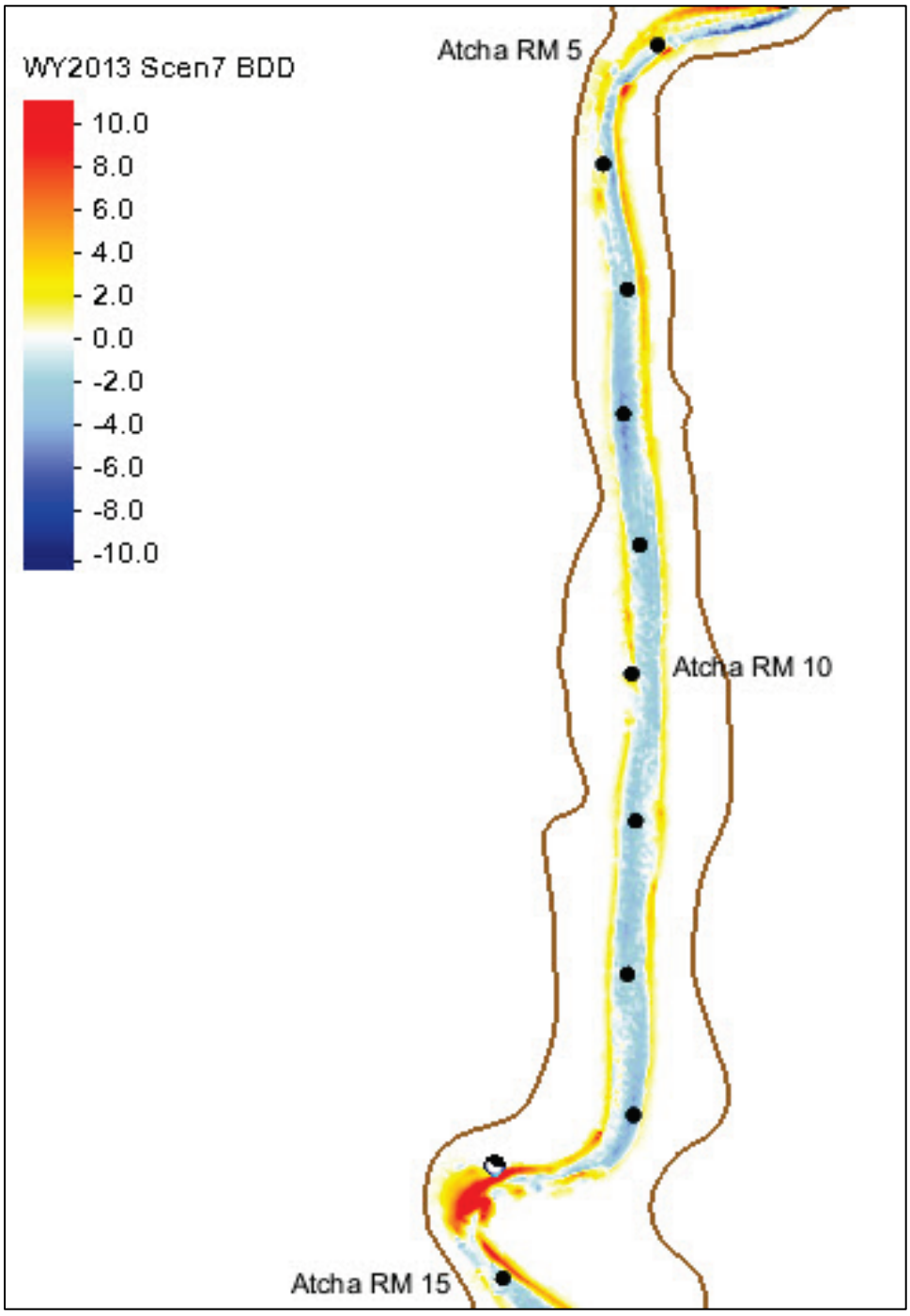
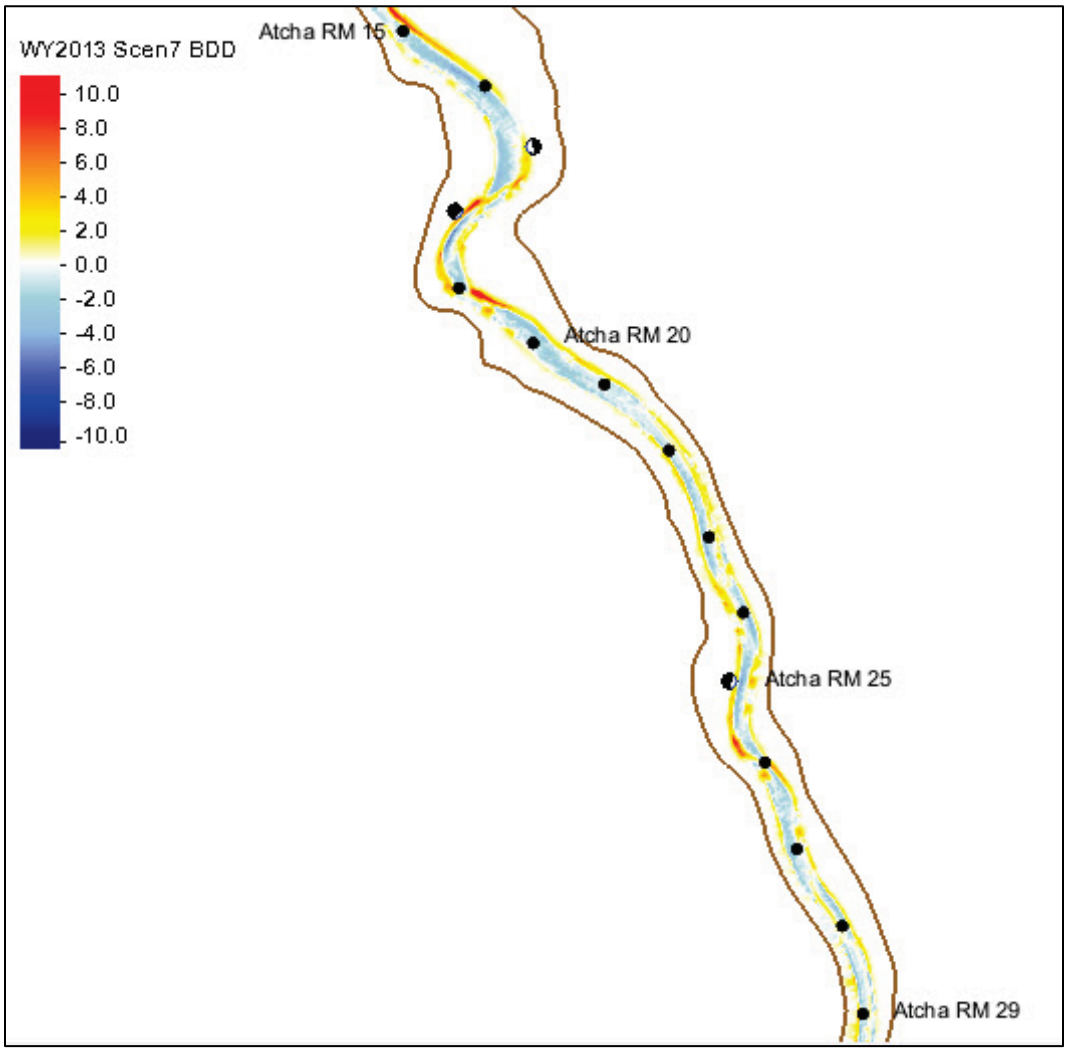


Plate F.57. WY2013 Scenario 7 BDD Atcha RM 15–Atcha RM 29.



F.7 Scenario 8a

Plate F.58. WY2013 Scenario 8a BDD RR RM 43–RR RM 30.

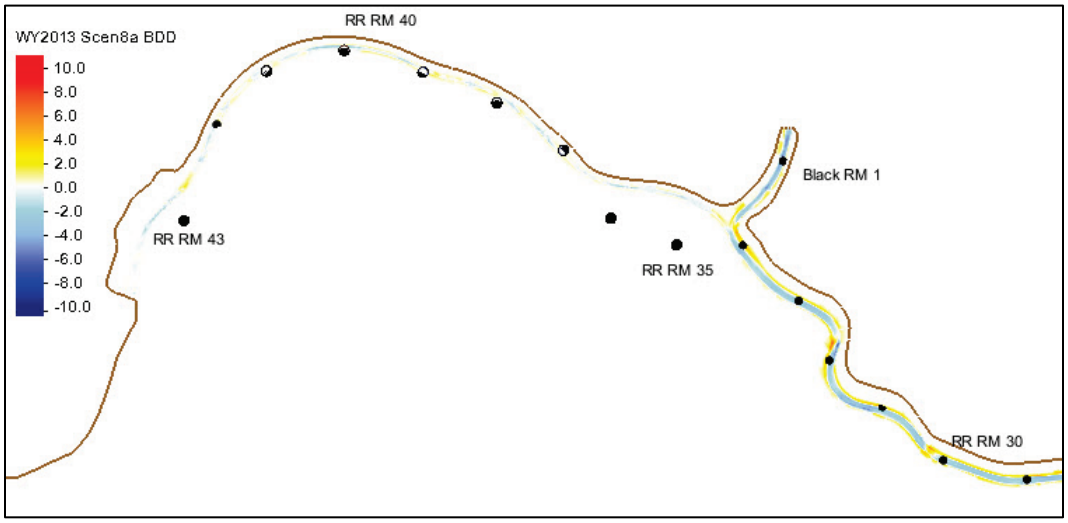


Plate F.59. WY2013 Scenario 8a BDD RR RM 30–RR RM 20.

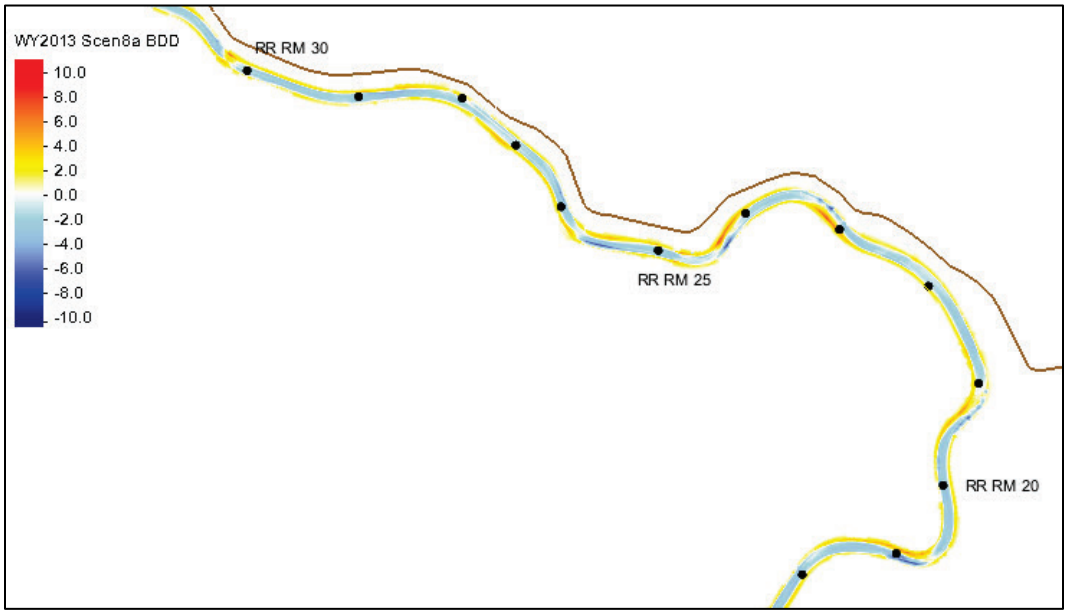


Plate F.60. WY2013 Scenario 8a BDD RR RM 20–RR RM 10 and Outflow Channel.

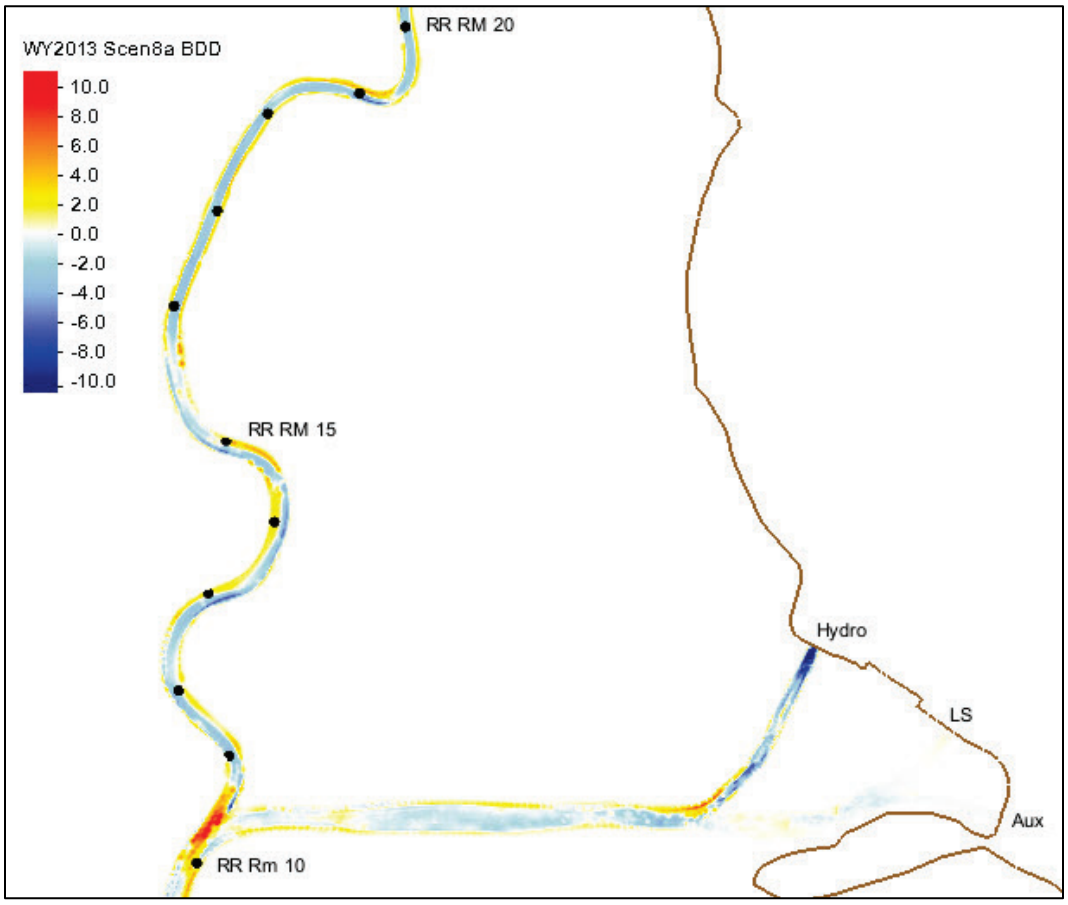


Plate F.61. WY2013 Scenario 8a BDD Outflow Channel.

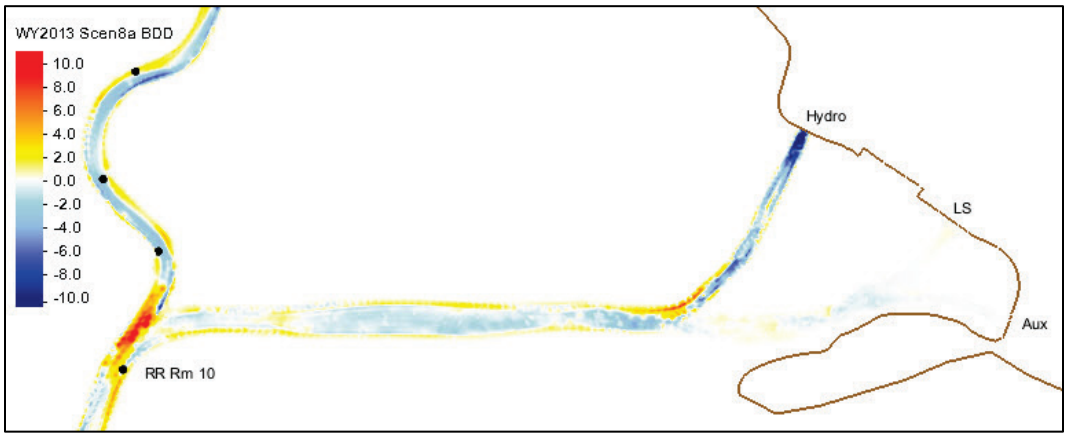


Plate F.62. WY2013 Scenario 8a BDD RR RM 10–Atcha RM 5.

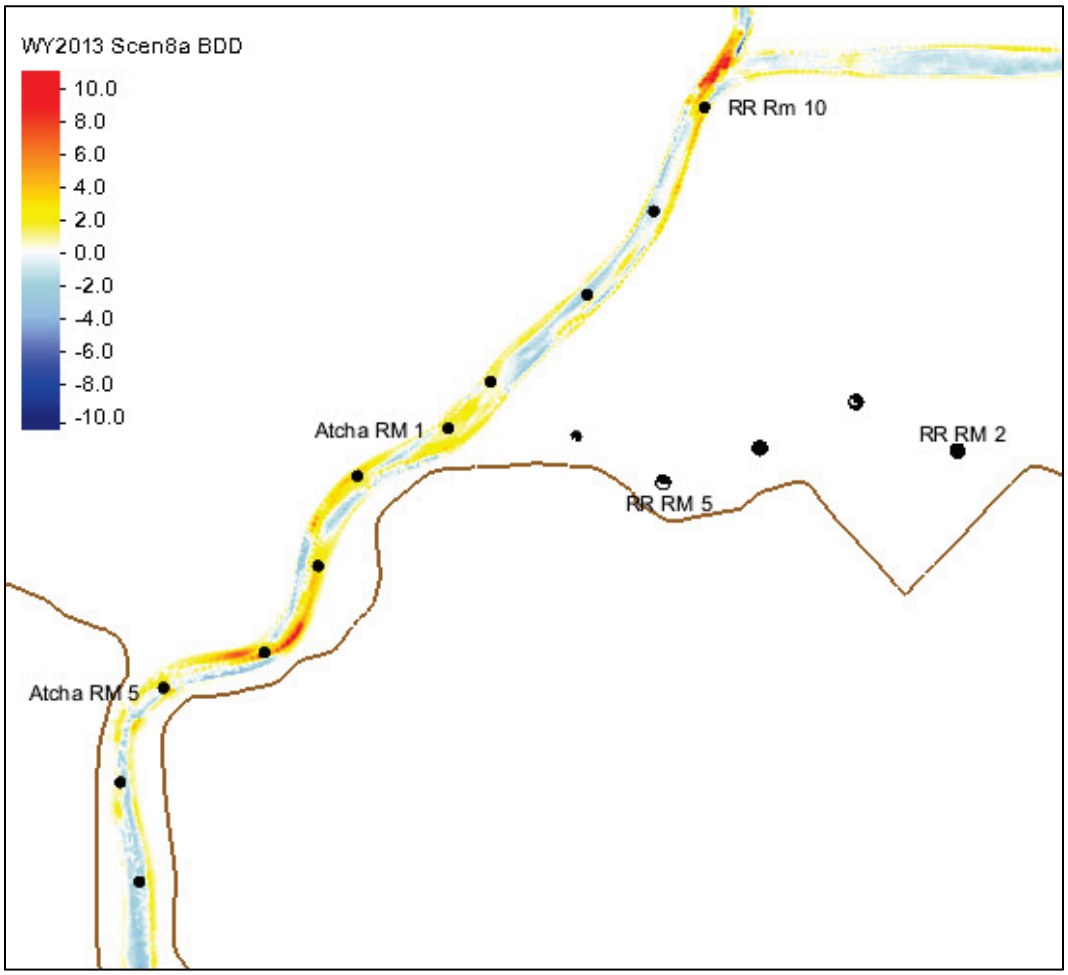


Plate F.63. WY2013 Scenario 8a BDD Atcha RM 5–Atcha RM 15.

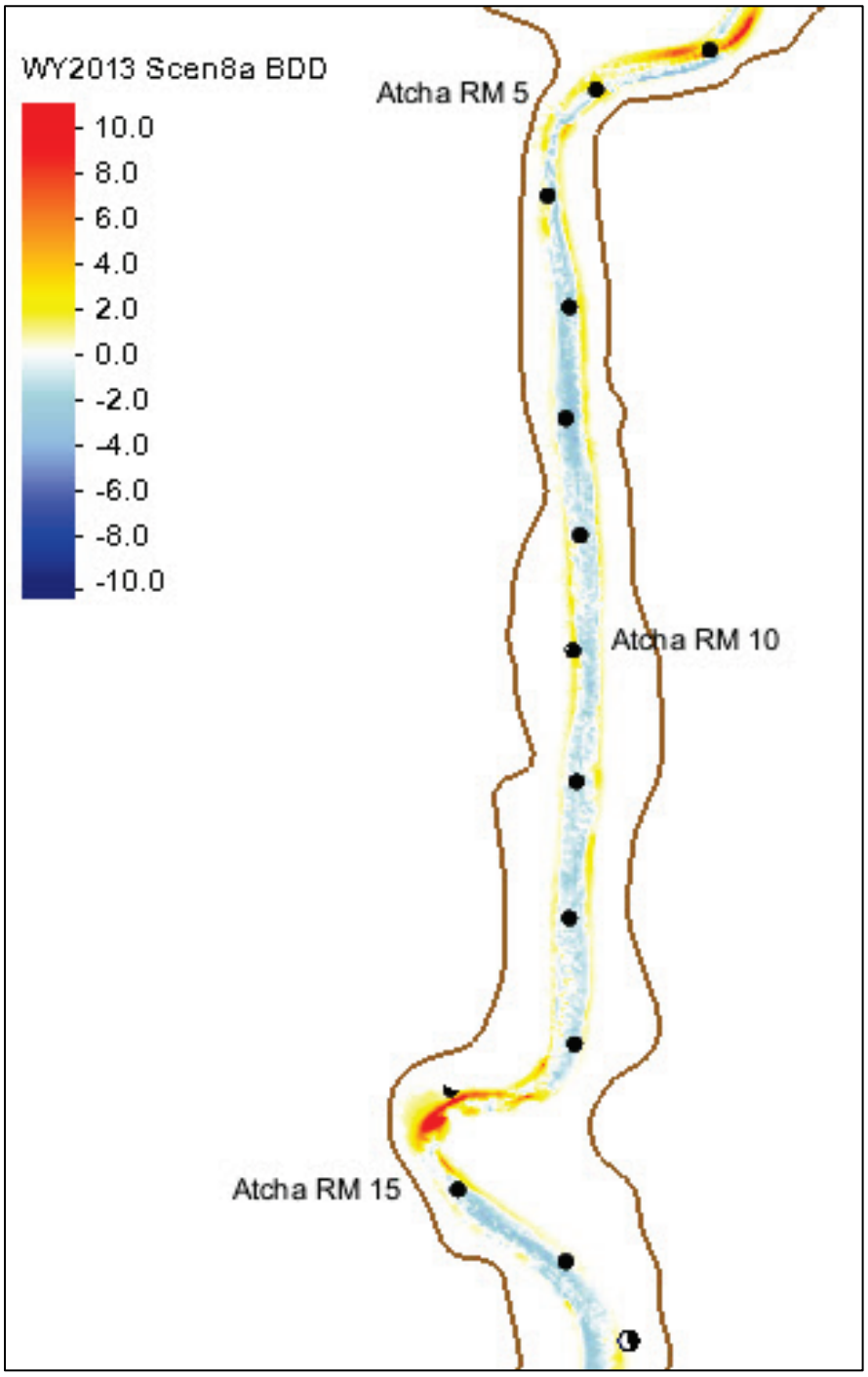
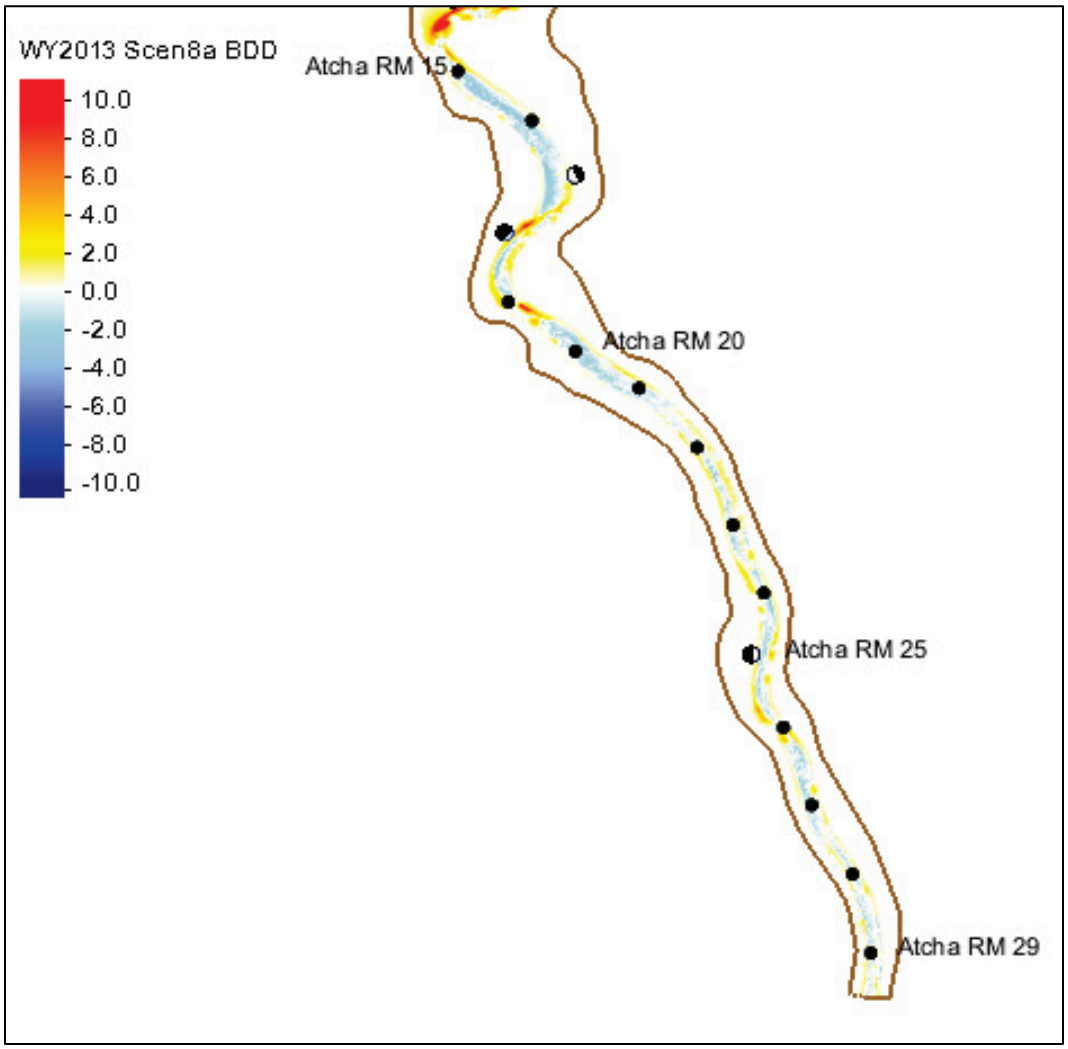


Plate F.64. WY2013 Scenario 8a BDD Atcha RM 15–Atcha RM 29.



F.8 Scenario 8b

Plate F.65. WY2013 Scenario 8b BDD RR RM 43–RR RM 30.

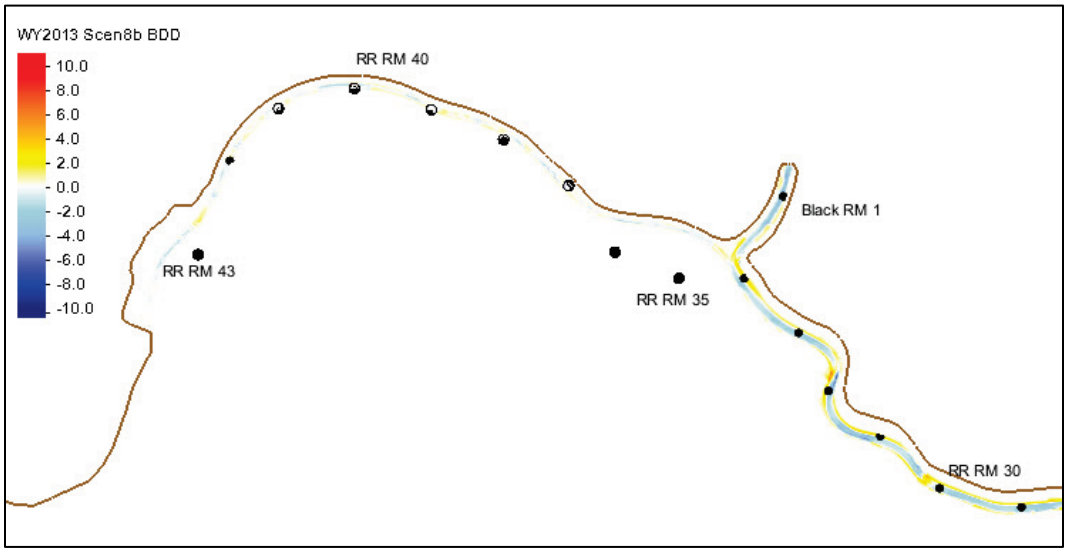


Plate F.66. WY2013 Scenario 8b BDD RR RM 30–RR RM 20.

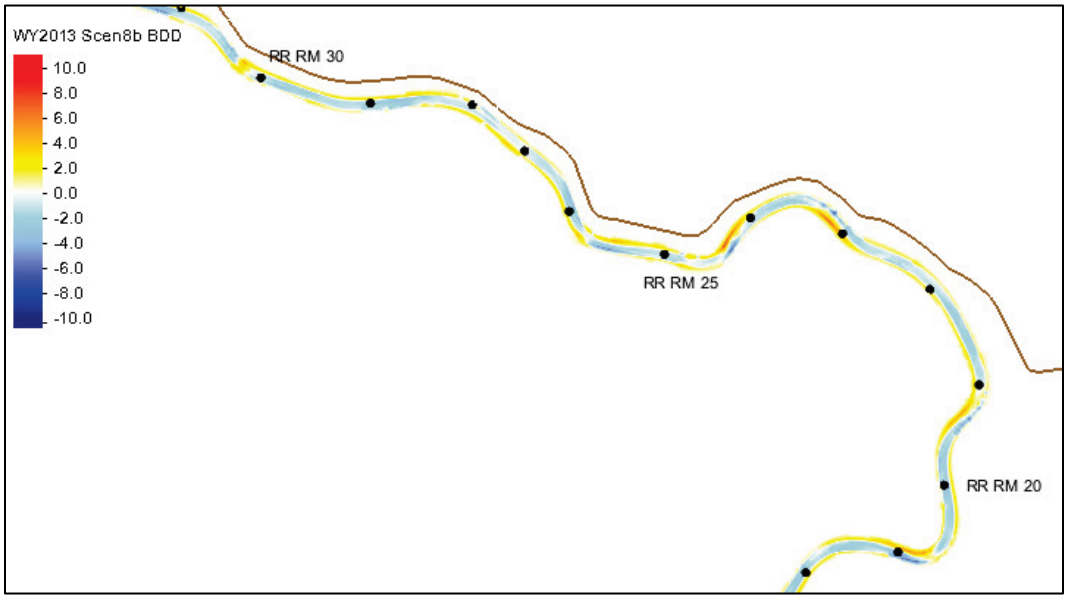


Plate F.67. WY2013 Scenario 8b BDD RR RM 20–RR RM 10 and Outflow Channel.

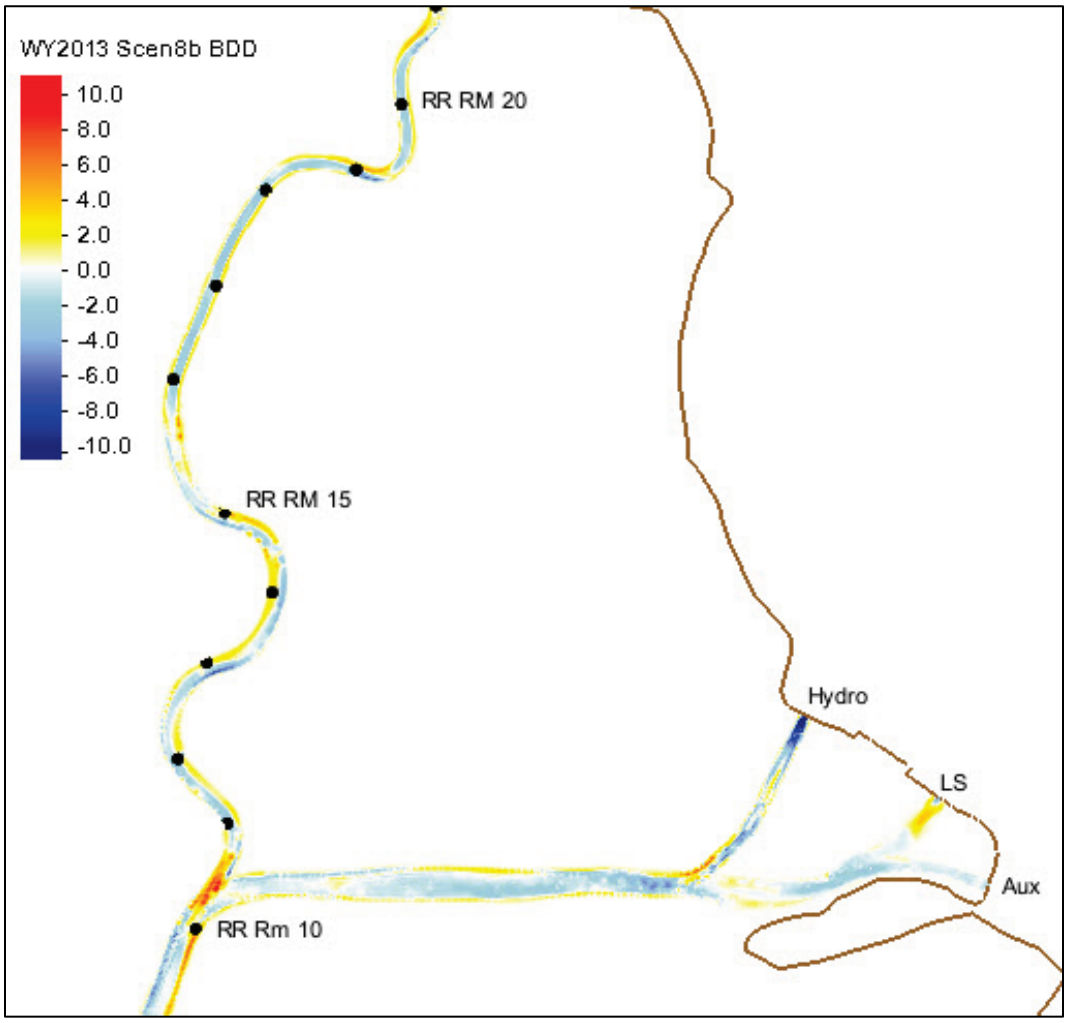


Plate F.68. WY2013 Scenario 8b BDD Outflow Channel.

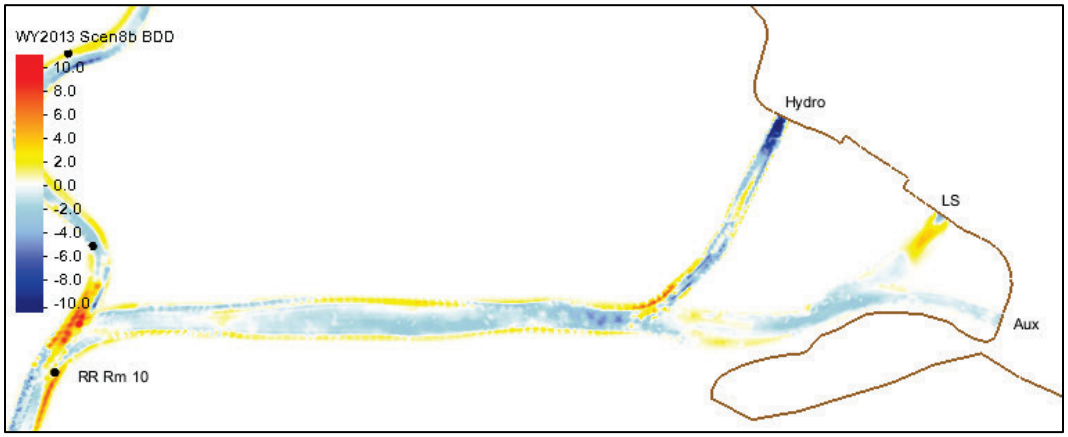


Plate F.69. WY2013 Scenario 8b BDD RR RM 10–Atcha RM 5.

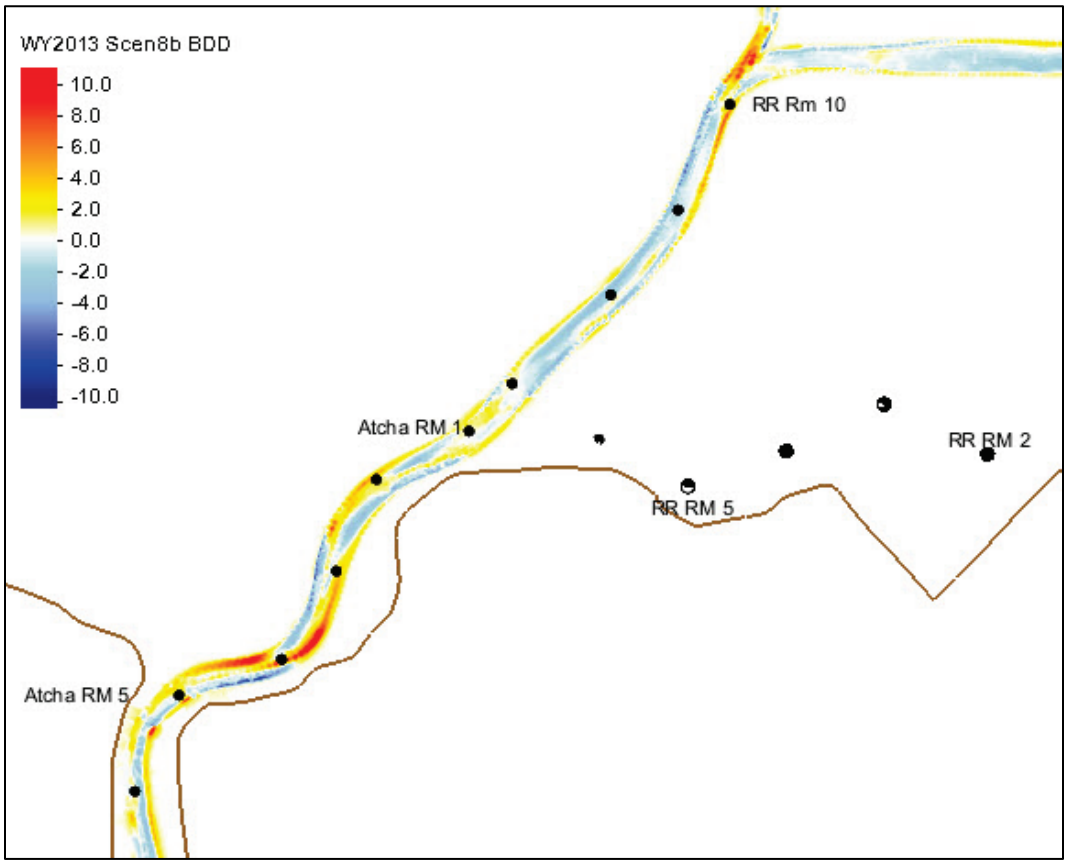


Plate F.70. WY2013 Scenario 8b BDD Atcha RM 5–Atcha RM 15.

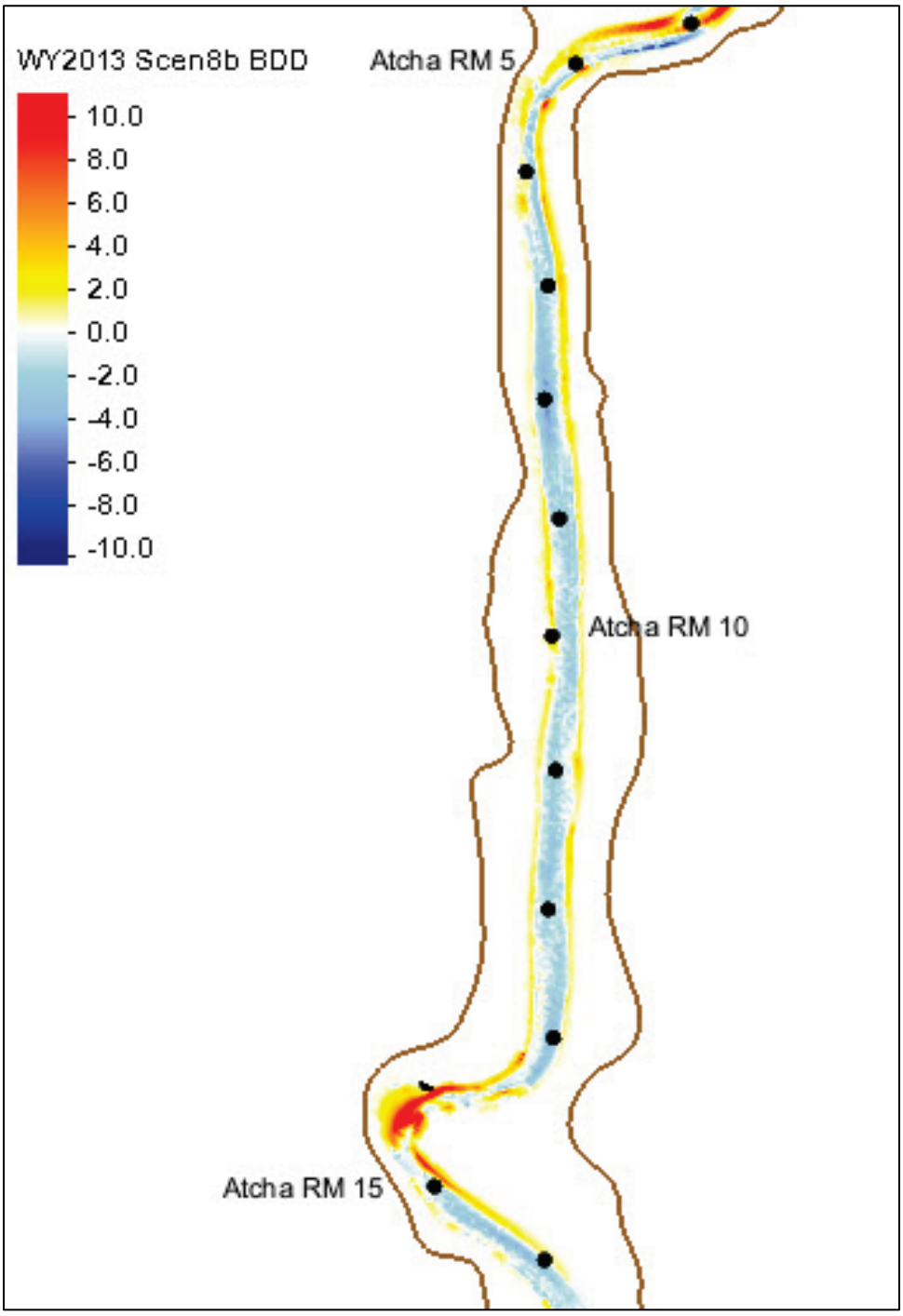
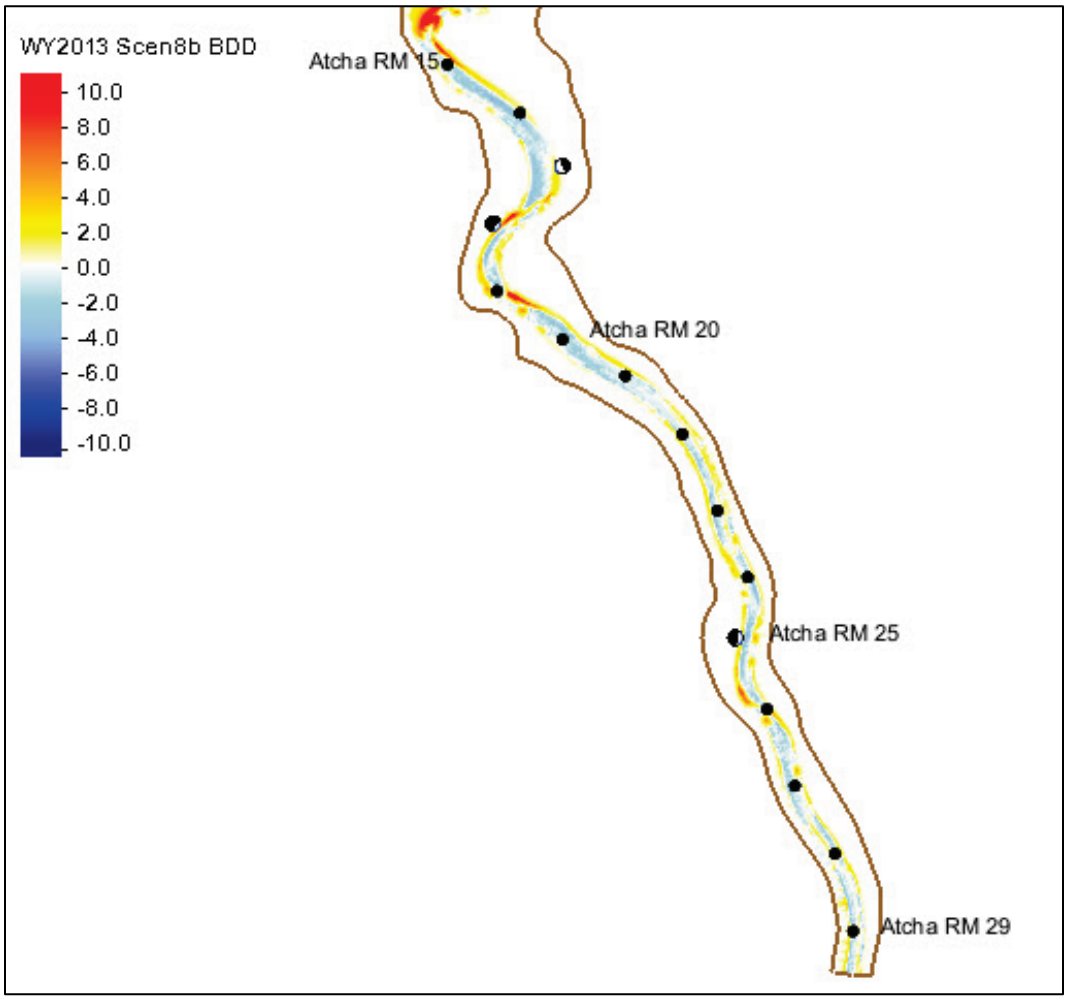


Plate F.71. WY2013 Scenario 8b BDD Atcha RM 15–Atcha RM 29.



F.9 Scenario 9

Plate F.72. WY2013 Scenario 9 BDD RR RM 43–RR RM 30.

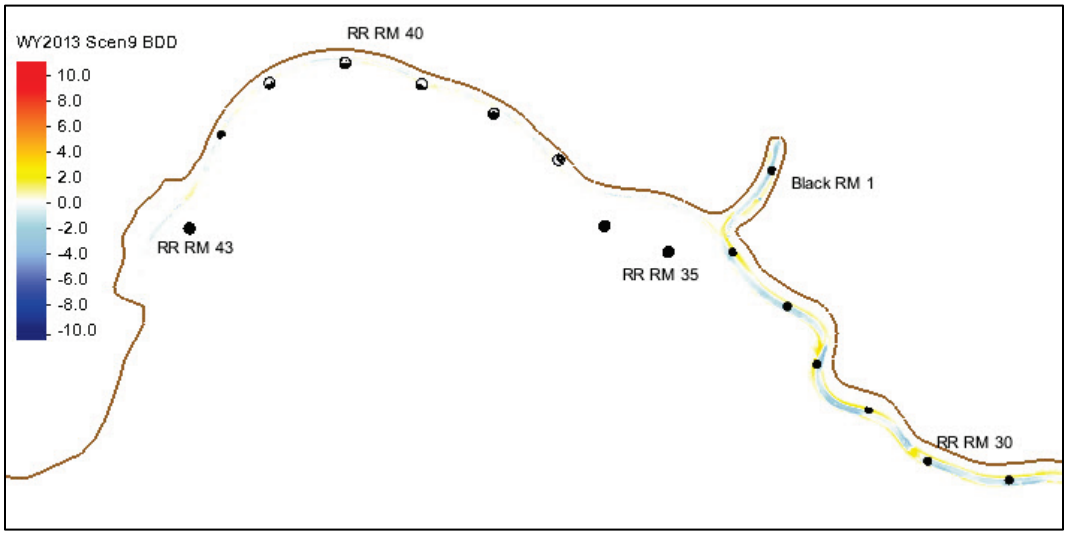


Plate F.73. WY2013 Scenario 9 BDD RR RM 30–RR RM 20.

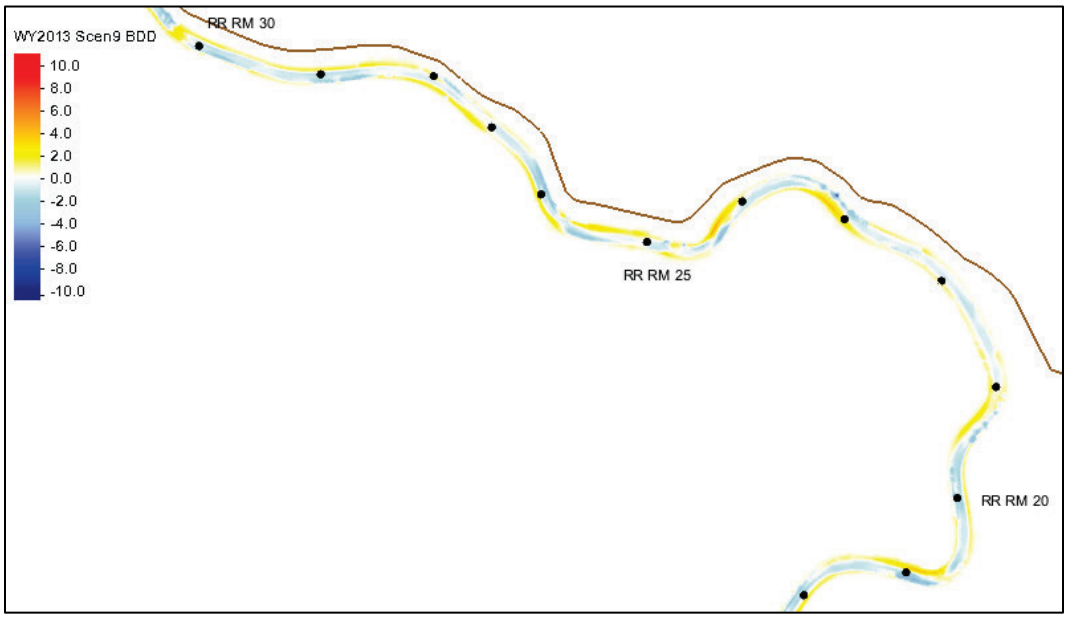


Plate F.74. WY2013 Scenario 9 BDD RR RM 20–RR RM 10 and Outflow Channel.

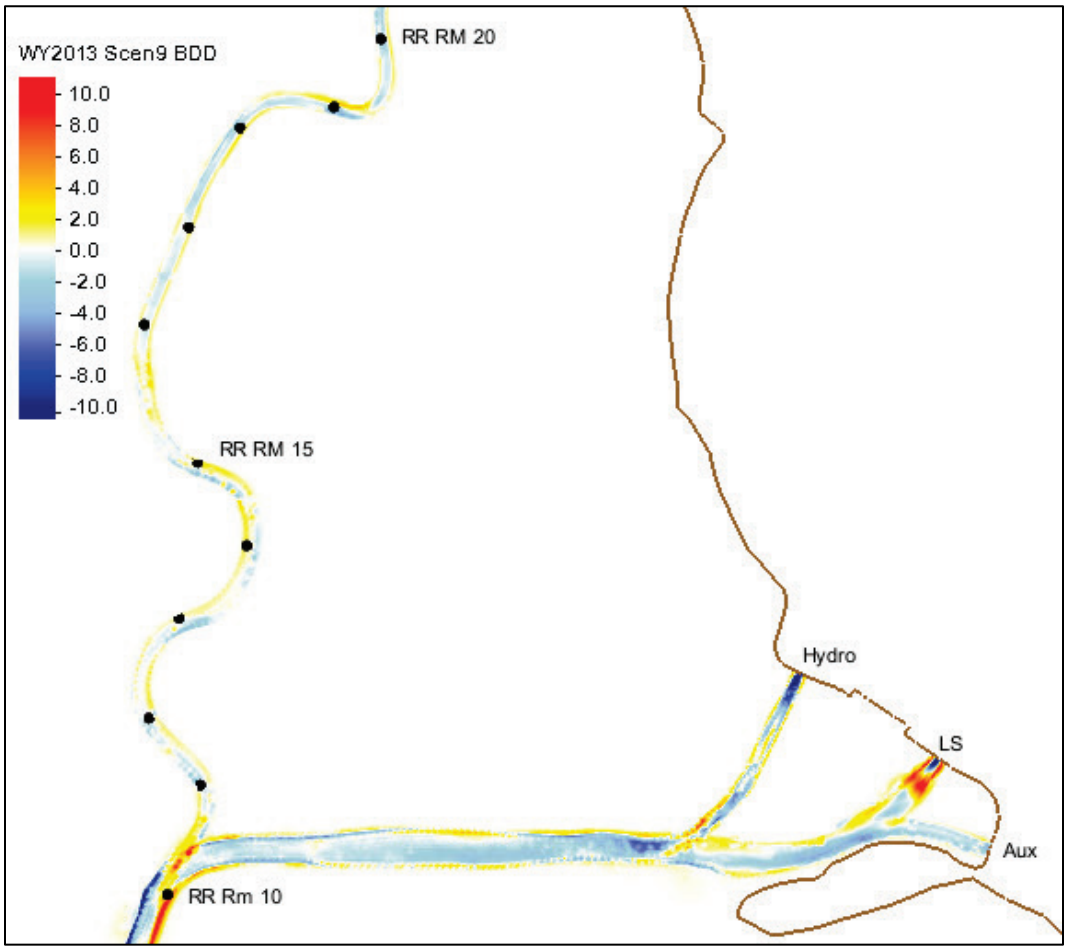


Plate F.75. WY2013 Scenario 9 BDD Outflow Channel.

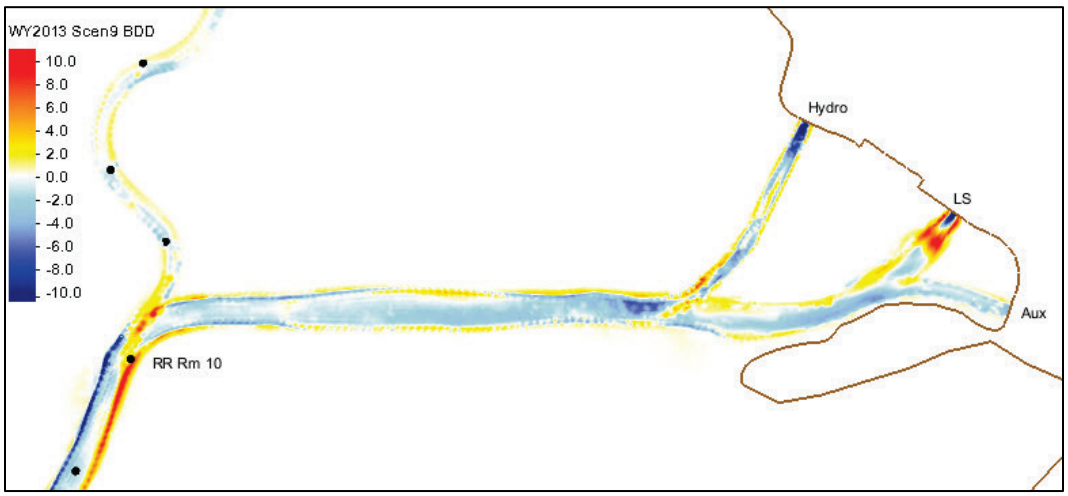


Plate F.76. WY2013 Scenario 9 BDD RR RM 10–Atcha RM 5.

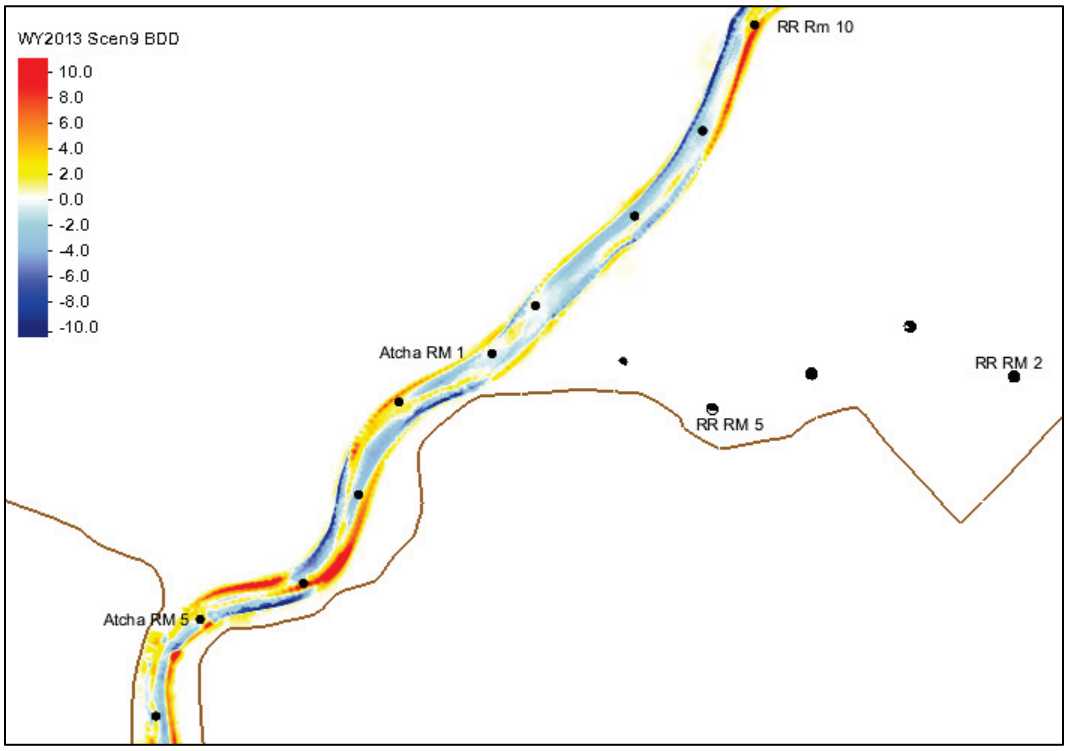


Plate F.77. WY2013 Scenario 9 BDD Atcha RM 5–Atcha RM 15.

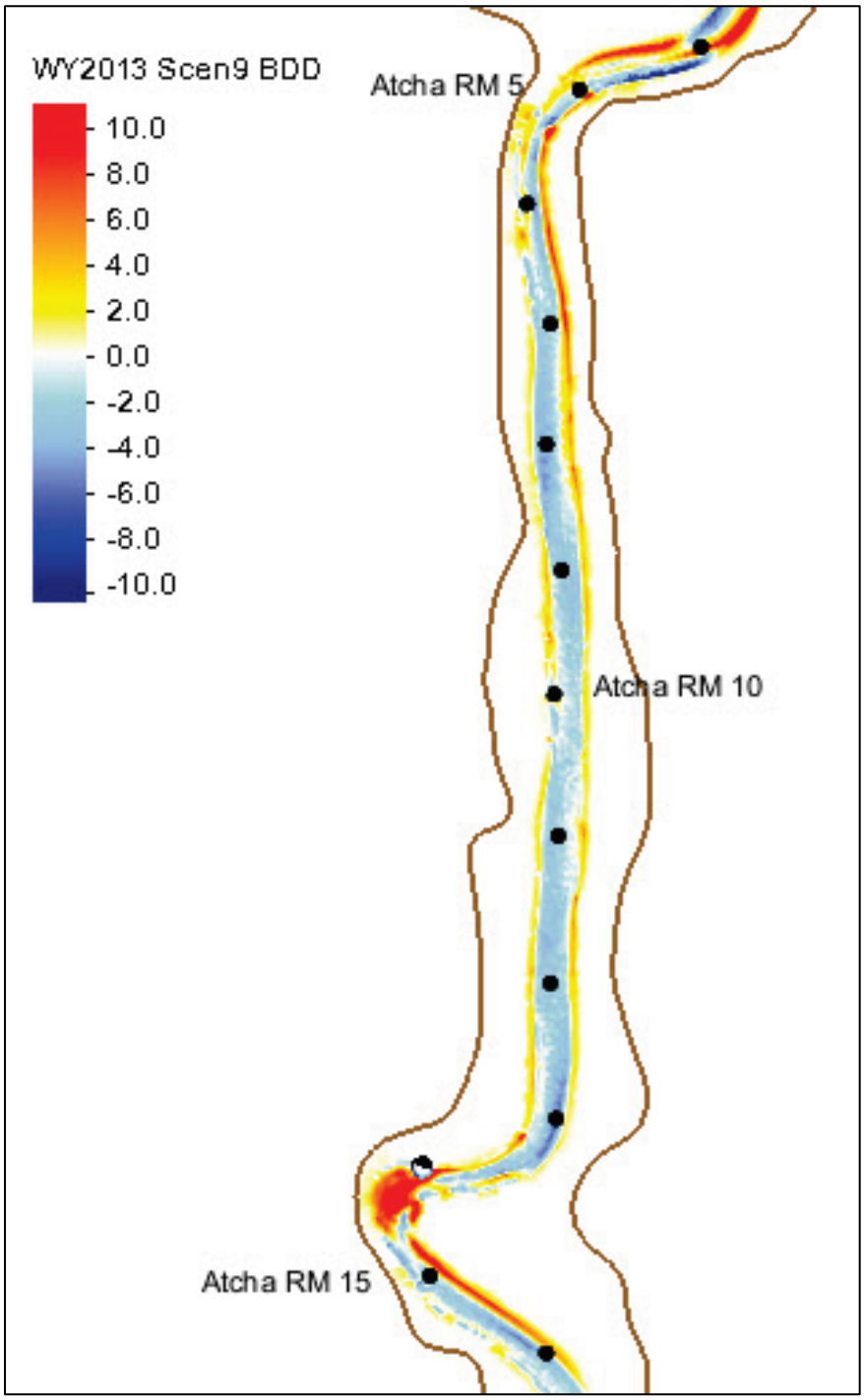
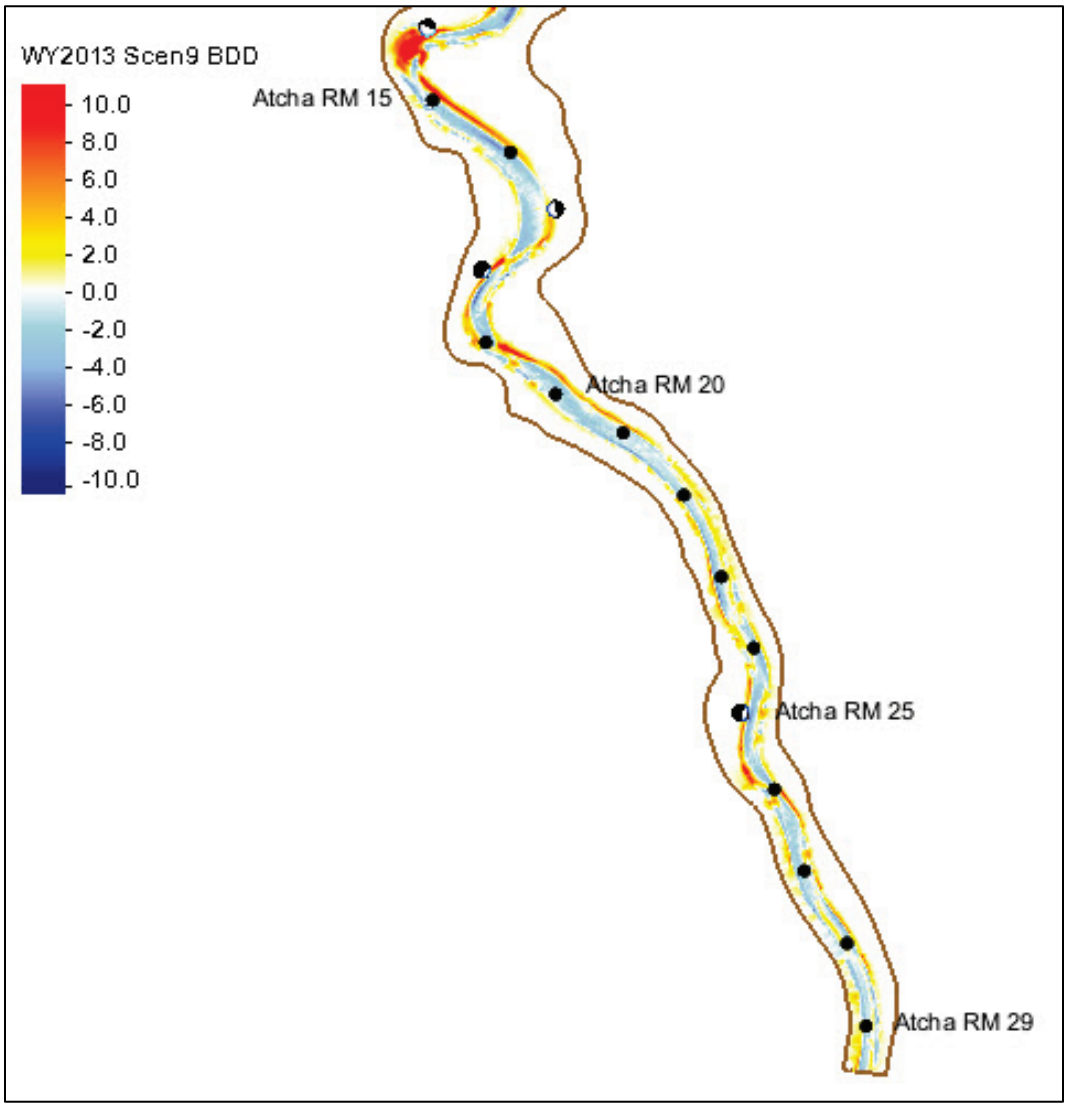


Plate F.78. WY2013 Scenario 9 BDD Atcha RM 15–Atcha RM 29.



F.10 Scenario 10

Plate F.79. WY2013 Scenario 10 BDD RR RM 43–RR RM 30.

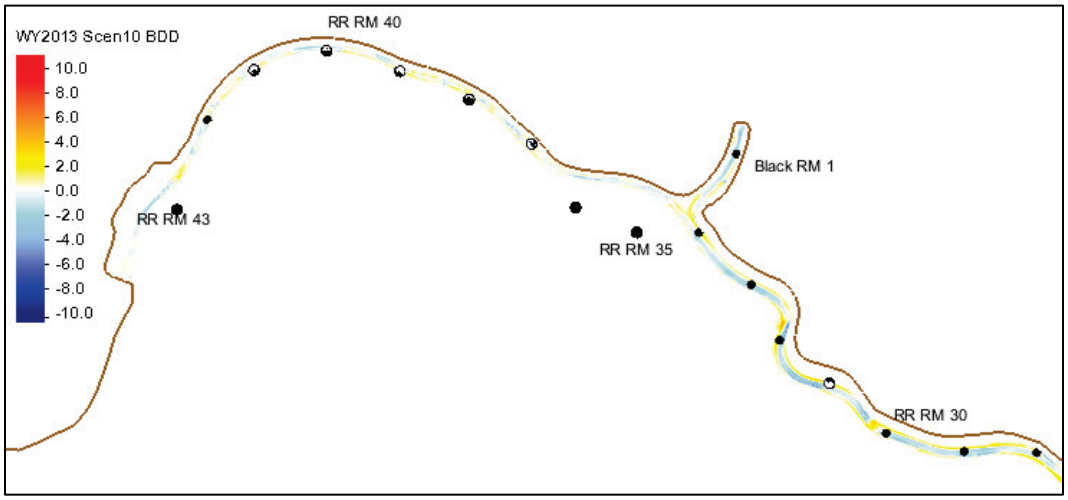


Plate F.80. WY2013 Scenario 10 BDD RR RM 30–RR RM 20.

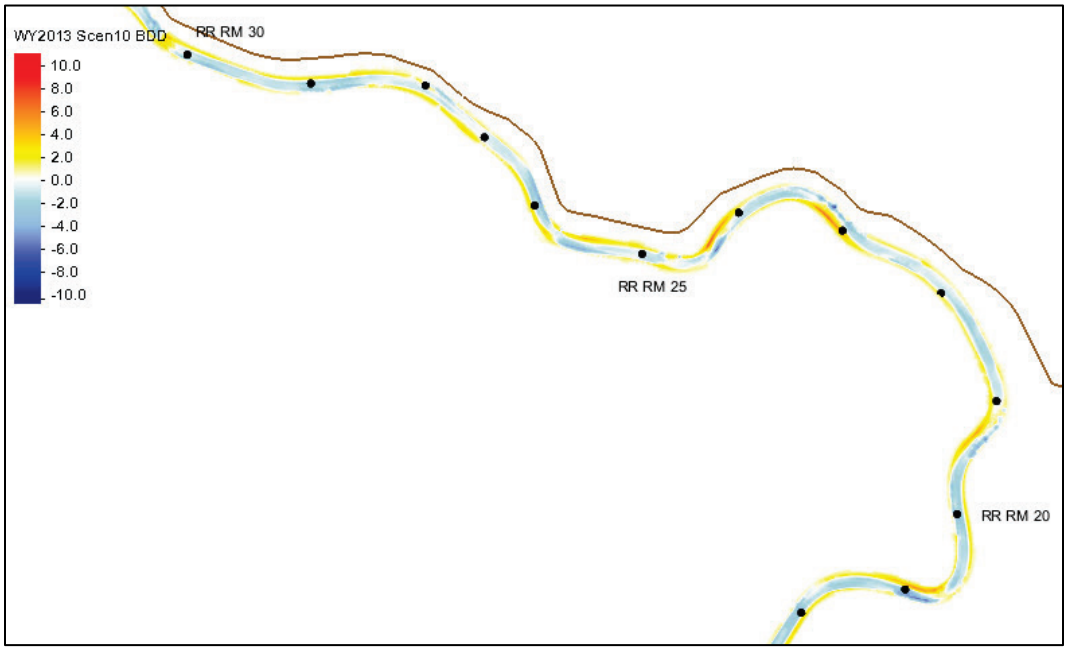


Plate F.81. WY2013 Scenario 10 BDD RR RM 20–RR RM 10 and Outflow Channel.

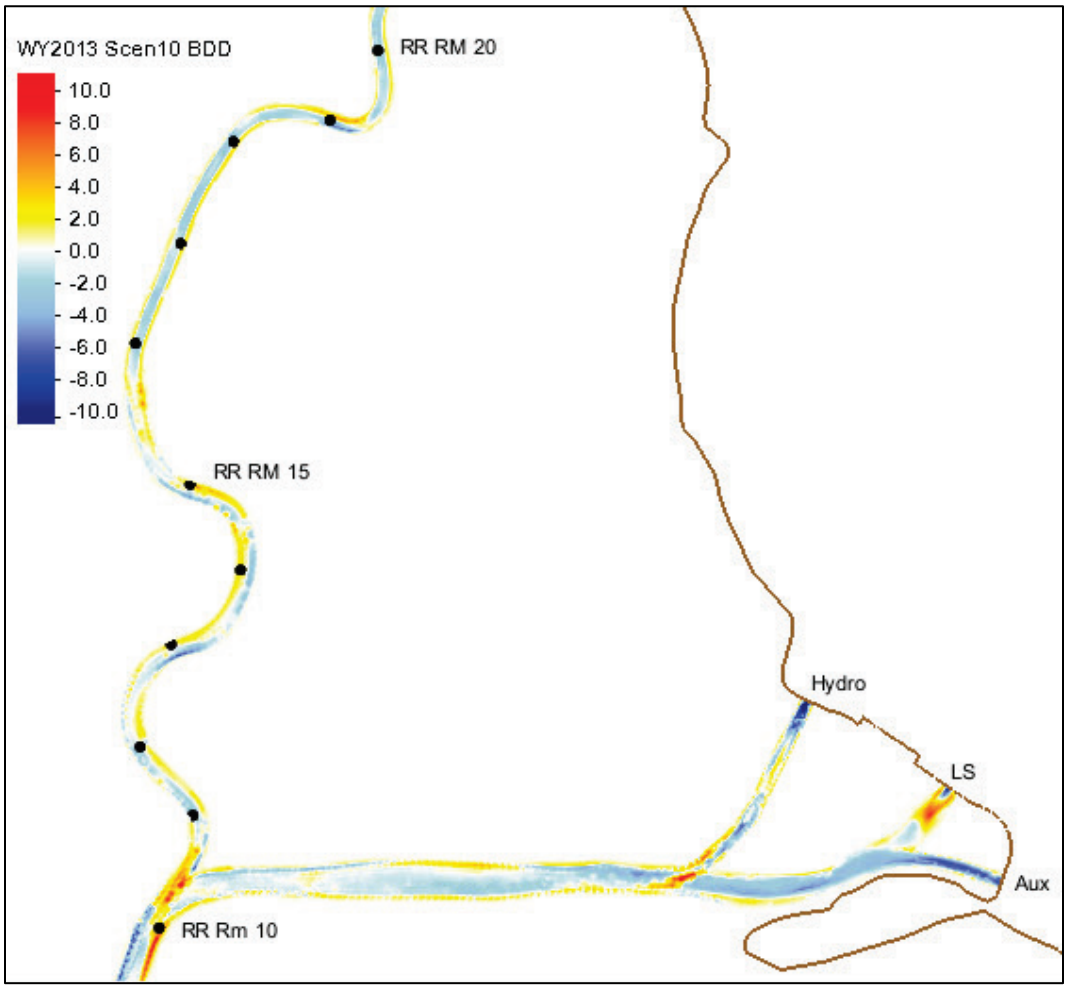


Plate F.82. WY2013 Scenario 10 BDD Outflow Channel.

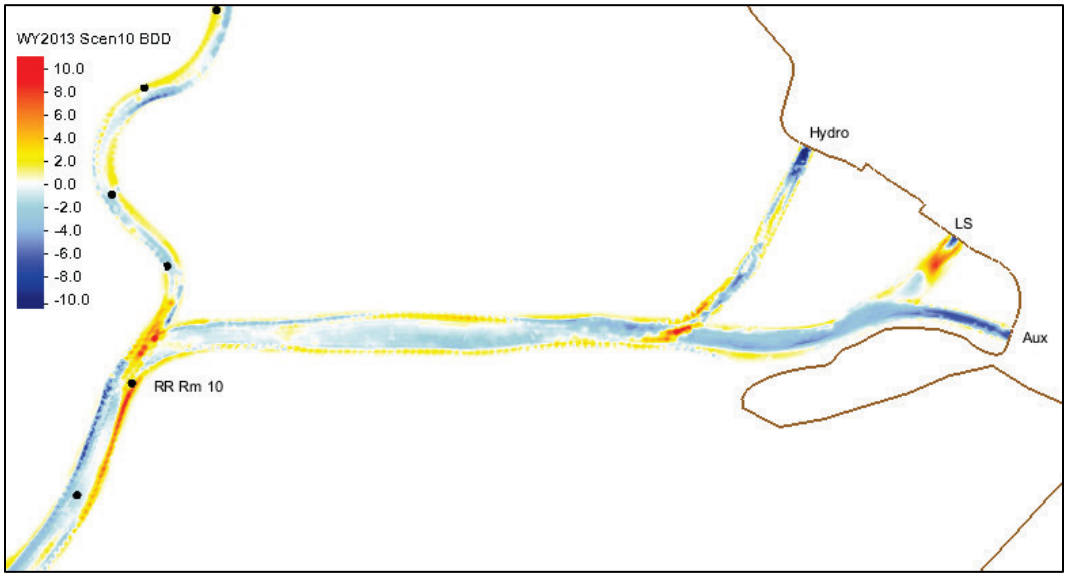


Plate F.83. WY2013 Scenario 10 BDD RR RM 10–Atcha RM 5.

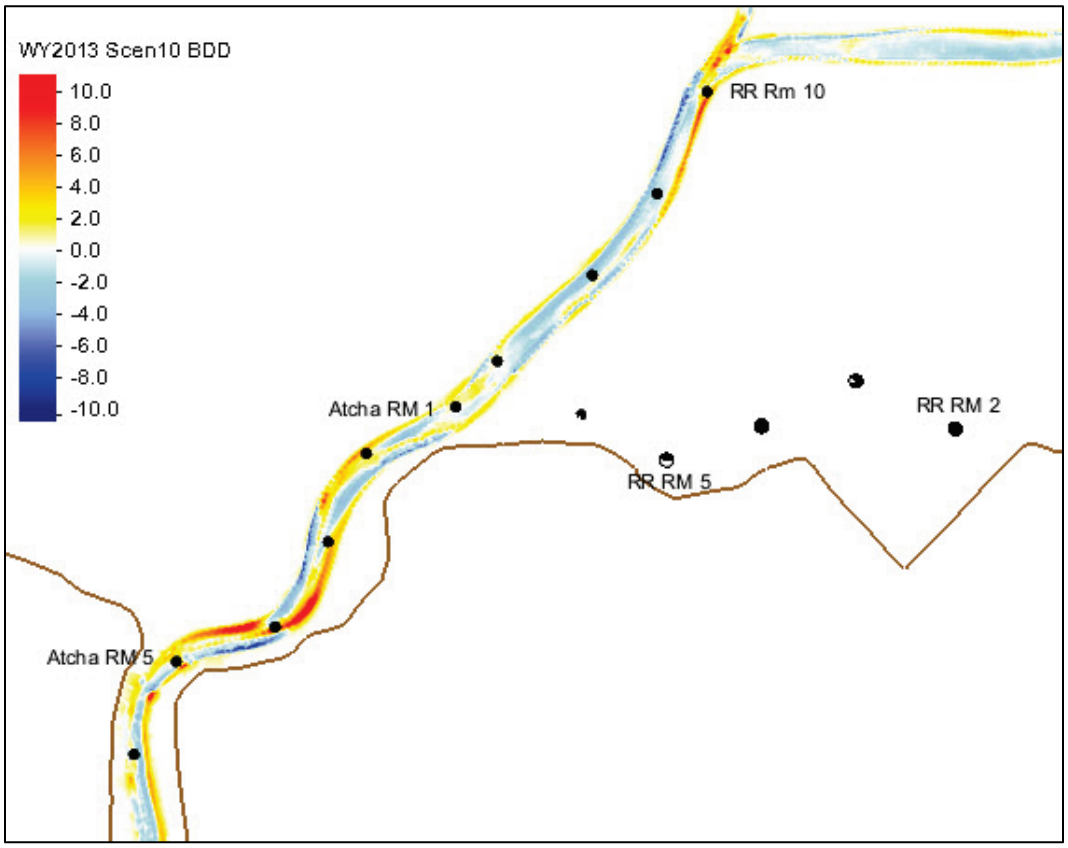


Plate F.84. WY2013 Scenario 10 BDD Atcha RM 5–Atcha RM 15.

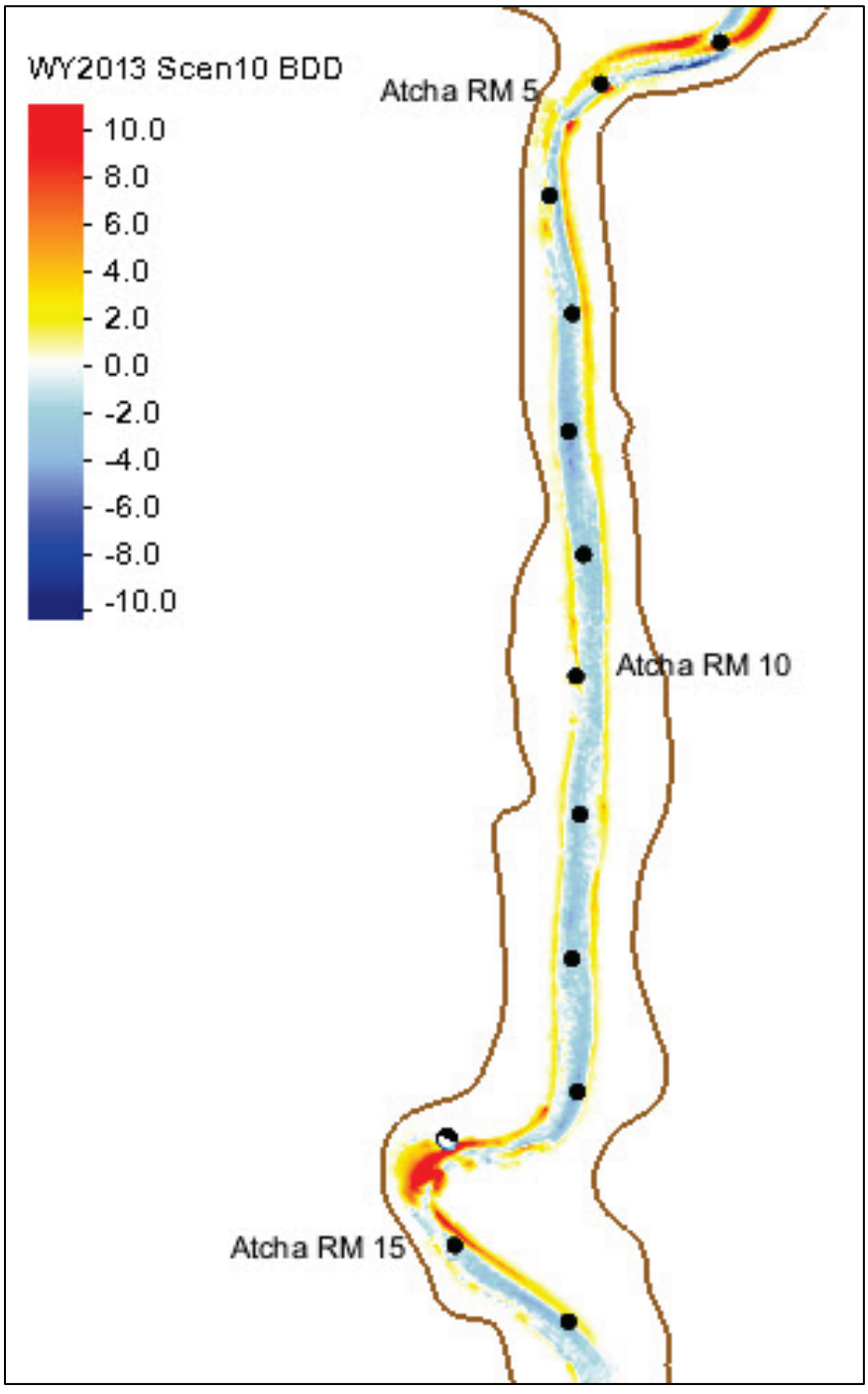
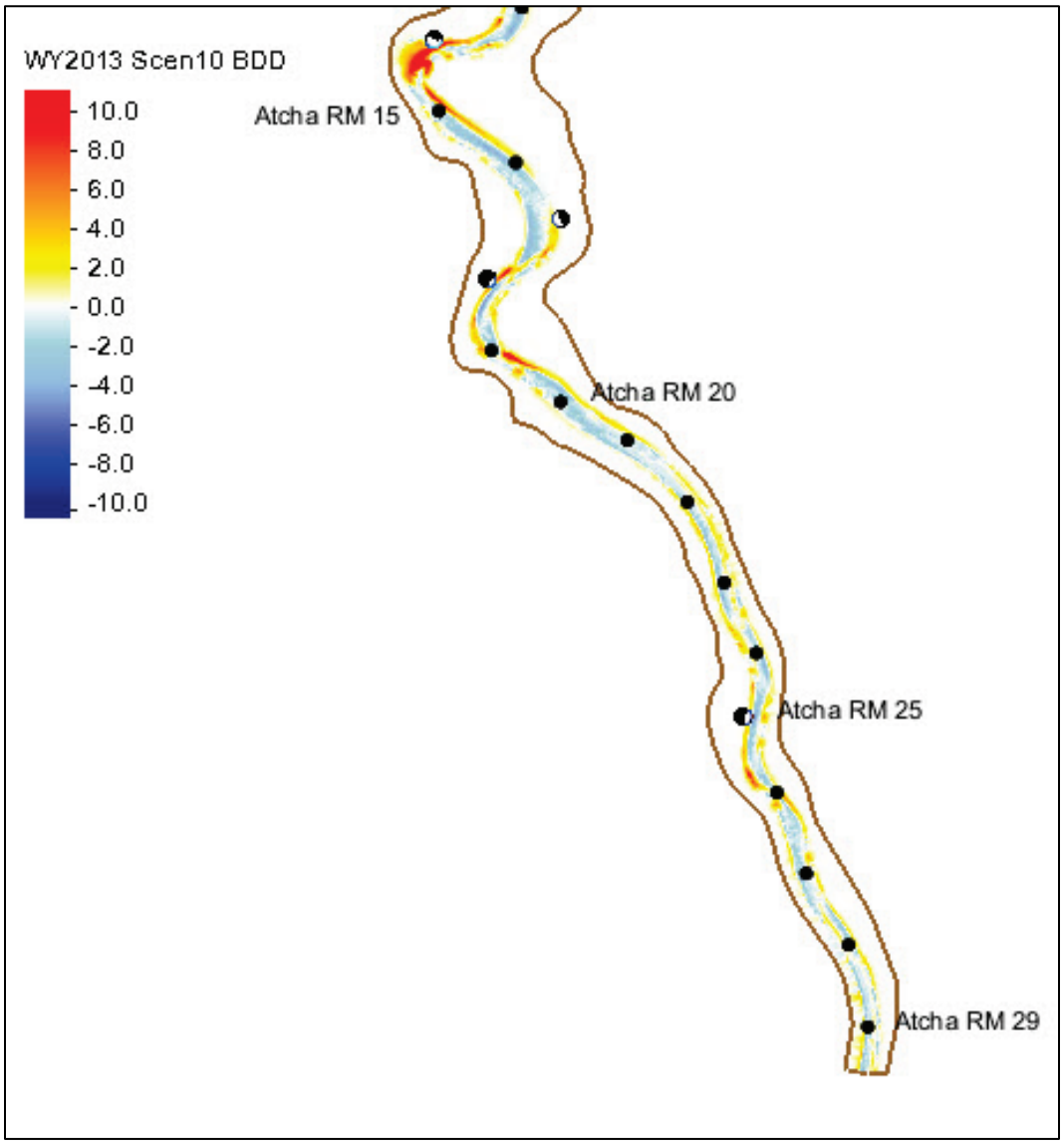


Plate F.85. WY2013 Scenario 10 BDD Atcha RM 15–Atcha RM 29.



F.11 Dredging Scenarios

F.11.1 Scenario 11

Plate F.86. WY2013 Scenario 11 BDD RR RM 43–RR RM 30.

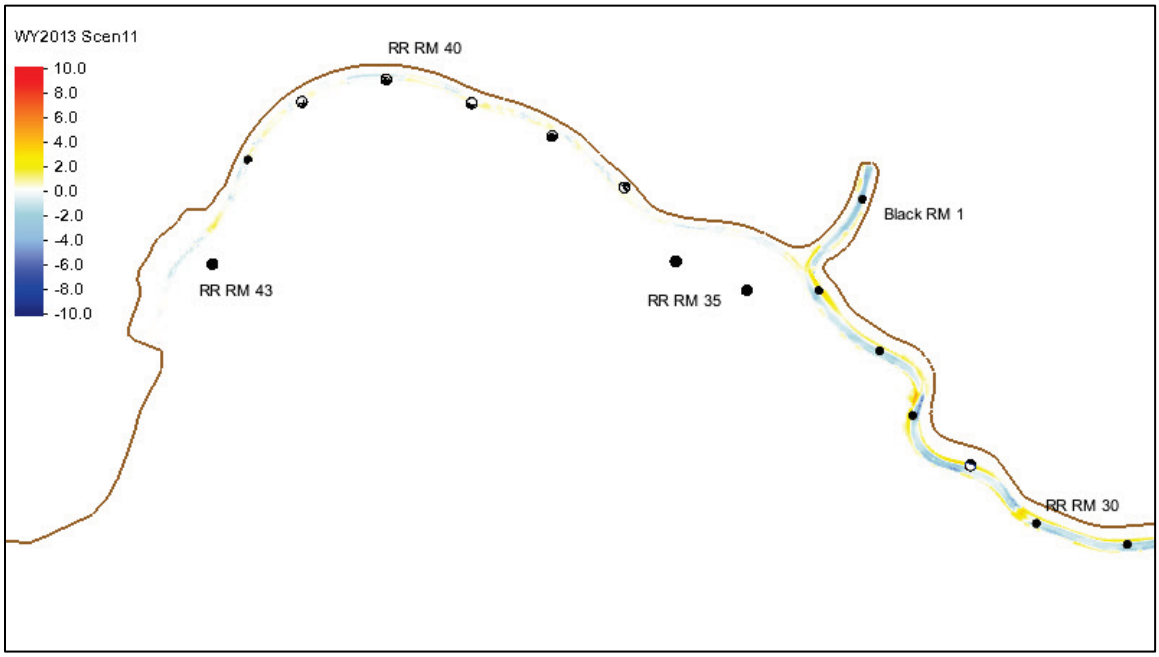


Plate F.87. WY2013 Scenario 11 BDD RR RM 30–RR RM 20.

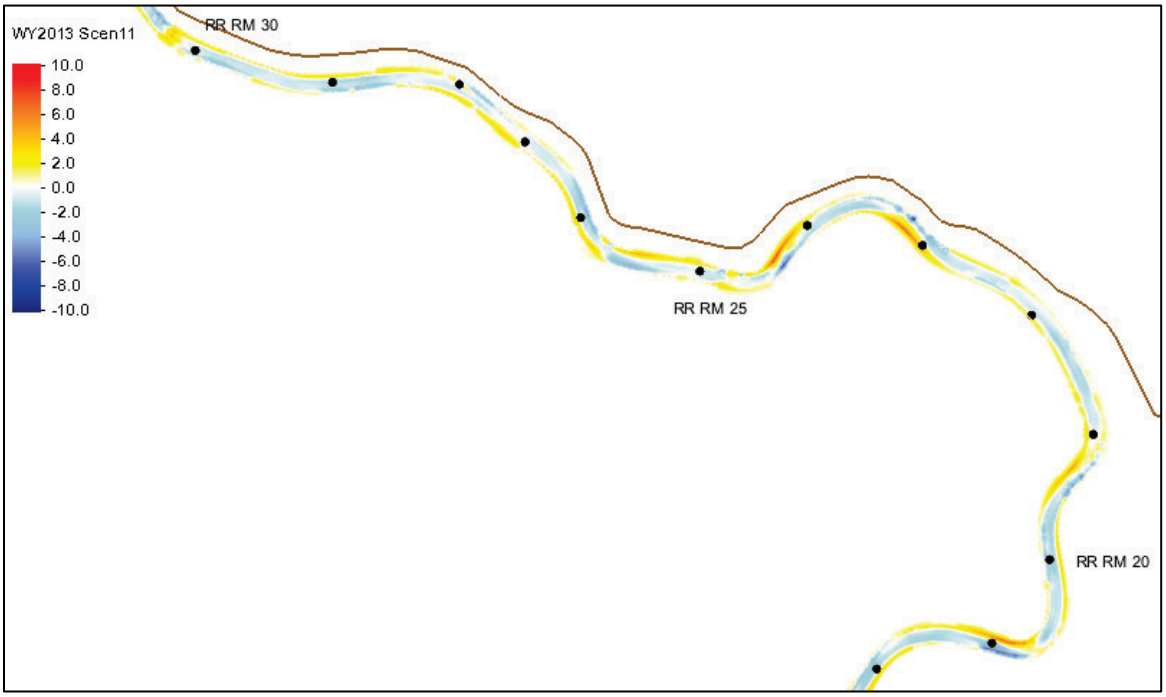


Plate F.88. WY2013 Scenario 11 BDD RR RM 20–RR RM 10.

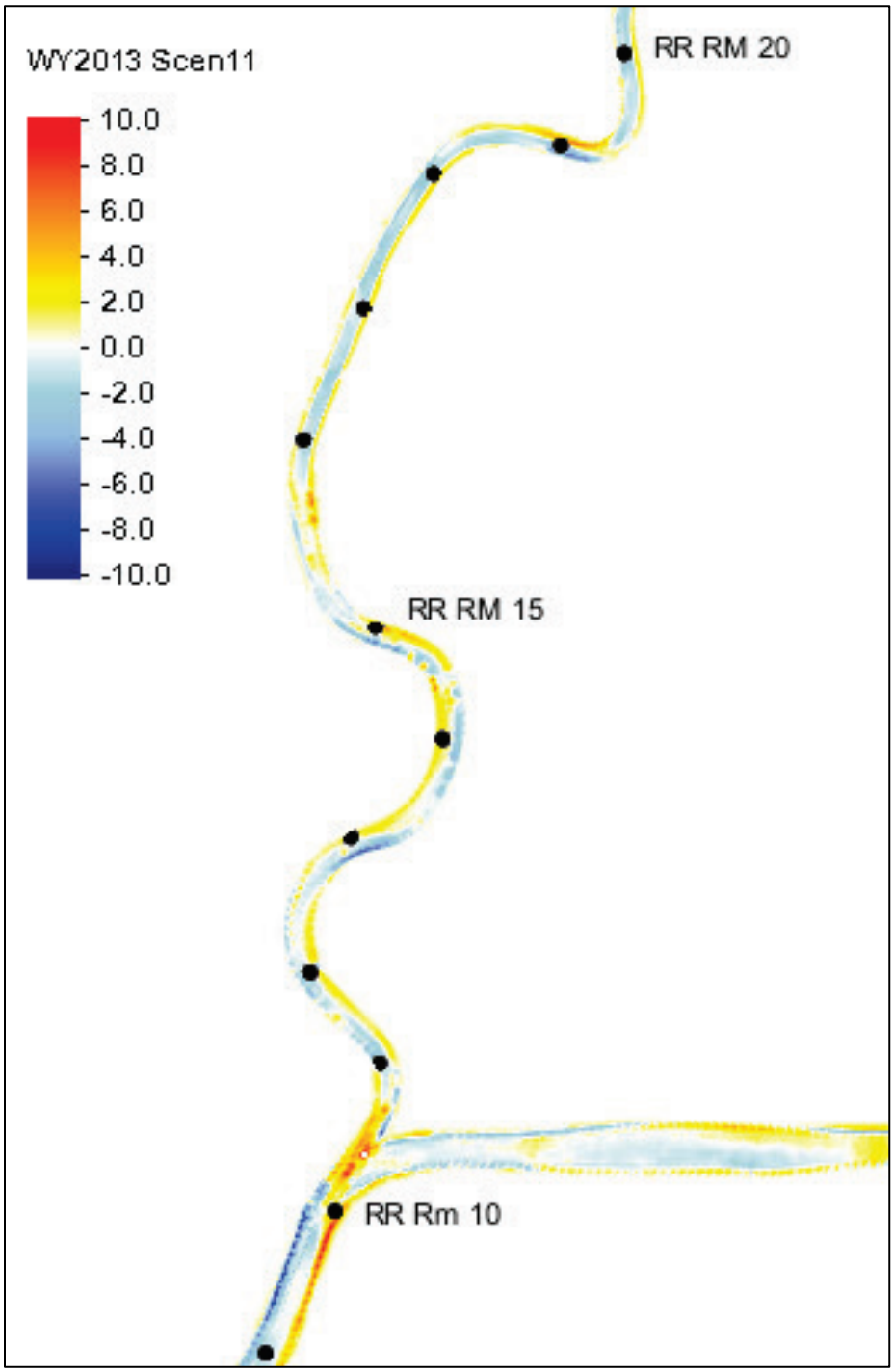


Plate F.89. WY2013 Scenario 11 BDD Outflow Channel.

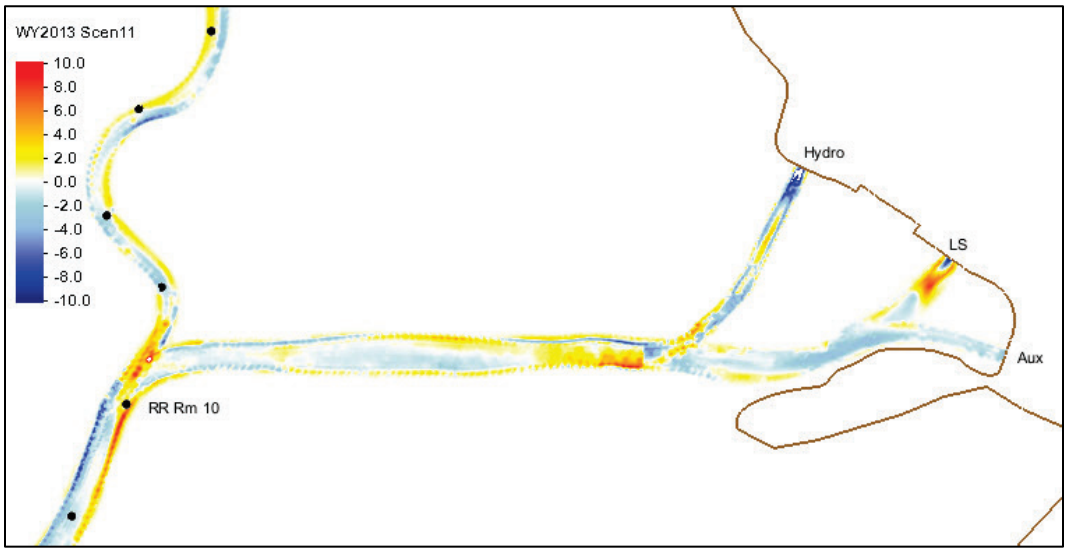


Plate F.90. WY2013 Scenario 11 BDD RR RM 10–Atcha RM 5.

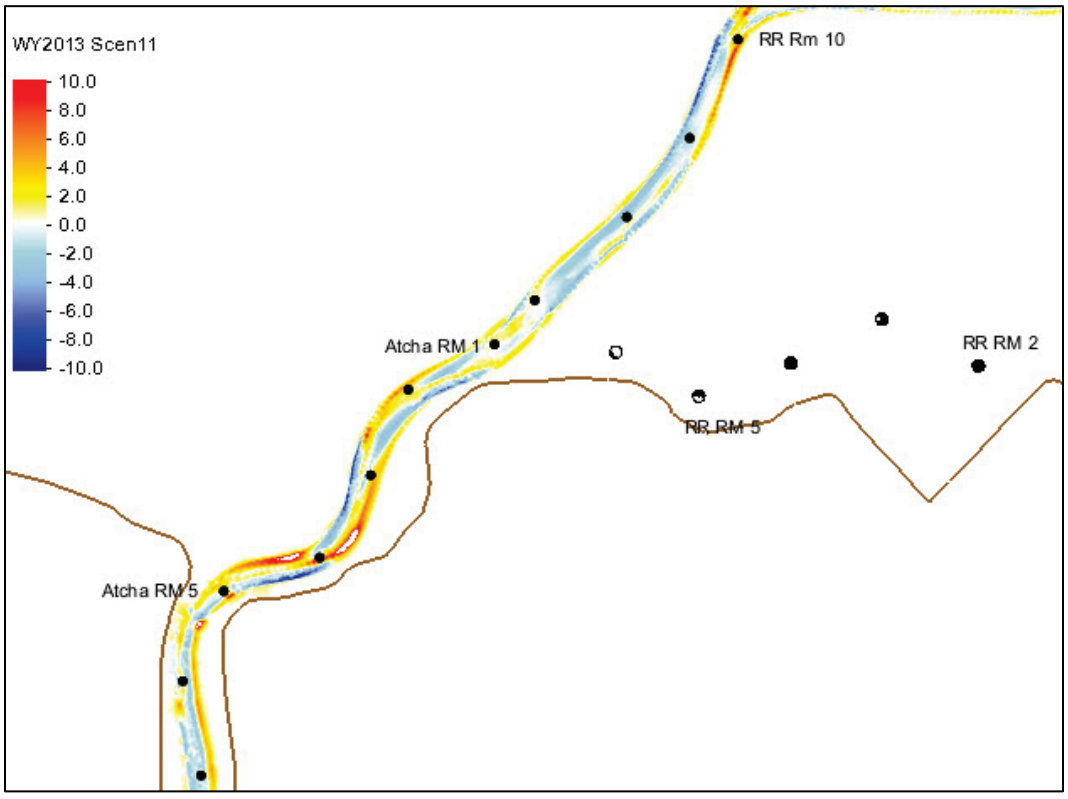


Plate F.91. WY2013 Scenario 11 BDD Atcha RM 5–Atcha RM 15.

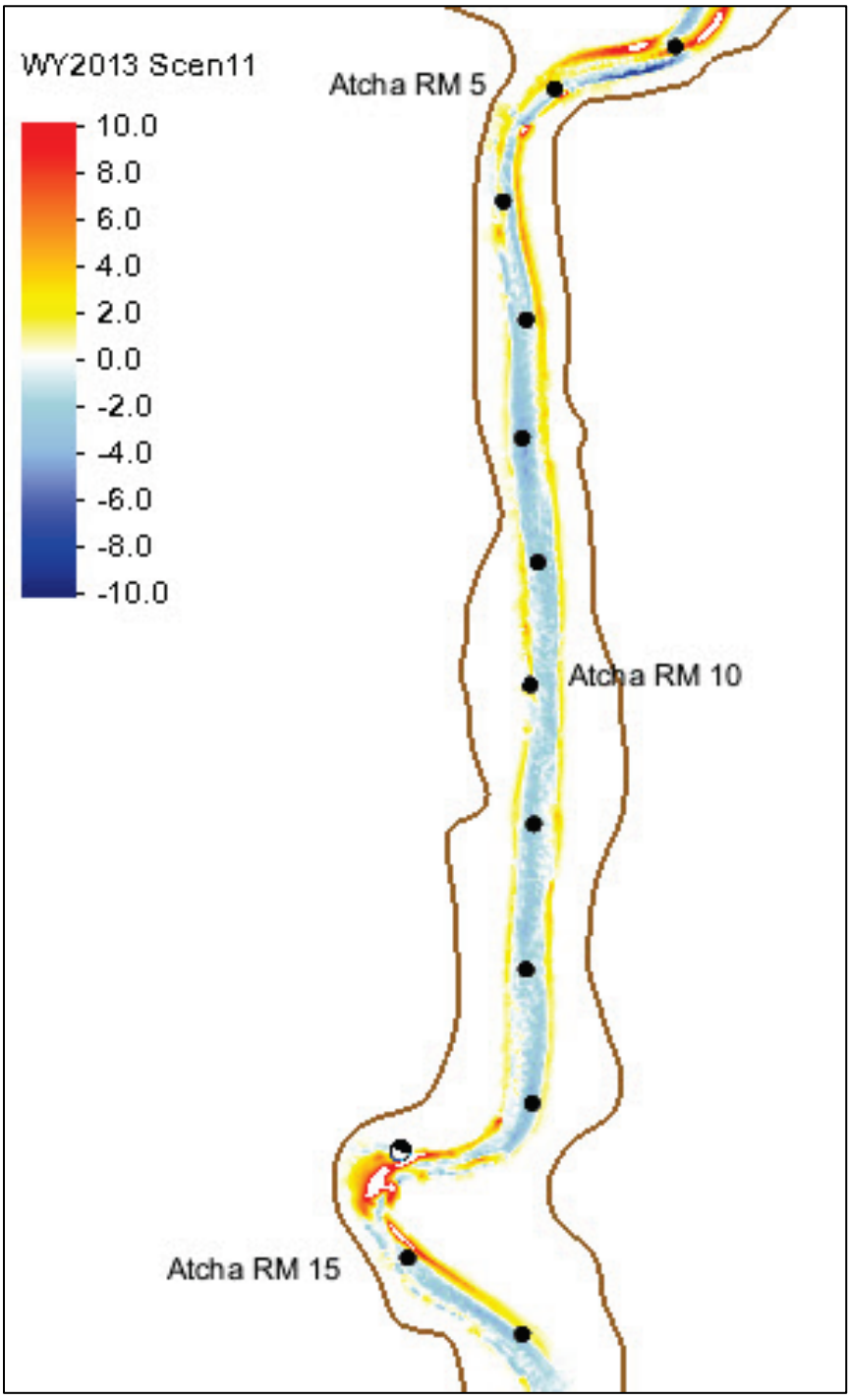
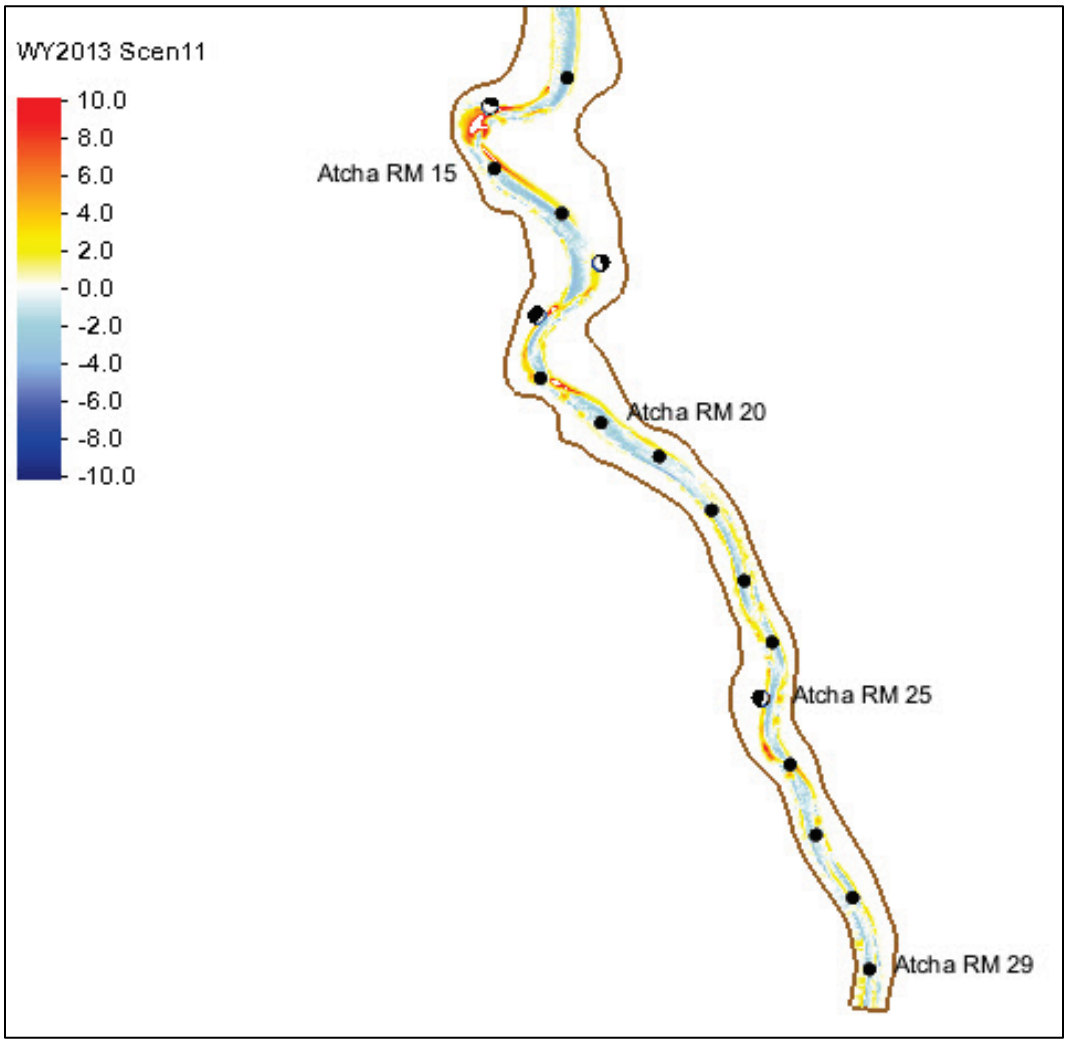


Plate F.92. WY2013 Scenario 11 BDD Atcha RM 15–Atcha RM 29.



F.11.2 Scenario 12

Plate F.93. WY2013 Scenario 12 BDD RR RM 43–RR RM 30.

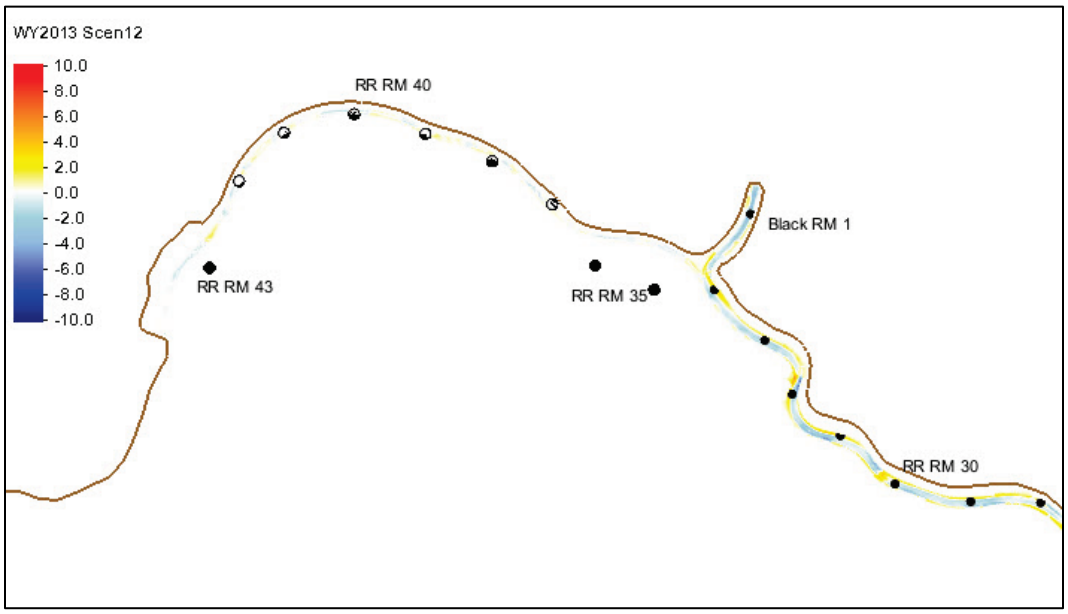


Plate F.94. WY2013 Scenario 12 BDD RR RM 30–RR RM 20.

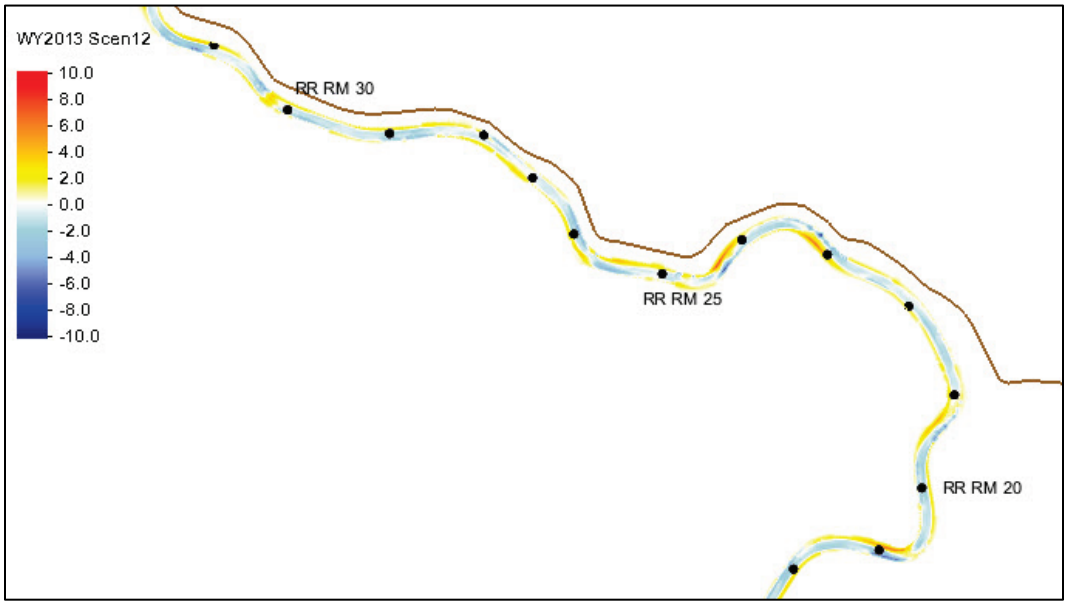


Plate F.95. WY2013 Scenario 12 BDD RR RM 20–RR RM 10.

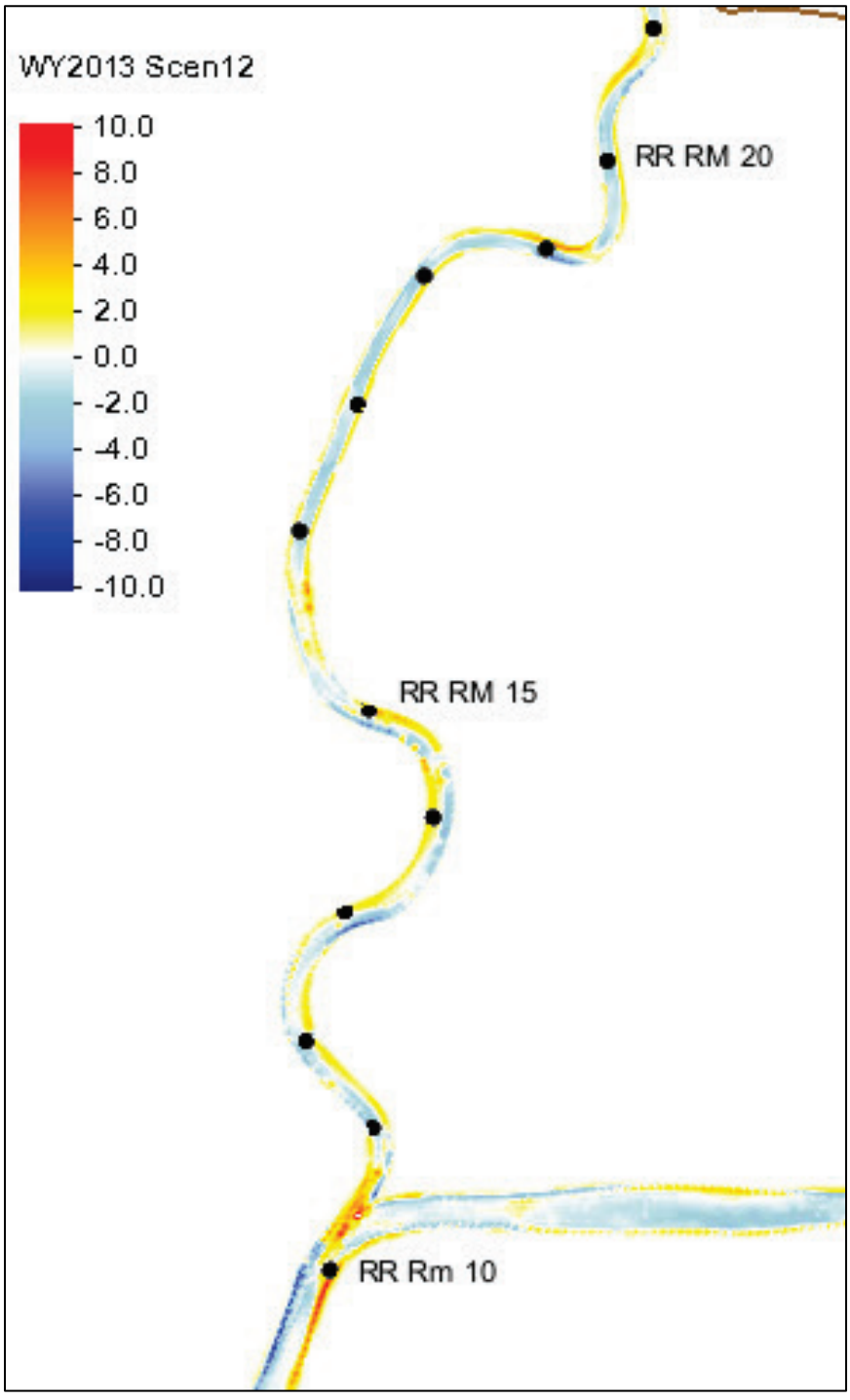


Plate F.96. WY2013 Scenario 12 BDD Outflow Channel.

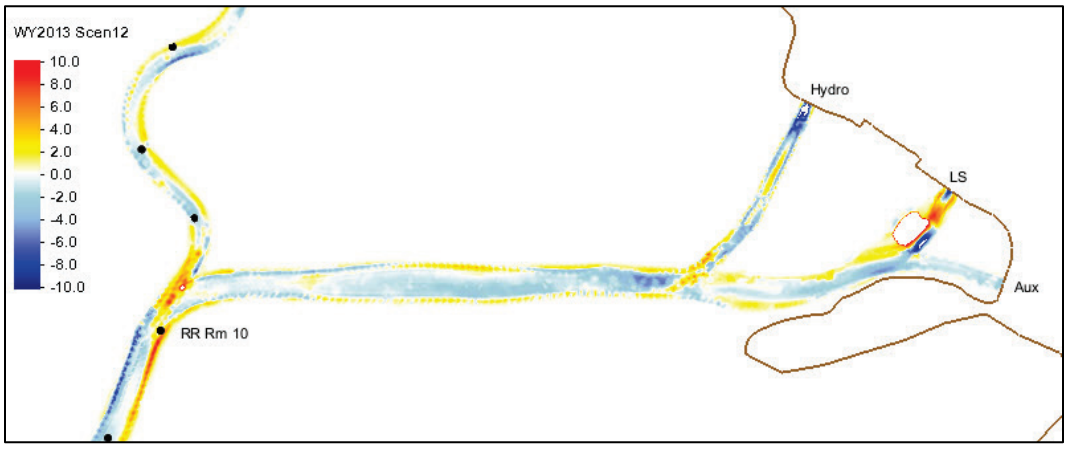


Plate F.97. WY2013 Scenario 12 BDD RR RM 10–Atcha RM 5.

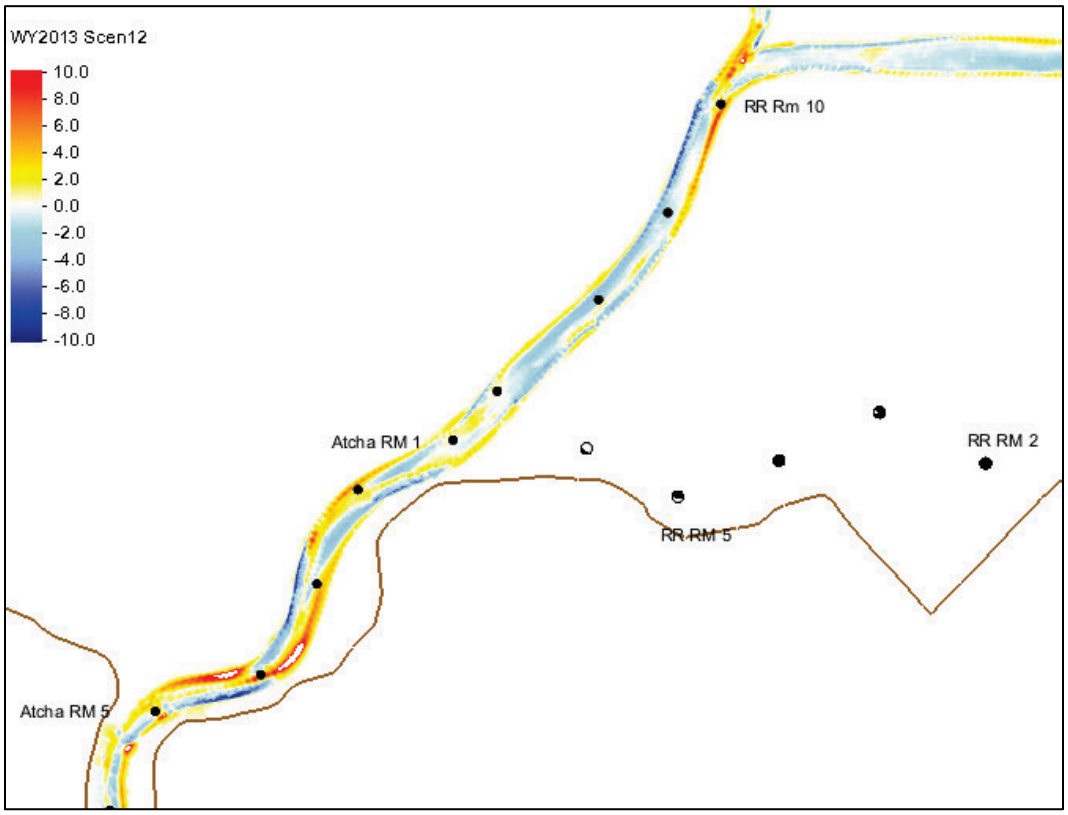


Plate F.98. WY2013 Scenario 12 BDD Atcha RM 5–Atcha RM 15.

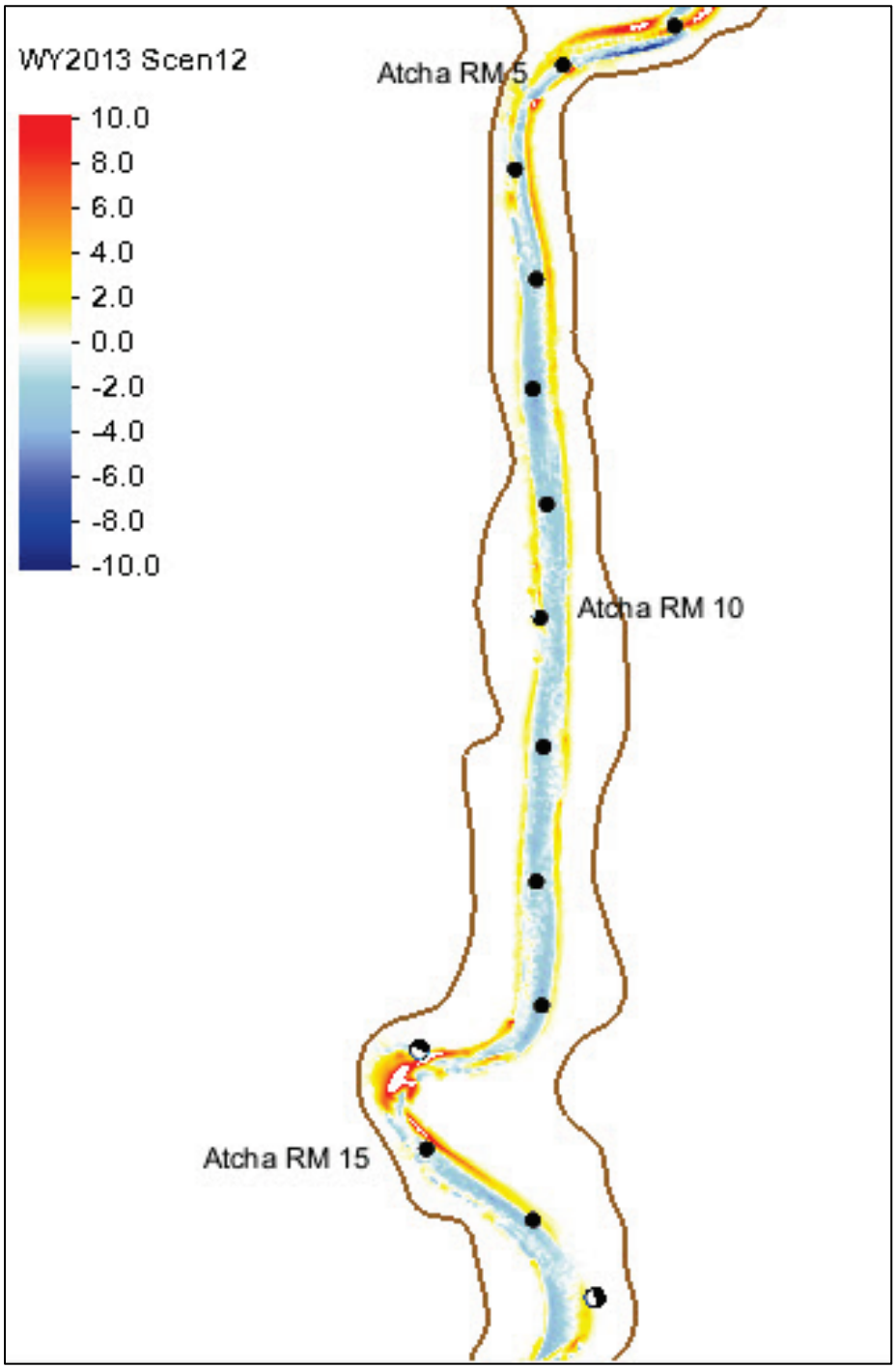
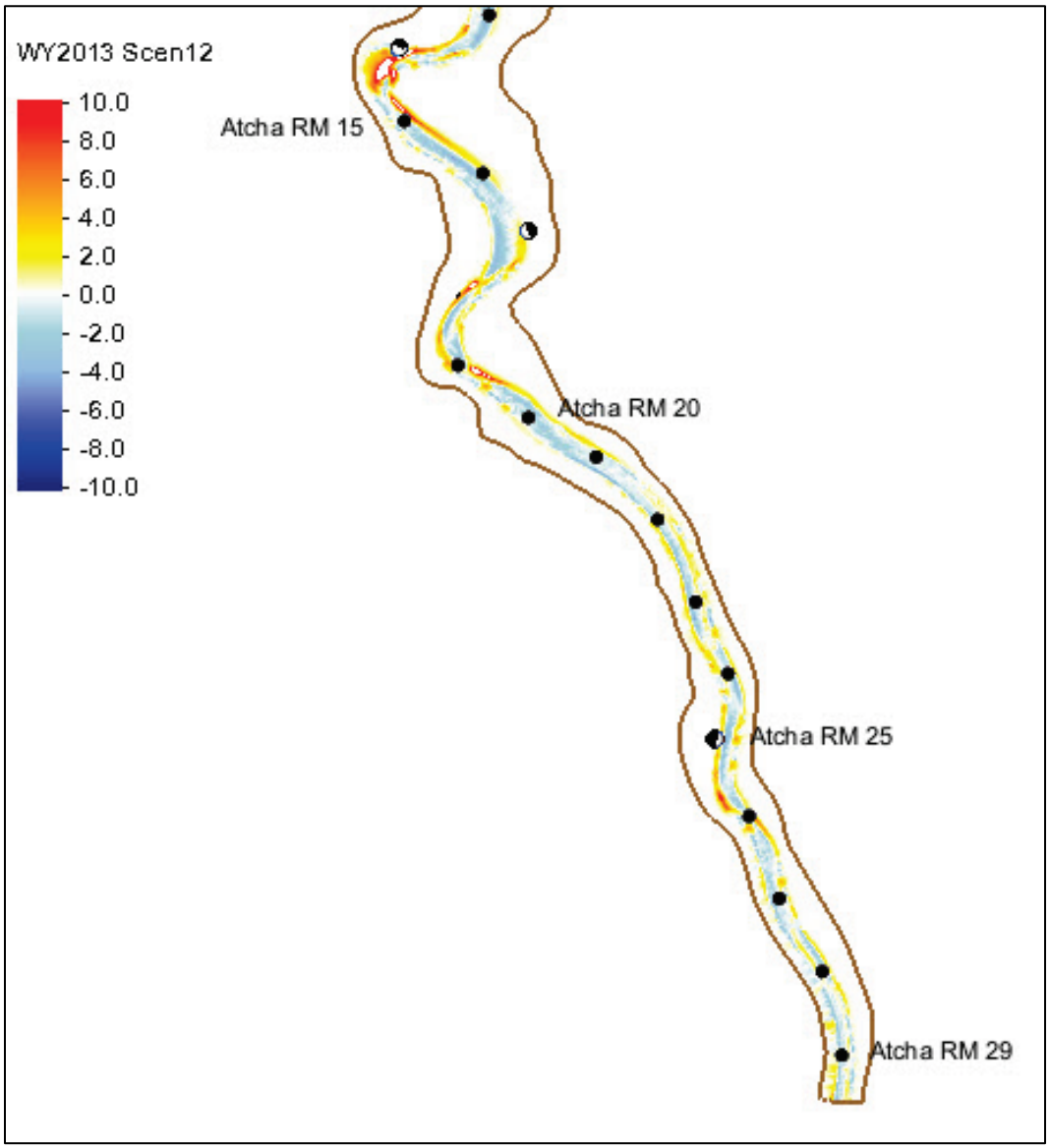


Plate F.99. WY2013 Scenario 12 BDD Atcha RM 15–Atcha RM 29.



F.11.3 Scenario 13

Plate F.100. WY2013 Scenario 13 BDD RR RM 43–RR RM 30.

Plate F.101. WY2013 Scenario 13 BDD RR RM 30–RR RM 20.

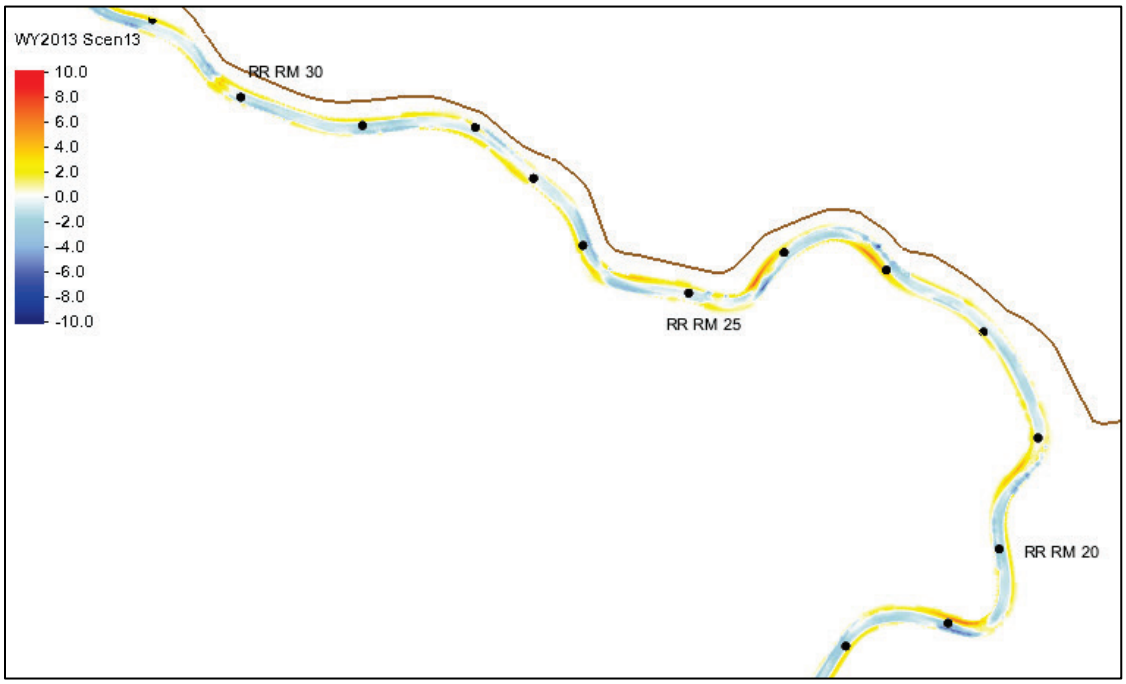


Plate F.102. WY2013 Scenario 13 BDD RR RM 20–RR RM 10.

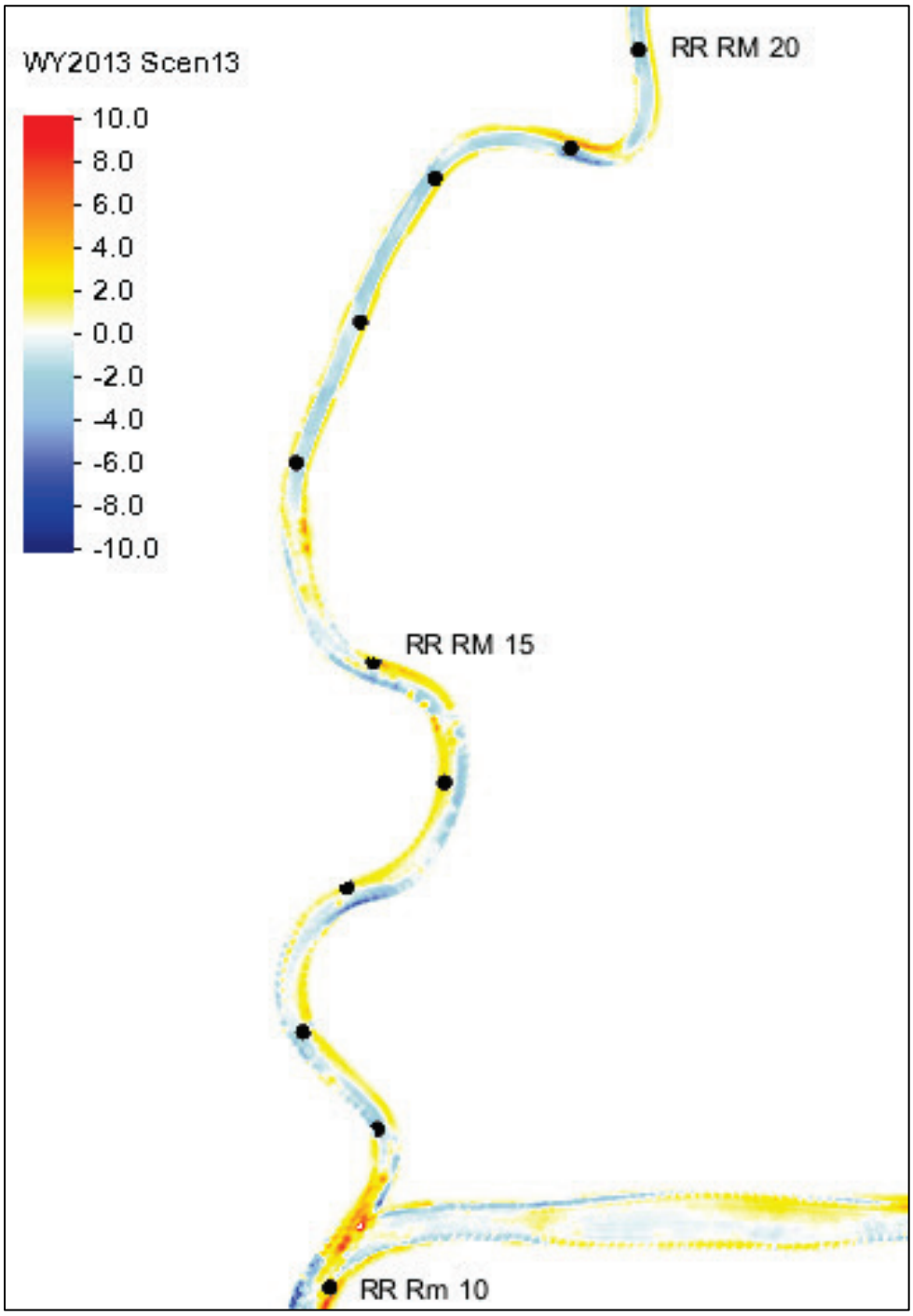


Plate F.103. WY2013 Scenario 13 BDD Outflow Channel.

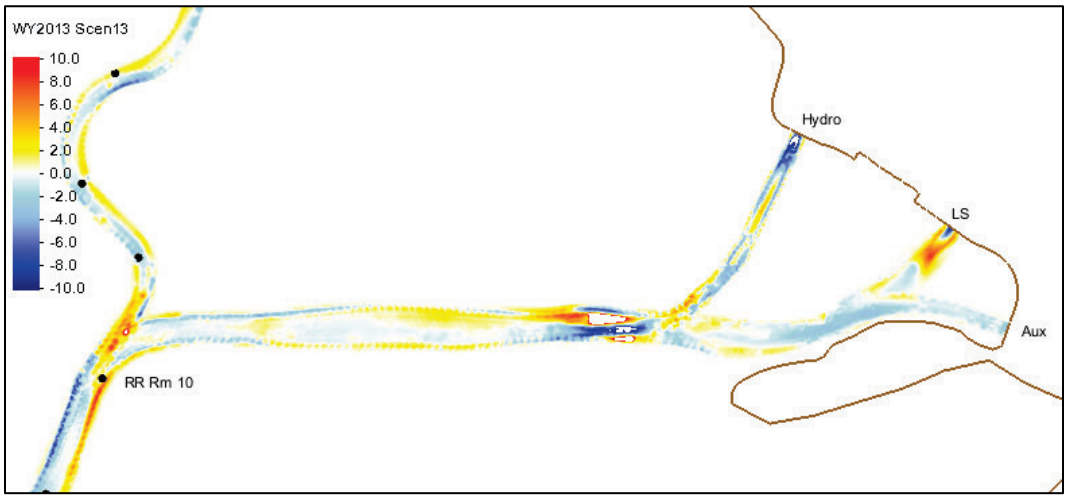


Plate F.104. WY2013 Scenario 13 BDD RR RM 10–Atcha RM 5.

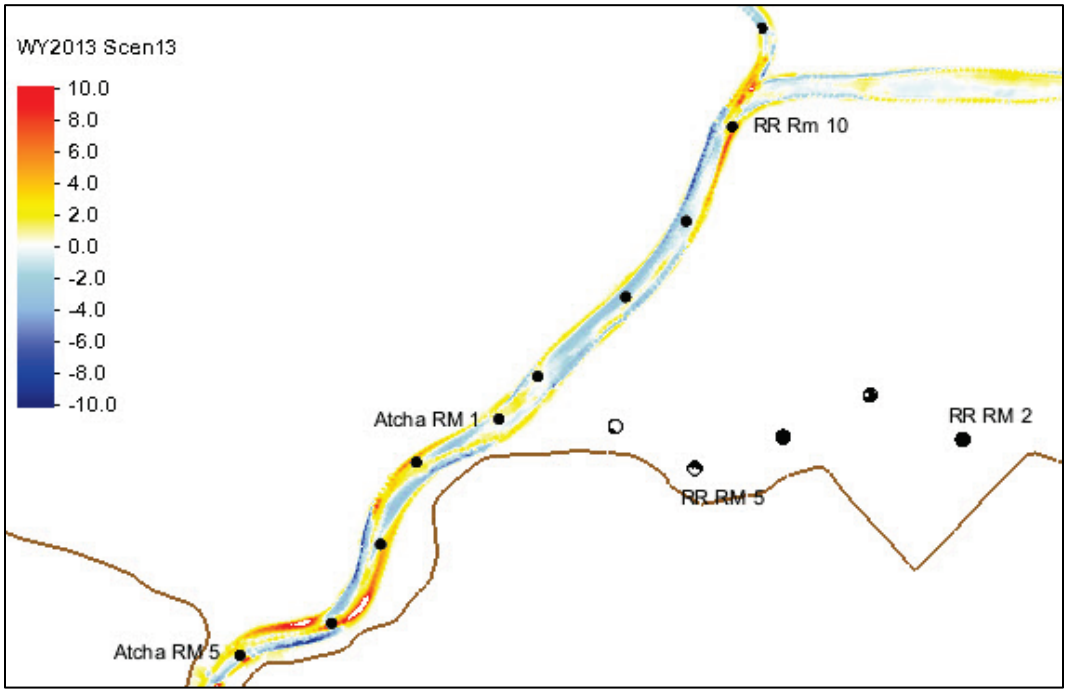


Plate F.105. WY2013 Scenario 13 BDD Atcha RM 5–Atcha RM 15.

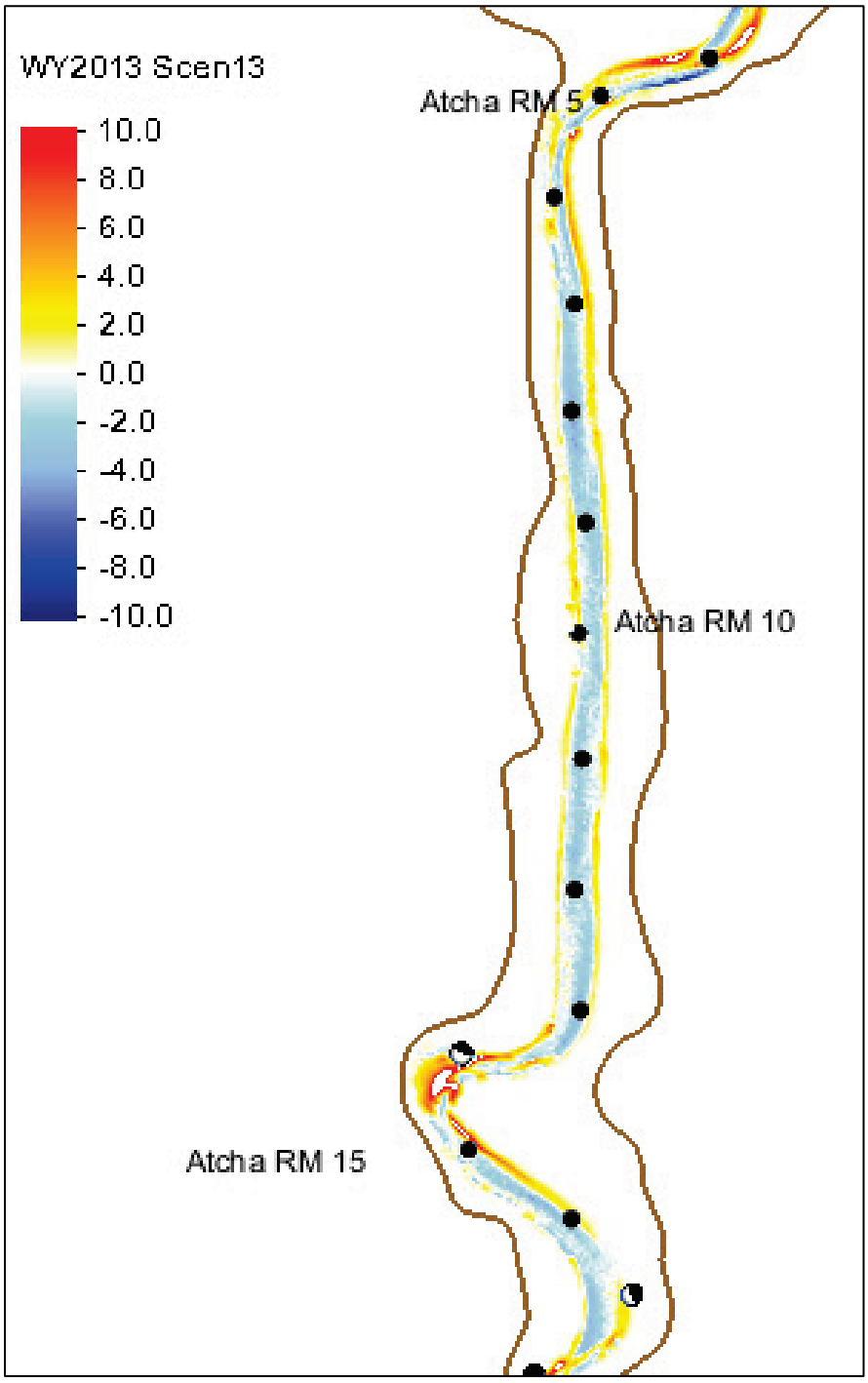
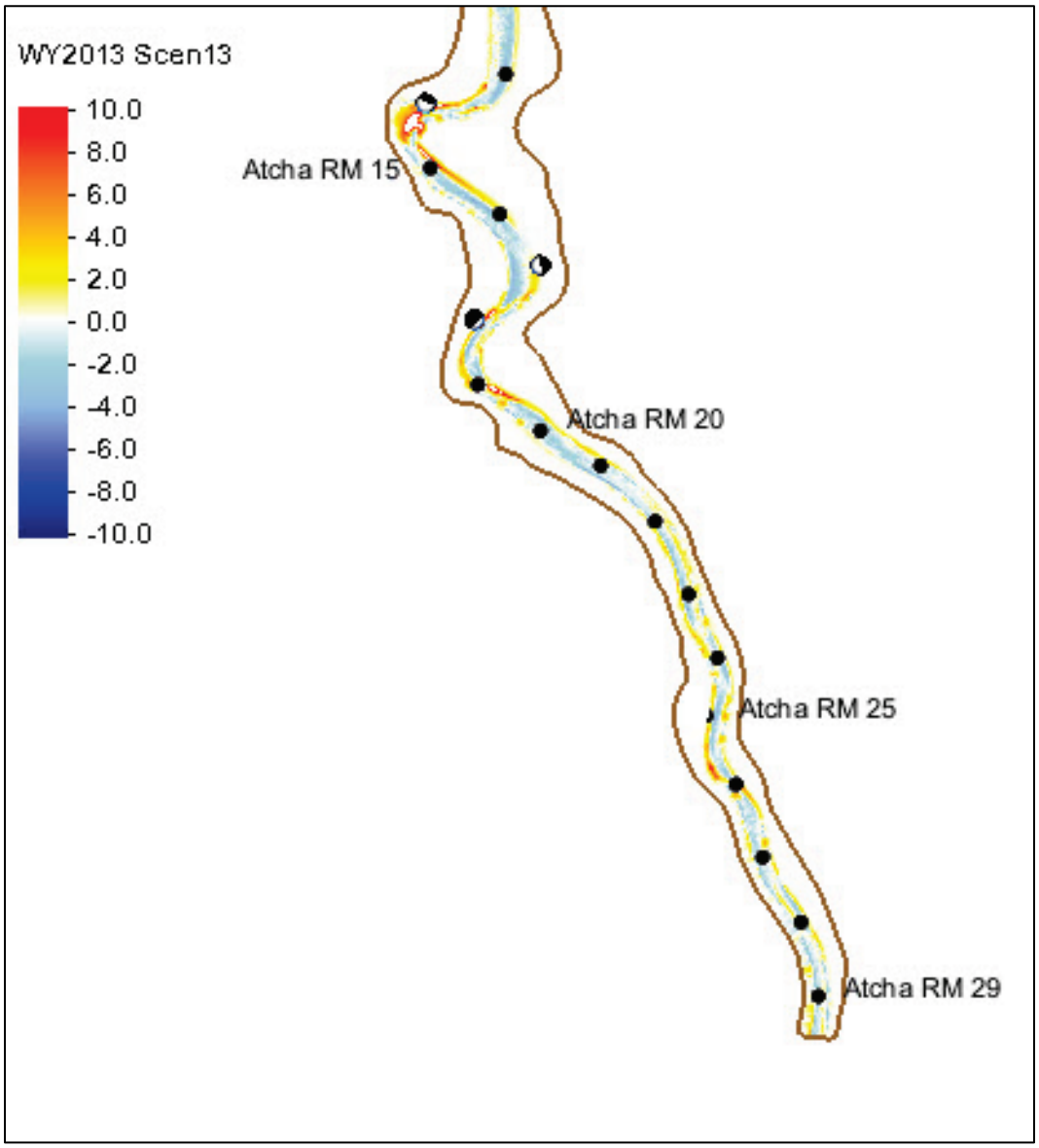


Plate F.106. WY2013 Scenario 13 BDD Atcha RM 15–Atcha RM 29.



F.11.4 Scenario 14

Plate F.107. WY2013 Scenario 14 BDD RR RM 43–RR RM 30.

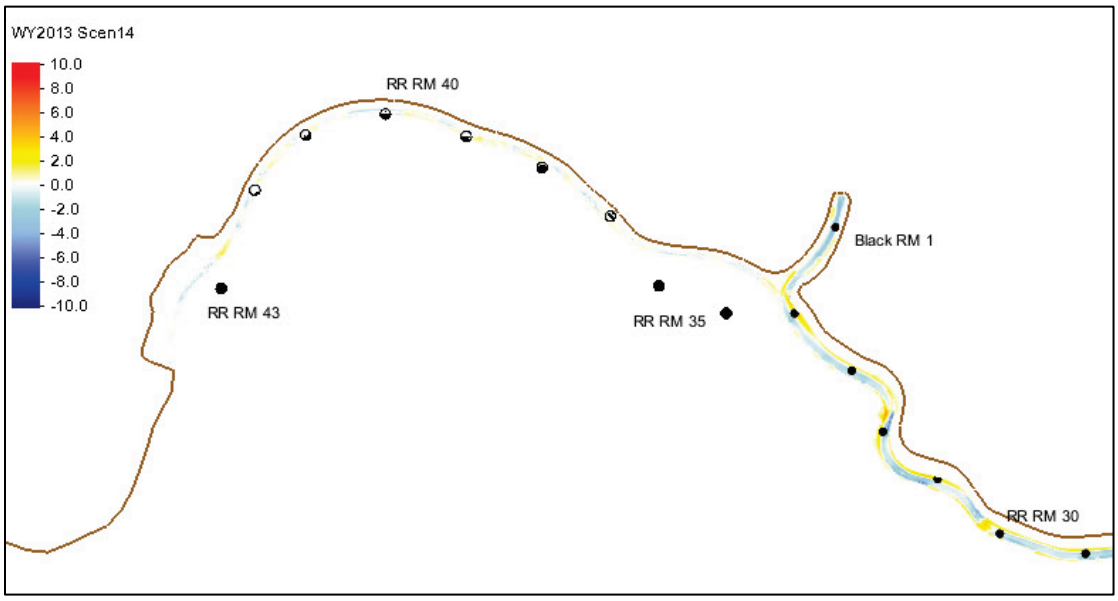


Plate F.108. WY2013 Scenario 14 BDD RR RM 30–RR RM 20.

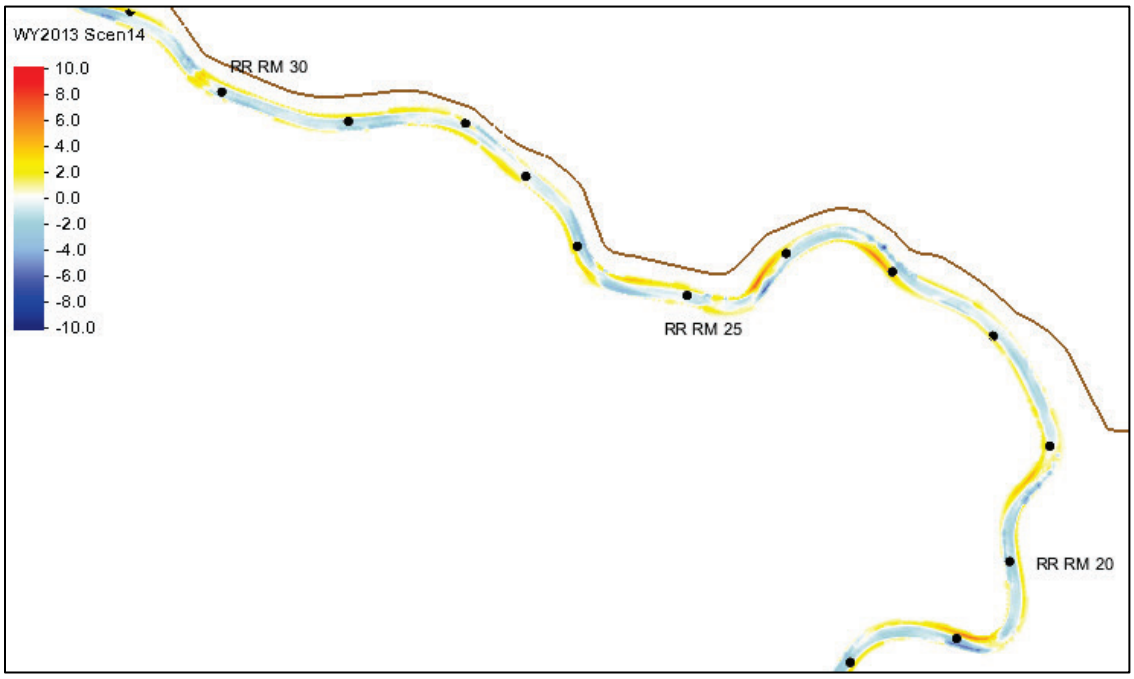


Plate F.109. WY2013 Scenario 14 BDD RR RM 20–RR RM 10.

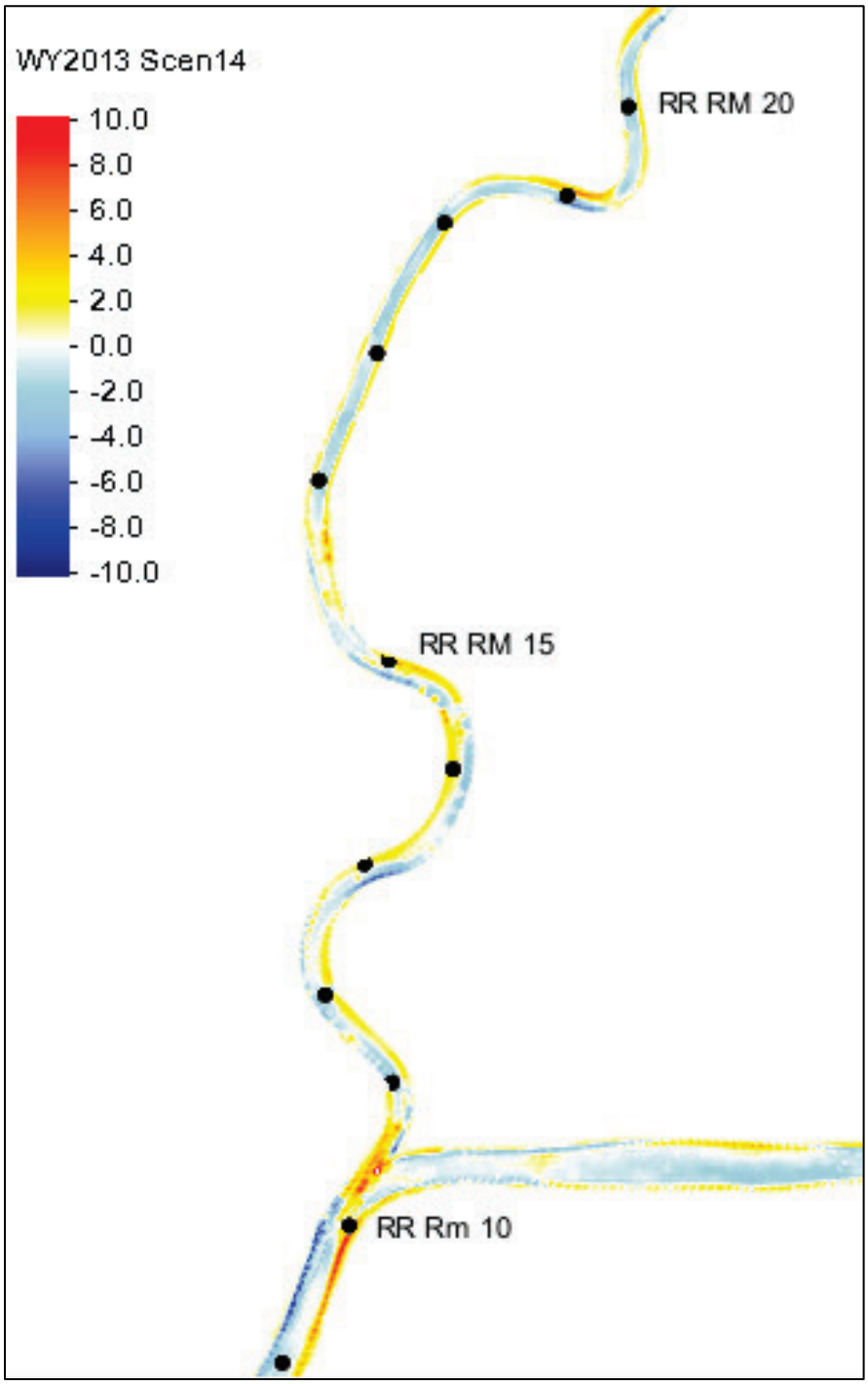


Plate F.110. WY2013 Scenario 14 BDD Outflow Channel.

Plate F.111. WY2013 Scenario 14 BDD RR RM 10–Atcha RM 5.

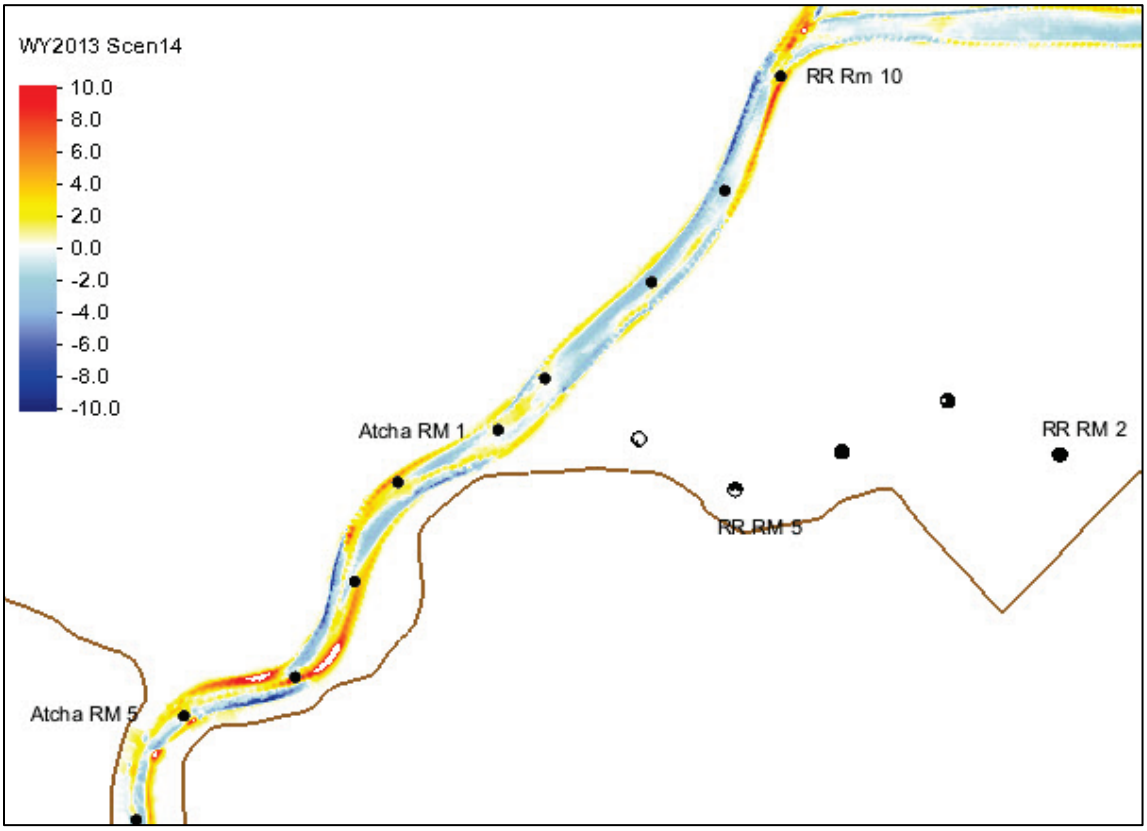


Plate F.112. WY2013 Scenario 14 BDD Atcha RM 5–Atcha RM 15.

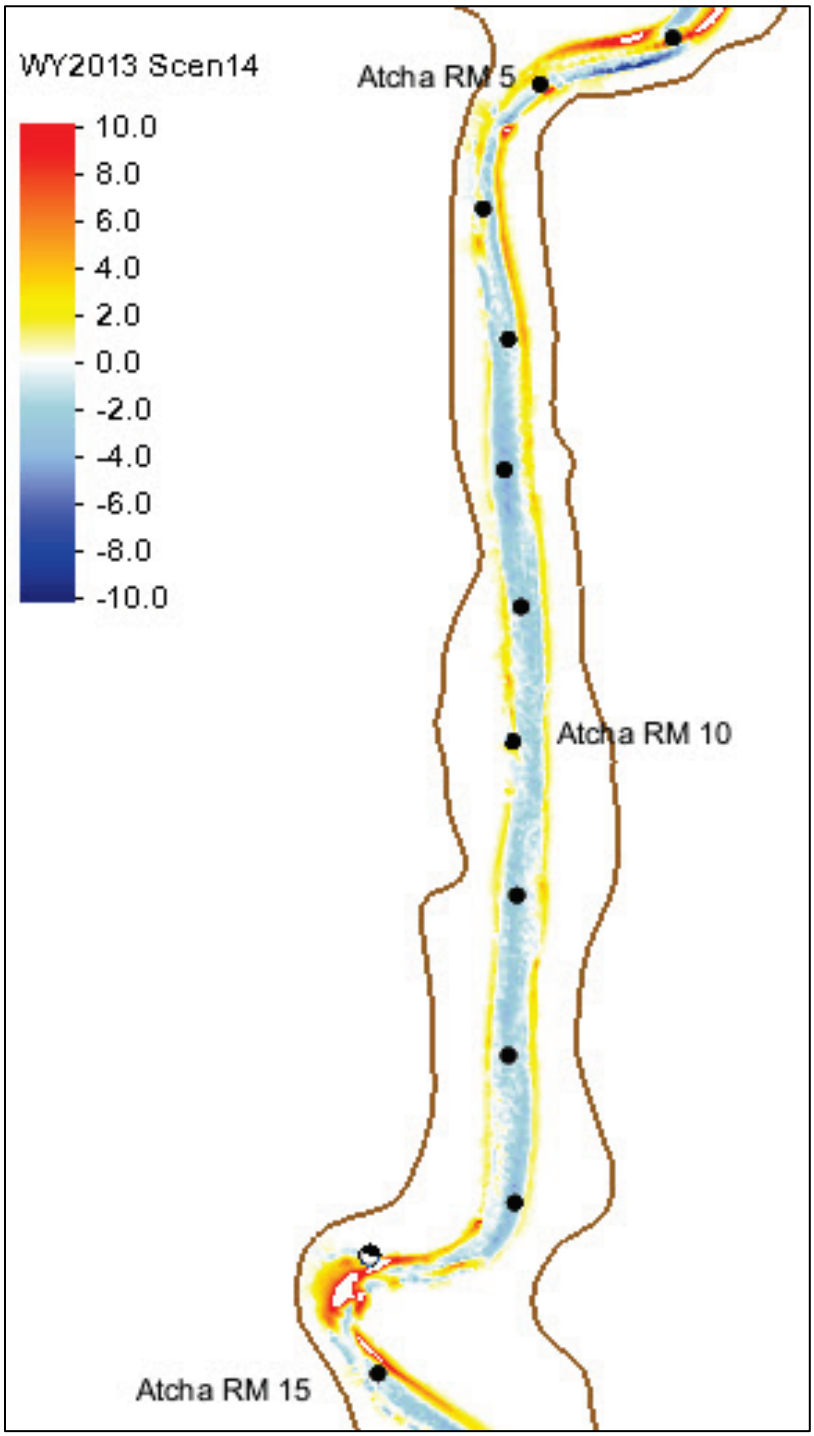
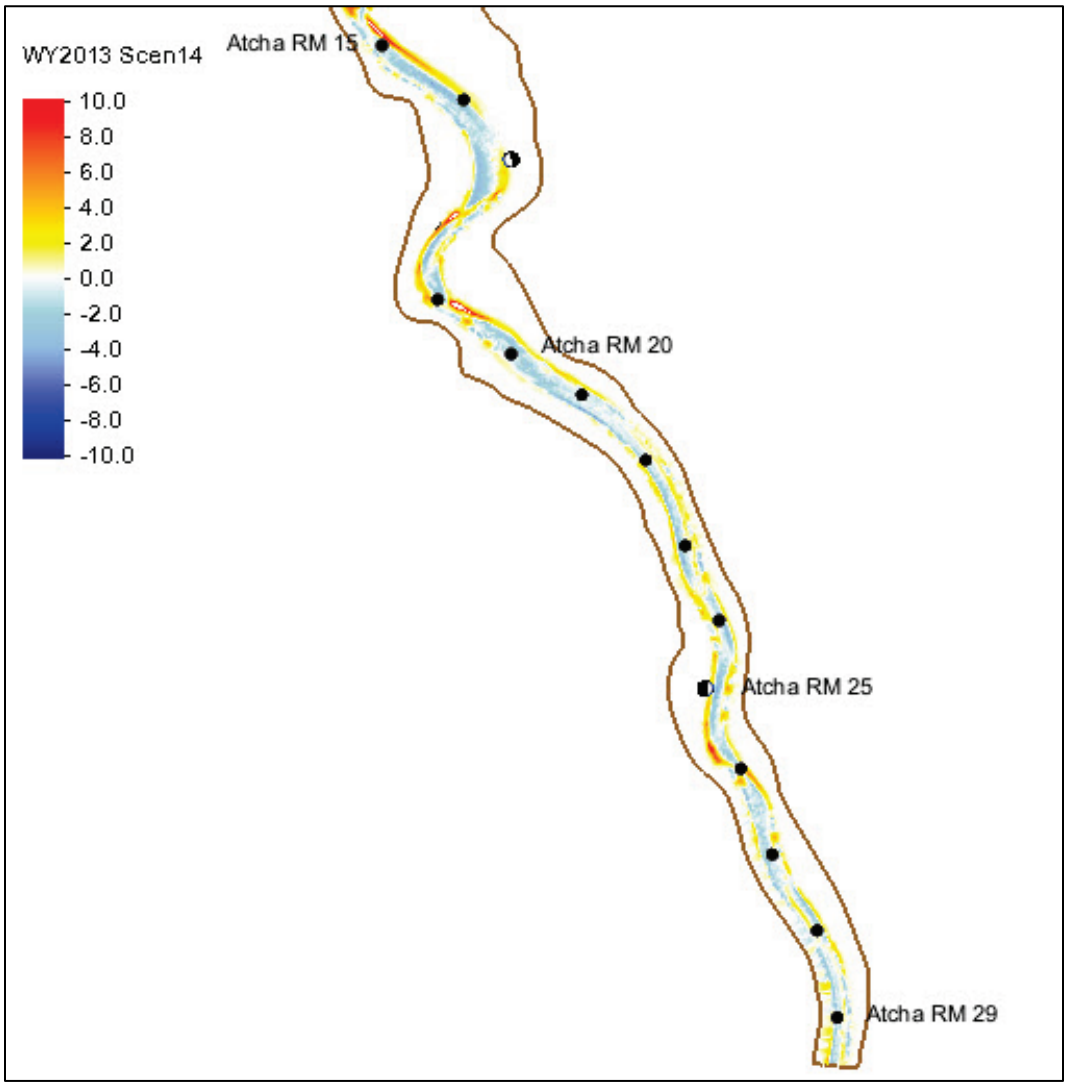


Plate F.113. WY2013 Scenario 14 BDD Atcha RM 15–Atcha RM 29.



F.12 Structure Options

F.12.1 Scenario 19

Plate F.114. WY2013 Scenario 19 BDD RR RM 43–RR RM 30.

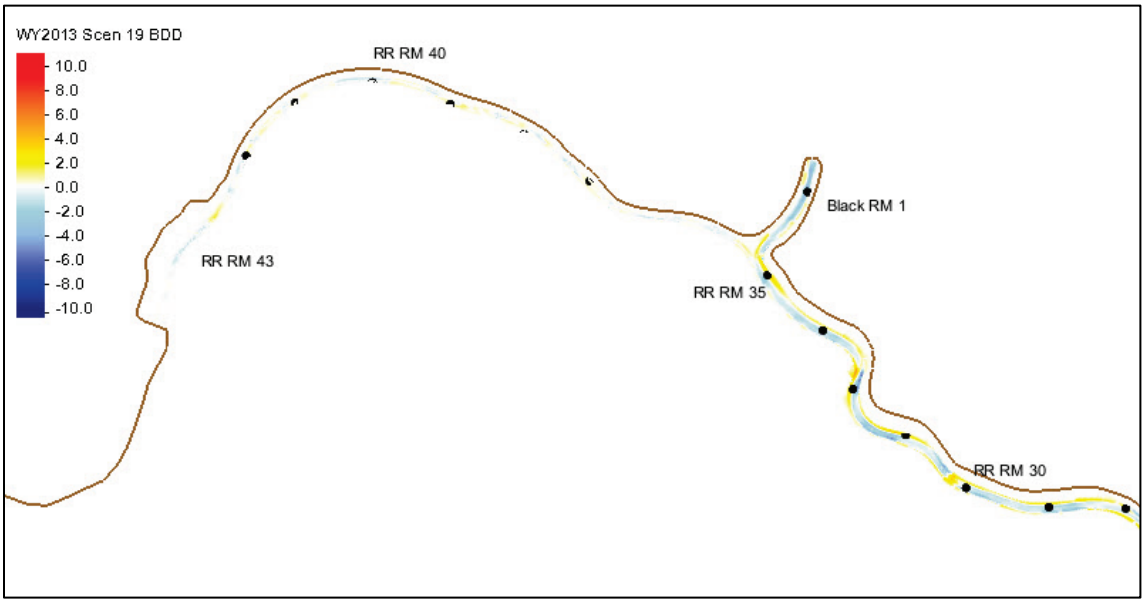


Plate F.115. WY2013 Scenario 19 BDD RR RM 30–RR RM 20.

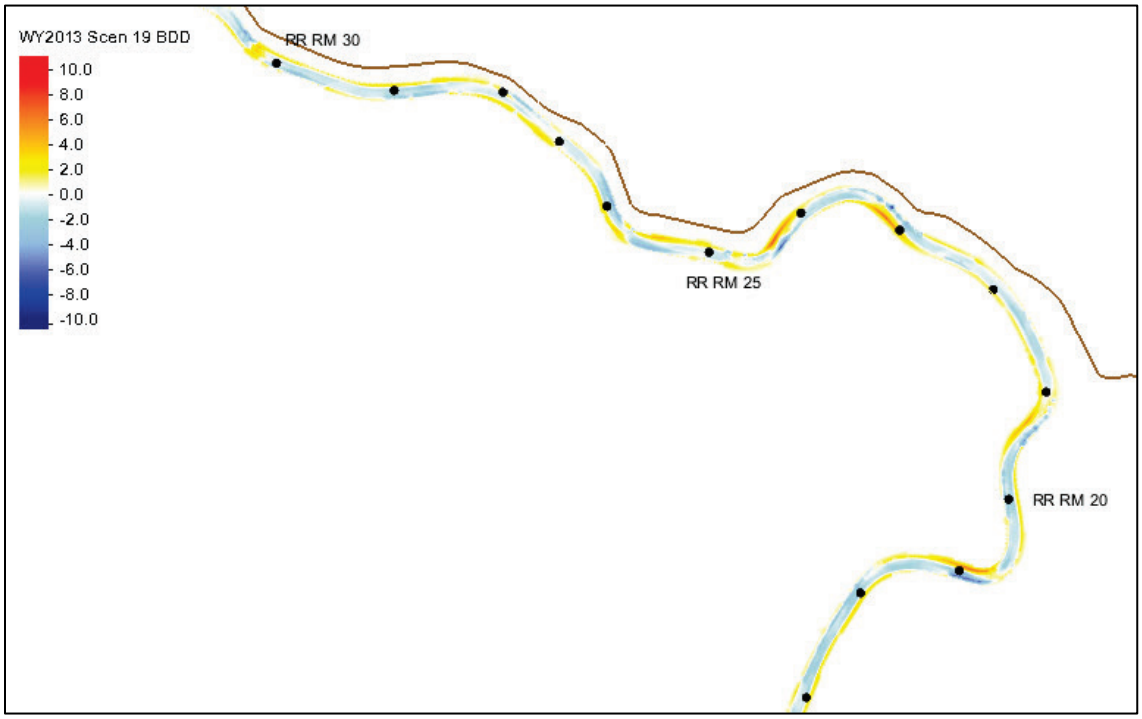


Plate F.116. WY2013 Scenario 19 BDD RR RM 20–RR RM 10 and Outflow Channel.

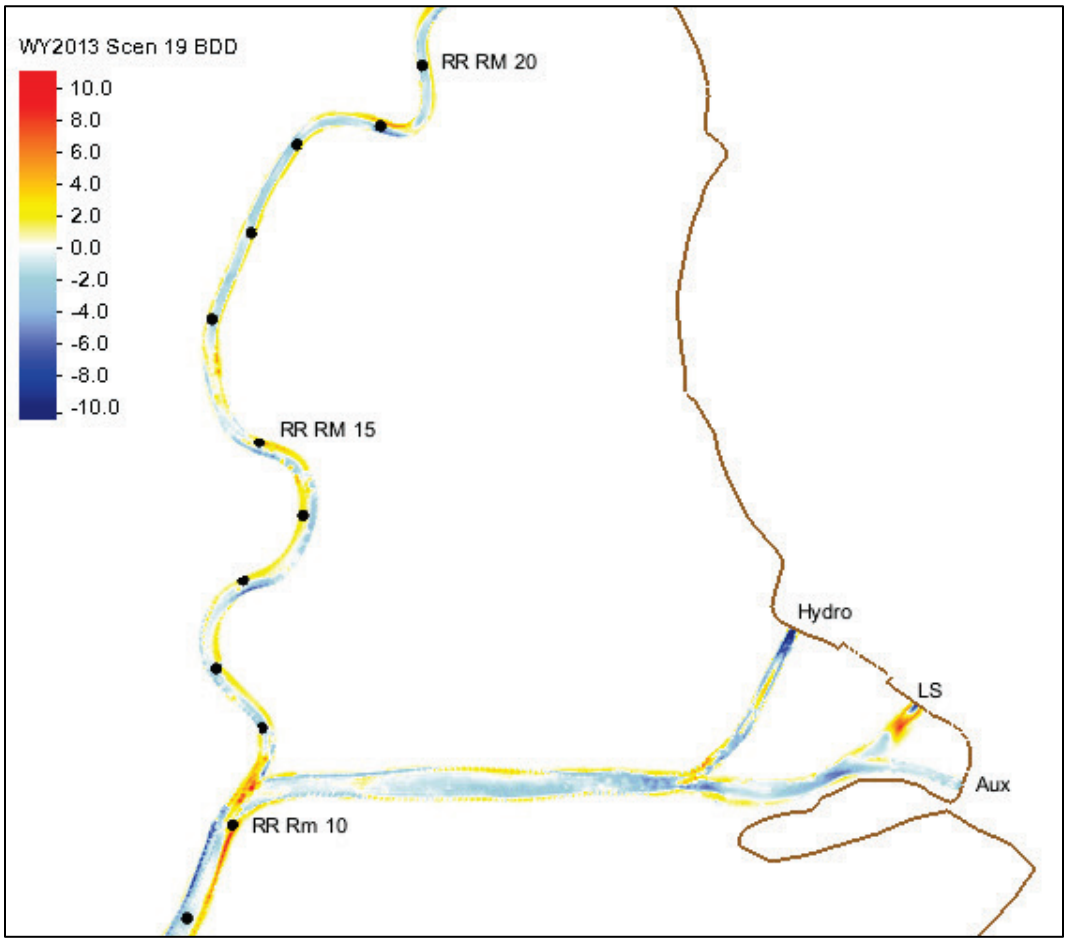


Plate F.117. WY2013 Scenario 19 BDD Outflow Channel.

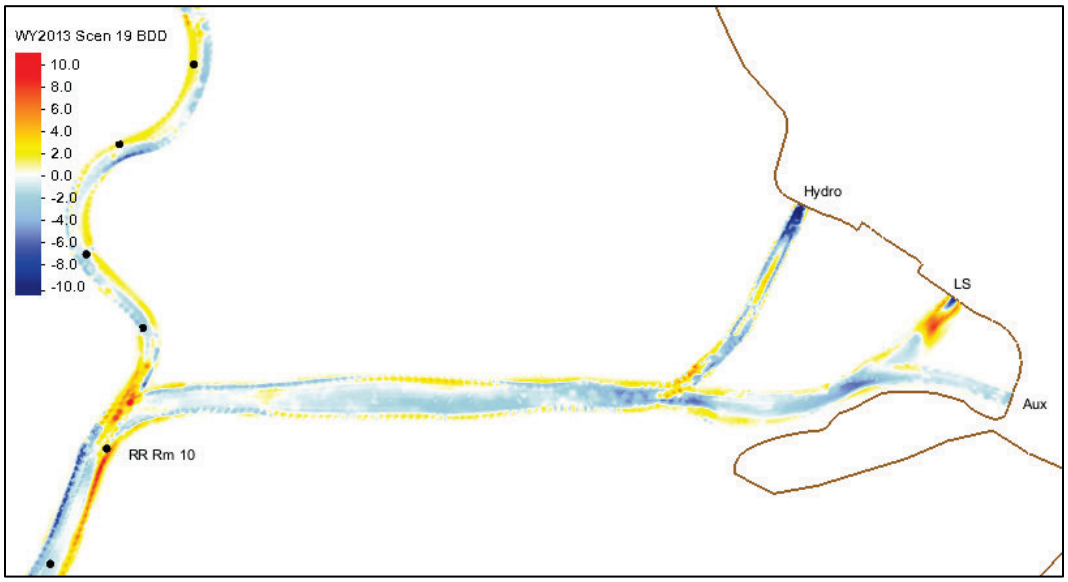


Plate F.118. WY2013 Scenario 19 BDD RR RM 10–Atcha RM 5.

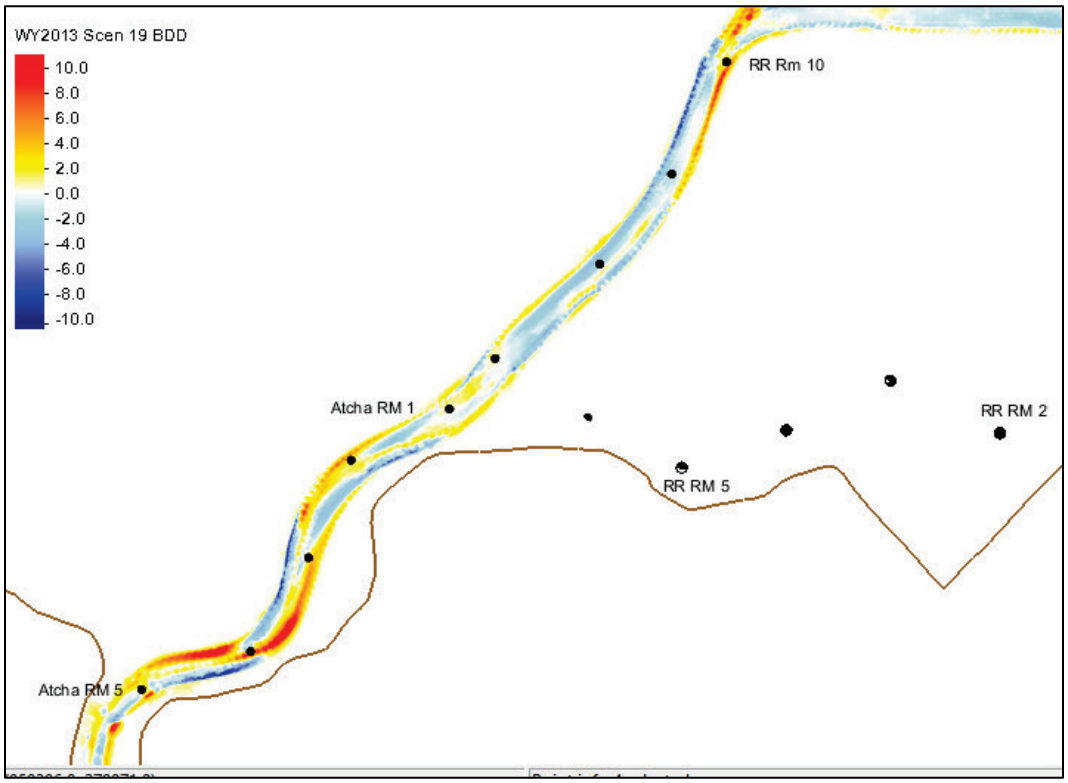


Plate F.119. WY2013 Scenario 19 BDD Atcha RM 5–Atcha RM 15.

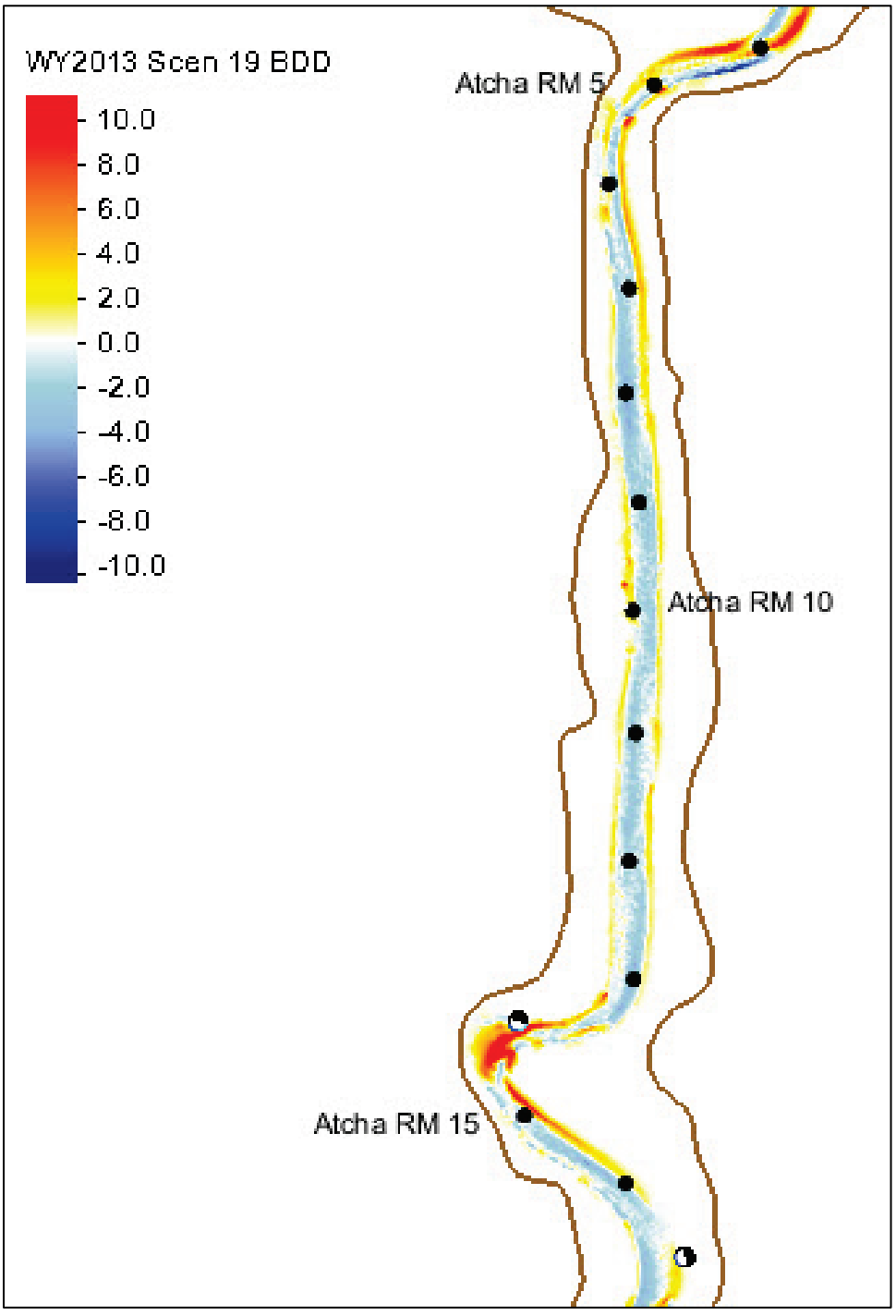
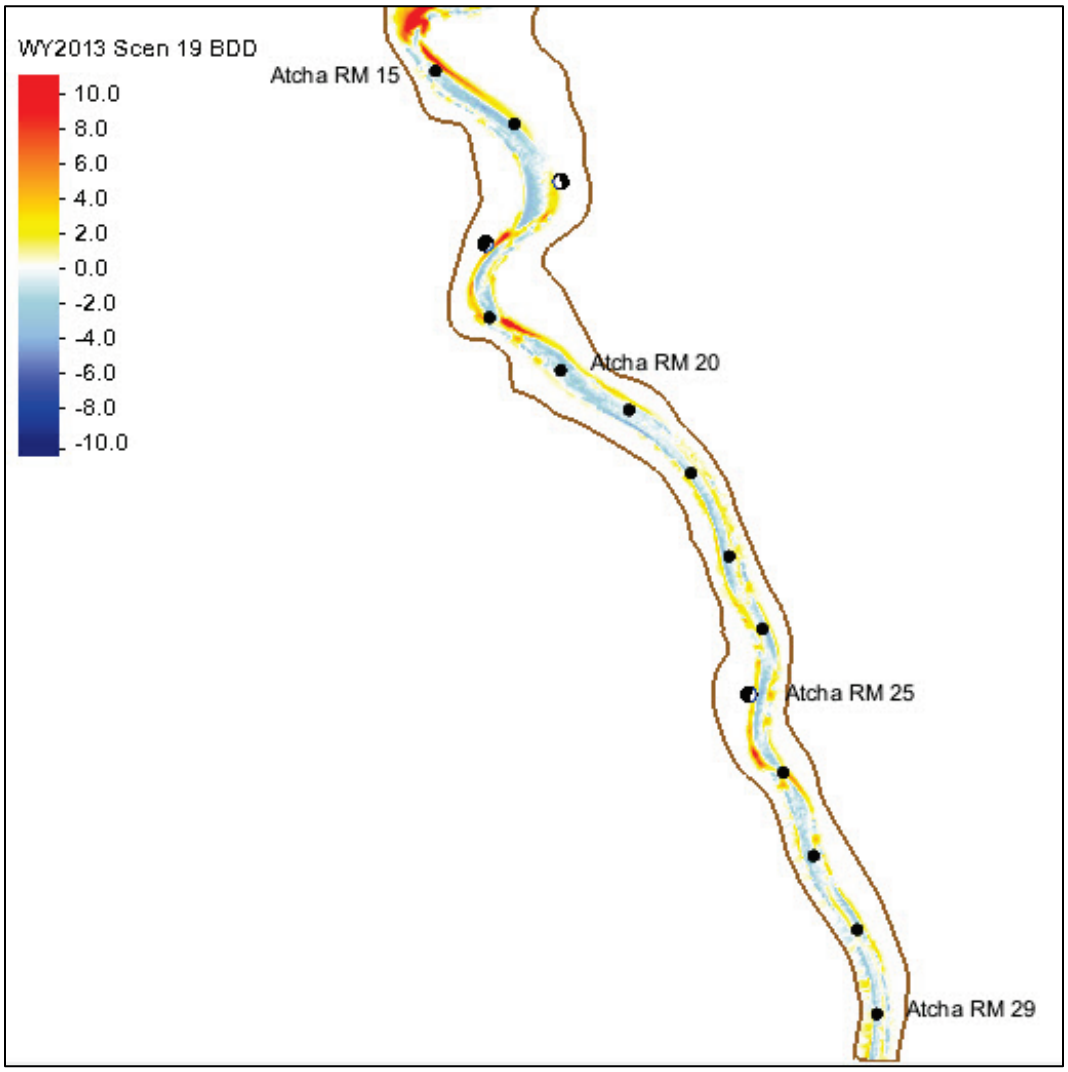


Plate F.120. WY2013 Scenario 19 BDD Atcha RM 15–Atcha RM 29.



F.12.2 Scenario 20

Plate F.121. WY2013 Scenario 20 BDD RR RM 43–RR RM 30.

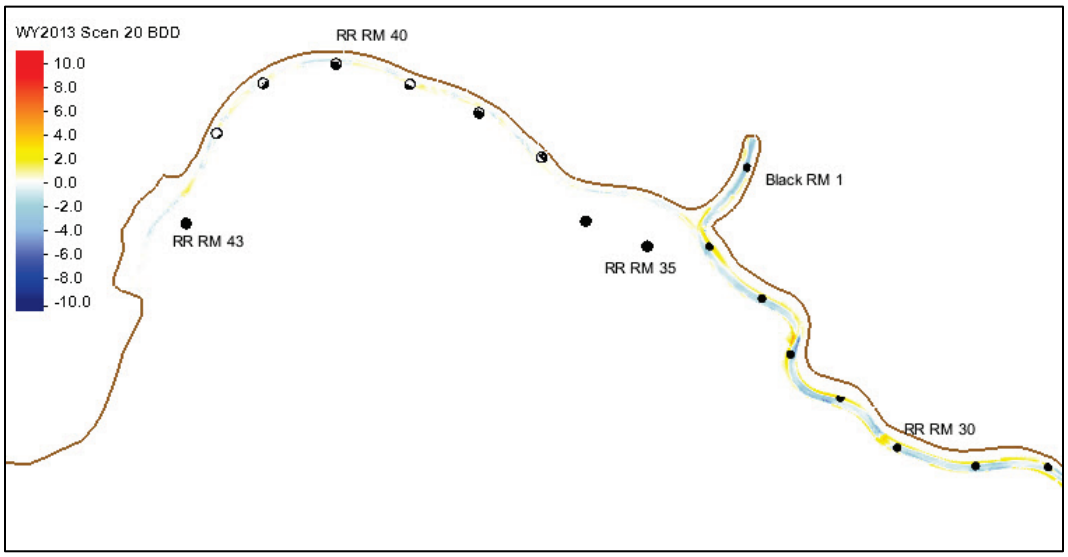


Plate F.122. WY2013 Scenario 20 BDD RR RM 30–RR RM 20.

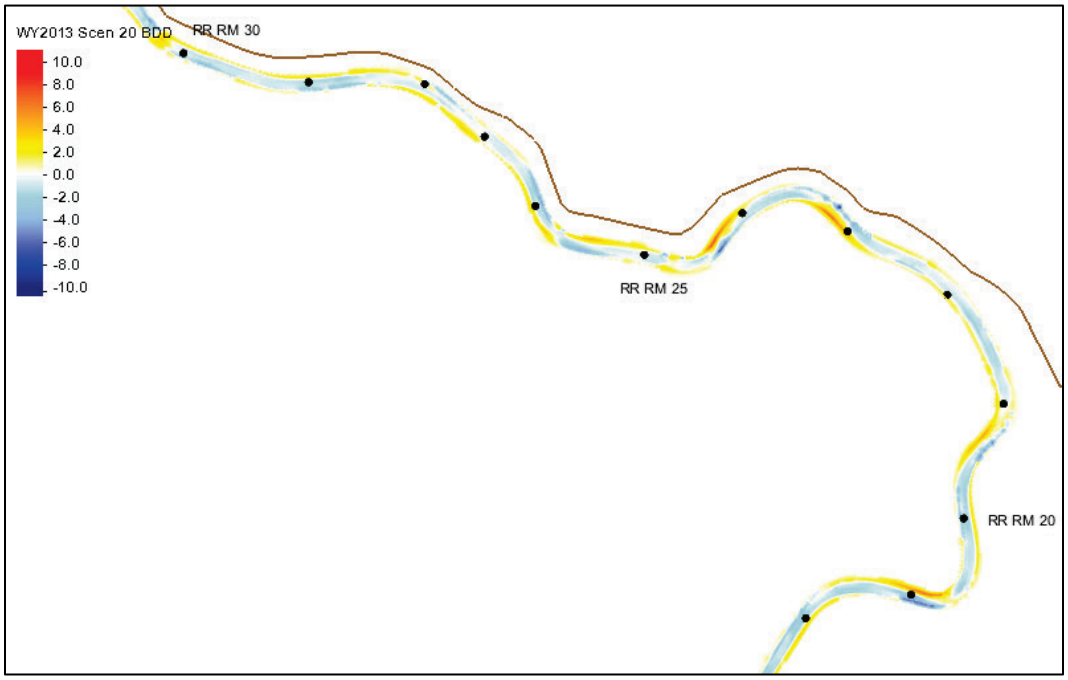


Plate F.123. WY2013 Scenario 20 BDD RR RM 20–RR RM 10 and Outflow Channel.

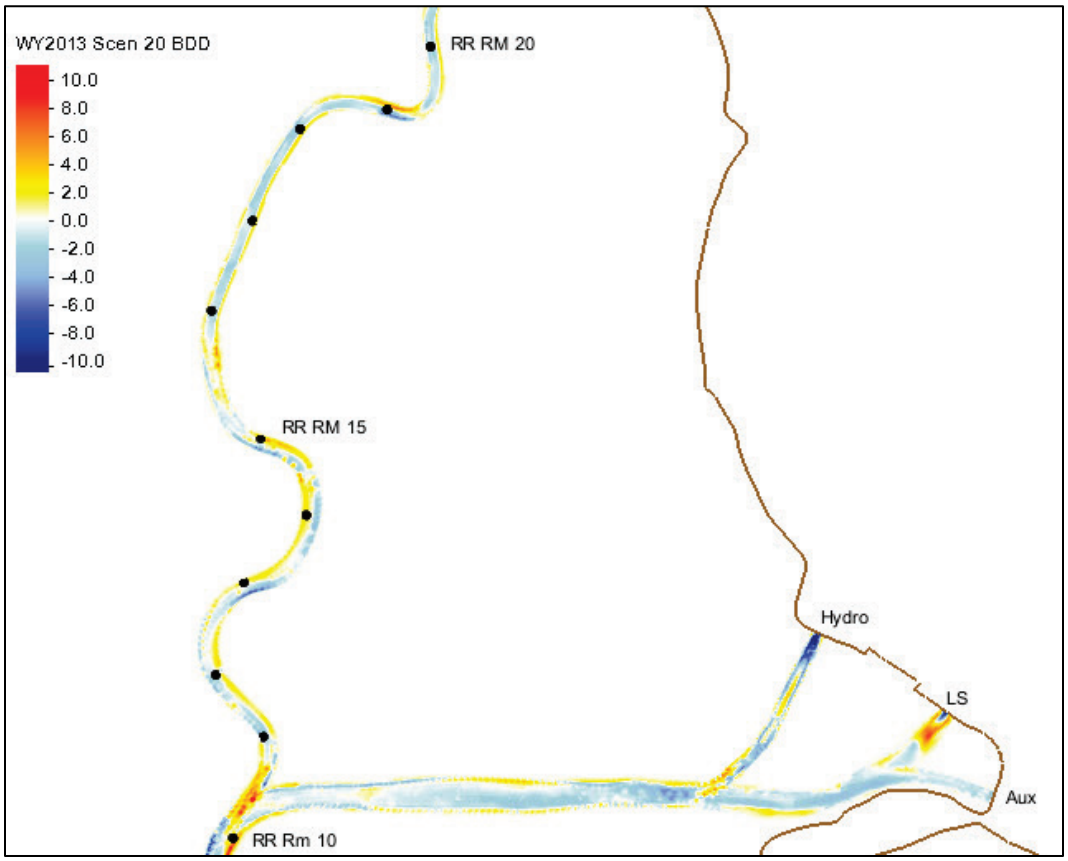


Plate F.124. WY2013 Scenario 20 BDD Outflow Channel.

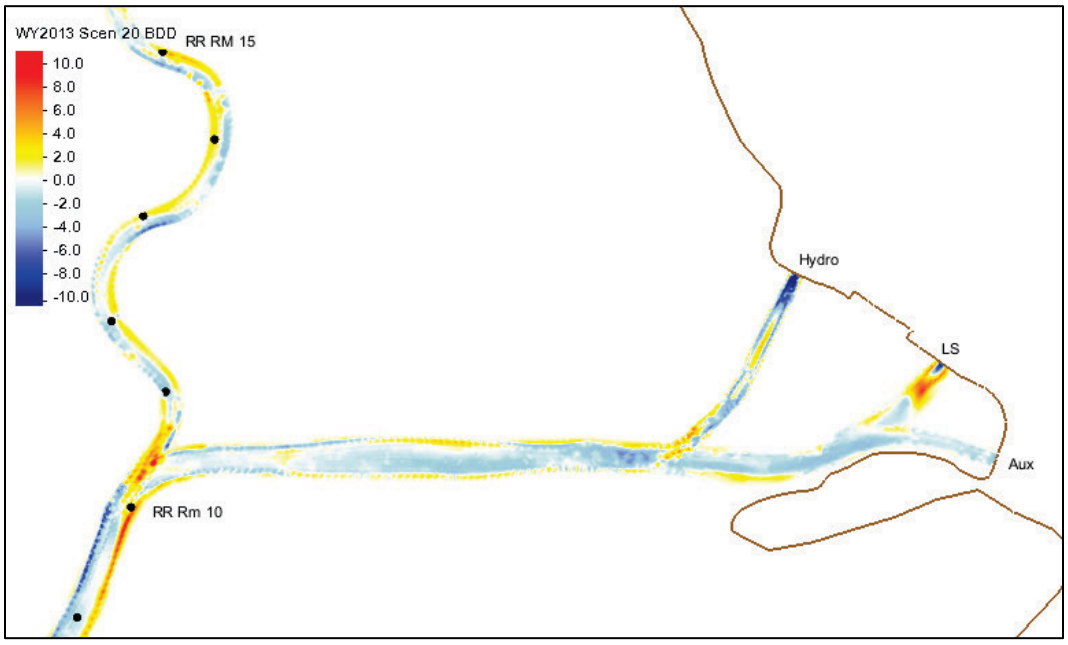


Plate F.125. WY2013 Scenario 20 BDD RR RM 10–Atcha RM 5.

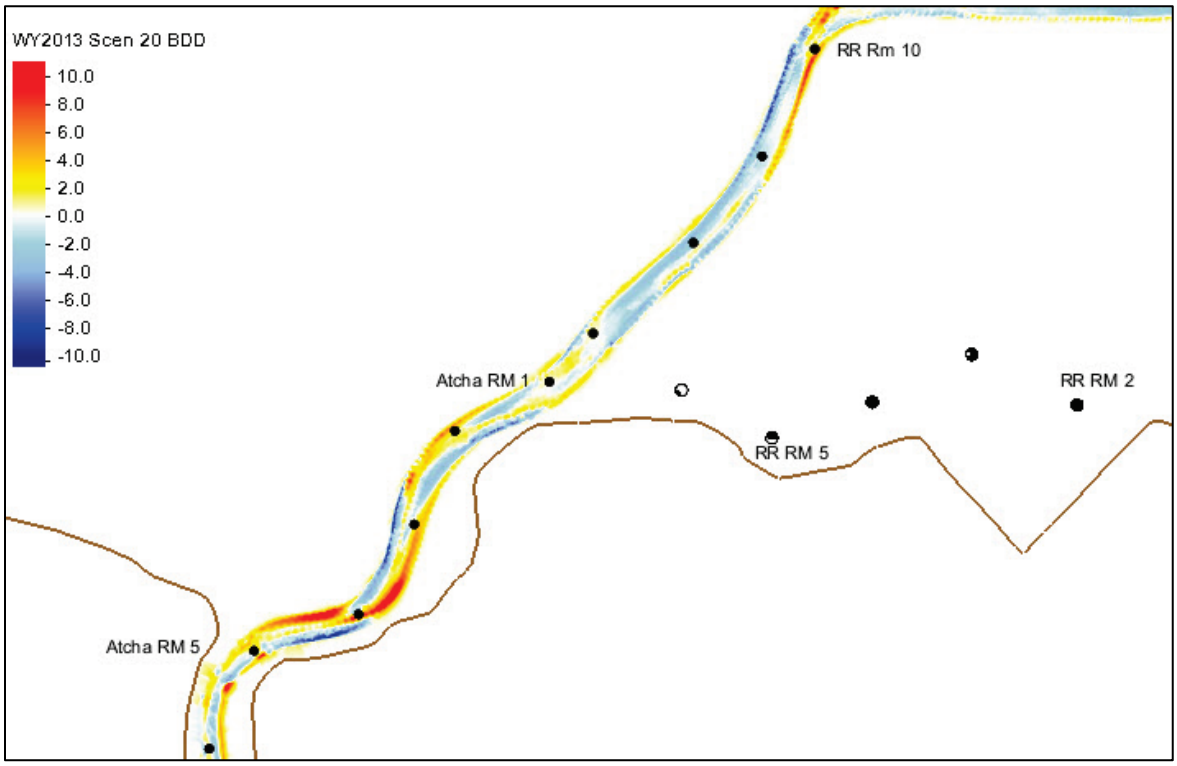


Plate F.126. WY2013 Scenario 20 BDD Atcha RM 5–Atcha RM 15.

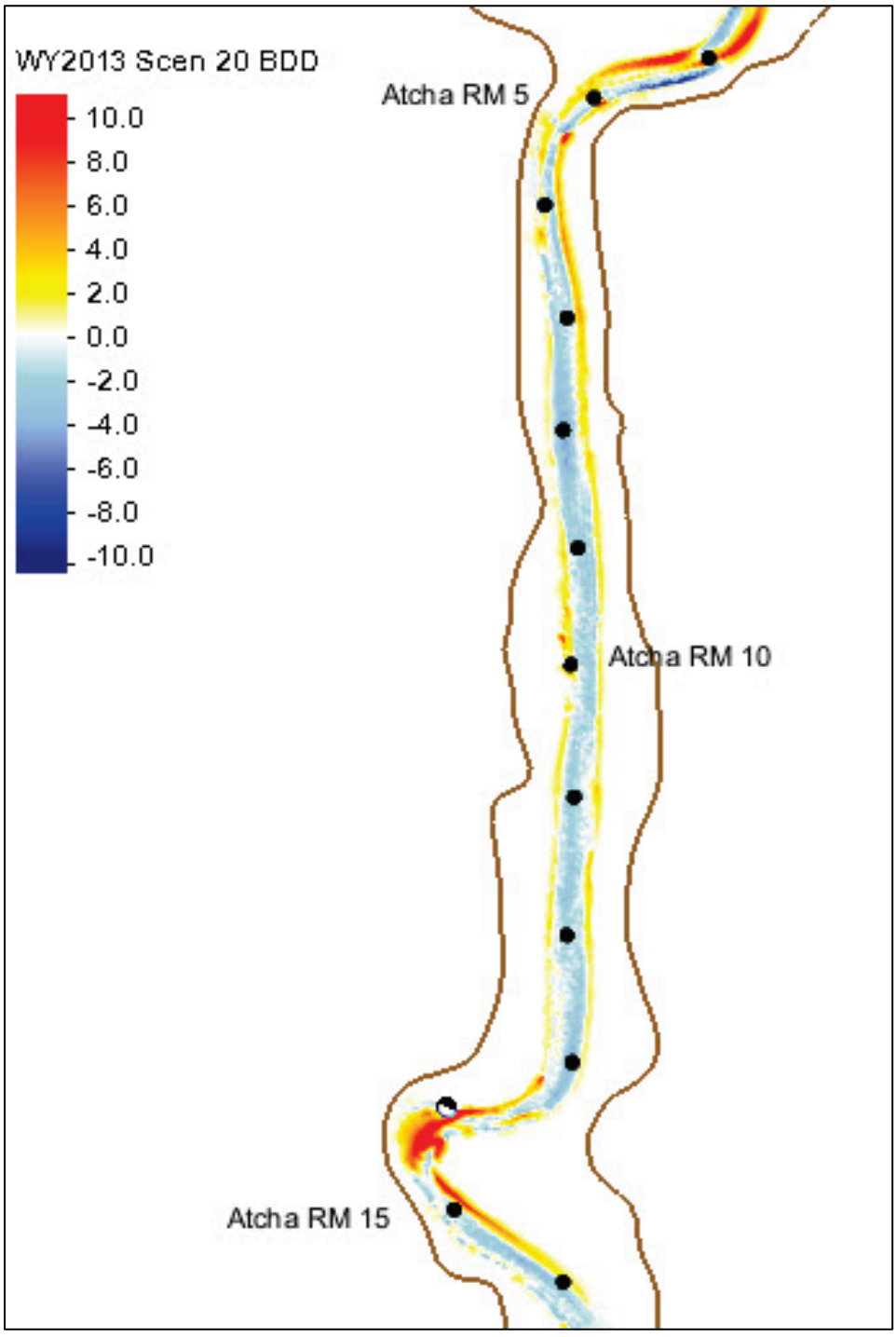
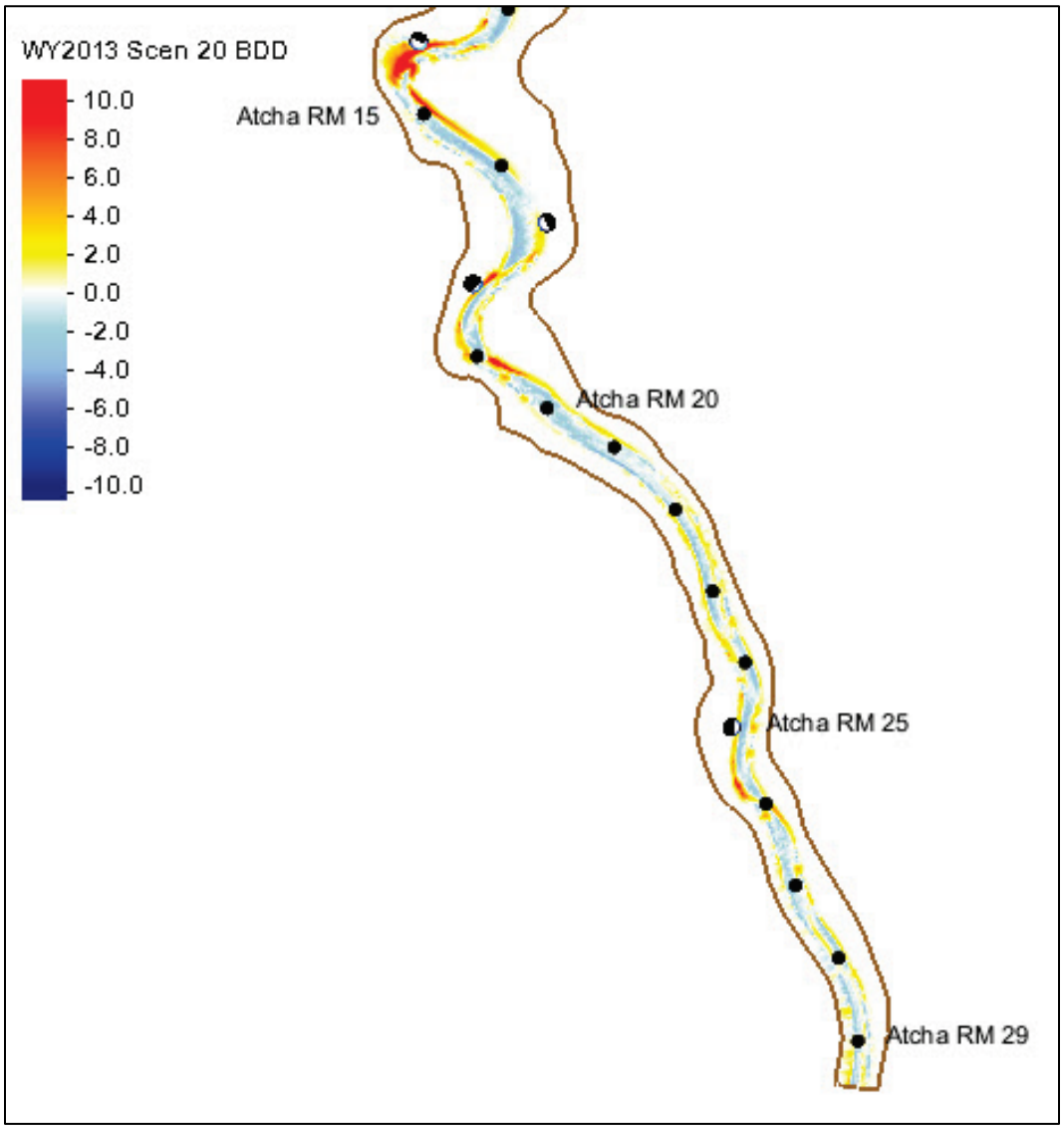
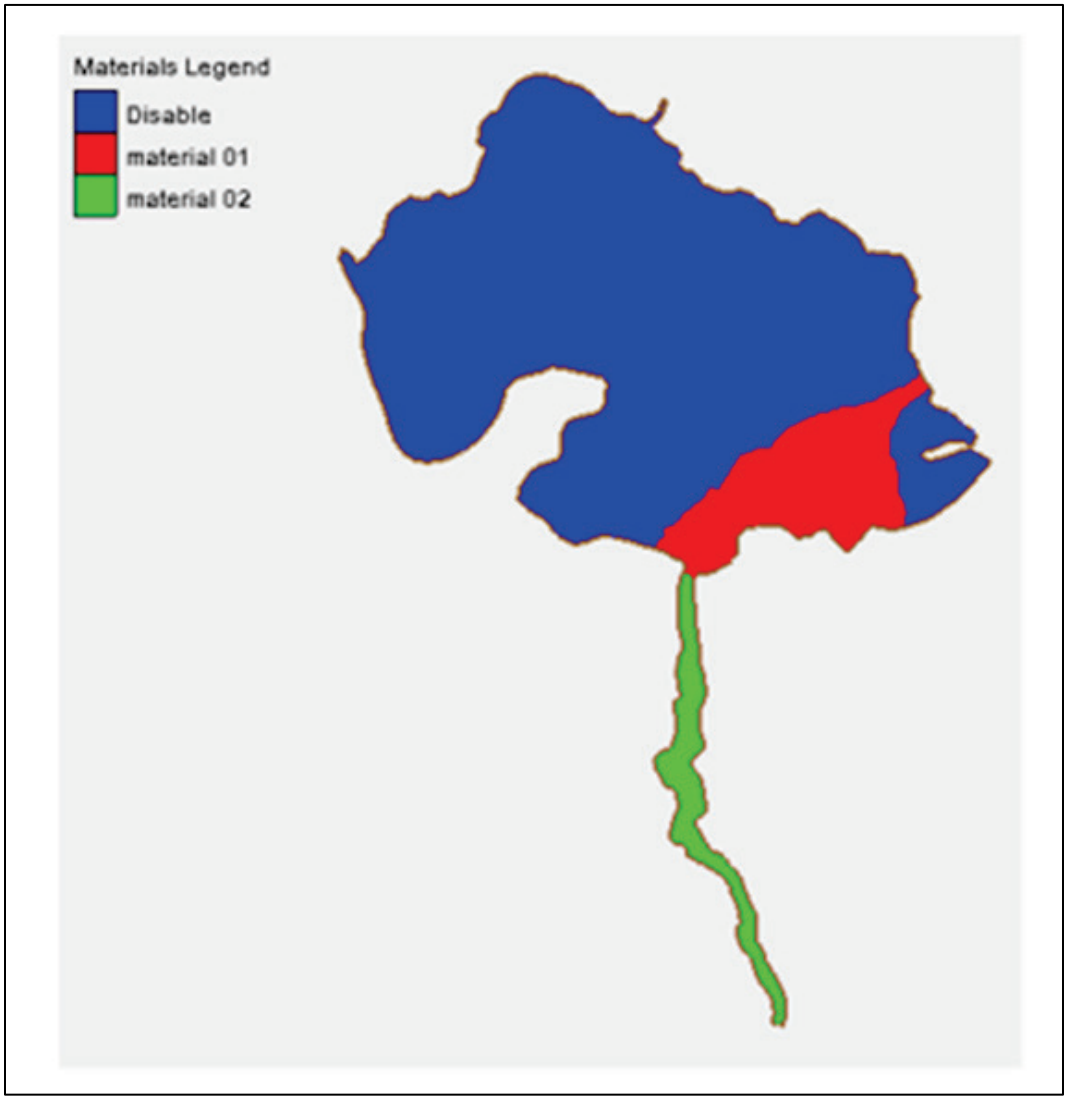


Plate F.127. WY2013 Scenario 20 BDD Atcha RM 15–Atcha RM 29.



Appendix G: WY2013 BSVC

Plate G.1. Material 1 Base Run and Scenarios 3–10.



G.1 Material 1 Base Run and Scenarios 3–10

Plate G.2. Material 1 WY2013 Base Run time versus sediment volume change/Simmesport discharge.

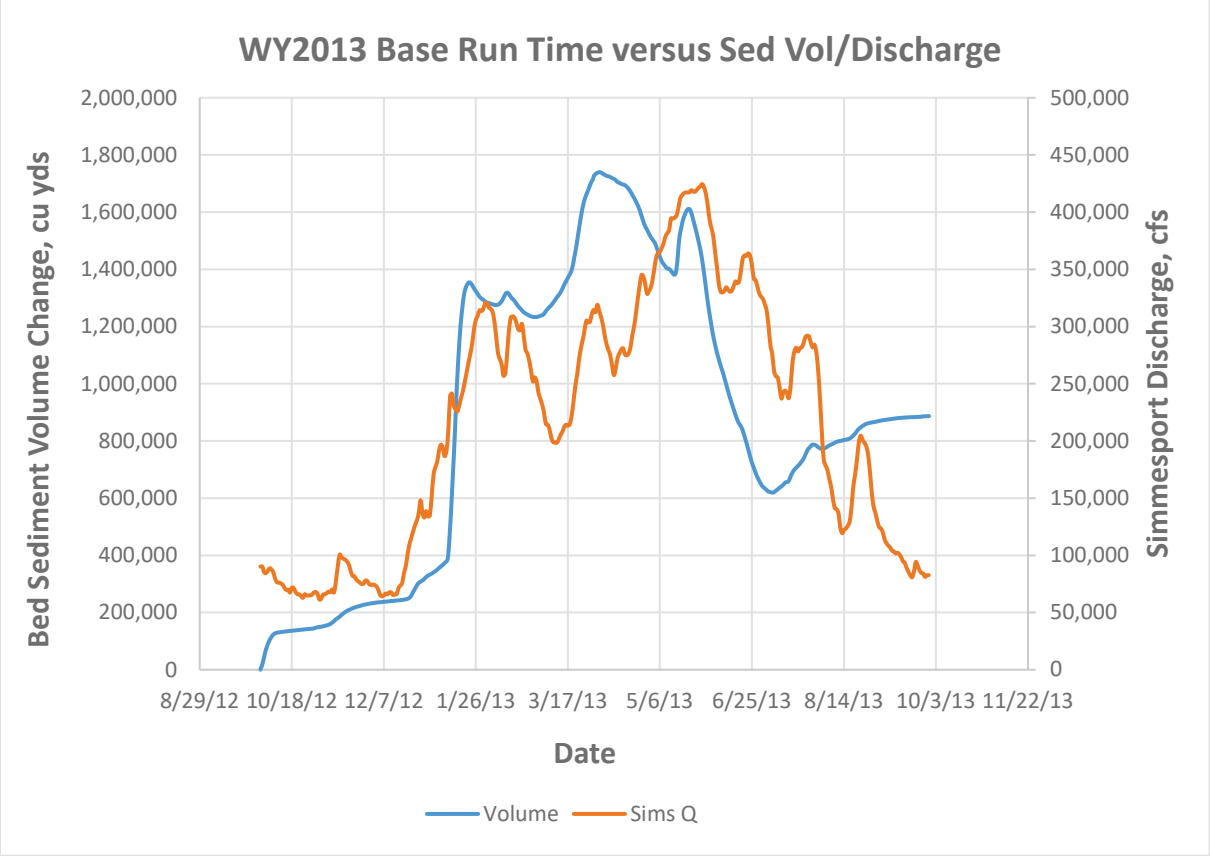


Plate G.3. Material 1 WY2013 Scenario 3 time versus sediment volume change/Simmesport discharge.

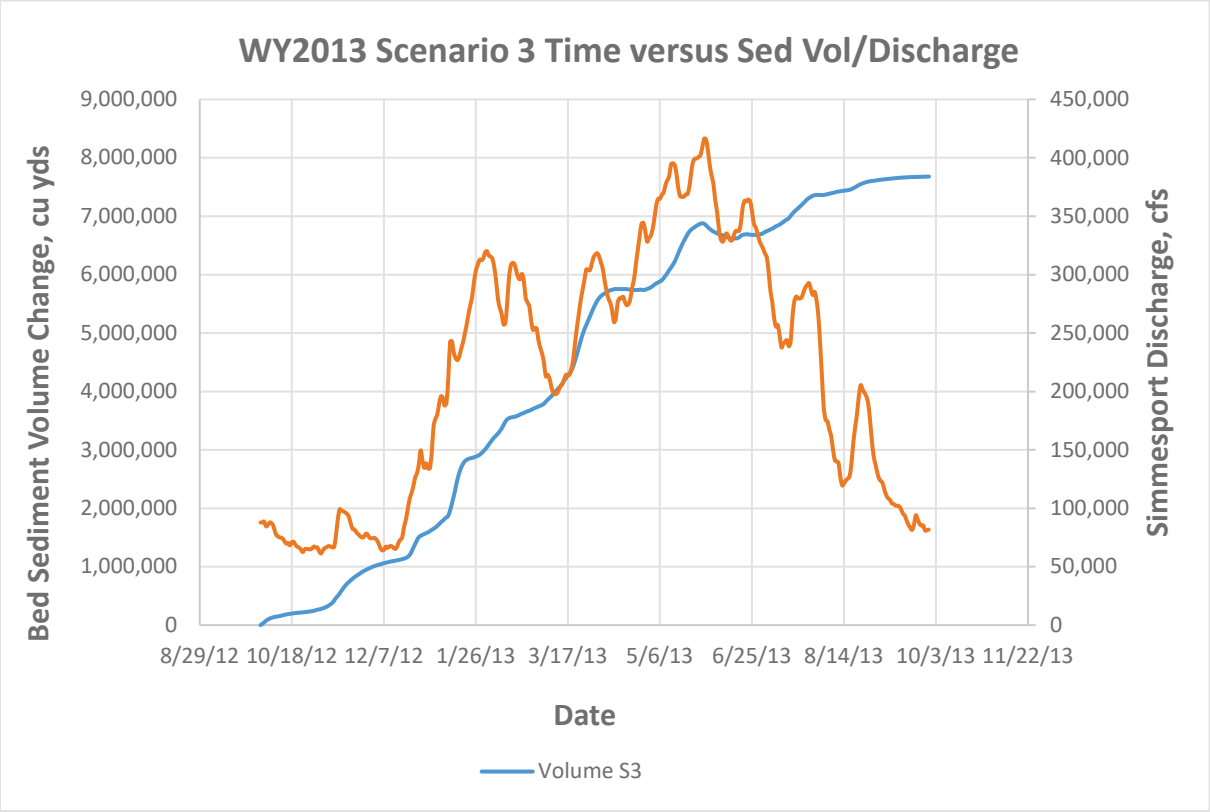


Plate G.4. Material 1 WY2013 Scenario 4 time versus sediment volume change/Simmesport discharge.

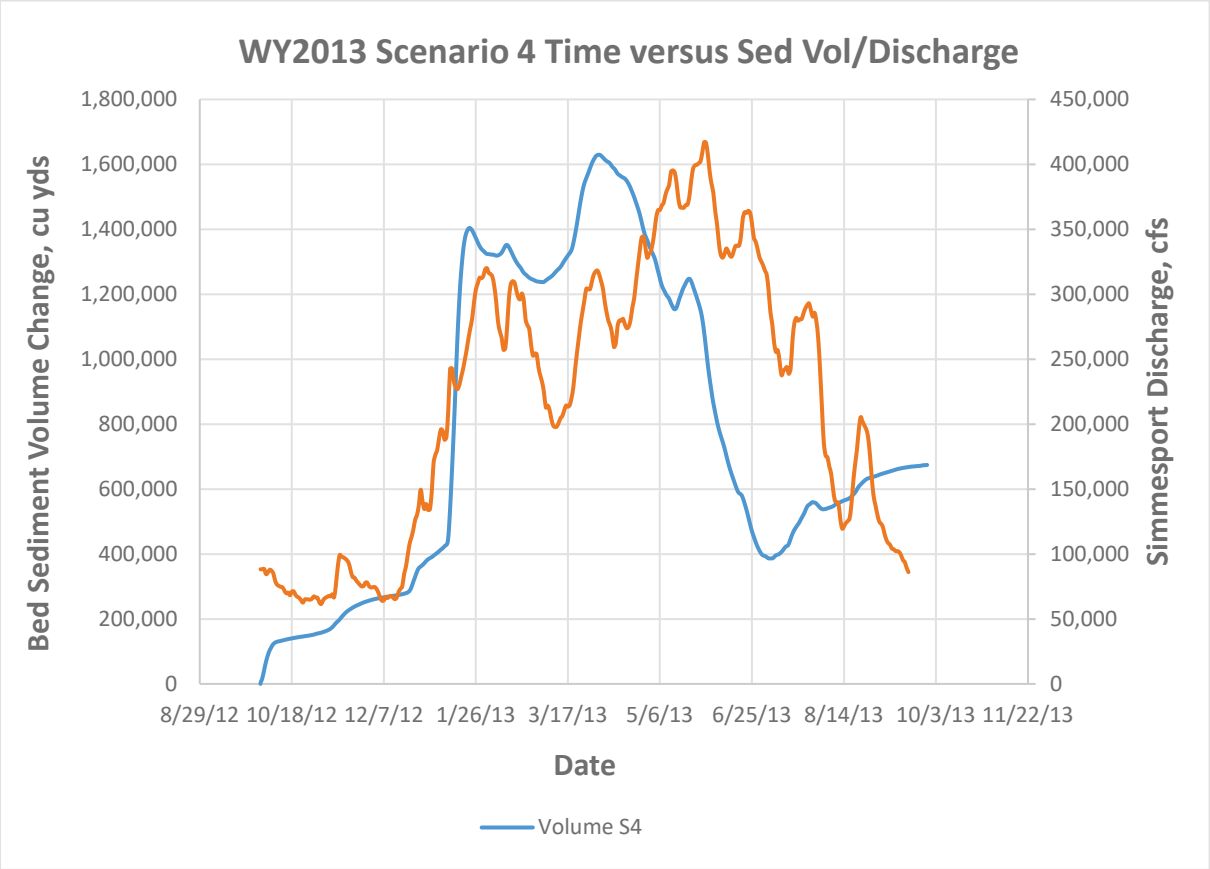


Plate G.5. Material 1 WY2013 Scenario 3 time versus sediment volume change/Simmesport discharge.

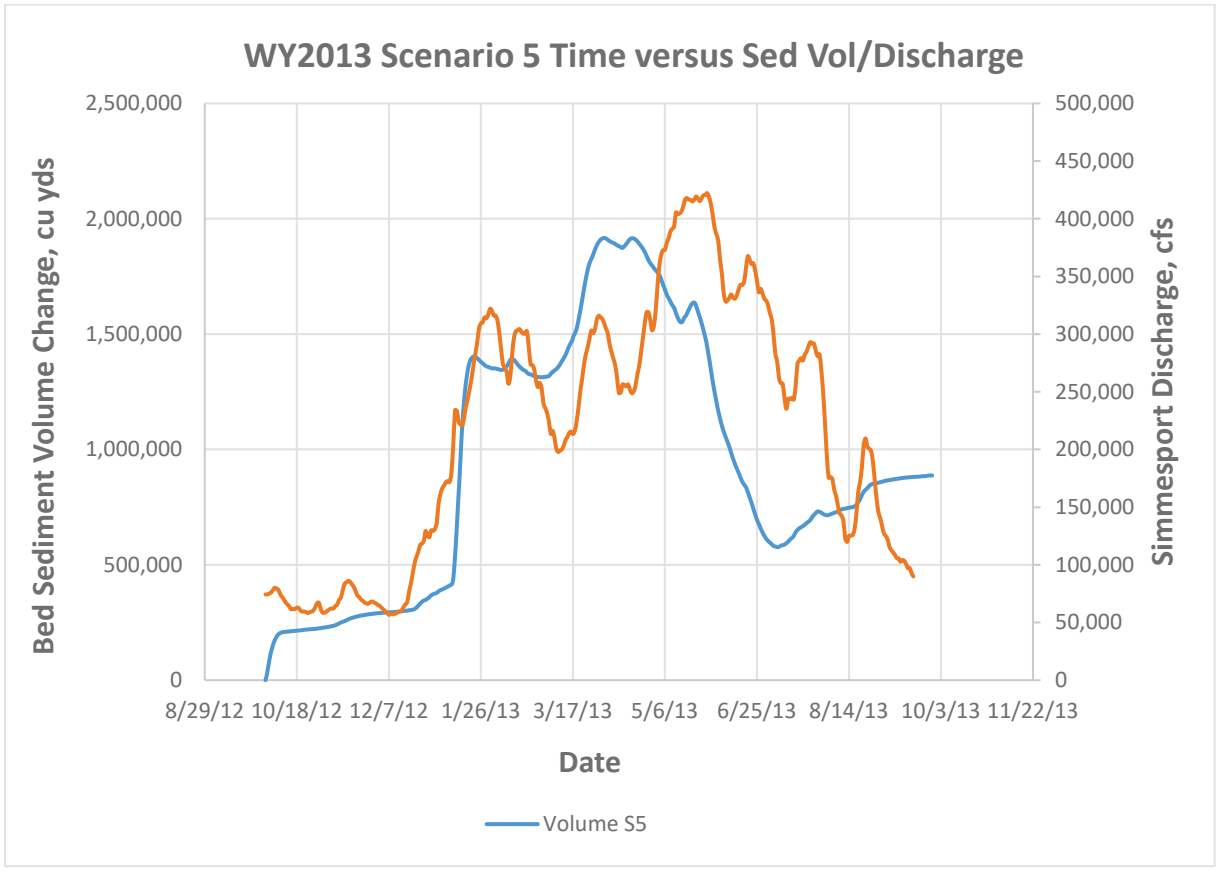


Plate G.6. Material 1 WY2013 Scenario 6 time versus sediment volume change/Simmesport discharge.

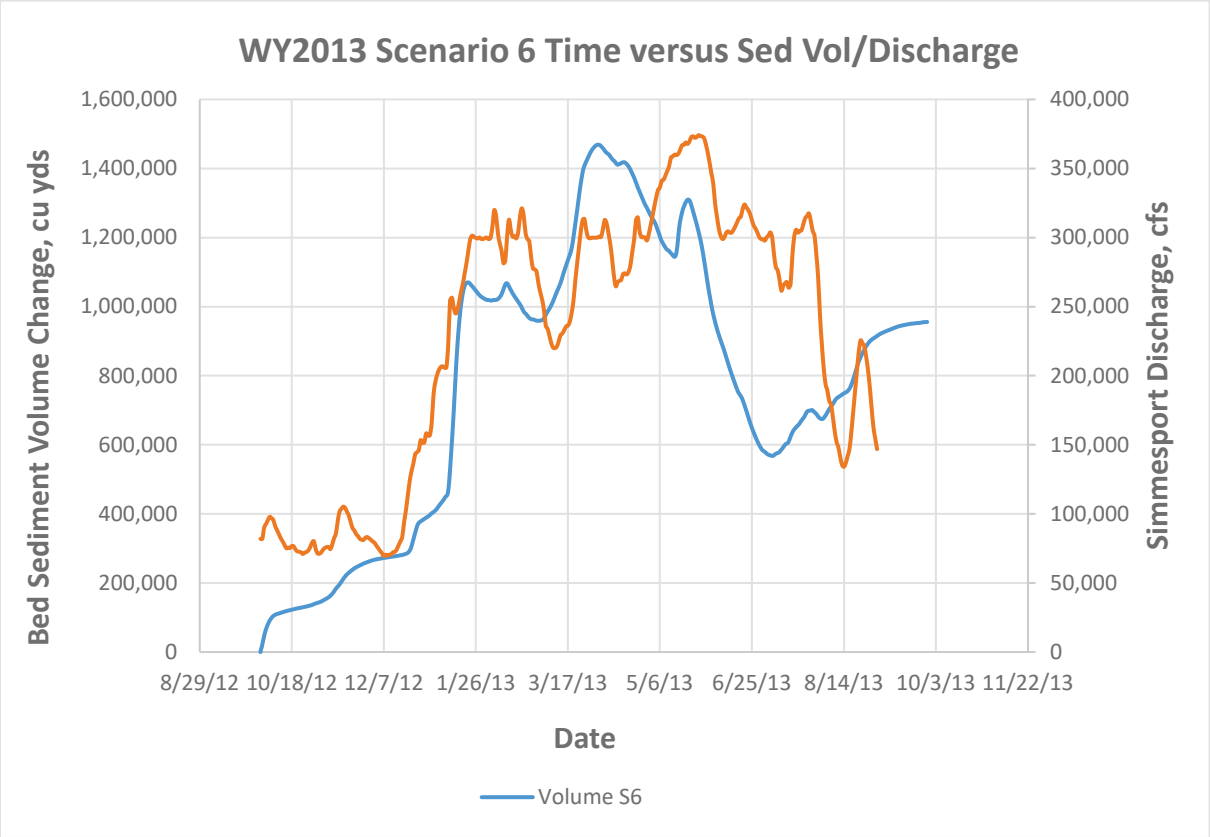


Plate G.7. Material 1 WY2013 Scenario 7 time versus sediment volume change/Simmesport discharge.

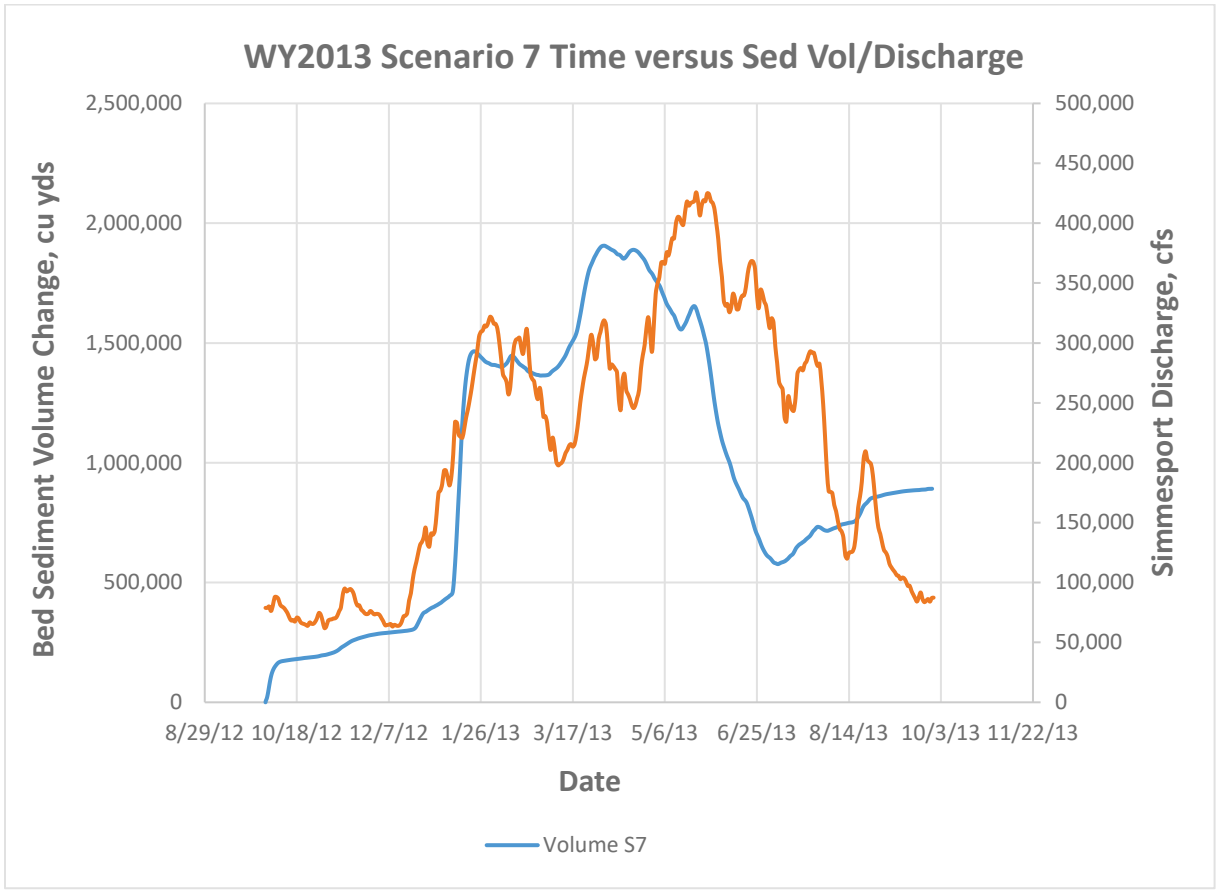


Plate G.8. Material 1 WY2013 Scenario 8a time versus sediment volume change/Simmesport discharge.

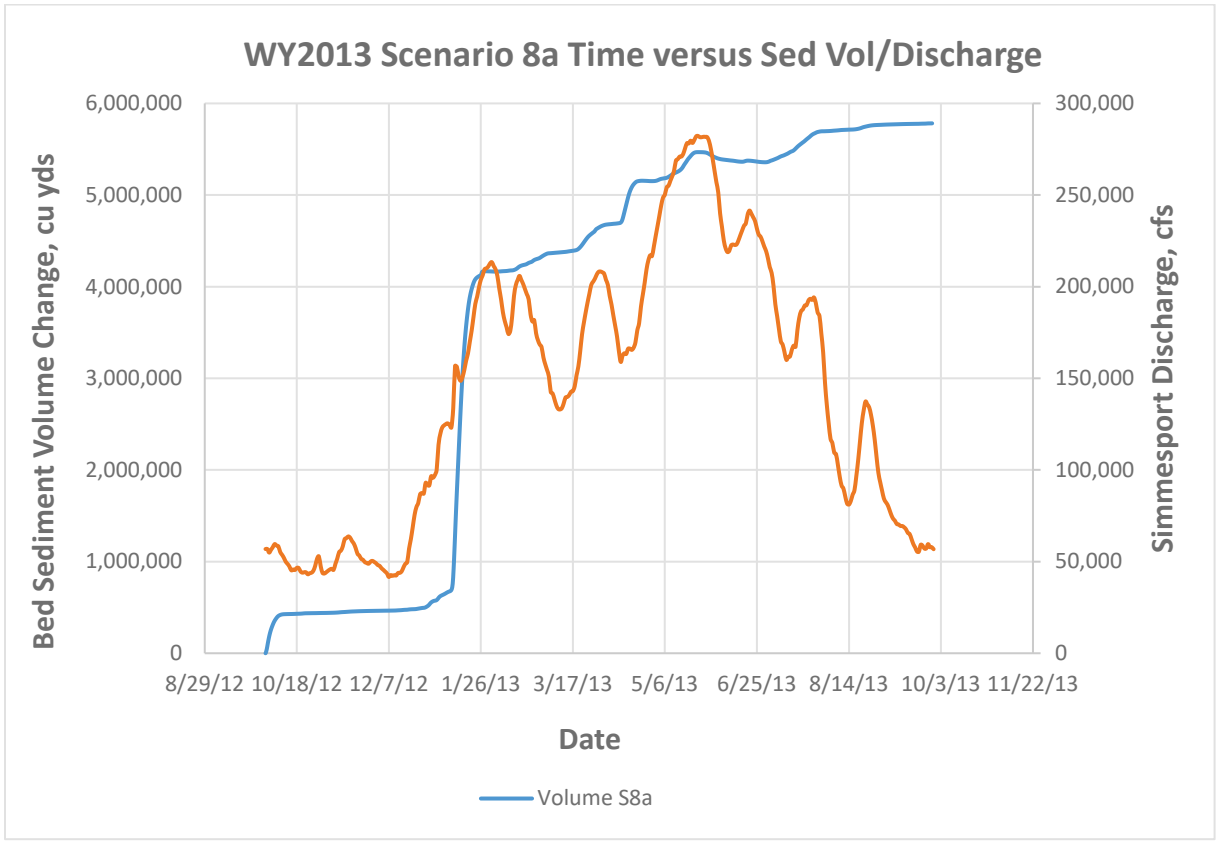


Plate G.9. Material 1 WY2013 Scenario 8b time versus sediment volume change/Simmesport discharge.

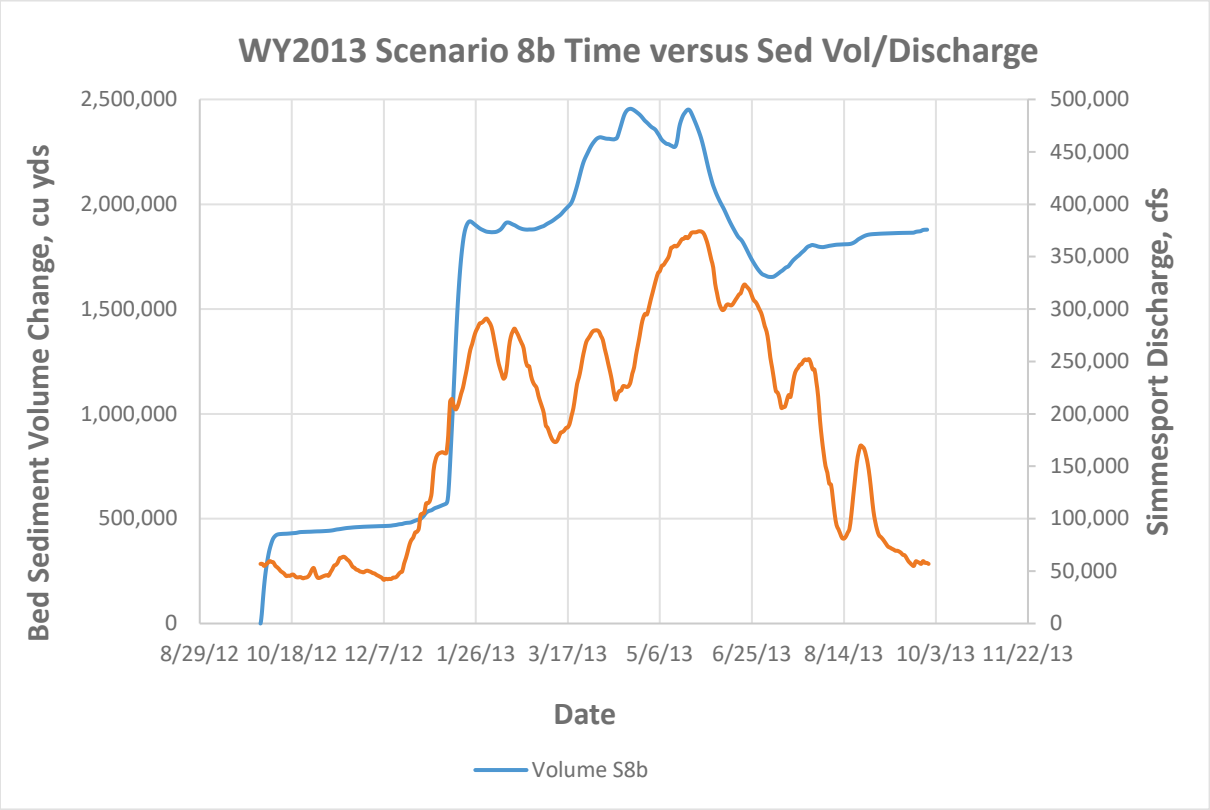


Plate G.10. Material 1 WY2013 Scenario 9 time versus sediment volume change/Simmesport discharge.

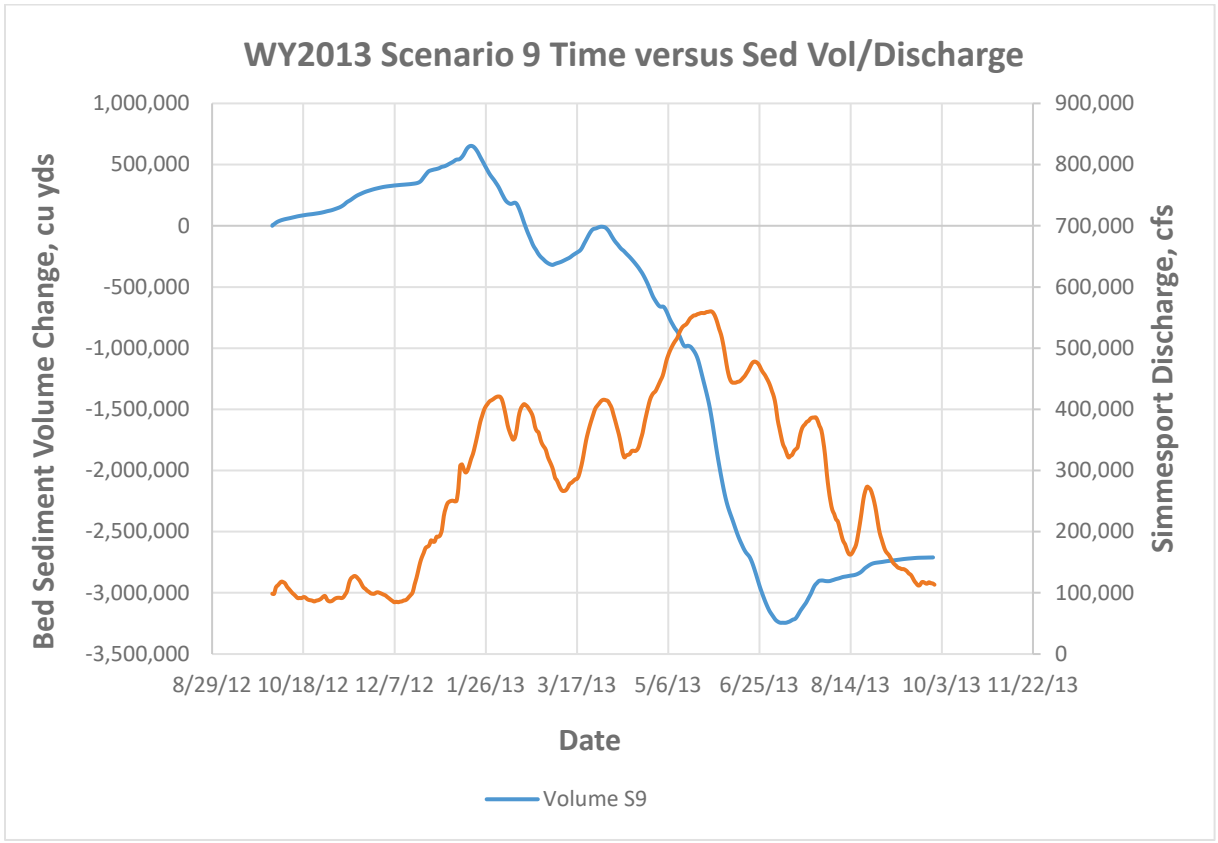


Plate G.11. Material 1 WY2013 Scenario 10 time versus sediment volume change/Simmesport discharge.

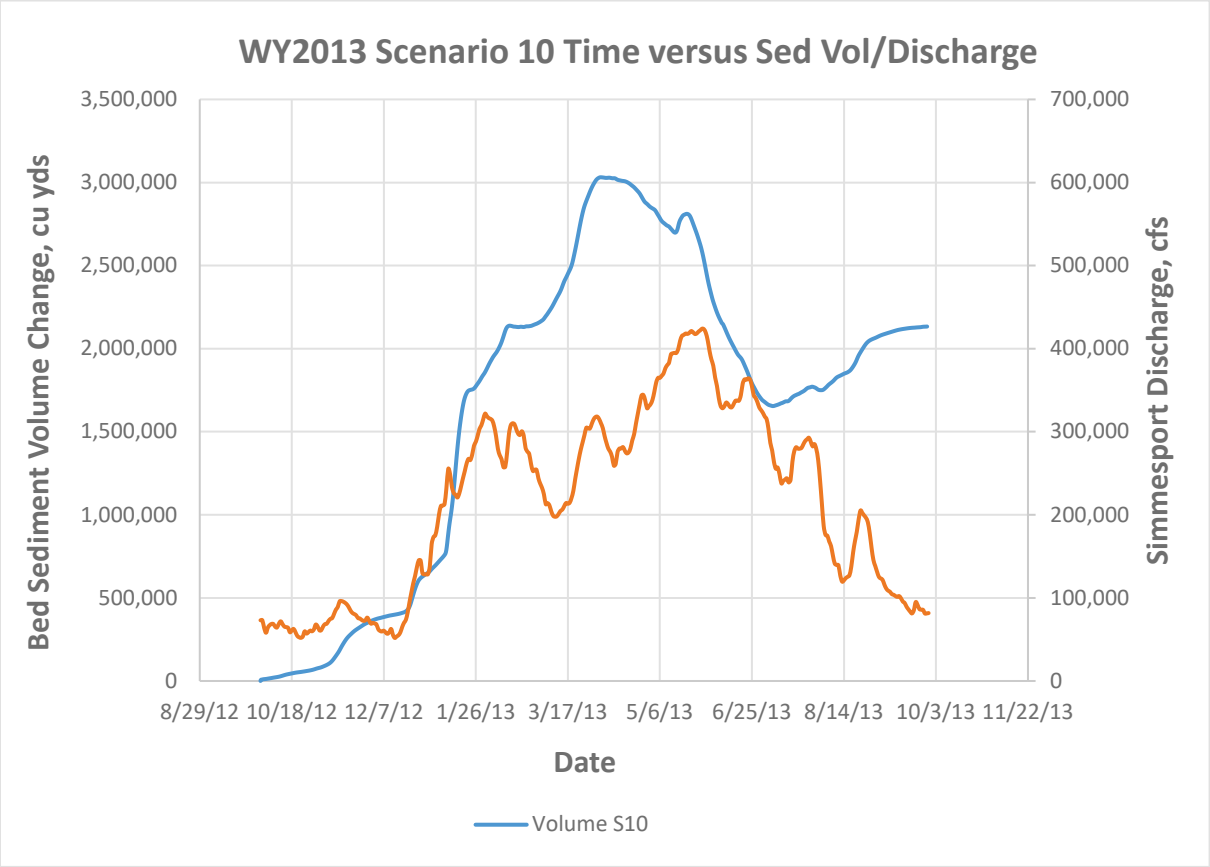
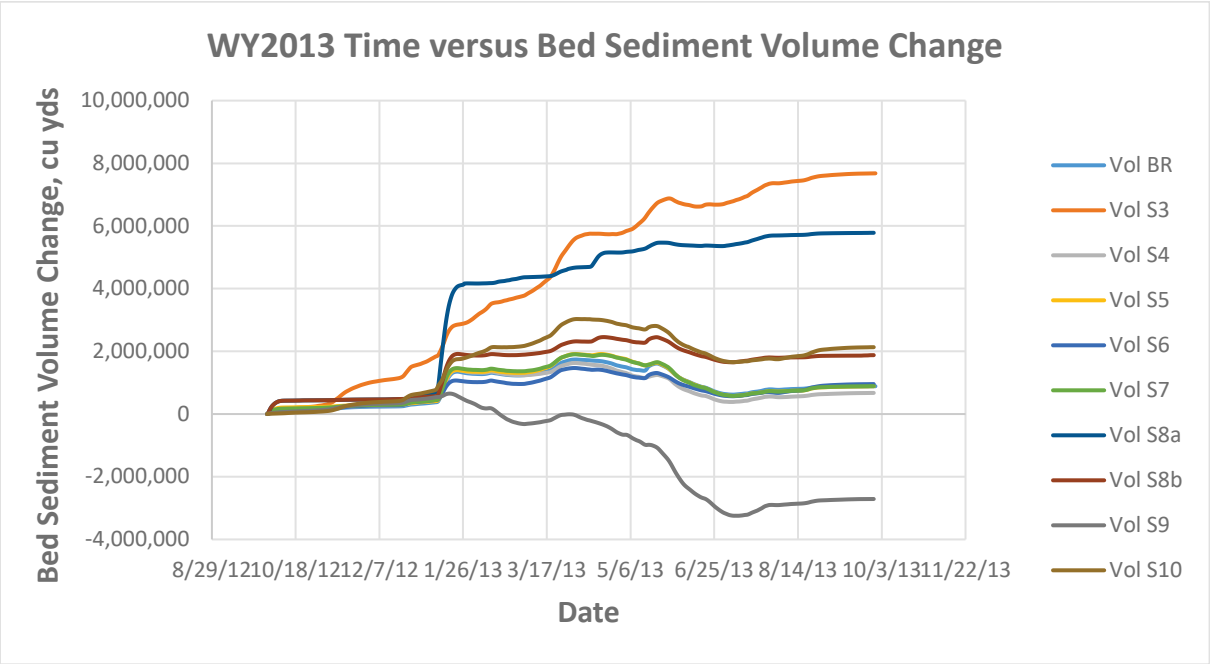


Plate G.12. Material 1 WY2013 Base Run and Scenarios 3–10 time versus sediment volume change.



G.2 Material 2 Base Run and Scenarios 3–10

Plate G.13. Material 2.

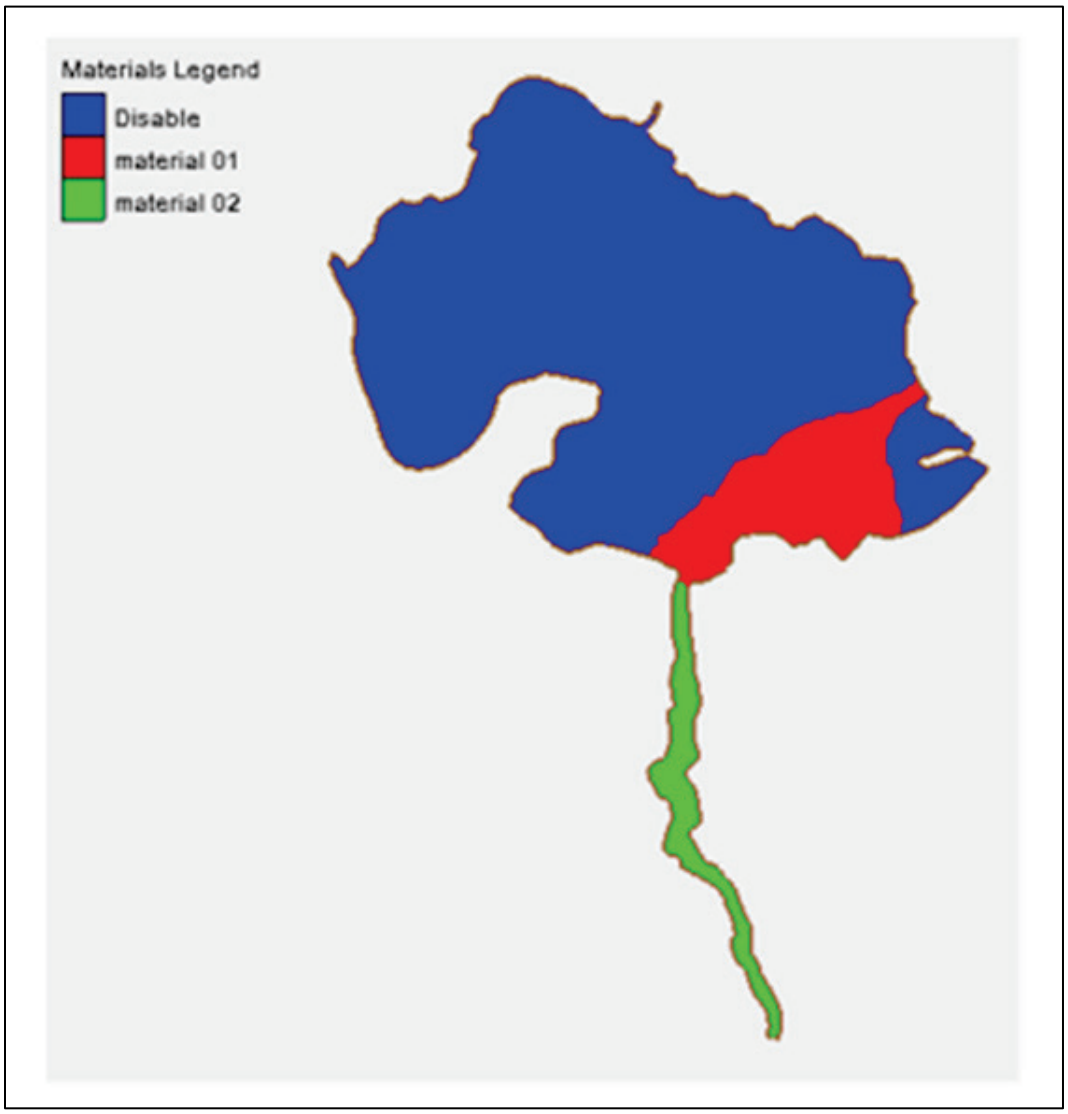


Plate G.14. Material 2 WY2013 Base Run time versus sediment volume change/Simmesport discharge.

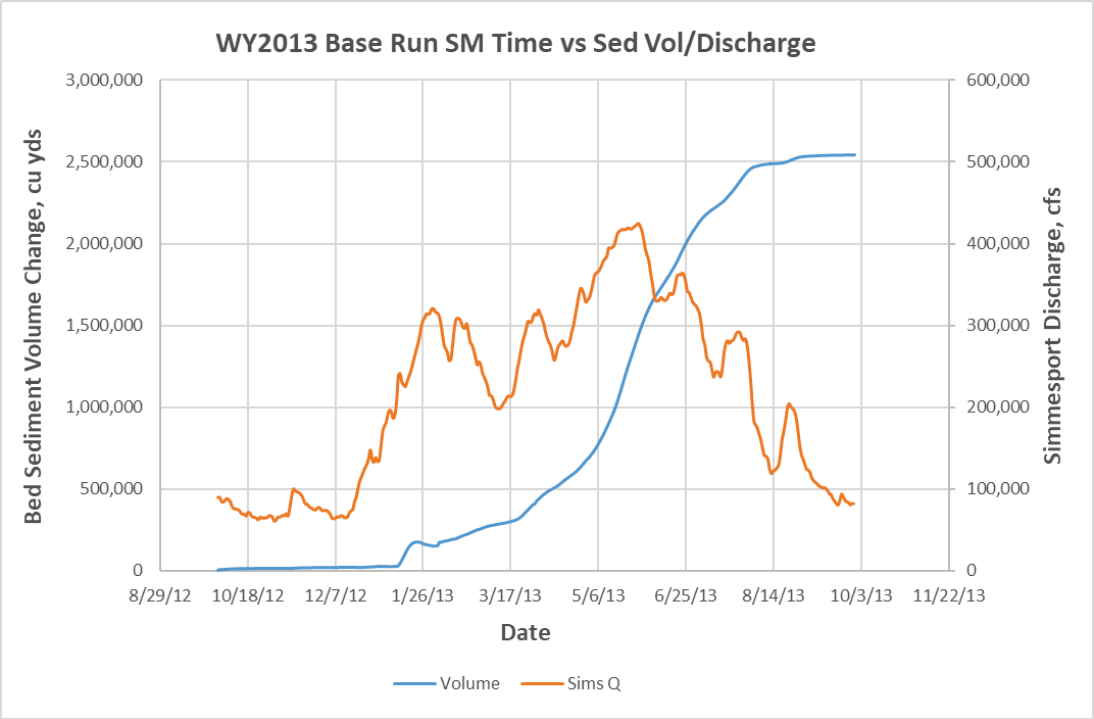


Plate G.15. Material 2 WY2013 Scenario 3 time versus sediment volume change/Simmesport discharge.

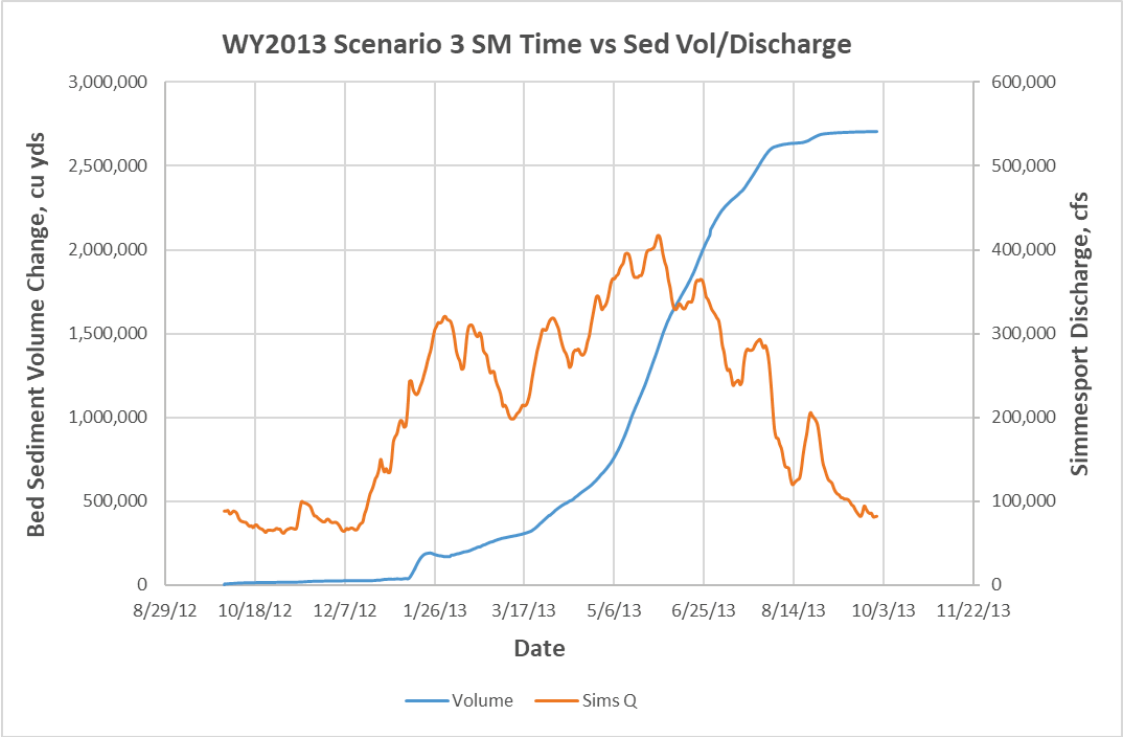


Plate G.16. Material 2 WY2013 Scenario 4 time versus sediment volume change/Simmesport discharge.

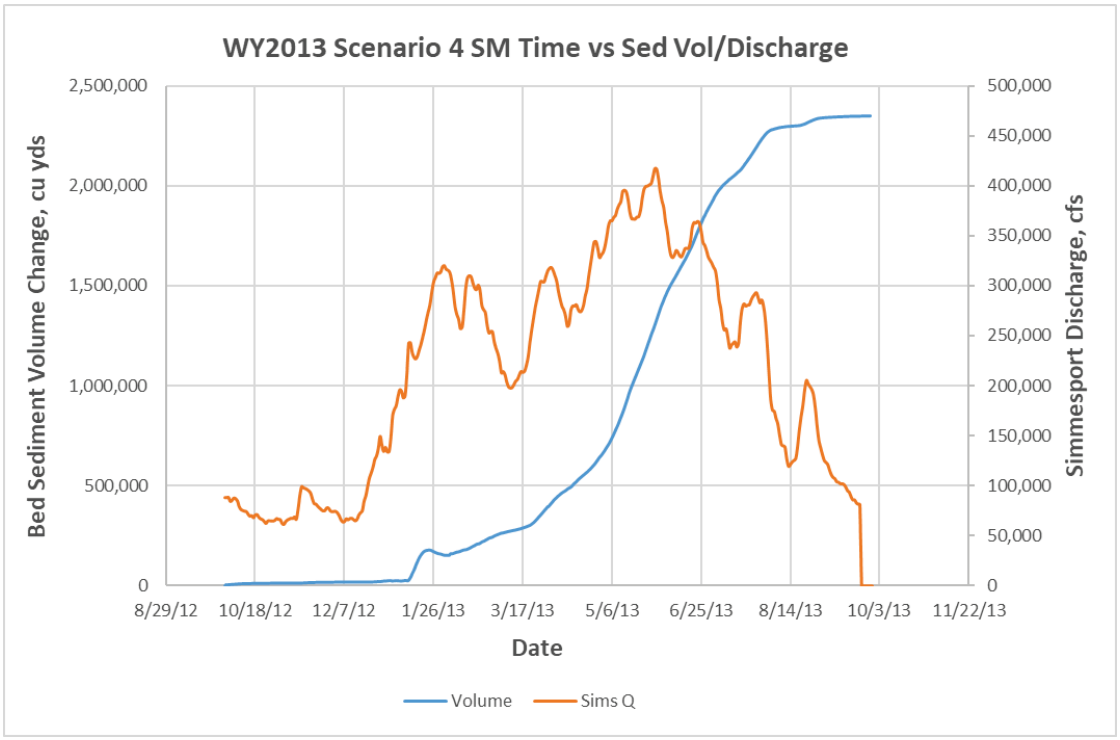


Plate G.17. Material 2 WY2013 Scenario 5 time versus sediment volume change/Simmesport discharge.

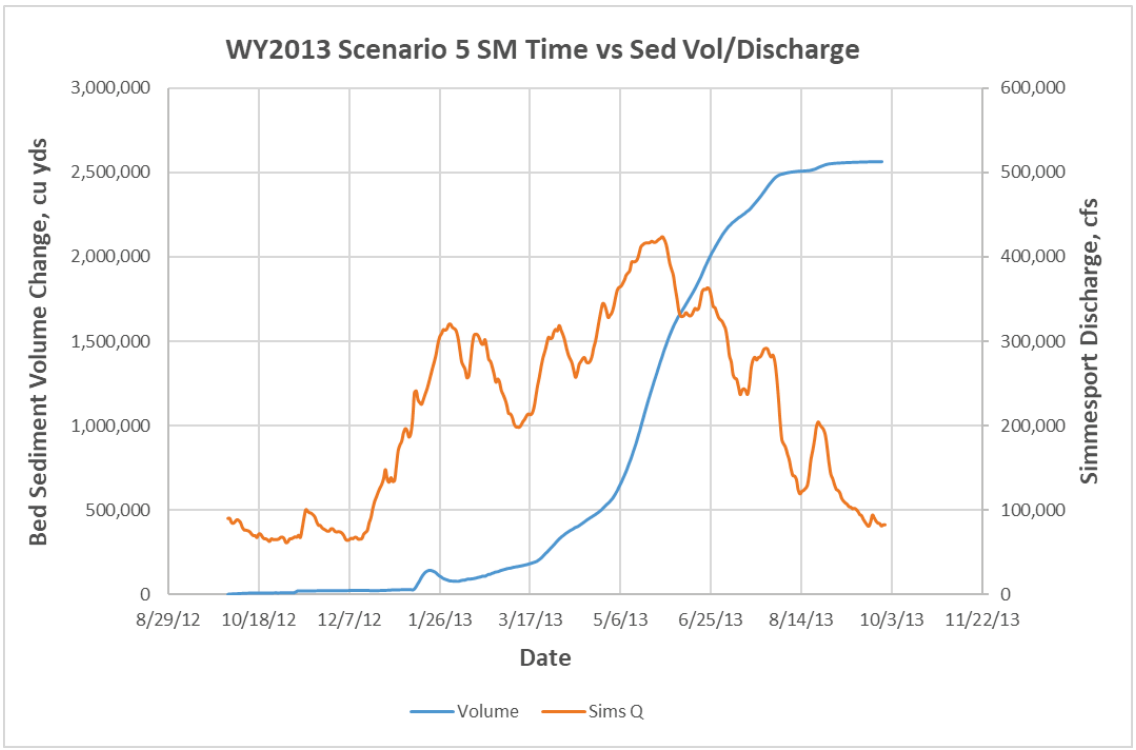


Plate G.18. Material 2 WY2013 Scenario 6 time versus sediment volume change/Simmesport discharge.

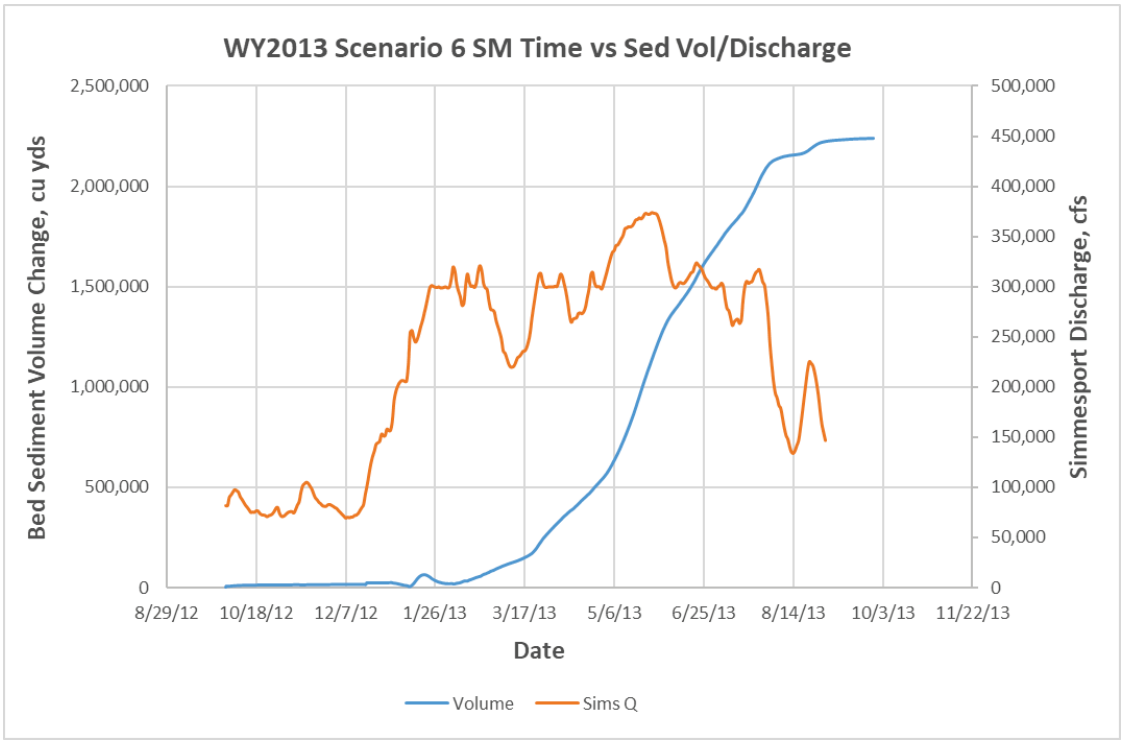


Plate G.19. Material 2 WY2013 Scenario 7 time versus sediment volume change/Simmesport discharge.

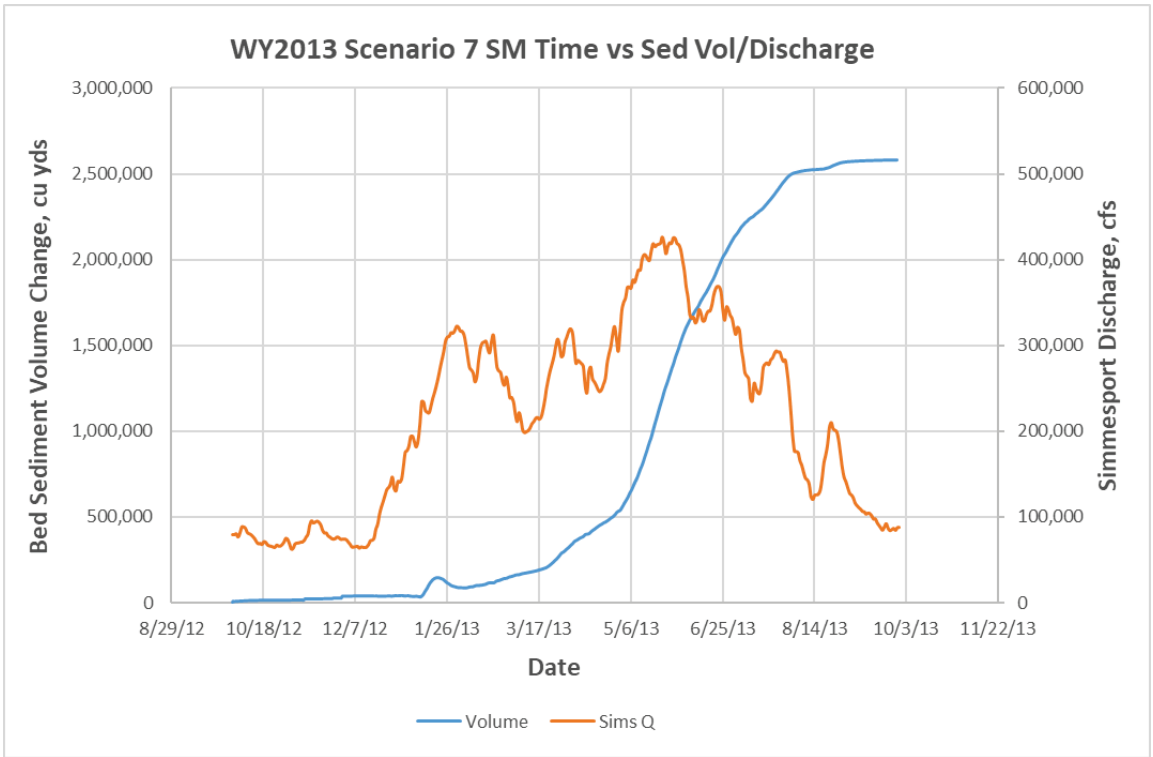


Plate G.20. Material 2 WY2013 Scenario 8a time versus sediment volume change/Simmesport discharge.

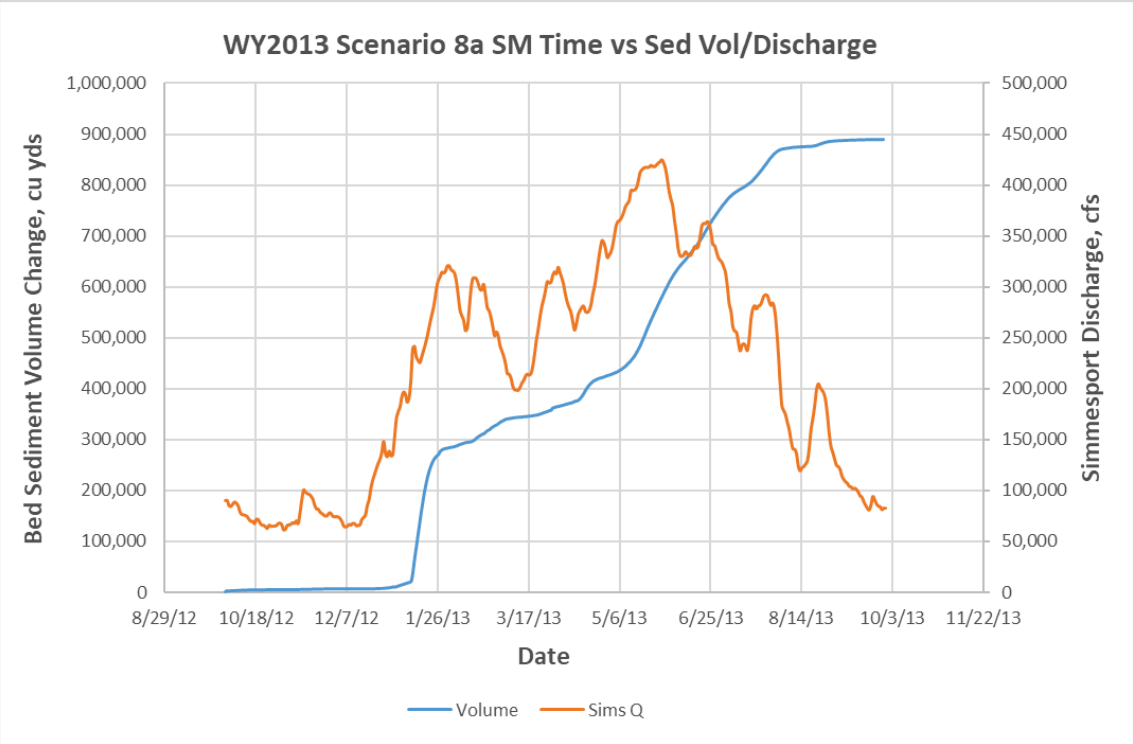


Plate G.21. Material 2 WY2013 Scenario 8b time versus sediment volume change/Simmesport discharge.

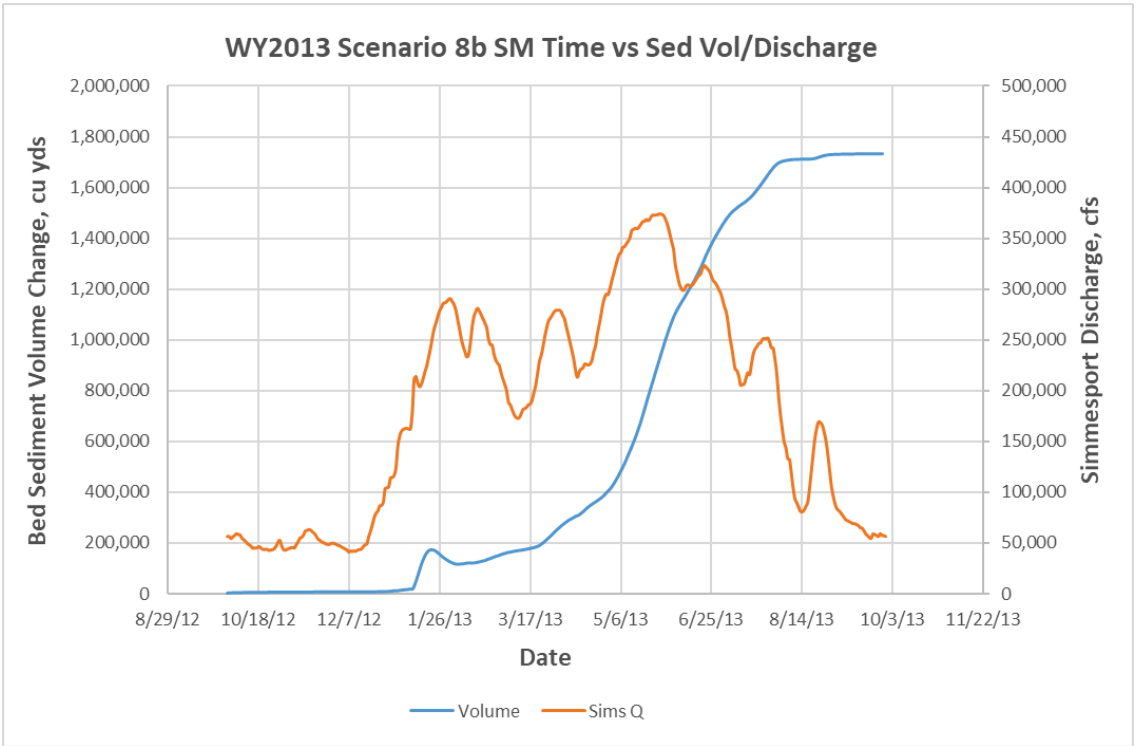


Plate G.22. Material 2 WY2013 Scenario 9 time versus sediment volume change/Simmesport discharge.

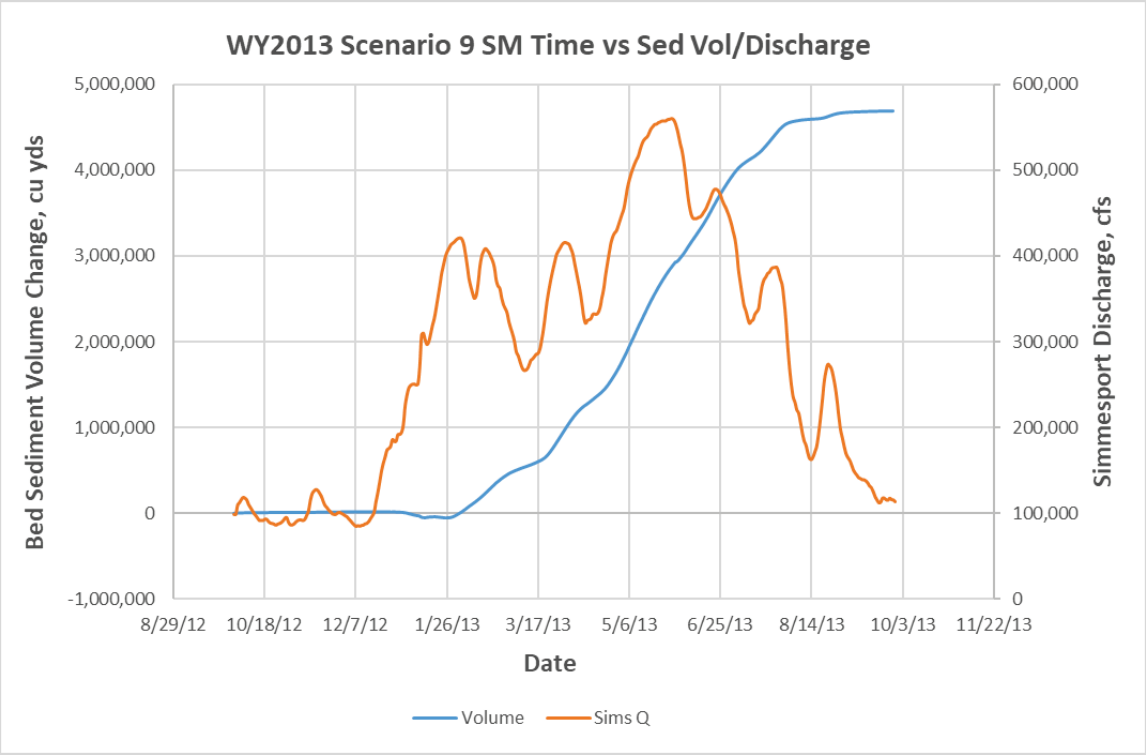


Plate G.23. Material 2 WY2013 Scenario 10 time versus sediment volume change/Simmesport discharge.

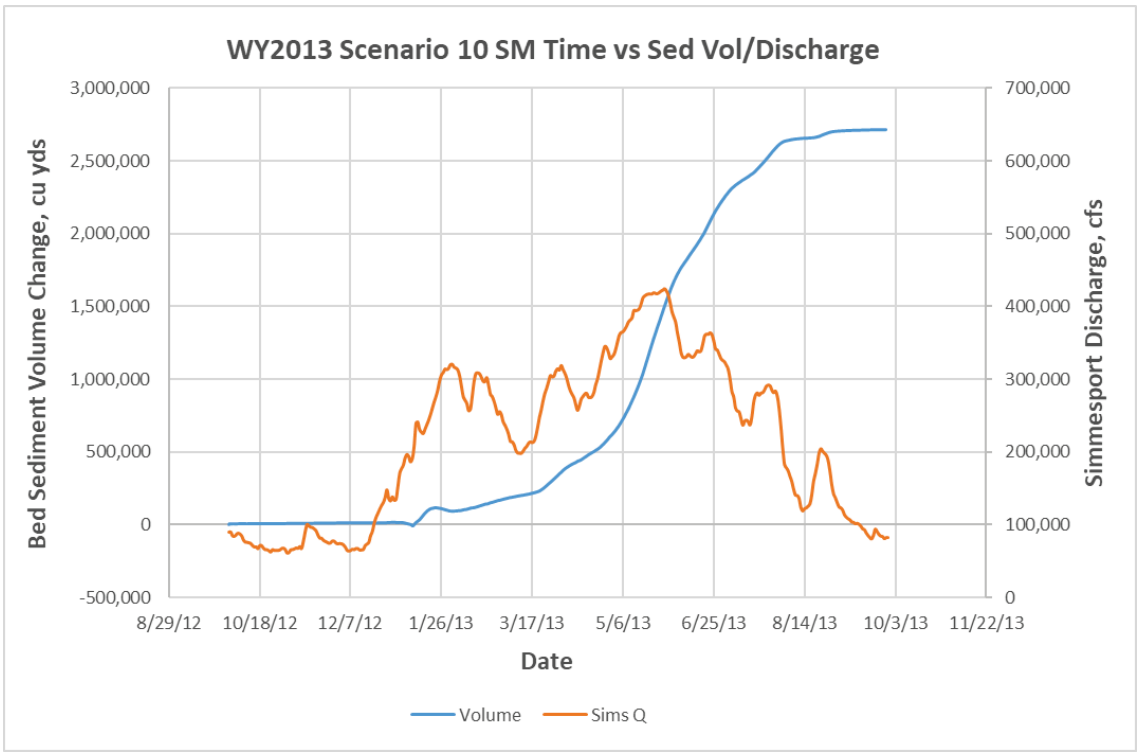
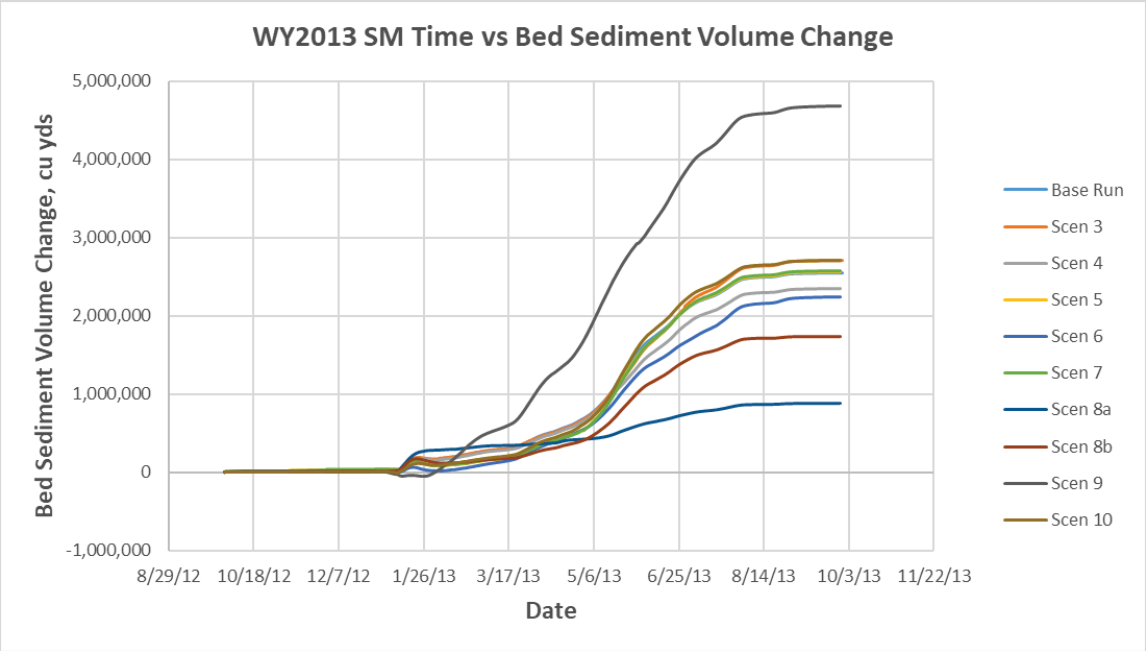


Plate G.24. Material 2 WY2013 Base Run and Scenario 3–10 time versus sediment volume change.



G.3 Material 1 Dredge Placement Scenarios 11–14

Plate G.25. Material 1 WY2013 Dredge Placement Scenario 11–14.

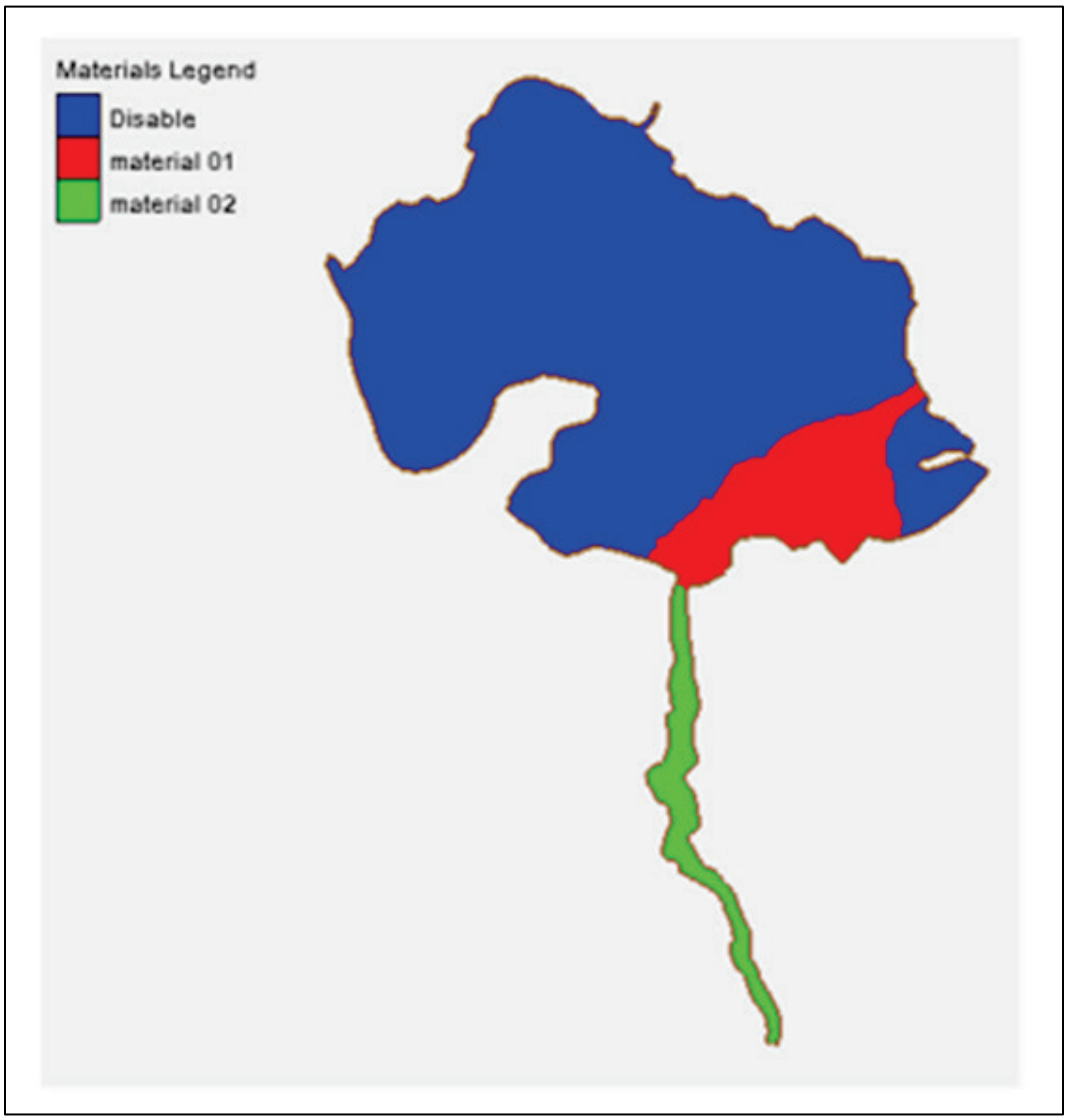


Plate G.26. Material 1 WY2013 Scenario 11 time versus sediment volume change/Simmesport discharge.

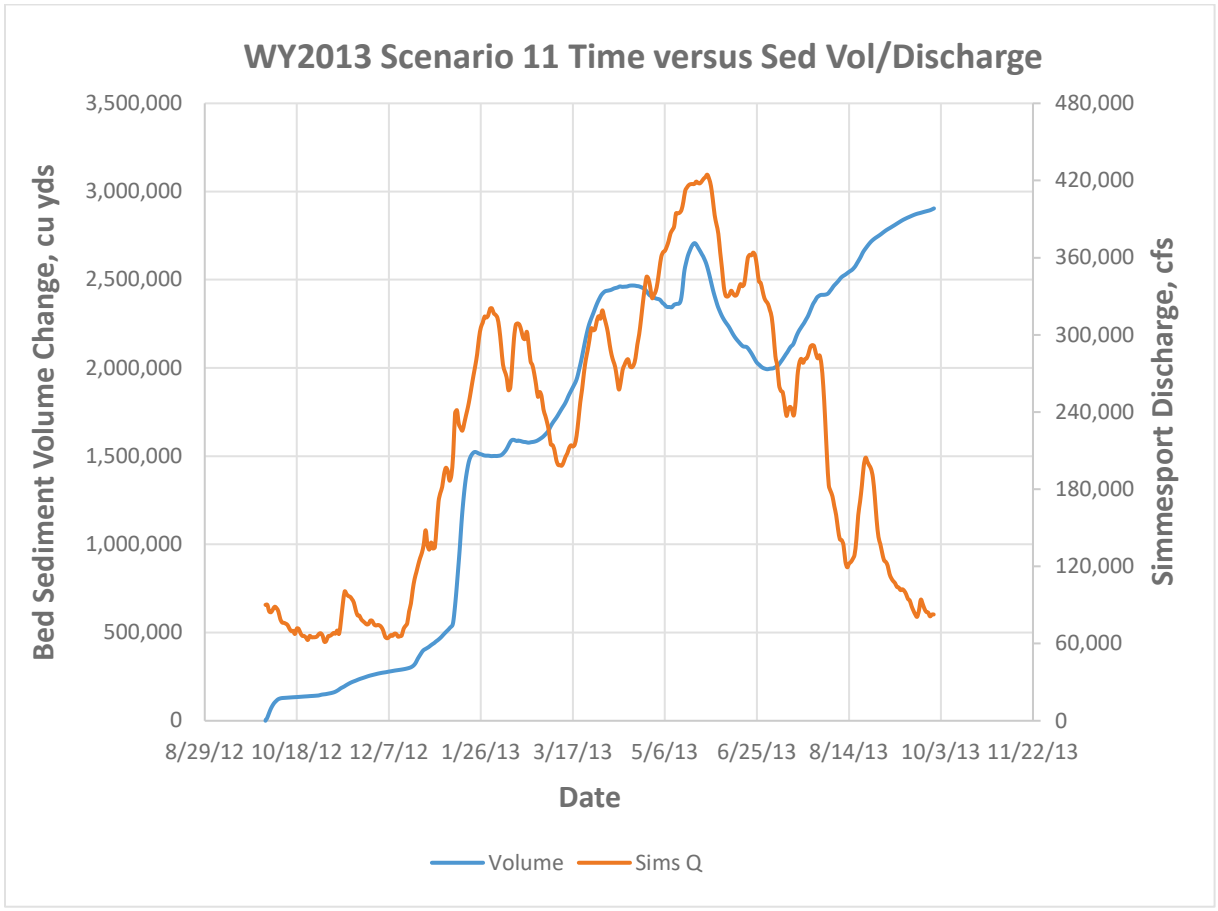


Plate G.27. Material 1 WY2013 Scenario 12 time versus sediment volume change/Simmesport discharge.

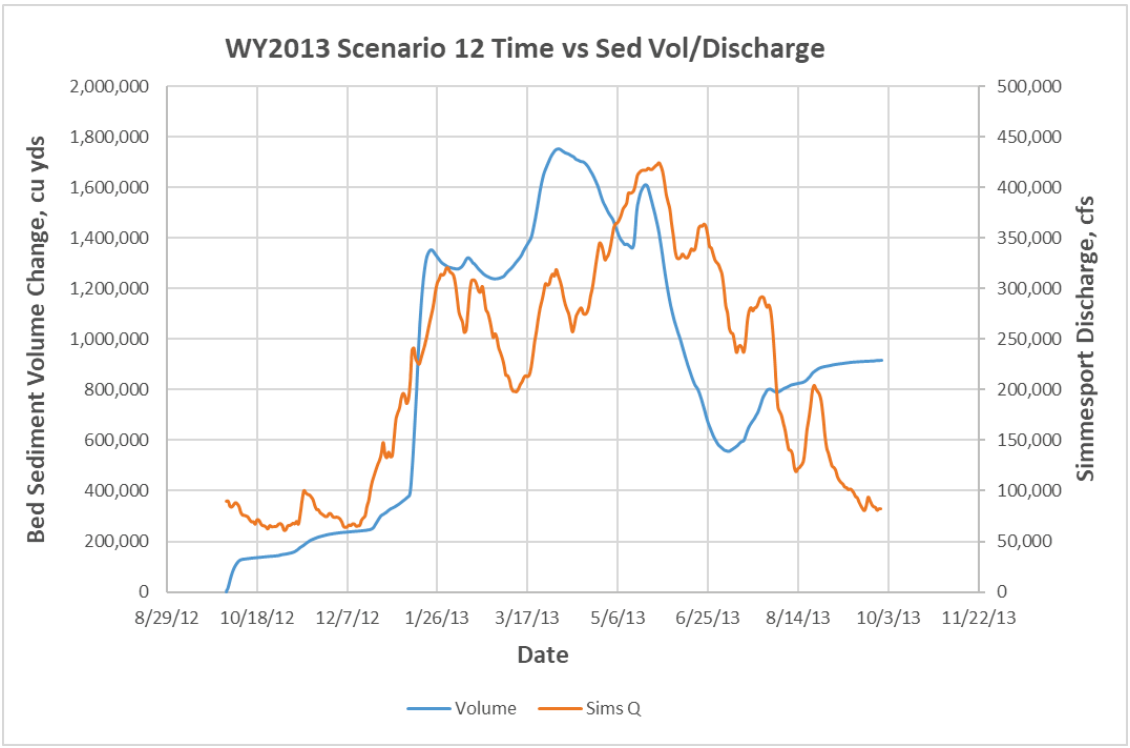


Plate G.28. Material 1 WY2013 Scenario 13 time versus sediment volume change/Simmesport discharge.

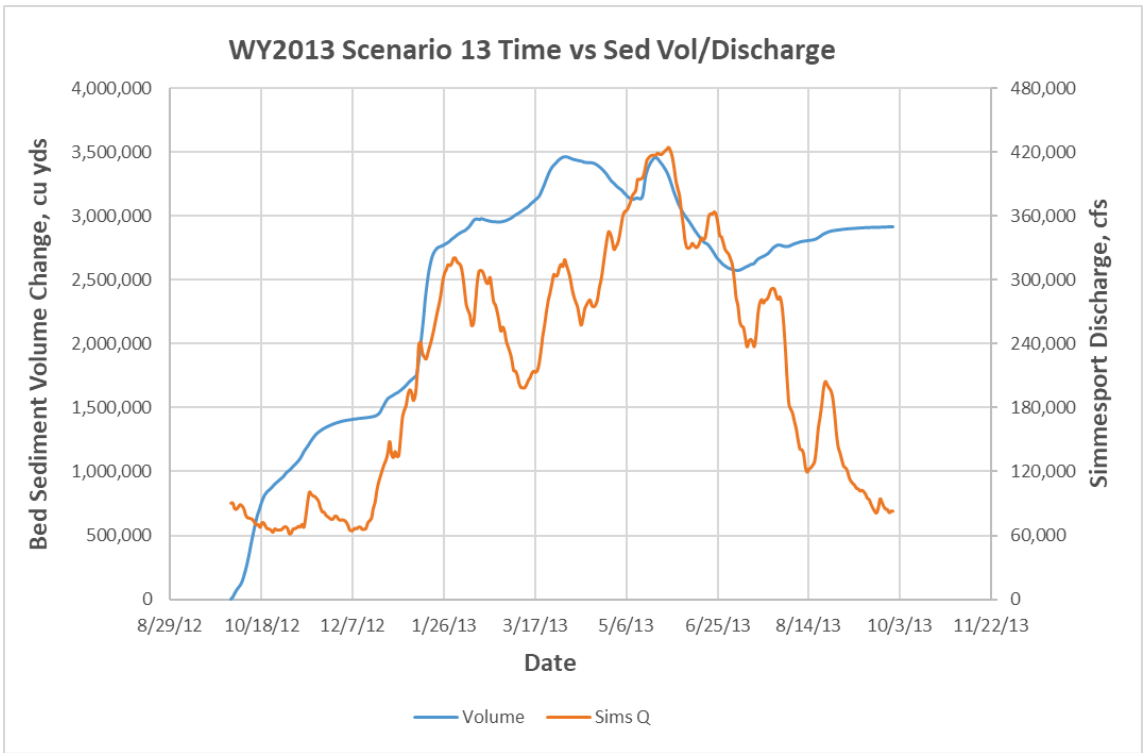


Plate G.29. Material 1 WY2013 Scenario 14 time versus sediment volume change/Simmesport discharge.

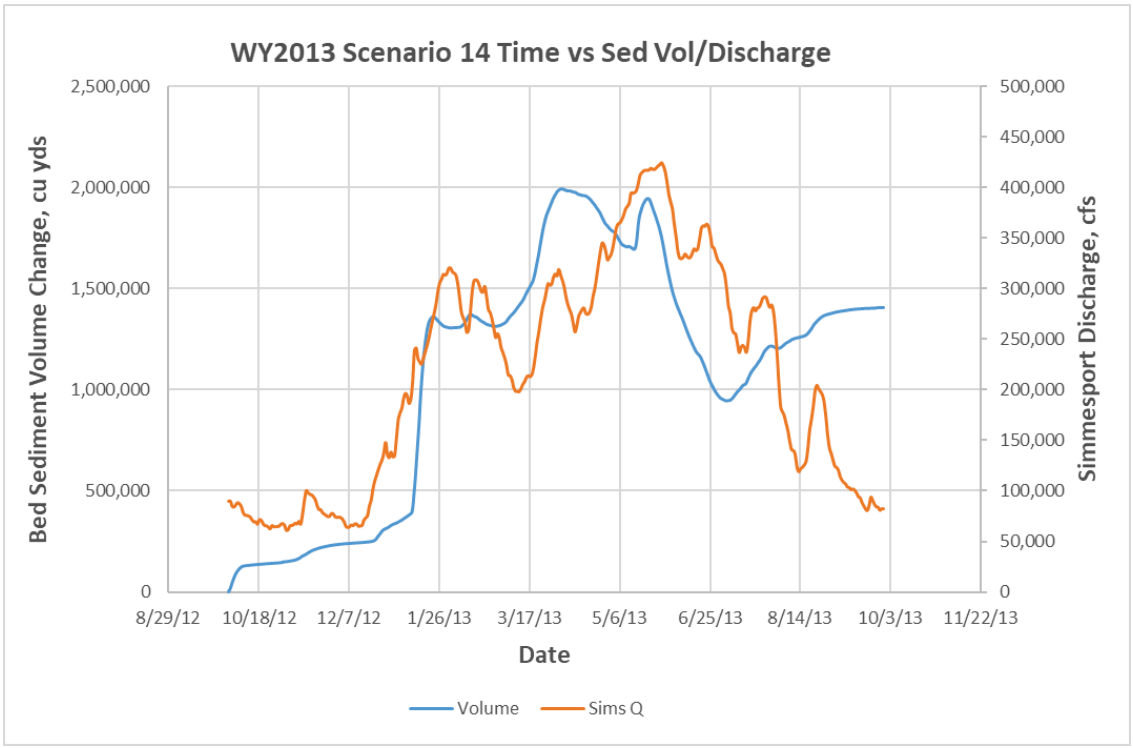
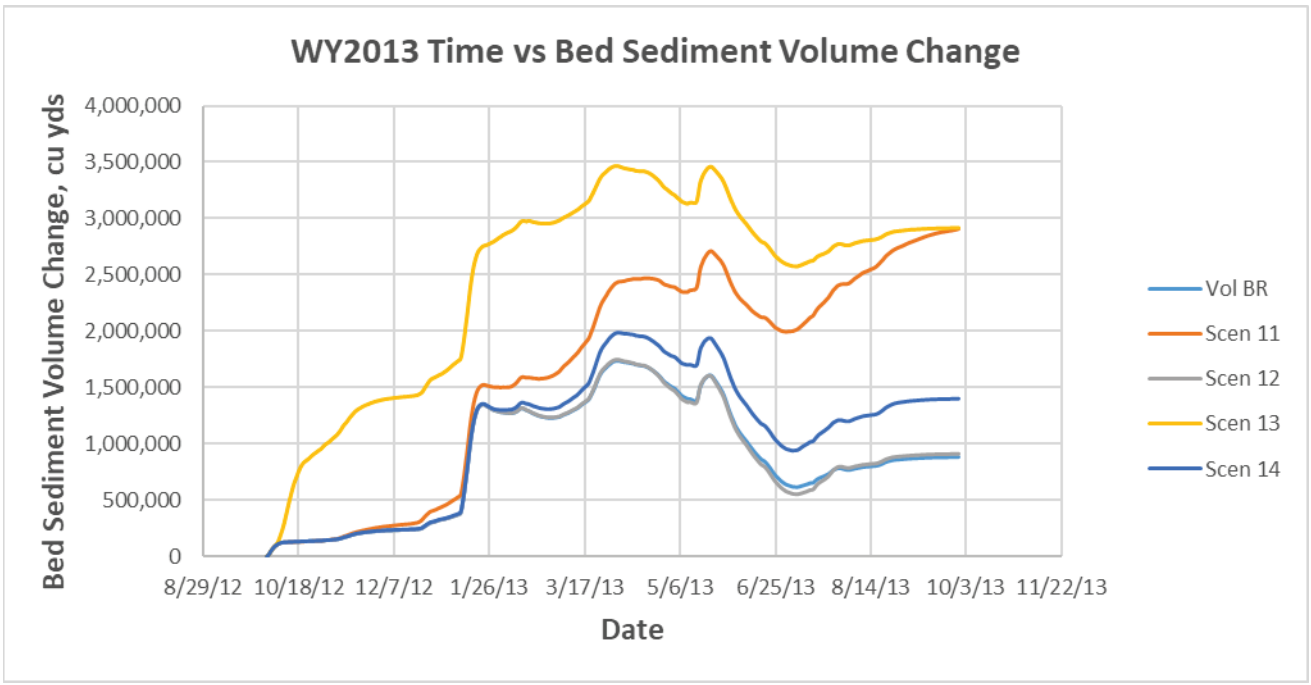


Plate G.30. Material 1 WY2013 Base Run and Scenario 11–14 time versus sediment volume change.



G.4 Material 2 Dredge Placement Scenarios 11–14

Plate G.31. Material 2 Dredge Placement Scenarios 11–14.

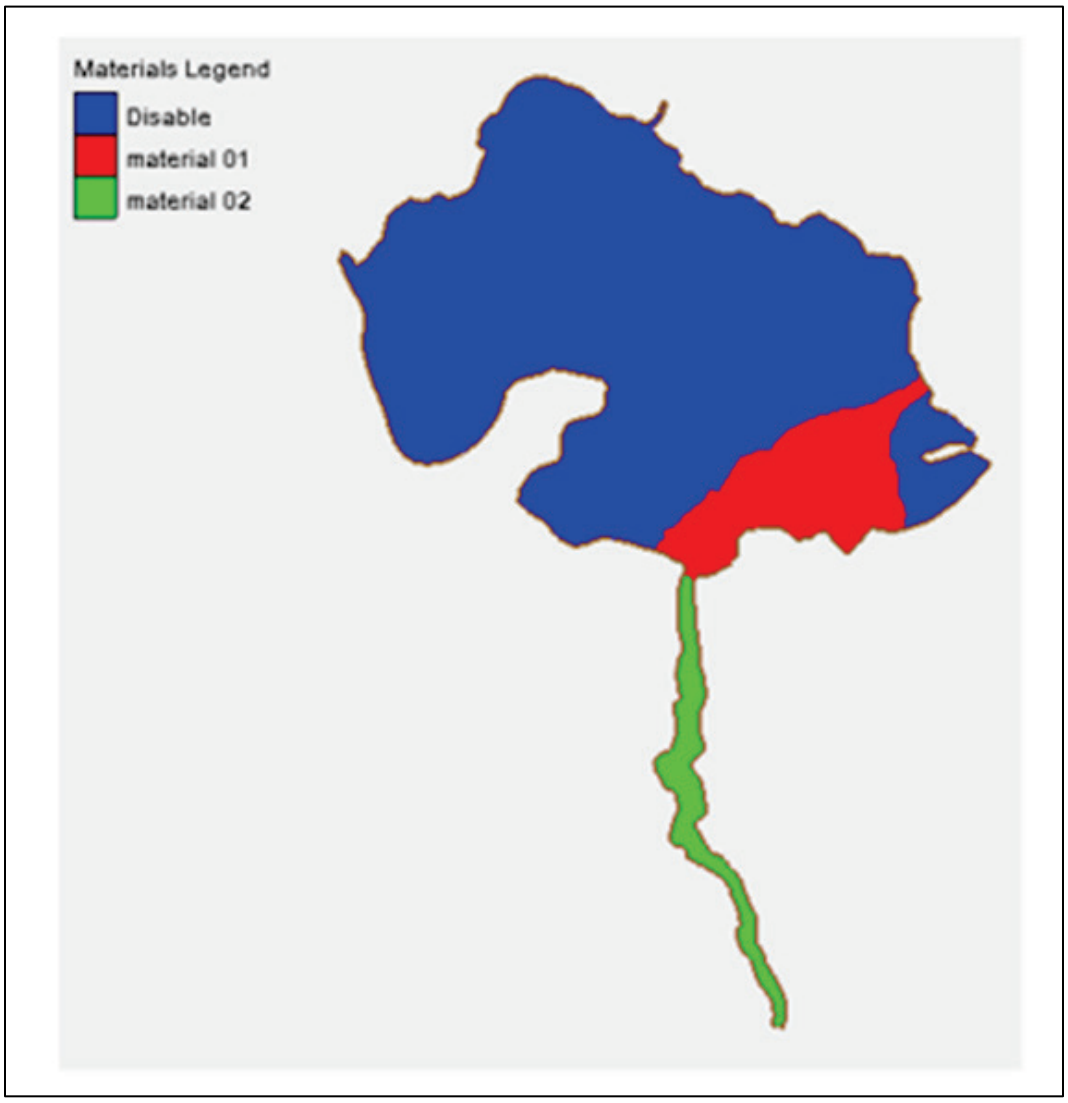


Plate G.32. Material 2 WY2013 Scenario 11 time versus sediment volume change/Simmesport discharge.

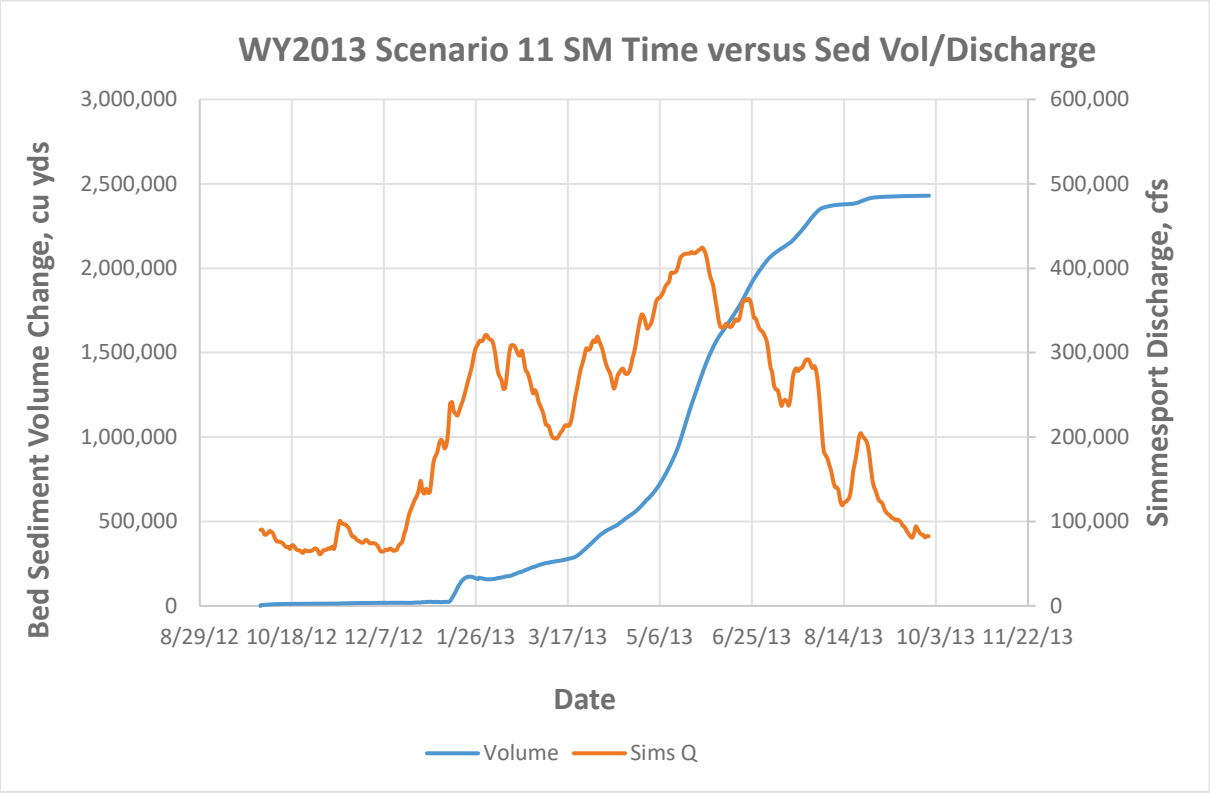


Plate G.33. Material 2 WY2013 Scenario 12 time versus sediment volume change/Simmesport discharge.

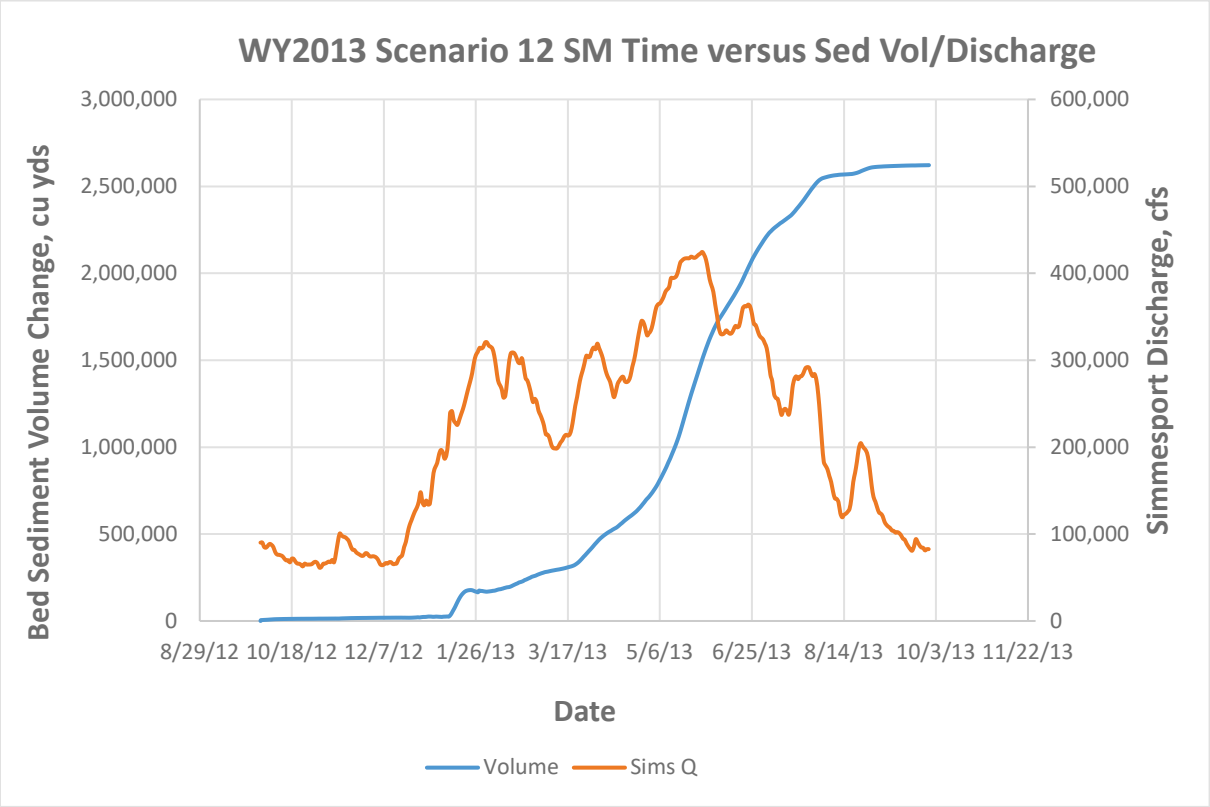


Plate G.34. Material 2 WY2013 Scenario 13 time versus sediment volume change/Simmesport discharge.

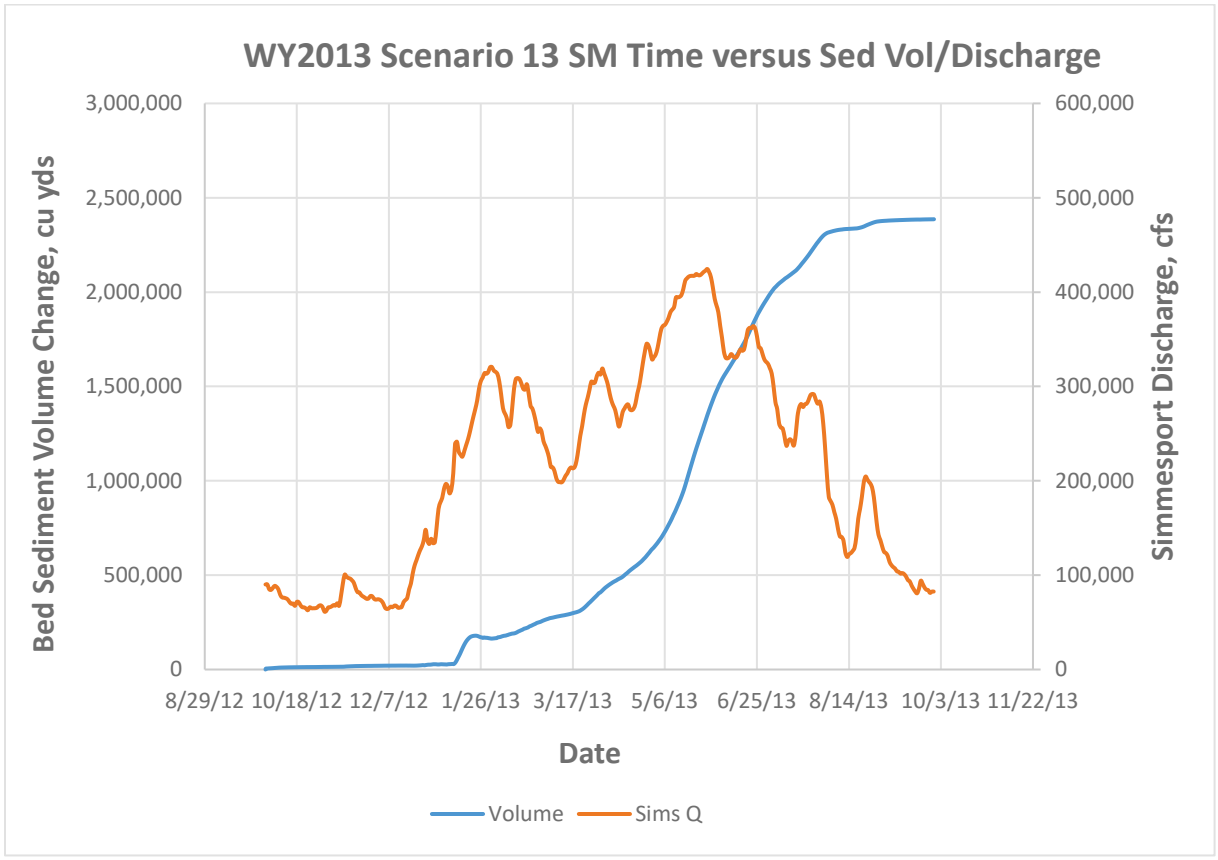


Plate G.35. Material 2 WY2013 Scenario 14 time versus sediment volume change/Simmesport discharge.

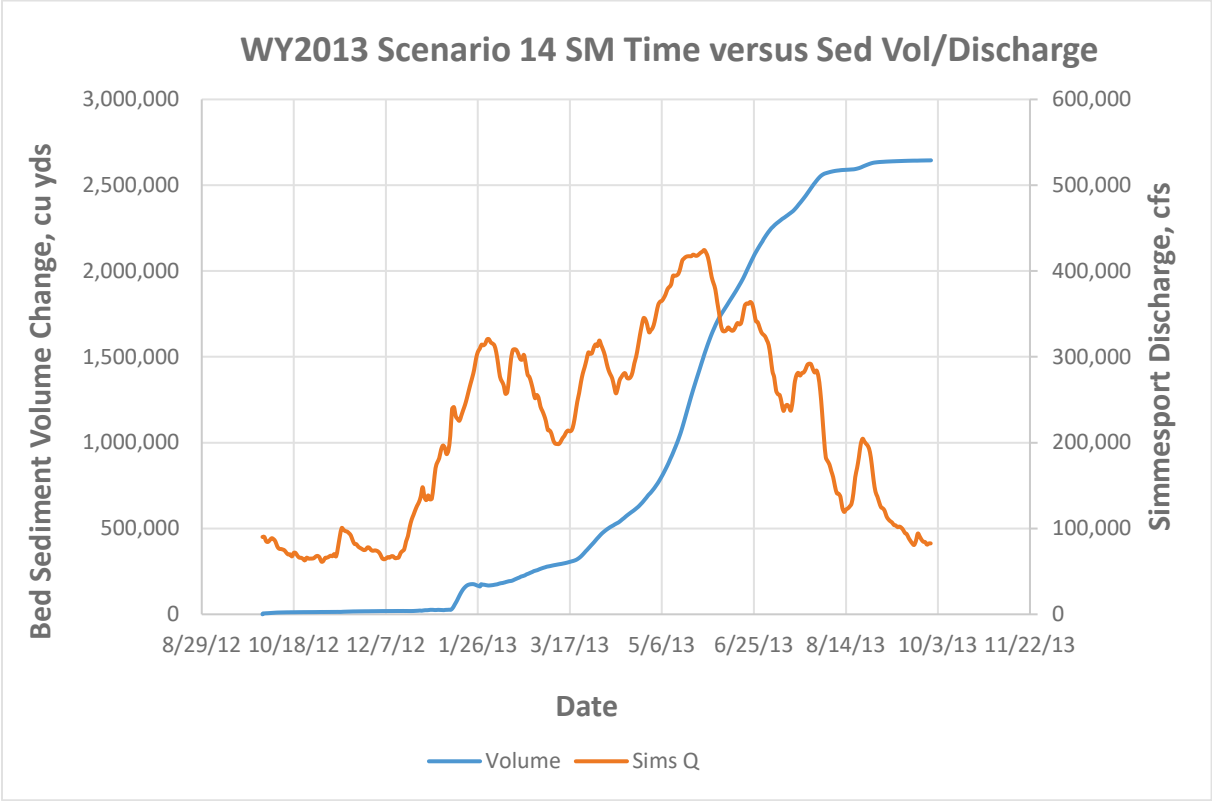
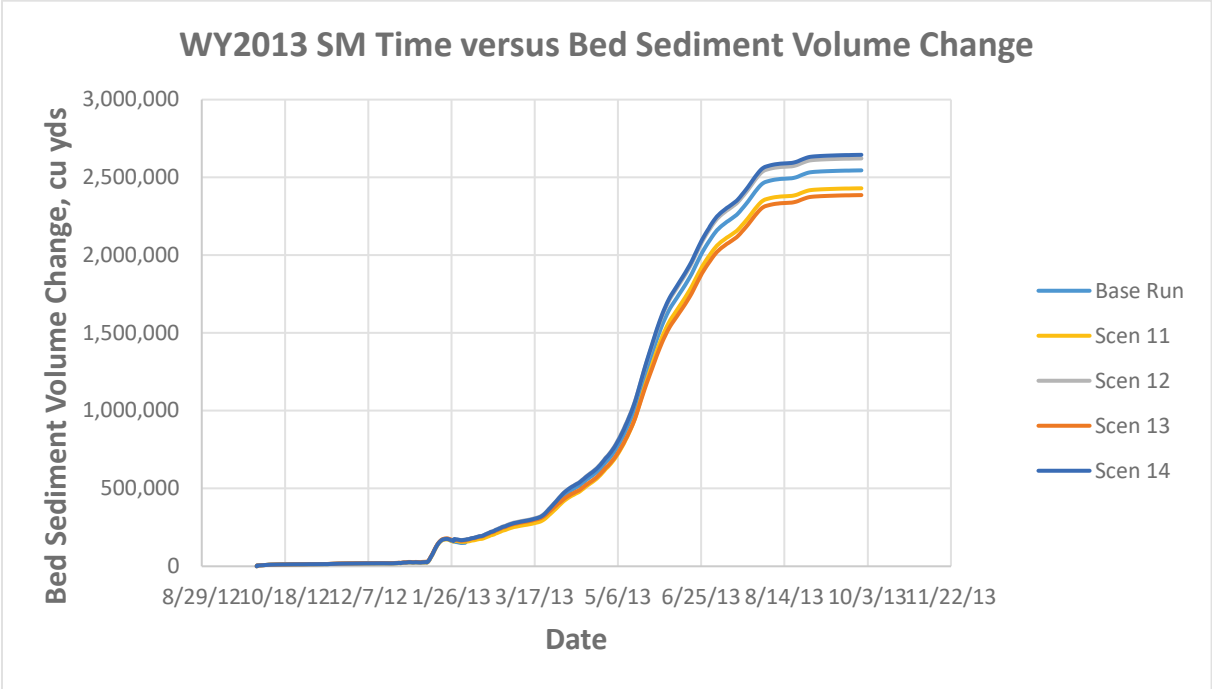


Plate G.36. Material 2 WY2013 Base Run and Scenario 11–14 time versus sediment volume change.



G.5 Material 1 Structure Options Scenario 19 and 20

Plate G.37. Material 1 Structure Option 19 and 20.

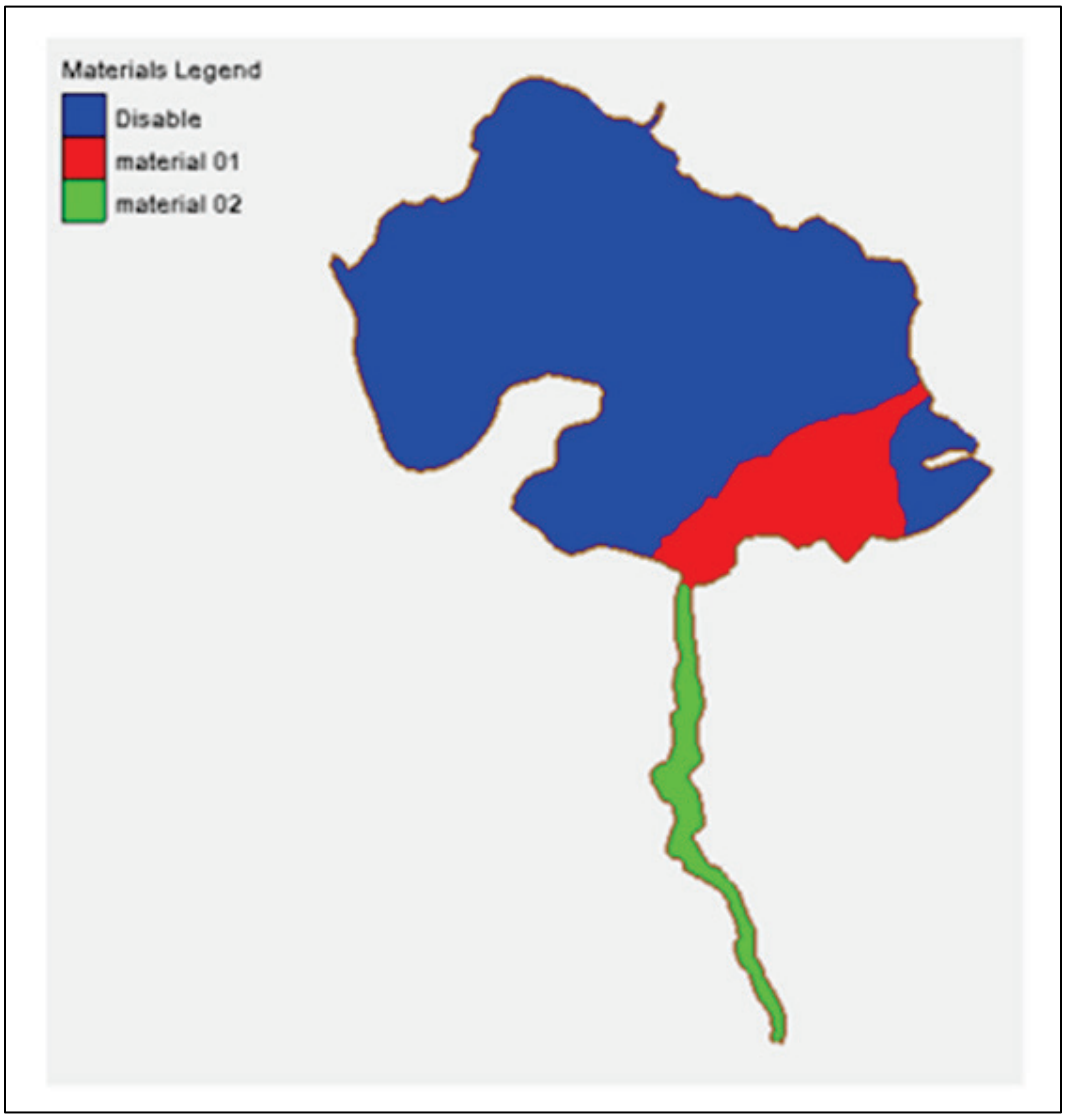


Plate G.38. Material 1 WY2013 Scenario 19 time versus sediment volume change/Simmesport discharge.

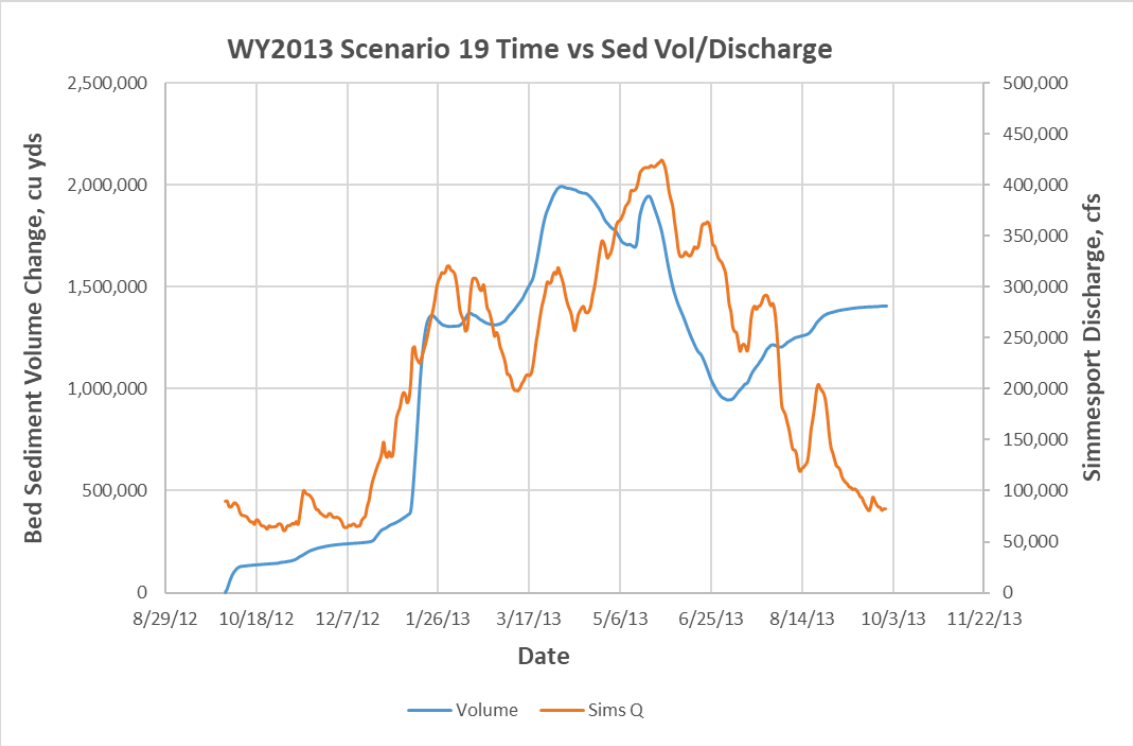


Plate G.39. Material 1 WY2013 Scenario 20 time versus sediment volume change/Simmesport discharge.

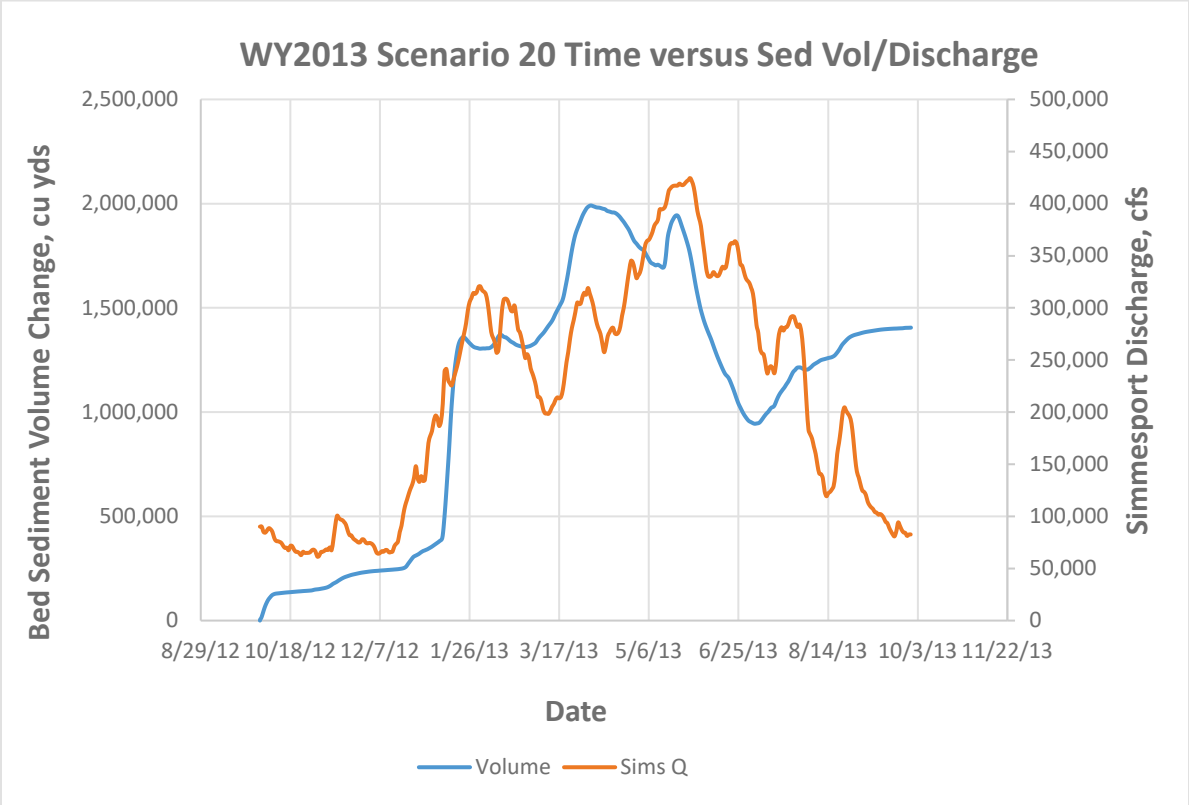
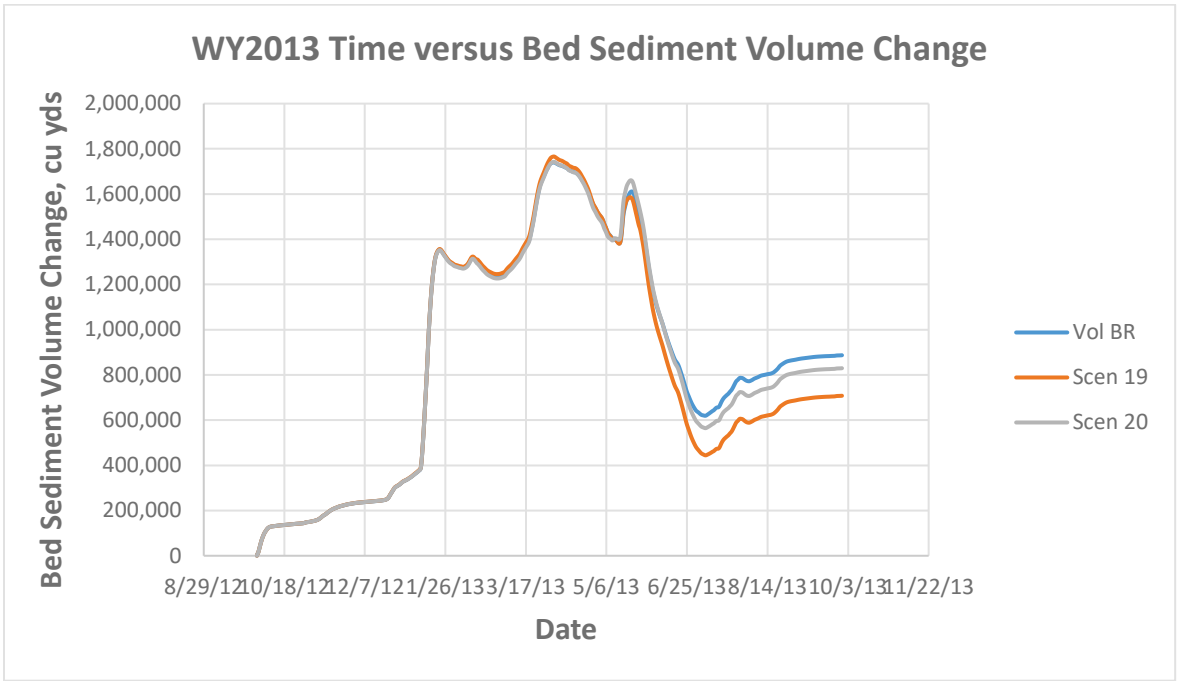


Plate G.40. Material 1 WY2013 Base Run and Scenario 19 and 20 time versus sediment volume change.



G.6 Material 2 Structure Options Scenario 19 and 20

Plate G.41. Material 2 Structure Options Scenarios 19 and 20.

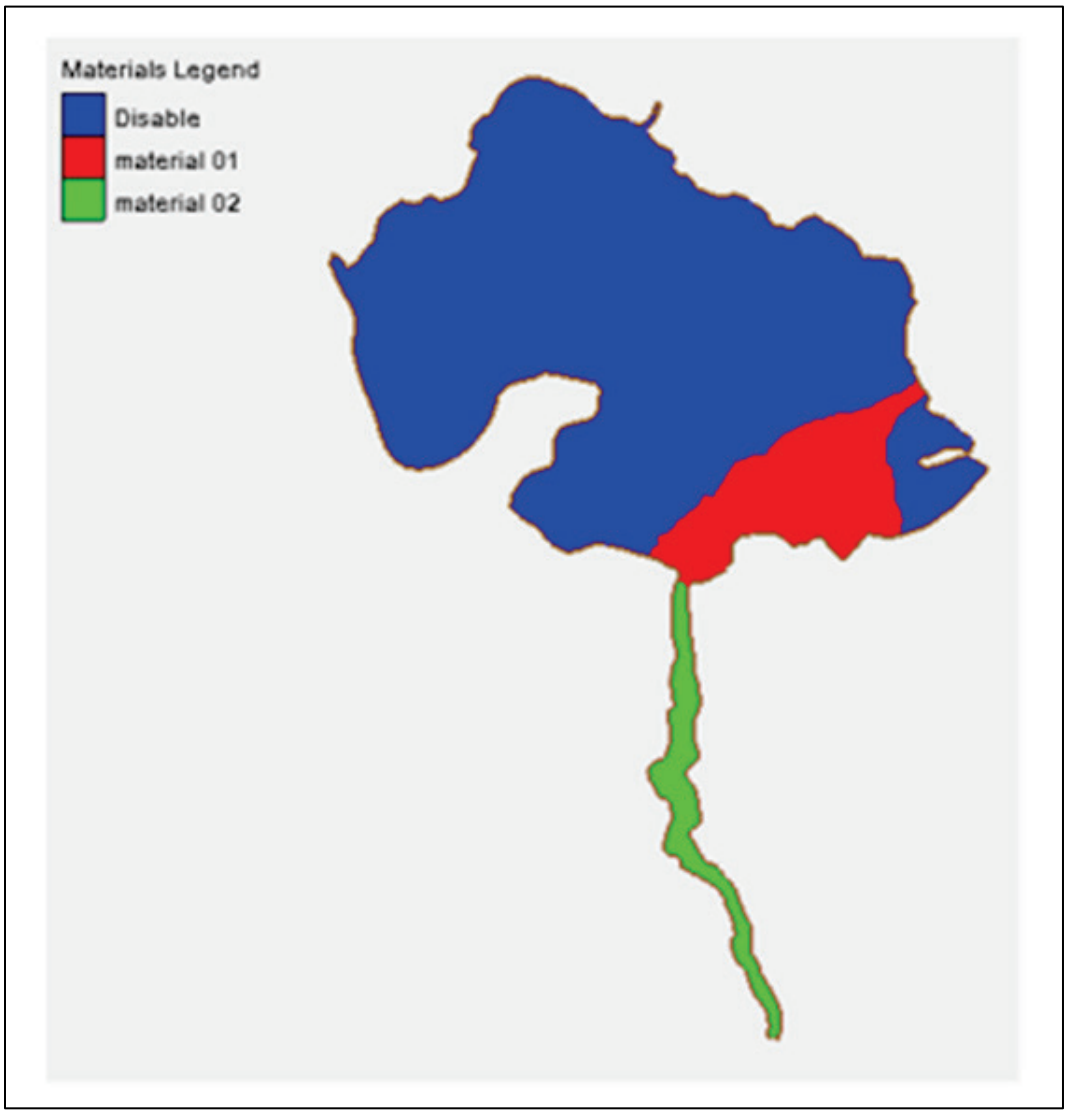


Plate G.42. Material 2 WY2013 Scenario 19 time versus sediment volume change/Simmesport discharge.

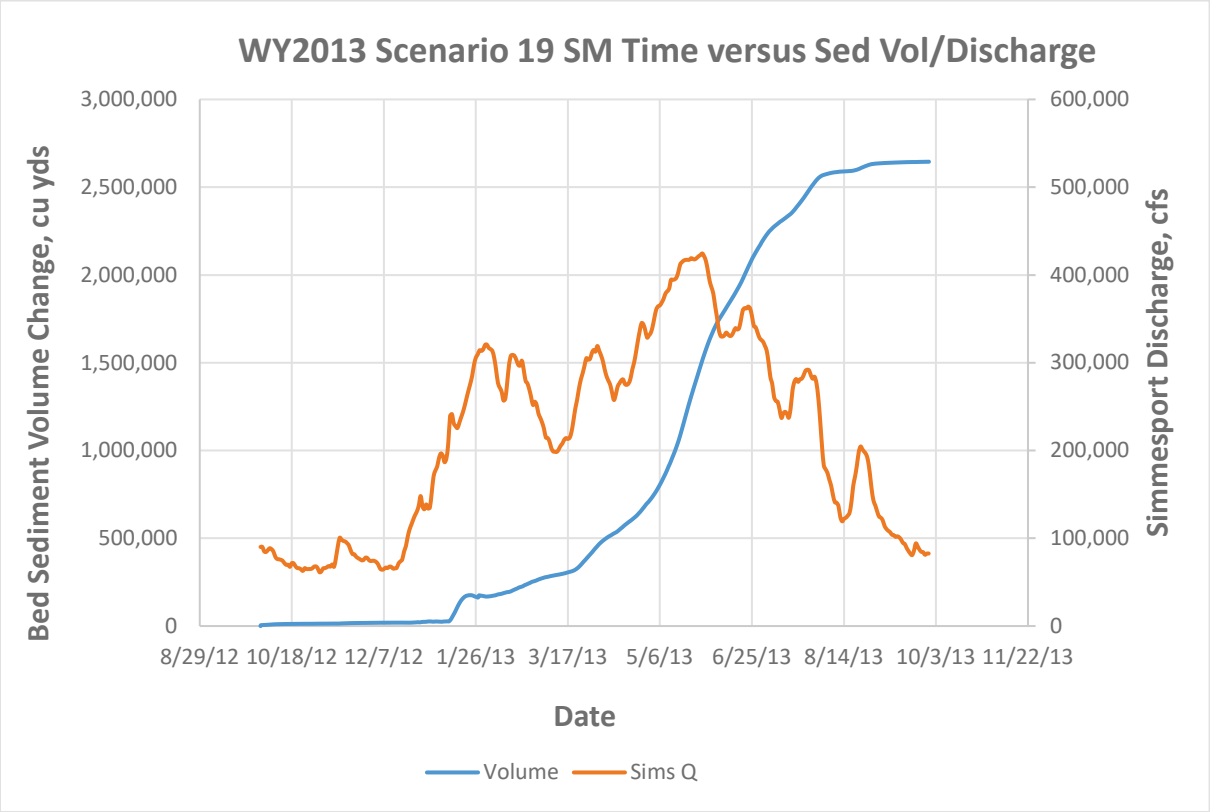


Plate G.43. Material 2 WY2013 Scenario 20 time versus sediment volume change/Simmesport discharge.

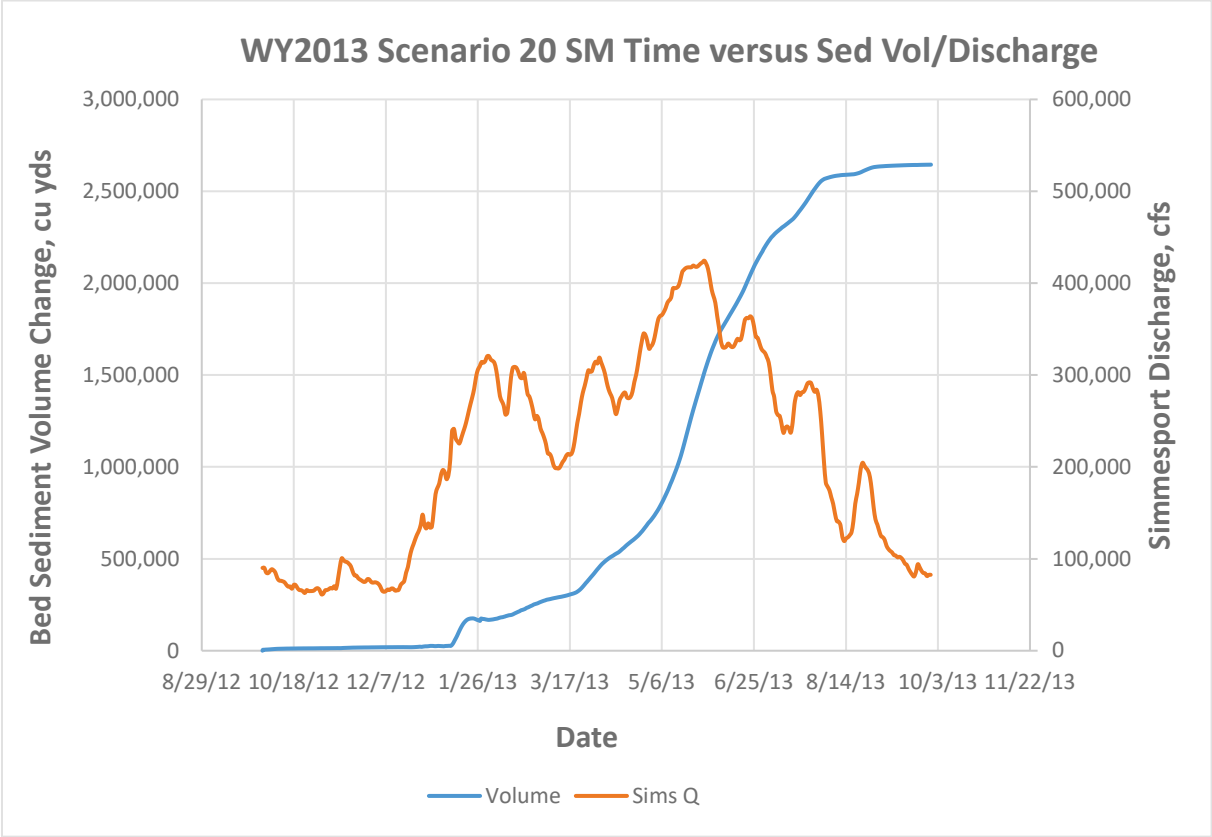
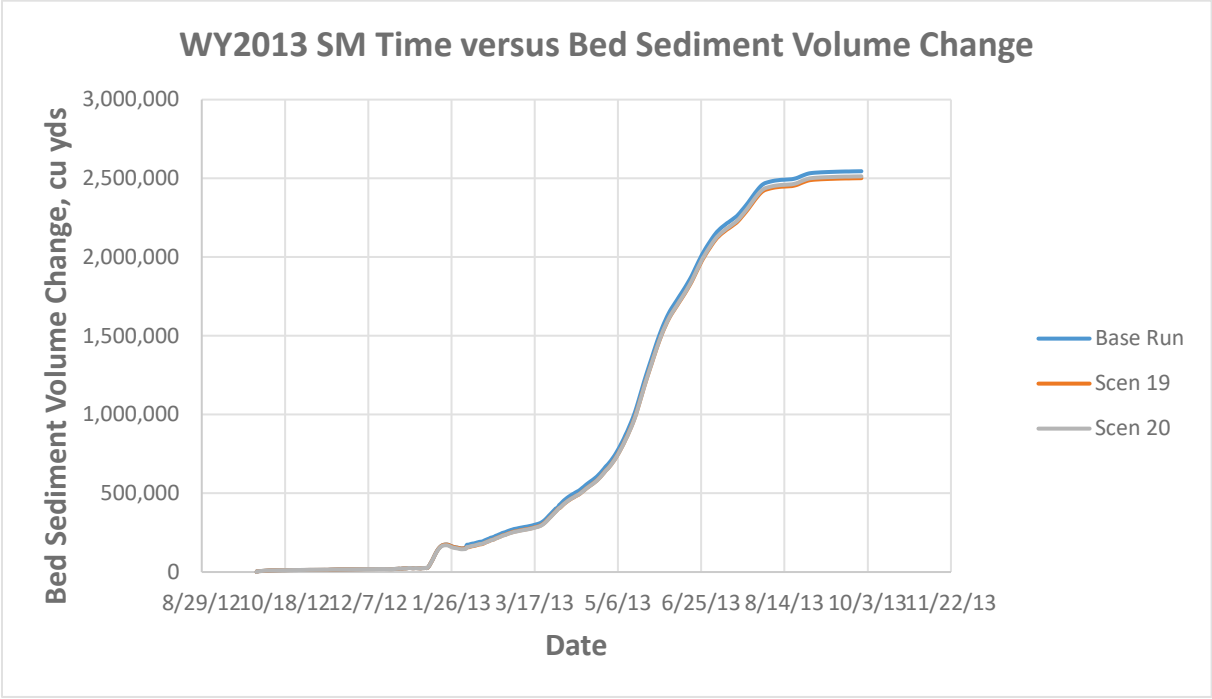


Plate G.44. Material 2 WY2013 Base Run and Scenario 19 and 20 time versus sediment volume change/Simmesport discharge.



Appendix H: Bed Sediment Analysis

H.1 Model sediment bed gradation

It is likely that all bed material data in this system have been influenced by historical degradation of the Atchafalaya River. Gravel deposits may have been locally sourced. Some samples may represent laterally averaged, centerline, or thalweg gradations; those samples are most likely coarser than bar materials that are more representative of the dominant bed material load.

H.2 ORCC Outflow Channel sediment bed gradation analysis

As a starting point, use the mean gradation from USACE samples gathered from 1974 to 1999 (Plate H.1). Note that very fine sand is less than the 10% threshold (Plate H.2) for classification as a component of the bed material load and that fine sand barely meets the threshold. Only 24% of the samples taken from 1974 to 1999 contained coarse gravel. The bed gradation appears to have more fine material in late 1980s, and in 1990s, it returned to typical coarser gradation like it was in 1970s. The gradations of subsequent samples fit within the scatter of the 1974 to 1999 data (Plate H.1).

Plate H.1 USACE ORCC outflow 1974–1999 bed gradation.

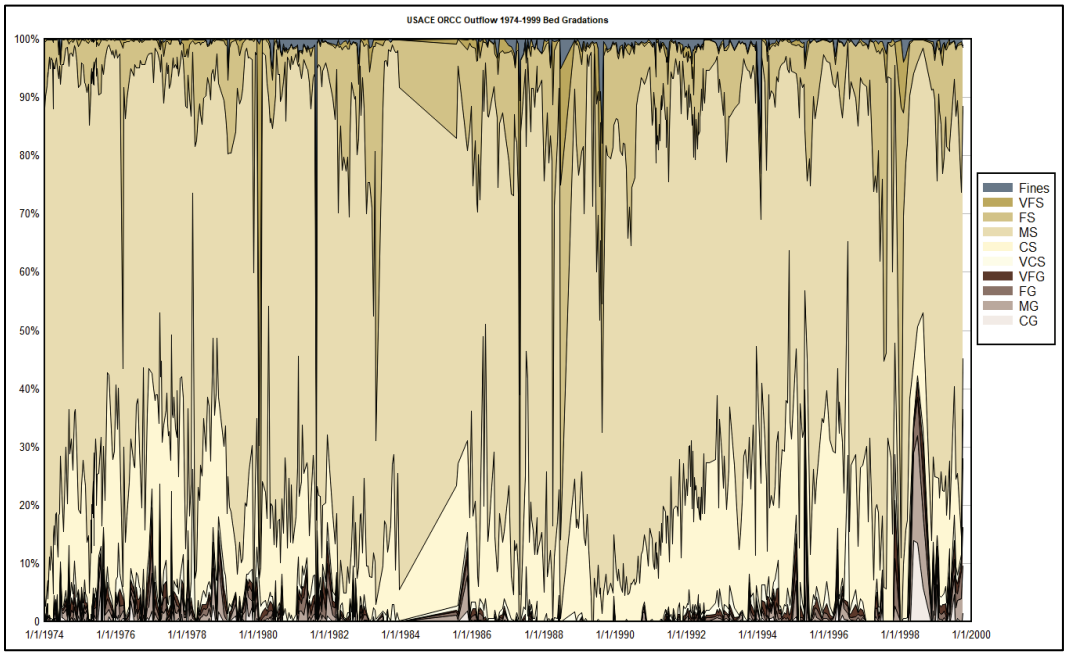


Plate H.2. Mean bed gradation from USACE samples gathered 1974–1999.

Percentage by AGU Size Class									
CG	MG	FG	VFG	VCS	CS	MS	FS	VFS	Fines
0.36%	0.83%	0.76%	0.80%	1.35%	17.53%	66.04%	10.30%	1.11%	0.93%
Size range (mm)					Size range (microns)				
16–32	8–16	4–8	2–4	1–2	500–1000	250–500	125–250	62.5–125	<62.5
Geometric mean grain size (mm)									
22.63	11.31	5.657	2.828	1.414	0.7071	0.3536	0.1768	0.08839	

If the mean gradation results in excessive armoring and underpredicts sand transport, the median bed gradation in Plate H.3 may be a better estimate.

Plate H.3. Median bed gradation from USACE samples gathered 1974–1999.

Percentage by AGU Size Class									
CG	MG	FG	VFG	VCS	CS	MS	FS	VFS	Fines
	0.23%	0.59%	0.68%	1.10%	17.42%	71.28%	7.81%	0.59%	0.30%

Samples collected for the ROMA study in 2004[1] were composed primarily of fine, medium, and coarse sand and contained only traces of material larger than 1 mm. The absence of gravel is inconsistent with previous and subsequent samples.

The mean gradation of five samples collected on 6 March 2019 (Plate H.4) is slightly more uniform than the long-term mean.

[1] ROMA. 2004. *The Red River, Old River, Mississippi River, and Atchafalaya River (ROMA)* study was started in 2004 to examine similar but more limited issues than the OMAR Assessment. It was not completed.

Plate H.4. Mean bed gradation of five samples collected on 6 March 2019.

Percentage by AGU Size Class									
CG	MG	FG	VFG	VCS	CS	MS	FS	VFS	Fines
	0.02%	0.15%	0.31%	0.81%	17.71%	71.42%	9.53%	0.07%	0.00%

The mean gradation of five samples collected on 14 March 2019 (H.7 and Plate H.5) is similar except for sample B, which contained 1.5% medium to coarse gravel. (A value of 0.076% could be assigned to coarse gravel based on interpolation; however, all of material passed the 19 mm sieve, and the amount that might have been retained on a 16 mm sieve is unknown.)

Plate H.5. Mean bed gradation of five samples collected on 14 March 2019.

Percentage by AGU Size Class									
CG	MG	FG	VFG	VCS	CS	MS	FS	VFS	Fines
	0.31%	0.03%	0.06%	0.20%	13.24%	76.12%	9.97%	0.05%	0.01%

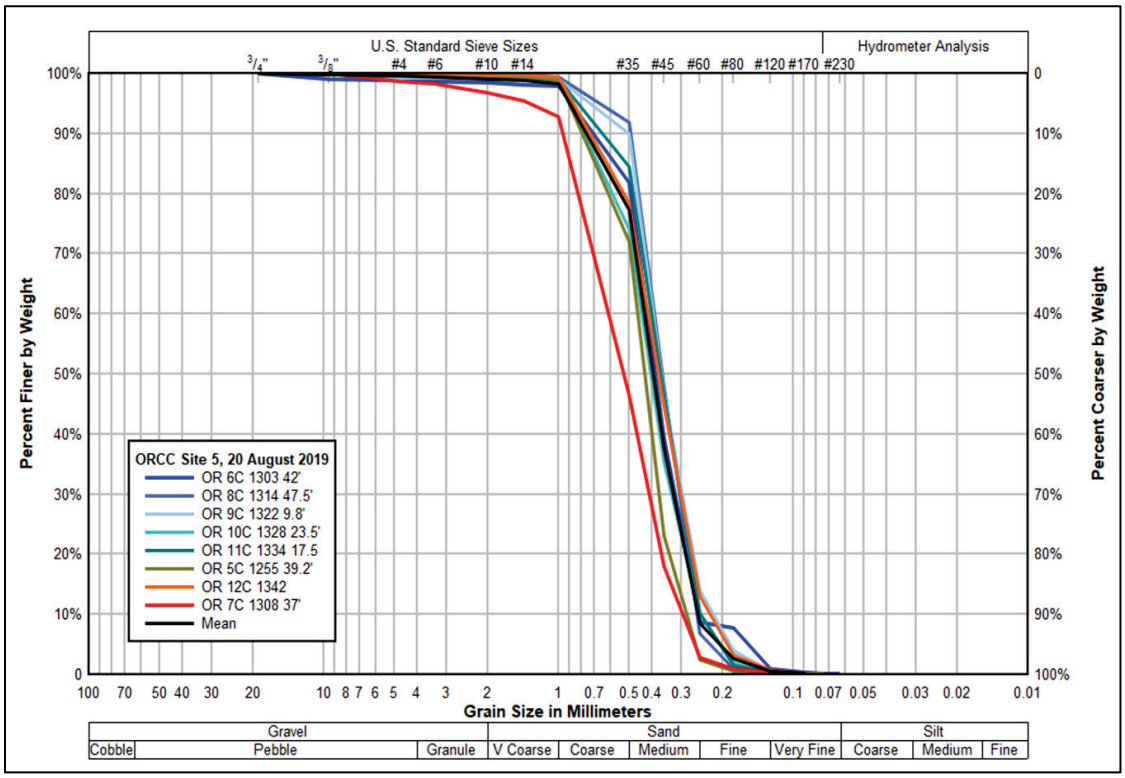
Bed material (eight samples) collected for the 20 August 2019 flushing event (Plate H.6) exhibits more similarity to the long-term mean and median gradations. The flushing event refers to the flushing of the sediment deposition in the Auxiliary Structure approach channel by operating the Auxiliary Structure at a higher than normal capacity.

Plate H.6. Bed material (eight samples) collected 20 August flushing event.

Percentage by AGU Size Class									
CG	MG	FG	VFG	VCS	CS	MS	FS	VFS	Fines
	0.20%	0.30%	0.38%	0.90%	20.85%	68.84%	8.04%	0.43%	0.05%

The median bed gradation shown in Plate H.3 was used in the model for the Outflow Channel.

Plate H.7. ORCC outflow channel bed gradations, 20 August 2019.



H.3 Atchafalaya River sediment bed gradation analysis

As a starting point, use the mean bed gradation from USACE samples gathered from 1974 to 1999 at Simmesport (H.10 and Plate H.8). Bed material samples collected at Simmesport since 1974 are significantly coarser than samples collected from 1954 to 1965. Very fine sand is less than the 10% threshold for classification as a component of the bed material load. The mean bed gradation contained 1.4% gravel.

Plate H.8. Mean bed gradation from USACE samples gathered 1974–1999 at Simmesport.

Percentage by AGU Size Class									
CG	MG	FG	VFG	VCS	CS	MS	FS	VFS	Fines
0.15%	0.47%	0.38%	0.37%	0.76%	13.74%	68.52%	13.17%	1.62%	0.81%

If the mean gradation results in excessive armoring and under predicts sand transport, the median bed gradation from the 1974–1999 samples may be a better estimate (Plate H.9).

Plate H.9. Median bed gradation from USACE samples gathered 1974–1999 at Simmesport.

Percentage by AGU Size Class									
CG	MG	FG	VFG	VCS	CS	MS	FS	VFS	Fines
	0.03%	0.12%	0.15%	0.60%	13.59%	73.32%	10.99%	0.80%	0.41%

Samples collected at Simmesport from 1997 to 1999 contained a mean of 5% to 6% gravel. Nordin's 1991 samples at Simmesport contained 3.4% gravel (Nordin 1991).

Samples collected for the ROMA study in 2005 (Plate H.11) were composed primarily of fine, medium, and coarse sand and contained only traces of material larger than 1 mm. The absence of gravel is inconsistent with previous samples. The ROMA samples did not exhibit any clear trend in gradation from Simmesport to Melville.

Plate H.10. History of bed material gradations collected at Simmesport 1974 to 1999.

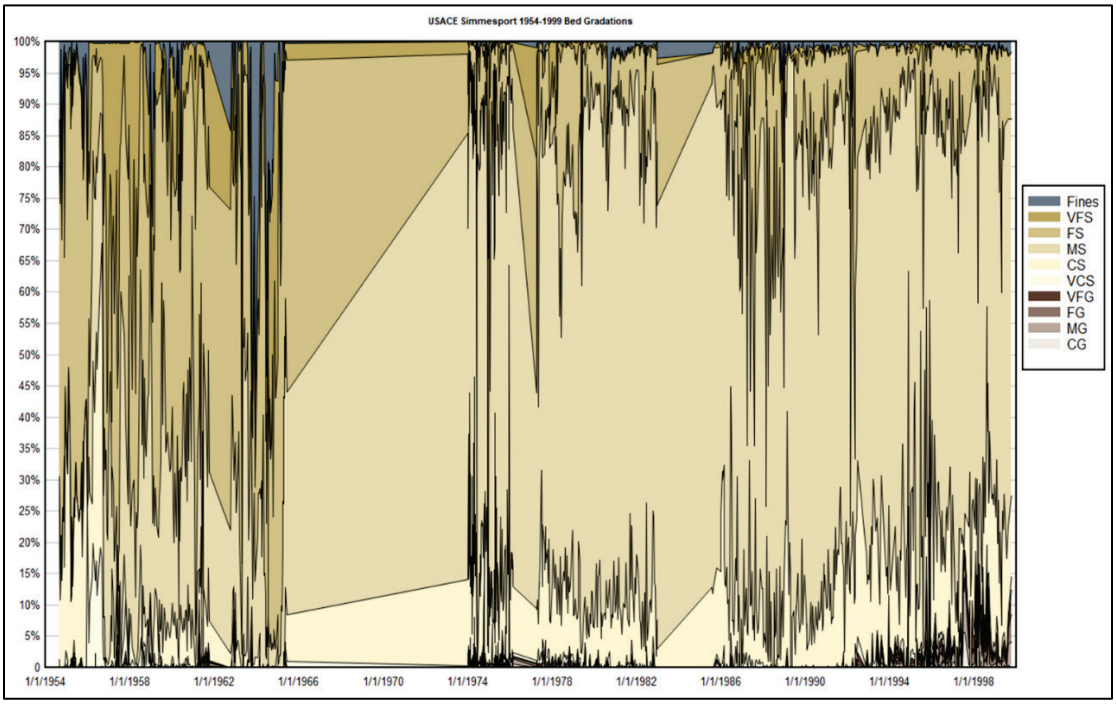
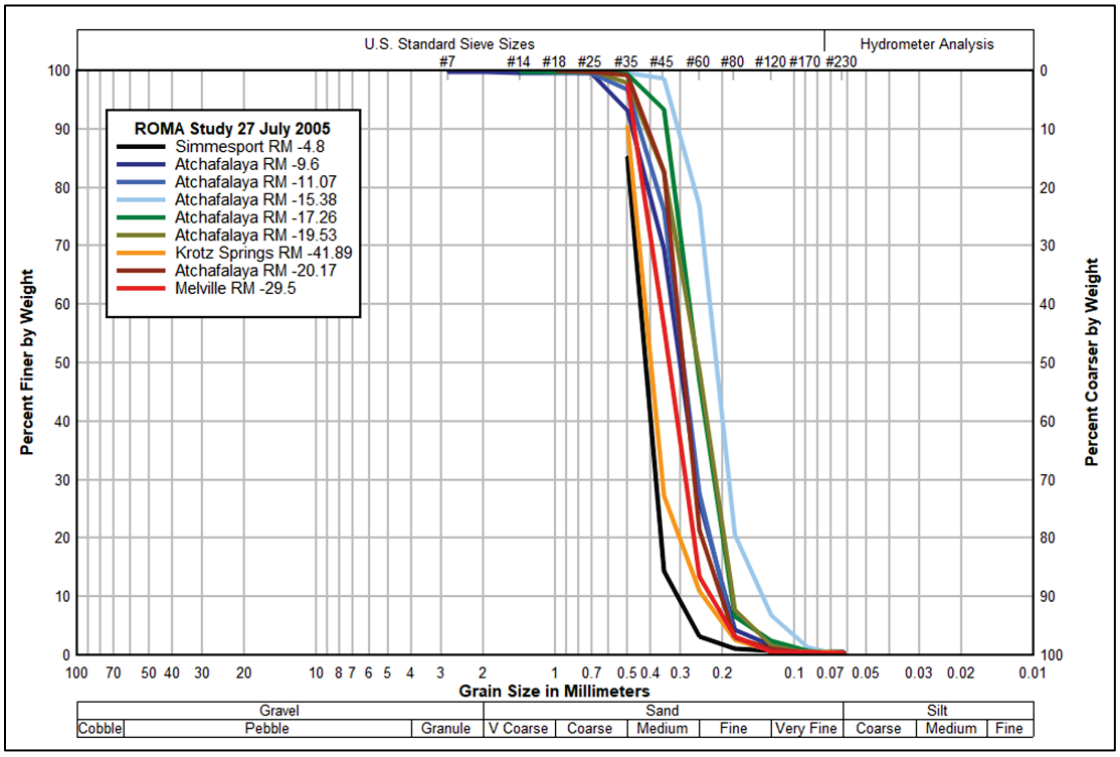


Plate H.11. Atchafalaya River bed material samples collected in 2005 for ROMA Study.



The median bed gradation shown in Plate H.9 was used in the model for the Atchafalaya River Channel.

H.4 Red River sediment bed gradation analysis

As a starting point, use the mean bed gradation from USACE samples gathered from 2007 to 2016 at Madam Lee gage (on the lower Red River) (Plate H.15 and Plate H.12). This is probably the best estimate of the bed gradation generated by bed material load supplied to the study area by the Red River. The mean gradation at Madam Lee contains more than twice as much fine sand as compared to the ORCC Outflow Channel. Very fine sand is less than the 10% threshold for classification as a component of the bed material load. Samples are available at Red River Lock & Dam 1; however, those samples are most likely influenced by dam operations and thus may not represent typical bed material load.

Plate H.12. Mean bed gradation from USACE samples gathered 2007–2016 at Madam Lee.

Percentage by AGU Size Class									
CG	MG	FG	VFG	VCS	CS	MS	FS	VFS	Fines
	0.15%	0.42%	0.57%	1.29%	16.20%	50.84%	24.46%	6.06%	

The mean gradation of samples collected at Acme on the Black River (Plate H.16 and Plate H.13) over the same time period are finer and more uniform than the samples at Madam Lee on the Red River. This site is influenced by backwater from the Red River.

Plate H.13. Mean bed gradation samples collected 2004–2016 at Acme.

Percentage by AGU Size Class									
CG	MG	FG	VFG	VCS	CS	MS	FS	VFS	Fines
	0.08%	0.19%	0.30%	0.58%	6.79%	63.27%	26.00%	2.80%	

The mean of samples collected from 1999 to 2004 in the Red River approximately one-half mile above the confluence with the Old River Outflow Channel (Plate H.17 and Plate H.14) are slightly coarser than the samples at Madam Lee (later samples) and Simmesport (earlier samples). The additional gravel in this gradation may reflect channel degradation.

Plate H.14. Mean bed gradation samples collected 1999 to 2004 in the Red River about one-half mile above the confluence with the Old River outflow channel.

Percentage by AGU Size Class									
CG	MG	FG	VFG	VCS	CS	MS	FS	VFS	Fines
0.47%	1.78%	2.09%	2.90%	2.74%	9.76%	50.80%	22.85%	5.12%	1.49%

Plate H.15. Mean and range of bed gradations at Madam Lee from 2004 to 2016.

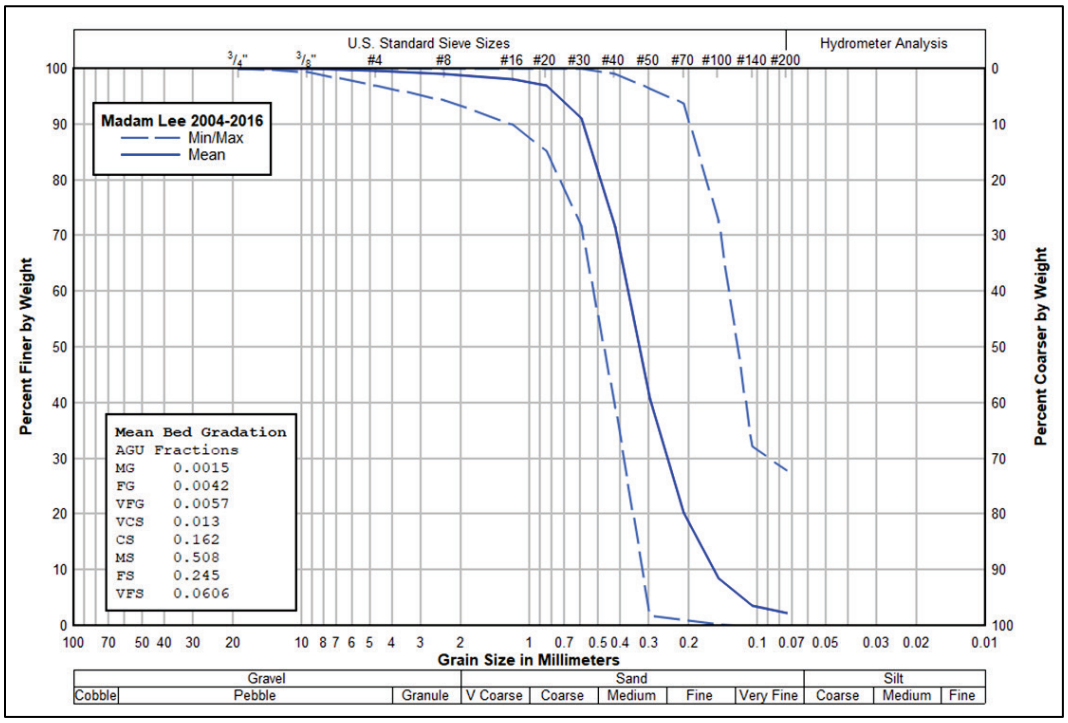


Plate H.16. Mean and range of bed gradations at Acme from 2004 to 2016.

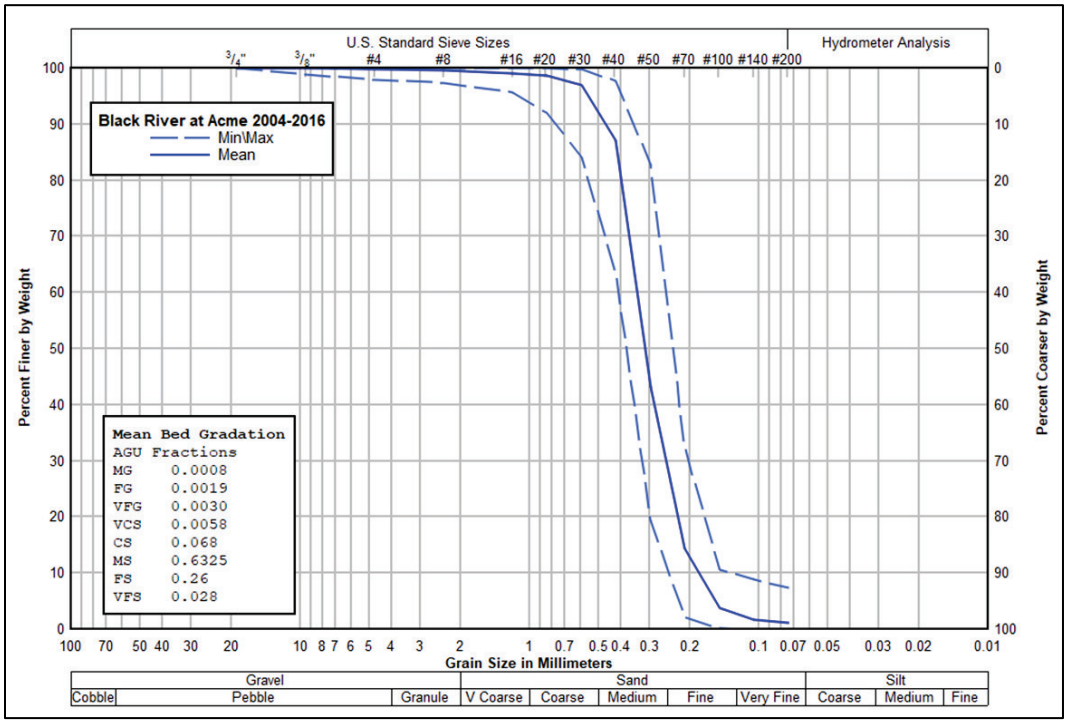
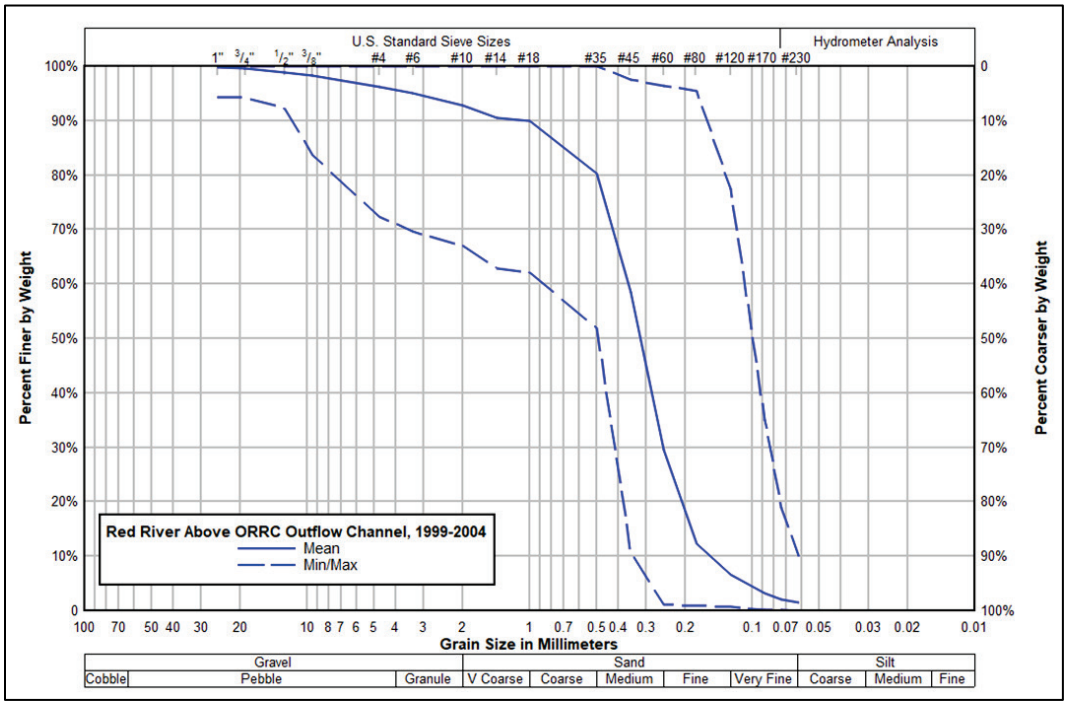


Plate H.17. Mean and range of Red River bed gradations ~ one-half mile above the ORCC outflow channel.



The mean gradation at Madam Lee collected 2007–2016 shown in Plate H.12 was used in the model.

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14. ABSTRACT

The Red River, Atchafalaya River, and the Old River Control Complex (ORCC) Outflow Channel Adaptive Hydraulics two-dimensional depth averaged sediment model (AdH-2D-SED) was used to evaluate the short-term and system-wide sedimentation effects of modifying the operation schedule at ORCC. The changes evaluated were increasing and decreasing the percentage of flow that is diverted to the Atchafalaya River from the Mississippi River at the ORCC and modifying the distributions through four ORCC structures. Sedimentation effects for several operation scenarios were compared to a Base condition for each water year that represented the existing operation protocols. Four dredging scenarios were developed and analyzed. Additionally, two structure options were developed and analyzed. The scenario analyses presented in this report are intended to identify large trends and to make gross assessments of the potential impacts of various proposed operational changes to the ORCC.

15. SUBJECT TERMS

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