ERDC TR-22-5

Coastal and Hydraulics Laboratory

US Army Corps of Engineers®
Engineer Research and Development Center

ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

Regional Sediment Management Program

Tombigbee River: River Miles 81.0–76.0 Sediment Management Study

Jasen L. Brown, Robert D. Davinroy, Ivan H. Nguyen, Aron M. Rhoads, Nathan D. Lovelace, Emily R. Russ, and Jessamin A. Straub

April 2022

Tombigbee River: River Miles 81.0–76.0 Sediment Management Study

Jasen L. Brown, Robert D. Davinroy, Ivan H. Nguyen, and Aron M. Rhoads

Applied River Engineering Center
US Army Corps of Engineers, St. Louis District
Foot of Arsenal Street
St. Louis, MO 63118

Nathan D. Lovelace

US Army Corps of Engineers, Mobile District
109 St. Joseph Street
Mobile, AL 36602

Emily R. Russ

Environmental Laboratory
US Army Engineer Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 31980-6199

Jessamin A. Straub

Coastal and Hydraulics Laboratory
US Army Engineer Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 31980-6199

Final report

Prepared for US Army Corps of Engineers
Washington, DC 20314-1000

US Army Corps of Engineers, Mobile District
Mobile, AL 36602

Under Funding Account Code U4381265; AMSCO Code 008303

Abstract

The US Army Corps of Engineers, St. Louis District, Applied River Engineering Center (AREC), in cooperation with the Operations Branch of the Mobile District, conducted a sediment management study of the Sunflower Bend reach of the Tombigbee River, between River Miles 81.0 and 76.0, near Jackson, AL. The objective of the study was to look at sediment management alternatives to alleviate or eliminate repetitive maintenance dredging. These alternatives involved various river engineering measures including dikes, weirs, channel armoring, disposal armoring, and combinations thereof. A physical Hydraulic Sediment Response model was used to examine the sediment response resulting from these alternatives. During model testing, and after discussions with AREC and Mobile Operations Division staff, a second objective was established to define existing non-erodible bed materials that were located throughout the reach. This was conducted to examine the merits of strategically removing these erosion resistant materials in the river as an additional dredging/excavation alternative. The most favorable alternatives involved removing bedload sand and consolidated clay material from between River Miles 79.1 and 78.0 to improve navigation.

Contents

Figures and Tables

Figures

Tables

Preface

This study was conducted for Headquarters, US Army Corps of Engineers (HQUSACE), Washington, DC, under the USACE Regional Sediment Management (RSM) Program, and the USACE Mobile District (SAM) under project "Alternate Training Work Construction Methods Using Dredge Material." The RSM program is administered by the US Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory, Vicksburg, MS, under the Navigation Program of USACE. At the time of publication of this report, Dr. Katherine E. Brutsché was the USACE National RSM program manager, and Ms. Tiffany Burroughs was the HQUSACE Navigation business line manager.

The work was performed by the USACE St. Louis District (MVS), Applied River Engineering Center, in cooperation with the Operations Branch of the SAM.

Survey personnel for the sub bottom profiling effort included Mr. Randy Trout and Mr. Shawn Kempshall (cartographic technicians), and Mr. Matt Staley, geodesist, of the Jacksonville District.

Study team members from the SAM who provided invaluable oversight, experience, and input included Mr. Duane Poiroux – chief, Coastal Branch; Mr. Carl Dyess – District Navigation section chief; Mr. Danny Hensley – operations project manager, Black Warrior Tombigbee/Alabama (BWT/AL) River Waterways; Mr. Anthony Perkins – Navigation manager, BWT/AL River Waterways; Mr. Derrek Kendrick – chief of Navigation BWT/AL River Waterways; Mr. Mark Goddard – civil engineer technician; Mr. Mark Eberhart – engineer technician/surveyor; and Mr. Thomas Beckham – civil engineer, Navigation section.

COL Teresa A. Schlosser was the commander of ERDC, and the director of ERDC was Dr. David W. Pittman.

1 Introduction

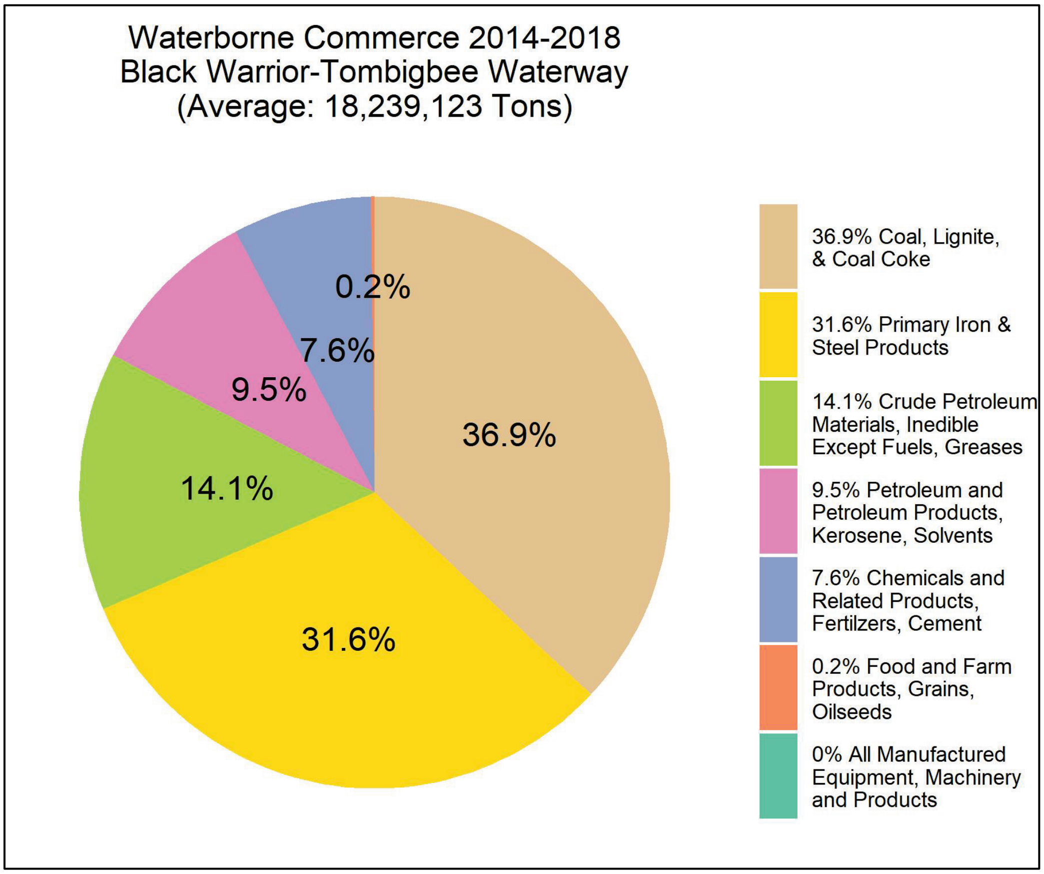
1.1 Background

The Tombigbee River serves as a key navigation artery of the Inland Marine Transportation System. The river is used to supply coal and other products to communities along the river including the major city of Mobile, AL. Coal is transported from the Ohio and Tennessee River Valleys via the Tennessee-Tombigbee Waterway (Figure 1).

Figure 1. Tombigbee and Tennessee-Tombigbee Waterway system.

Between 2014 and 2018, tonnage on the Black Warrior-Tombigbee Waterway (Black Warrior River is the main tributary to Tombigbee River) ranged from 16.7 to 21.2 million tons per year, with an average of 18.6 million tons per year (USACE WCUS 2021). Steel, coal, petroleum, and chemical products make up the bulk of the commodities moving along the river (Figure 2).

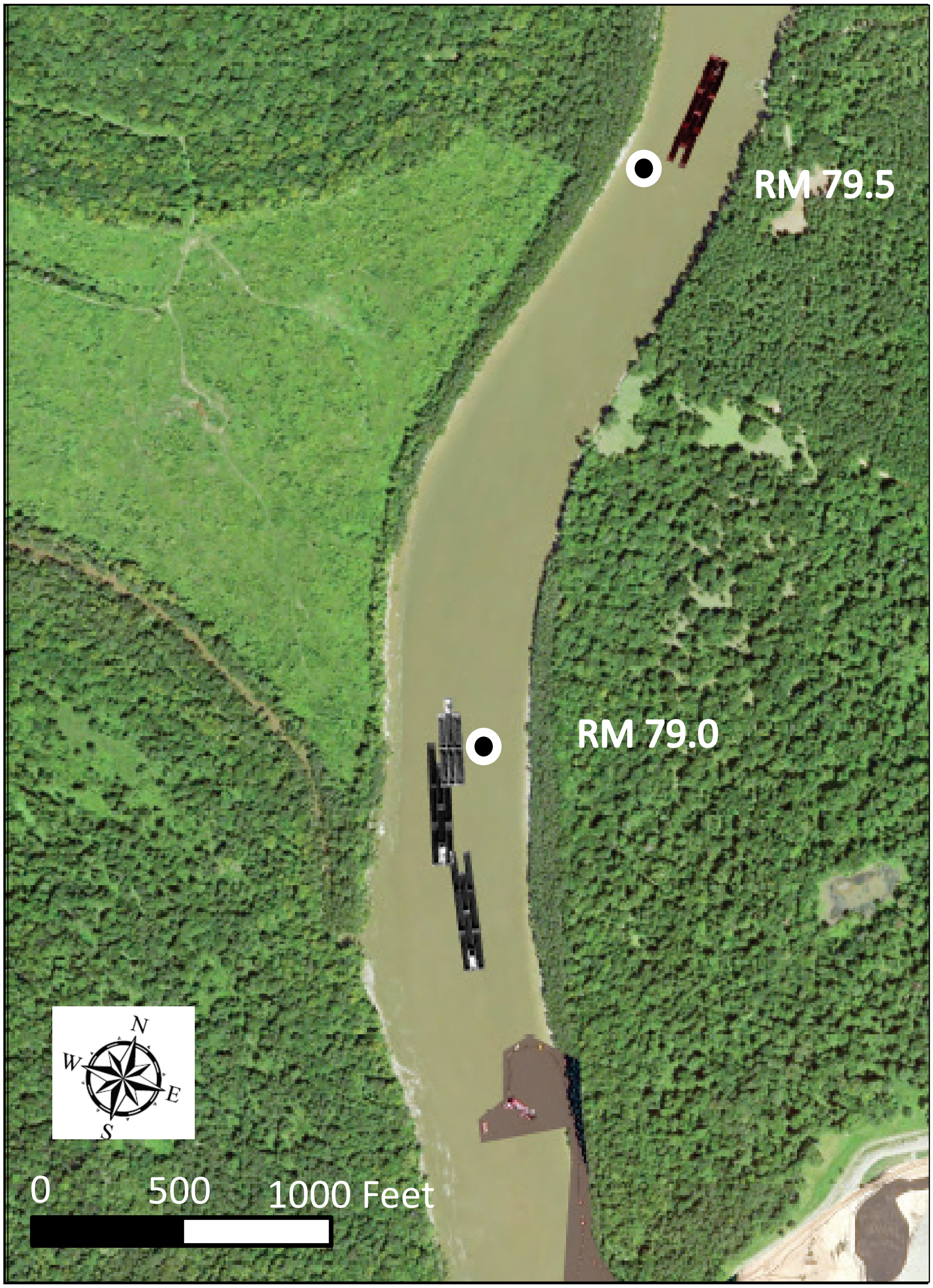
Figure 2. Tonnage on the Black Warrior-Tombigbee Waterway.



Navigation channel dimensions of 200 ft[1] wide and 9 ft deep at low water are maintained by a series of locks and dams and dredging. The Sunflower reach is located approximately 36 mi downstream of Coffeeville Lock and is located in the *open river* section of the waterway. Therefore, channel dimensions also depend upon the tidal influence of the gulf and maintenance dredging during times of low water.

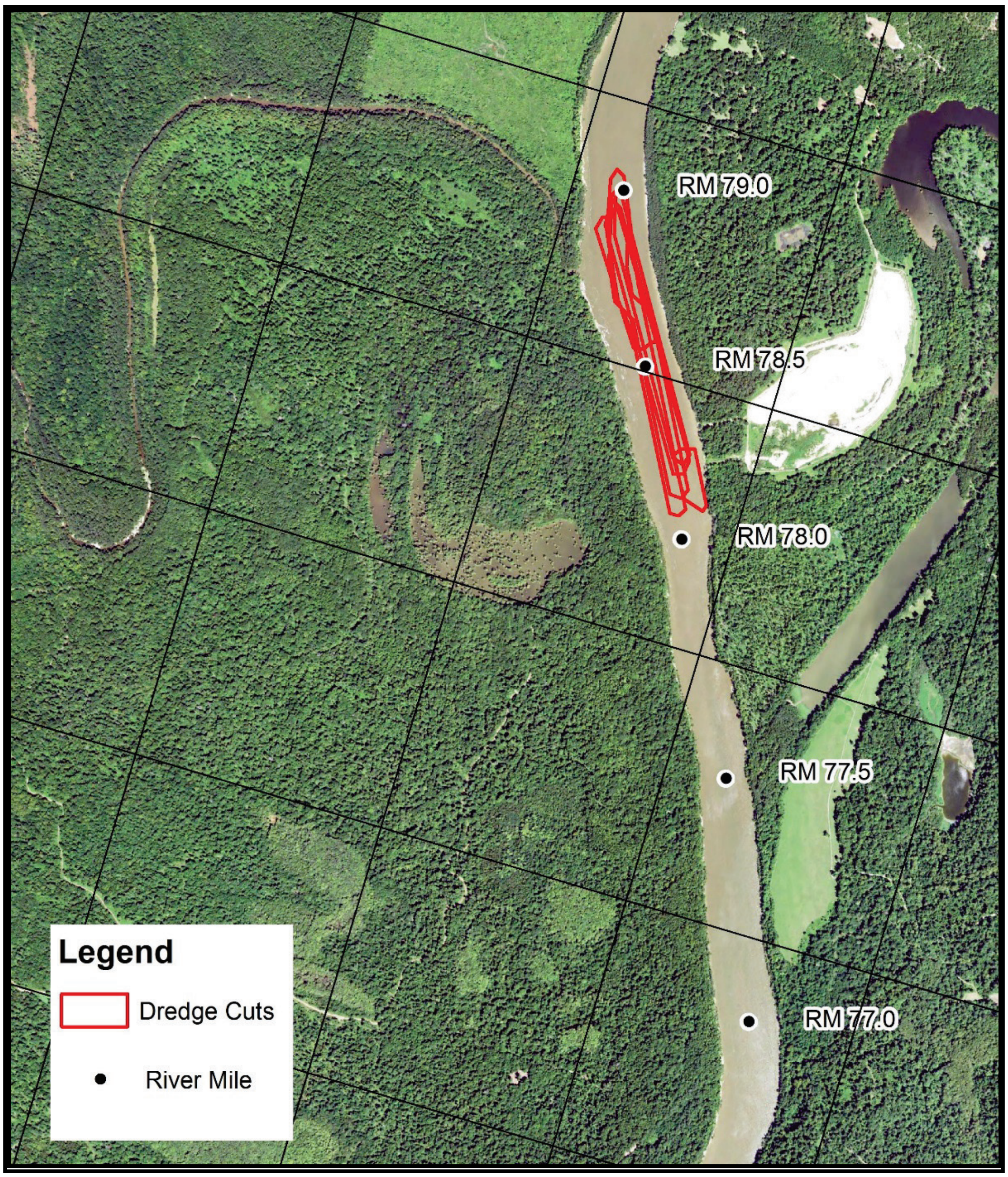
[1] For a full list of the spelled-out forms of the units of measure used in this document, please refer to *US Government Publishing Office Style Manual*, 31st ed. (Washington, DC: US Government Publishing Office 2016), 248-52, https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf.

Figure 3. Typical tow configurations at Sunflower bend between River Miles (RM) 79.5 and 79.0.



The Mobile District, Operations Branch, has conducted historical repetitive maintenance dredging in the Sunflower reach of the Tombigbee Waterway, specifically between River Miles (RM) 79.0 and 78.0 (see Appendix A, Plates 1 and 2, for location and vicinity map of the study reach and 2015 aerial photograph illustrating the planform and nomenclature of the study reach, respectively). Figure 4 shows typical dredge cut locations.

Figure 4. Location of recent dredge cuts.

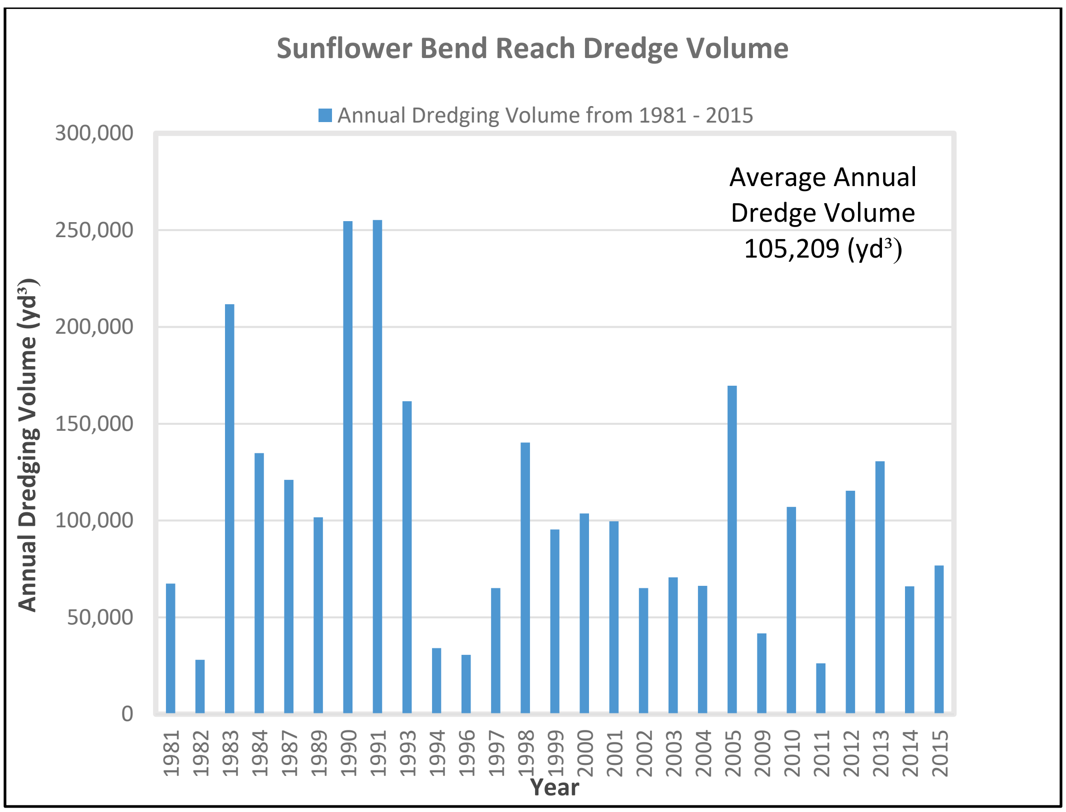


The river thalweg crosses from the left descending bank (LDB) toward the right descending bank (RDB) in a relatively short length of river near RM 79.2. As is typical of many river crossings, there is a tendency for shoaling that has the potential to present hazards to navigation during lower river stages. The alignment of this crossing can also be problematic for navigation as it involves a sharp transition from one side of the river to the other.

The reach between RMs 79.1–78.0 has also shown a tendency to become too shallow for navigation and requires repetitive channel dredging to maintain the navigation channel. Specifically, the bar along the LDB tends to build out toward the RDB leaving insufficient navigable width for barge tows to safely traverse this reach.

The amount of dredging has varied over the years. Between 2011 and 2016, the average amount of material removed from the channel was 83,000 cy/yr, at an average cost of $4.00/cy, or $332,000 per year. Since 1981, the average volume has been approximately 105,000 cy, with two events exceeding 250,000 cy (Figure 5).

Figure 5. Sunflower Bend annual dredging volume 1981–2015.



There are several sites within the river channel that have also been used for dredge material disposal in recent years (see Appendix A, Plate 4, for an aerial view of the in-bank dredge disposal areas).

Prior to dredge disposal within the river channel, an upland dredge disposal area was utilized. However, the upland dredge disposal site located off the LDB at RM 78.3 has reached its capacity (see Appendix A, Plate 5, for an aerial view of the upland disposal area).

1.2 Objectives

The objectives of this study were to

1. Investigate and provide analysis on the existing flow mechanics causing the sedimentation problems.
2. Evaluate a variety of remedial measures utilizing a physical Hydraulic Sediment Response (HSR) model to identify the most effective and economical plan to reduce or eliminate dredging and maintain an efficient navigation alignment. The following criteria were used to evaluate each alternative:
   a. Alternatives should increase the depth at the thalweg crossing at RM 79.2.
   b. Alternatives should improve the alignment of the thalweg crossing at RM 79.2.
   c. Alternatives should improve the navigation widths and depths between RM 79.1 and 78.0.
3. Communicate to engineers, river industry personnel, and other stakeholders as necessary the results of the HSR model tests and the plans for improvements.

1.3 Approach

The study comprised a 5 mi stretch of the Tombigbee River, between RM 81.0 and 76.0 in Clarke County near Jackson, AL. Existing hydrographic surveys and high-resolution aerial imagery, as well as data collected from the field (e.g., locations of bank lines and structures that could not be determined from aerial imagery and sub-bottom profile data to determine the elevation of non-erodible material in the channel) were used to develop an HSR model to test sediment management alternatives. Bathymetry and velocity of the modeled alternatives were then evaluated to determine the best alternative (see section 3 for more details on the HSR model development and section 4 for design alternative results).

2 Study Site

2.1 Study reach channel characteristics and general trends

Present and historic hydrographic surveys of the Tombigbee River, in the HSR model study area, are shown in Appendix A, Plates 10 – 15. The plates show bathymetric surveys from 2006, 2007, 2008, 2011, 2012, and 2015, respectively. Table 1 describes the qualitative bathymetric trends that have remained relatively constant after comparison of the above mentioned hydrographic surveys.

Table 1. Study reach qualitative bathymetric trends based on 2006–2015 surveys (Appendix A, Plates 10–15).

River Miles	Description
81.0 – 80.5	In this reach, the thalweg located along the RDB with depths as low as between 20 – 30 ft below Mean Sea Level (MSL). A narrow sandbar can be seen along the LDB (inside of the bend).
80.5	At this river mile, the thalweg crosses from the RDB toward the LDB as the river begins to turn. Depths in the crossing are shown to be between 15 and 20 ft below MSL.
80.5 – 80.0	The thalweg was located along the LDB with depths between 40 – 50 ft below MSL. A sandbar was located along the RDB (inside of the bend).
80.0 – 79.2	The thalweg was located along the LDB with depths between 30 – 40 ft below MSL.
79.2	At this river mile, the thalweg crosses from the LDB toward the RDB as the river begins to turn. Depths in the crossing are shown to be between 15 – 20 ft below MSL.
79.2 – 78.0	In this reach, the thalweg was located along the RDB. A wide sandbar was located along the LDB (widths vary over space and time but are wide enough to encroach on the navigation channel). Depths in this reach, which was dredged periodically to maintain the navigation channel dimensions (depth and width), were 10 – 15 ft below MSL. Note that depths in this stretch appeared unusually shallow relative to the rest of the study reach.
78.0 – 77.5	Deep water in this stretch (20 – 30 ft below MSL) extended from bank to bank. This location is the only stretch in the study reach that showed this trend. It was noted that this deep stretch was immediately downstream of a stretch that appeared unusually shallow.
77.5 – 76.8	The thalweg was located along the LDB from RMs 77.5 – 77.2 before there was a crossing of the thalweg toward the RDB between RMs 77.2 – 77.0. The thalweg crossed toward the LDB between RMs 77.0 – 76.8. Depths in this reach were between 15 and 20 ft below MSL.
76.8 – 76.0	In this stretch, the thalweg was located on the outside of the bend (LDB). Depths in this reach were between 30 – 40 ft below MSL

2.2 Study reach site visit

On June 14, 2016, the authors of this report visited the Sunflower Bend reach to examine bank lines, structures, and any data that could not otherwise be gathered in the office (see Figures 6-10 for images from this site visit). At the US Geological Survey Gage 02470050 at Steamplant near Leroy, AL, the river stage was 1.4 ft.

Figure 6. The MV *Simpson* preparing to dock so passengers can board.

Figure 7. Silty clay banks along the Tombigbee River.

Figure 8. Heavily consolidated silts and clays along the bank of the Tombigbee River.

Figure 9. Active bankline erosion

Figure 10. Towboat transporting barges on the Tombigbee River.

During this site visit, sub-bottom profile data were collected to identify the elevation of consolidated non-erodible materials in the problem reach, which was preferred over side-scan sonar since it reveals buried non-erodible materials as opposed to only bed elevation (Wadman and McNinch 2020). As a result of this data collection, engineers confirmed that the non-erodible material in the channel was directly contributing to the lack of navigation depth and width through the problem reach.

3 Hydraulic Sediment Response (HSR) Development

3.1 Model calibration and replication

The HSR modeling (see Appendix C for details on HSR theory) methodology employed a three-step calibration process designed to replicate the general conditions in the river at the time of the model study.

First, planform *fixed* boundary conditions of the study reach (i.e., bank lines, islands, side channels, tributaries and other physical features were established according to the most recently available high resolution aerial photographs). Various other fixed boundaries were also introduced into the model including any channel improvement structures, underwater rock, clay, and other non-mobile boundaries. These boundaries were based off of documentation (such as plans and specifications) provided by the Mobile District.

Second, *loose* boundary conditions of the model were replicated. Bed material was introduced into the channel throughout the model to an approximate level plane. The combination of the fixed and loose boundaries served as the starting condition of the model.

Third, model tests were run using steady state discharge. Adjustment of the discharge, sediment volume, model slope, fixed boundaries, and entrance conditions were refined during these tests as part of an overall calibration of physical forcing parameters. The bed progressed from a static, flat, arbitrary bed into a fully formed, dynamic, three-dimensional (3D) mobile bed response. Repeated tests were simulated for the assurance of model stability and repeatability. When the general trends of the model bathymetry were similar to observed recent river bathymetry, and the tests were repeatable, the model was considered calibrated and alternative testing began.

Note that in calibration, non-erodible bed material was used in a localized area on the model riverbed to represent the presence of clay material present in the prototype.

3.2 Scales and bed materials

The model employed a horizontal scale of 1 in. = 350 ft, or 1:4200, and a vertical scale of 1 in. = 55 ft, or 1:660, for a 4.20 to 1 distortion ratio of linear scales. This distortion supplied the necessary forces required for the simulation of sediment transport conditions similar to those observed in the prototype. The bed material was granular plastic urea, Type II, with a specific gravity of 1.40.

3.3 Appurtenances

The HSR model planform insert was constructed according to the 2015 high-resolution aerial photography of the study reach. The insert was then mounted in a standard HSR model flume. The riverbanks of the model were routed into dense polystyrene foam and modified during calibration with clay and polymesh. Rotational jacks located within the hydraulic flume controlled the slope of the model. The measured slope of the insert and flume was approximately 0.007 in./in. River training structures in the model were made of galvanized steel mesh to generate appropriate scaled roughness.

3.4 Flow control

Water and sediment flow into the model was regulated by customized computer hardware and software interfaced with an electronic control valve and submersible pump. For all model tests, water flow entering the model was held steady at 0.9 gpm. This served as the average expected energy response of the river. Because of the constant variation experienced in the river, this steady state flow was used to replicate existing general conditions and later used to analyze the sediment response that occurred under alternative model conditions.

3.5 Data collection

Data from the HSR model was collected with a 3D laser scanner (Perceptron ScanWorks V4i, V5 mounted to CimCore Infinite series portable CMM arms). The riverbed in the model was surveyed with a high-definition, 3D laser scanner that collects a dense cloud of xyz data points. These xyz data points were then georeferenced to real-world coordinates and triangulated to create a 3D surface. The surface was then color coded by elevation using standard color tables that were also used in color coding prototype surveys. This process allowed a direct comparison between HSR model bathymetry surveys and prototype bathymetry surveys.

3.6 Replication test

Once the physical model adequately replicated general prototype trends, the resultant bathymetry served as a baseline for the comparison of all model alternative tests. In this manner, the actions of any alternative, such as new channel improvement structures, realignments, etc., were compared directly to the baseline model condition. General trends were evaluated for any major positive or negative differences between the alternative test conditions and the baseline test by comparing the surveys of the two and also carefully observing the model while the actual testing was taking place.

Bathymetric trends were recorded from the model using a 3D laser scanner. Calibration was achieved after numerous favorable bathymetric comparisons of the prototype surveys were made to several surveys of the model. The resultant bathymetry served as the bathymetry base test for the model and is shown in Appendix A, Plate 9. Qualitative trends, due to funding limitations, determined from comparisons between the HSR model base test bathymetry and the 2006 through 2015 prototype surveys are described in Table 2.

Table 2. Study reach and prototype bathymetry (2006–2015) qualitative trend comparison.

River Miles	Description
81.0 – 80.5	The model survey began at RM 80.75 and showed the thalweg along the RDB, similar to the prototype.
80.5	The river crossing at this location was generally shallower in the model than the prototype. However, the location of this crossing matched very well.
80.5 – 80.0	This reach of the model matched the prototype very well. However, the sandbar along the RDB was slightly more prominent in the model compared to the prototype.
80.0 – 79.2	This reach of the model matched the prototype very well.
79.2	The river crossing at this location was slightly deeper in the model than the prototype. However, the location of this crossing matched very well.
79.2 – 78.0	This reach of the model matched the prototype well. However, the prototype survey demonstrated the result of repetitive channel maintenance dredging whereas the model is intended to demonstrate a river condition without dredging and demonstrated the tendency of the sandbar along the LDB to encroach upon the navigation channel.
78.0 – 77.5	This reach of the model matched the prototype very well.
77.5 – 76.8	This reach of the model matched the prototype very well.
76.8 – 76.0	This reach of the model matched the prototype very well.

4 Design Alternative Results

The testing process consisted of modeling alternative measures in the HSR model followed by analyses of the bathymetry and velocity results (see Appendix A, plates 16–45 for bathymetry results of design alternatives 1-30). The goal was to identify river conditions that would reduce or eliminate shoaling in the Sunflower Reach area. Evaluation of each alternative was accomplished through a qualitative comparison to the model replication test bathymetry. Structure information (e.g., type of structure, dimensions) and locations (e.g., River Mile, LDB/RDB, and structure top elevation) are described in Appendix B for design alternatives 1 – 30.

Note, non-erodible material (plastic mesh material) was utilized in the problem reach based on analysis of bathymetric data through all alternative testing. However, as a result of the data gathered from the sub-bottom profile effort, non-erodible clay was added in the model to simulate the non-erodible materials in the prototype. Alternatives 23 through 30 were tested after the change to the non-erodible materials in the model were complete.

Design alternative model tests were evaluated on whether the following navigation improvements were observed: increased channel crossing depths at RM 79.2, improved alignment at RM 79.2, and improved navigation channel width between RM 79.1–78.0. These results are summarized in Table 3.

Table 3. Evaluation and summary of design alternative model tests.

Alternatives	Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
Alternative 1	No	No	No
Alternative 2	No	No	No
Alternative 3	No	No	No
Alternative 4	No	No	No
Alternative 5	No	Yes	No
Alternative 6	Yes	Yes	No
Alternative 7	Yes	Yes	No
Alternative 8	Yes	Yes	No

Alternatives	Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
Alternative 9	Yes	Yes	No
Alternative 10	Yes	No	No
Alternative 11	No	No	No
Alternative 12	No	Yes	No
Alternative 13	No	Yes	No
Alternative 14	Yes	Yes	No
Alternative 15	No	Yes	No
Alternative 16	No	Yes	No
Alternative 17	No	Yes	No
Alternative 18	No	No	No
Alternative 19	No	Yes	No
Alternative 20	No	No	No
Alternative 21	No	Yes	No
Alternative 22	No	No	No
Alternative 23	No	Yes	Yes
Alternative 24	Yes	Yes	Yes
Alternative 25	No	No	No
Alternative 26	No	No	Yes
Alternative 27	No	No	Yes
Alternative 28	No	Yes	Yes
Alternative 29	Yes	Yes	Yes
Alternative 30	Yes	Yes	Yes

5 Recommendations and Conclusions

5.1 Design alternative recommendations

Alternatives 24, 29, and 30 had a positive impact on the three criteria used for alternative evaluation in this study. All three of these alternatives involved removing bedload sand and consolidated clay material between RM 79.1 and 78.0 (approximately). Alternative 24 involved dredging along the LDB, while Alternatives 29 and 30 involved dredging along the RDB. Substantially less sandbar deposition was shown in Alternatives 29 and 30 compared to Alternative 24 since material passing through the reach after the dredge cut was modeled showed no tendency to accrete in the navigation channel. Alternative 30 showed that additional depth through the reach can be gained if the dredge cut along the RDB reaches -20 ft Mean Sea Level (MSL) as opposed to -17 ft MSL (as seen in Alternative 29). Therefore, to ensure the best possibility of reducing future dredging needs, Alternative 30 is the recommended course of action based on HSR modeling results.

5.2 Interpretation of model results

In the interpretation and evaluation of the model test results, note that these results are qualitative in nature. Any hydraulic model, whether physical or numerical, is subject to biases introduced as a result of the inherent complexities that exist in the prototype. Anomalies in actual hydrographic events, such as prolonged periods of high or low flows are not reflected in these results. Water surfaces were not analyzed, and flood flows were not simulated in this study.

This model study was intended to serve as a tool for the river engineer to guide in assessing the general trends that could be expected to occur in the Tombigbee River from a variety of imposed design alternatives. Measures for the final design may be modified based upon engineering knowledge and experience, real estate and construction considerations, economic and environmental impacts, or any other requirements.

For economic considerations, some analysis and judgment of the expected dredging reductions associated with Alternatives 24, 29, and 30 are necessary. Note that actual future dredging needs are dependent on future river hydrograph and bedload conditions and that the estimates below are approximations based on the information considered during this model study effort.

To determine the relative effectiveness of the three successful alternatives, it was determined that a comparison of the increases in channel volume below sea level (relative to the model base test) for each alternative would be appropriate. For this analysis, the recommended alternative, Alternative 30, was used as a reference to measure the effectiveness of Alternatives 24 and 29. To account for river dynamics, the effectiveness of Alternative 30 was discounted to 90% effective in reducing dredge needs in the future. The results of the volume comparisons and relative effectiveness of each alternative are shown in the Table 4 (and Appendix A, Plate 46).

Table 4. Volume comparisons and effectiveness of recommended alternatives.

	Base Test	Alternative 24	Alternative 29	Alternative 30
Volume Below Sea Level (cy)	7,091,450	7,469,113	7,913,656	8,267,487
Difference in Channel Volume from Base Test (cy)	0	377,662	822,206	1,176,036
Percent Effectiveness (Relative to Alternative 30)	0%	32%	70%	100%
Percent Effectiveness (Relative to Alternative 30 at 90% Dredge Reduction Effectiveness)	0%	29%	63%	90%

In summary, and based on the assumptions and qualifying statements listed above, it is the engineering opinion that Alternative 24 will result in a 29% reduction in future dredging needs, Alternative 29 will result in a 63% reduction in future dredging needs, and Alternative 30 will result in 90% reduction in future dredging needs.

Dredging through consolidated material that is, as has been shown in this case, acting as a depth control in the river has the possibility of causing channel instability upstream of the dredge cut area. It is recommended that a channel stability analysis (e.g., 1D HEC-RAS modeling effort) be completed to address this concern.

References

USACE WCUS (US Army Corps of Engineers, Waterborne Commerce of the United States). 2021. WCUS Ports and Waterways Web Tool. http://cwbi-ndc-nav.s3-website-us-east-1.amazonaws.com/files/wcsc/webpub/#/

Wadman H. M., and J. E. McNinch. 2020. *Application of Chirp Acoustic Sub-Bottom Data in Riverine Environments: Identification of Underlying Rocky Hazards at Cape Girardeau, Missouri, and Thebes, Illinois*. MRG&P Report No. 31. Vicksburg, MS: US Army Engineer Research and Development Center. https://hdl.handle.net/11681/35734

Appendix A: Report Plates

Plate 1. Location and vicinity map.

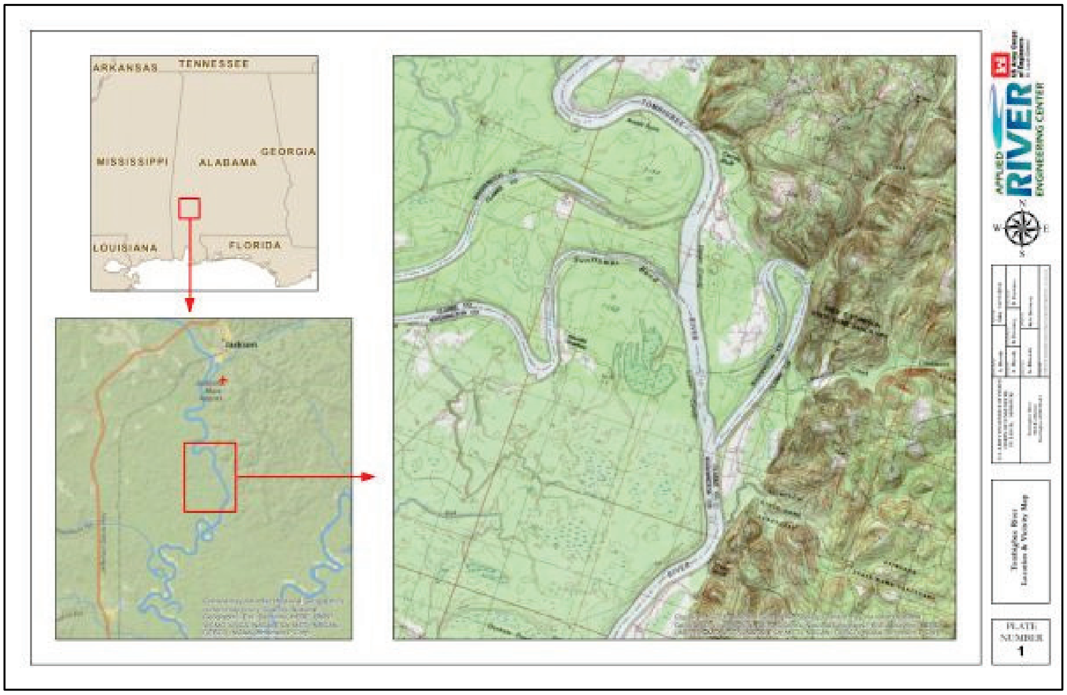


Plate 2. Planform and nomenclature.

Plate 3. Dredging location.

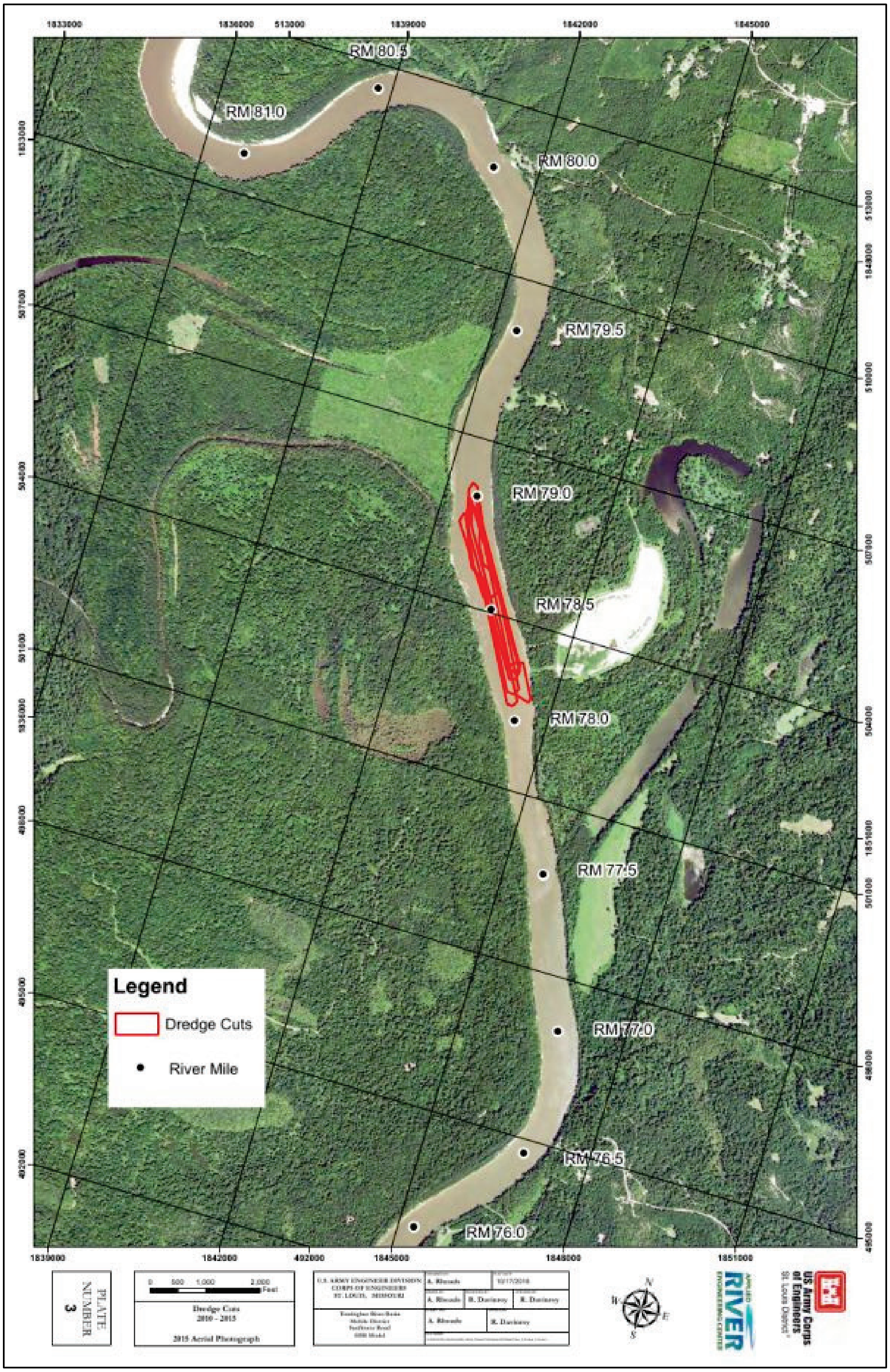


Plate 4. In-bank disposal locations.

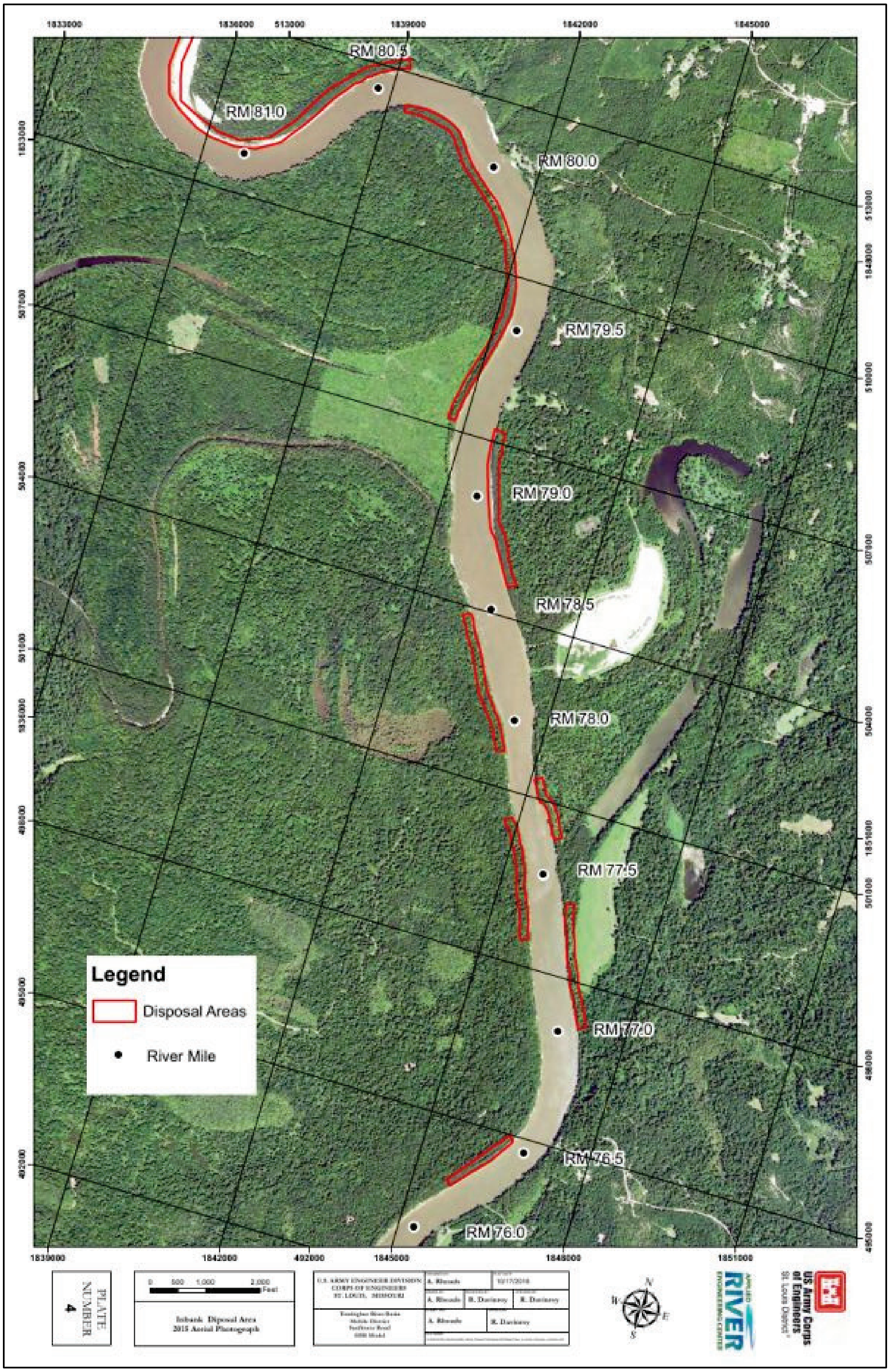


Plate 5. Upland disposal locations.

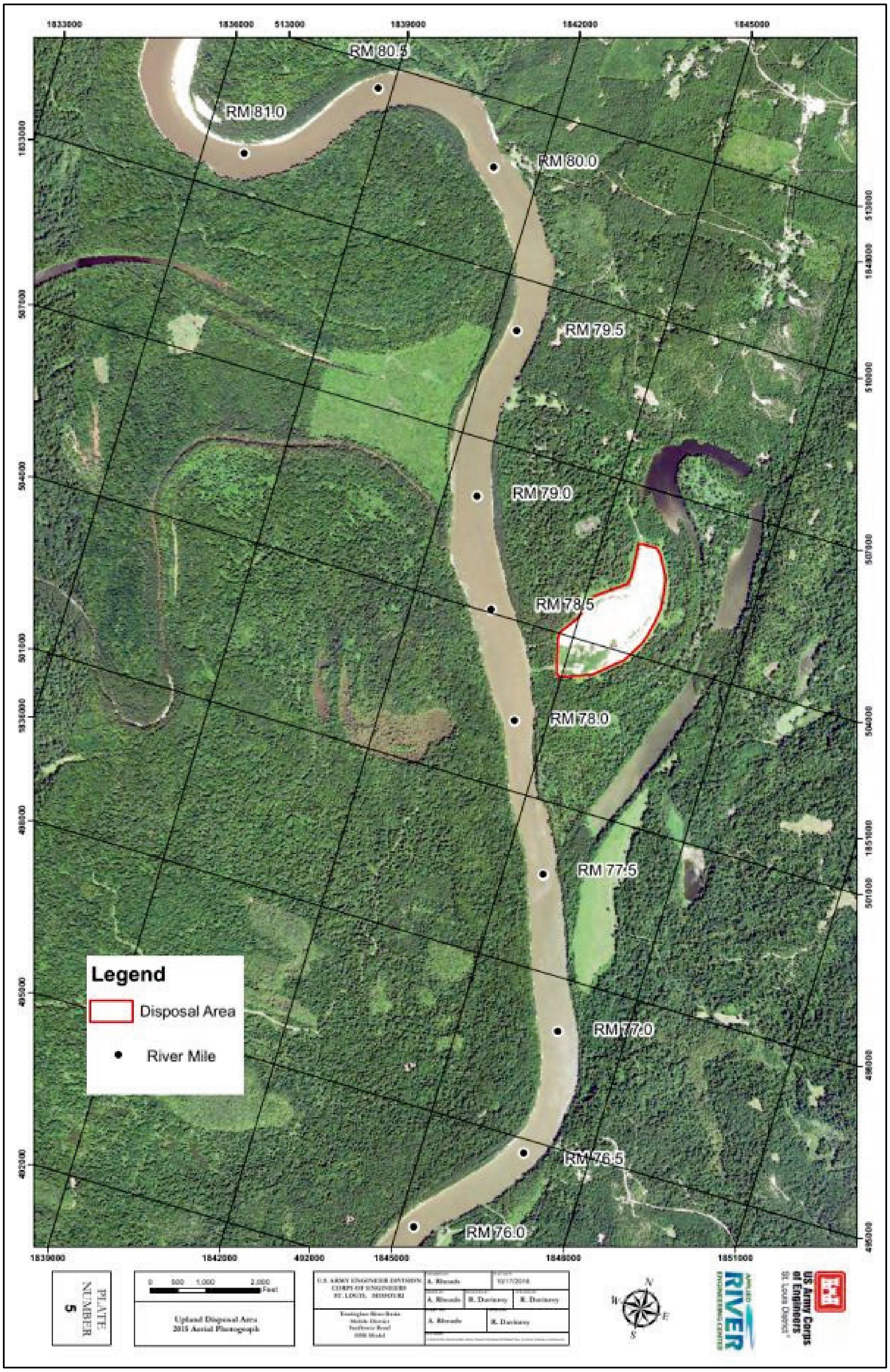


Plate 6. Cutoff area.

Plate 7. Sub-bottom profile.

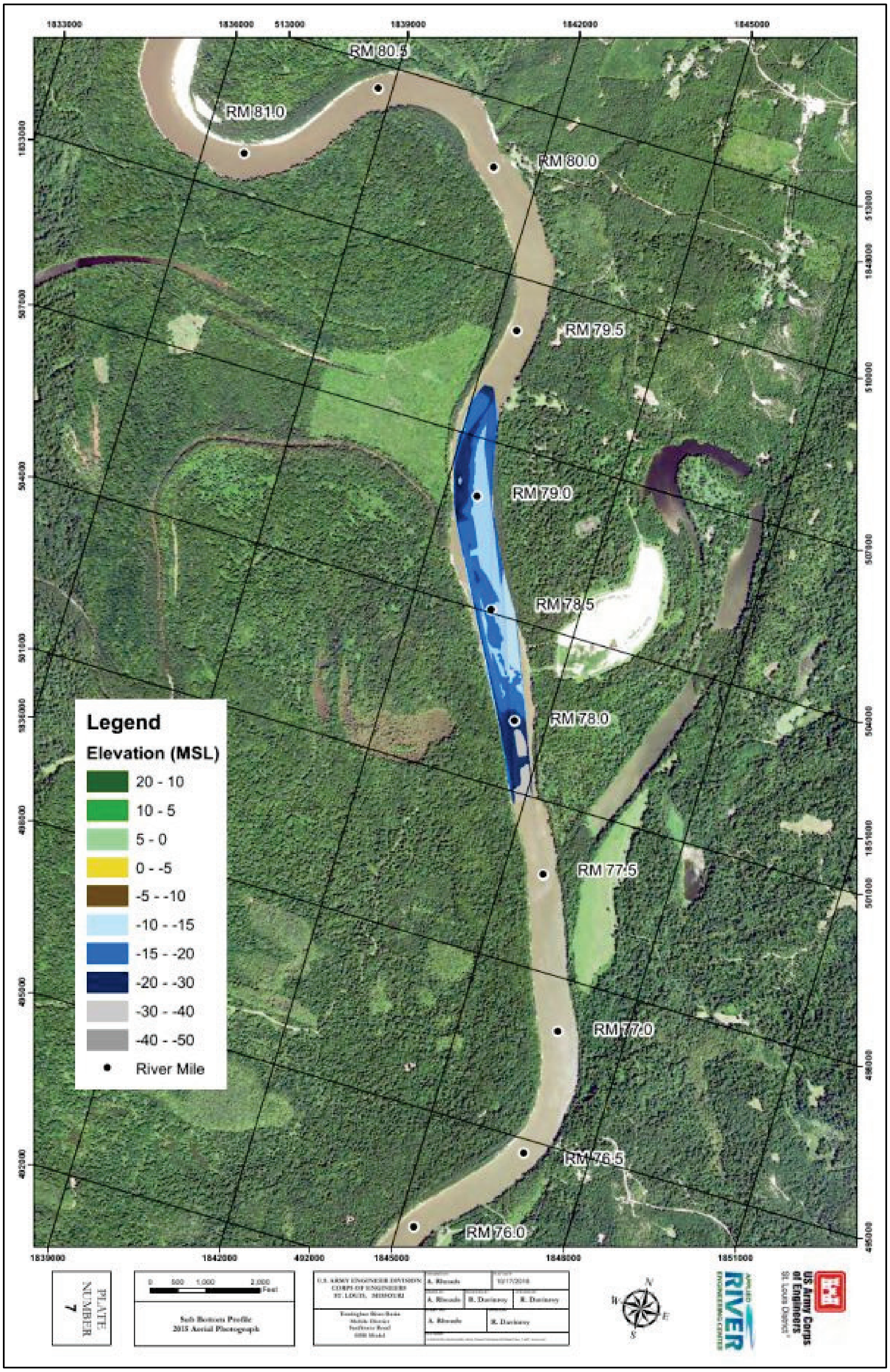


Plate 8. Recent pre-dredge survey.

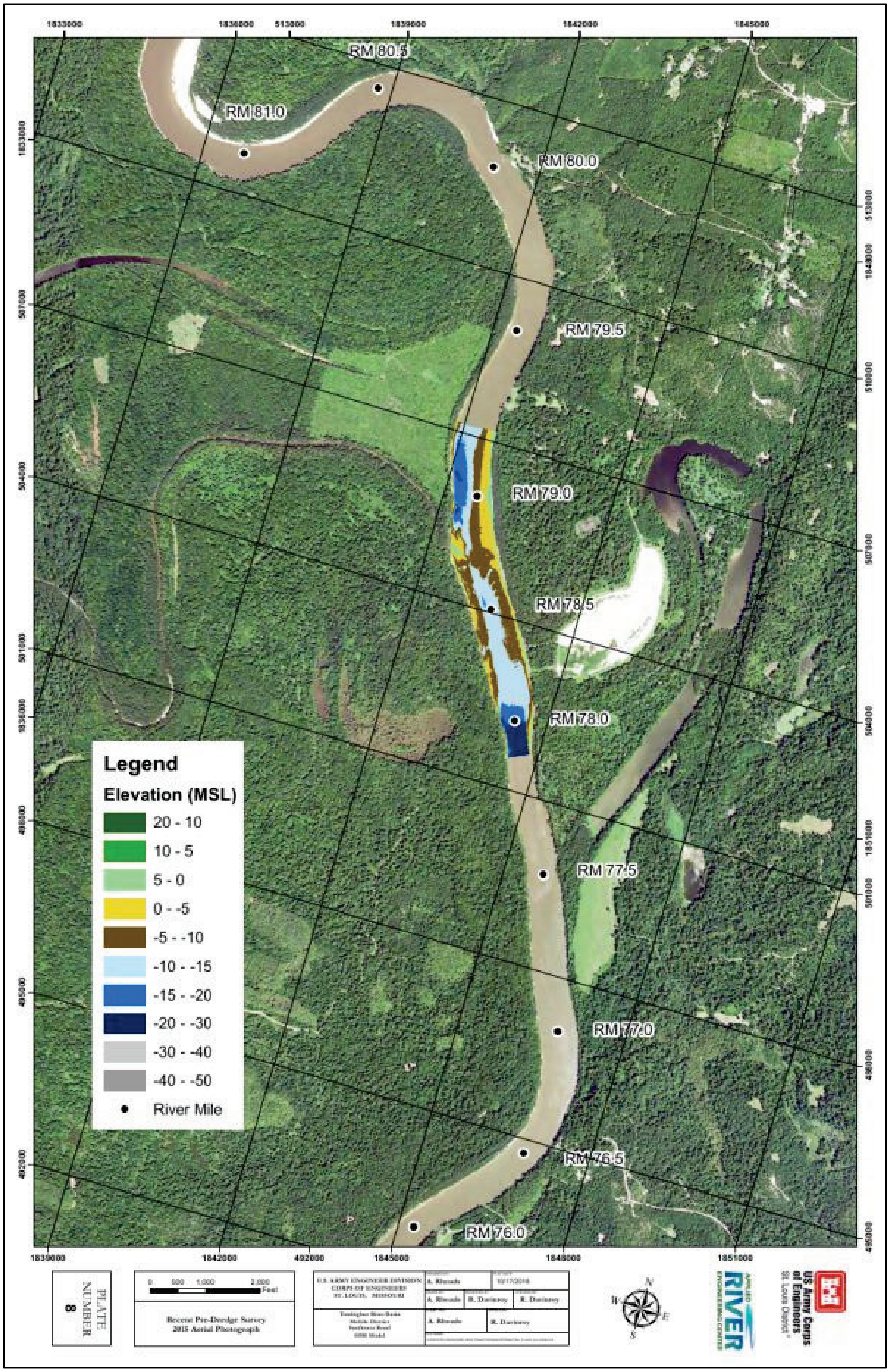


Plate 9. Prototype replication.

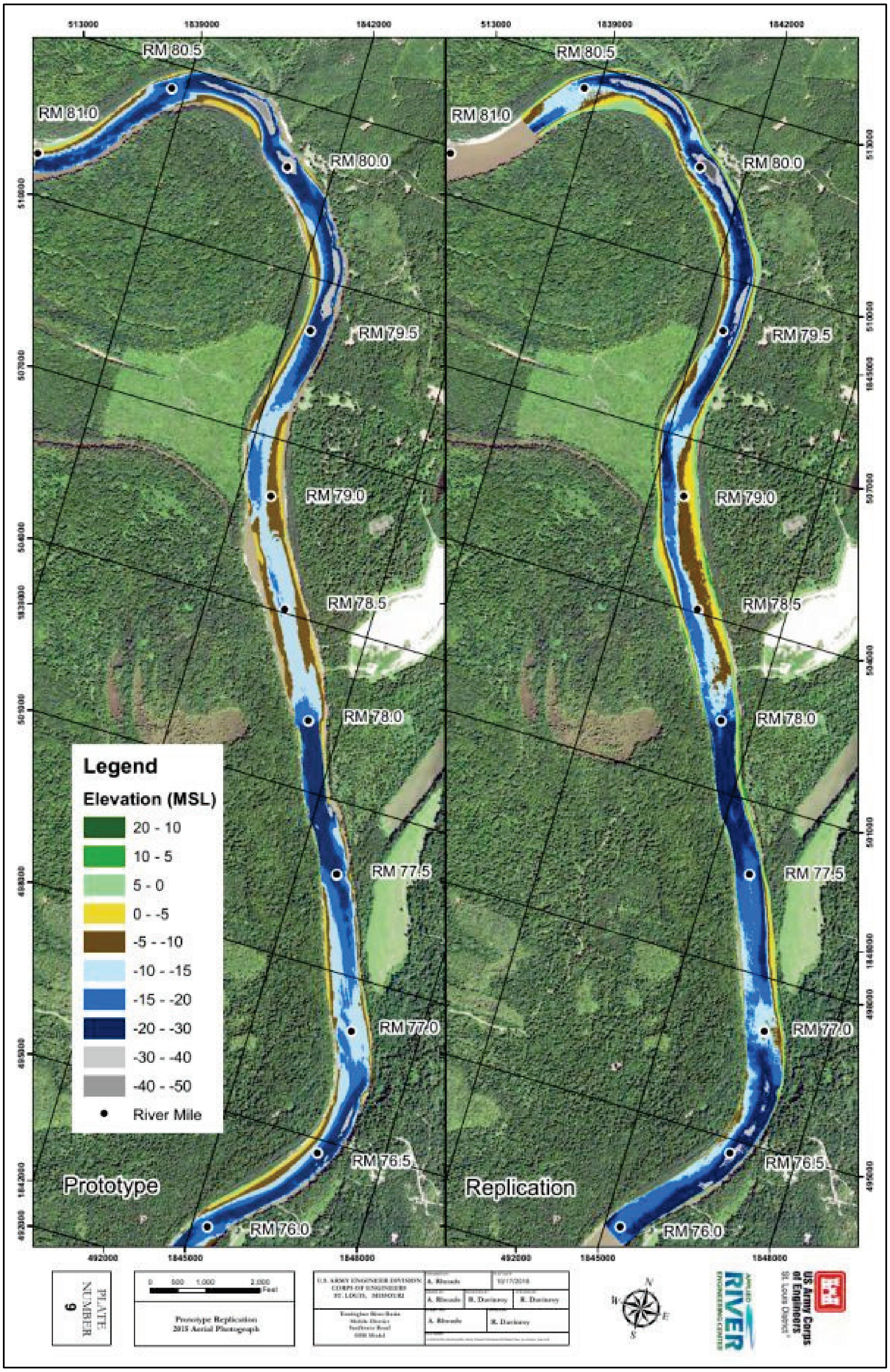


Plate 10. 2006 Survey.

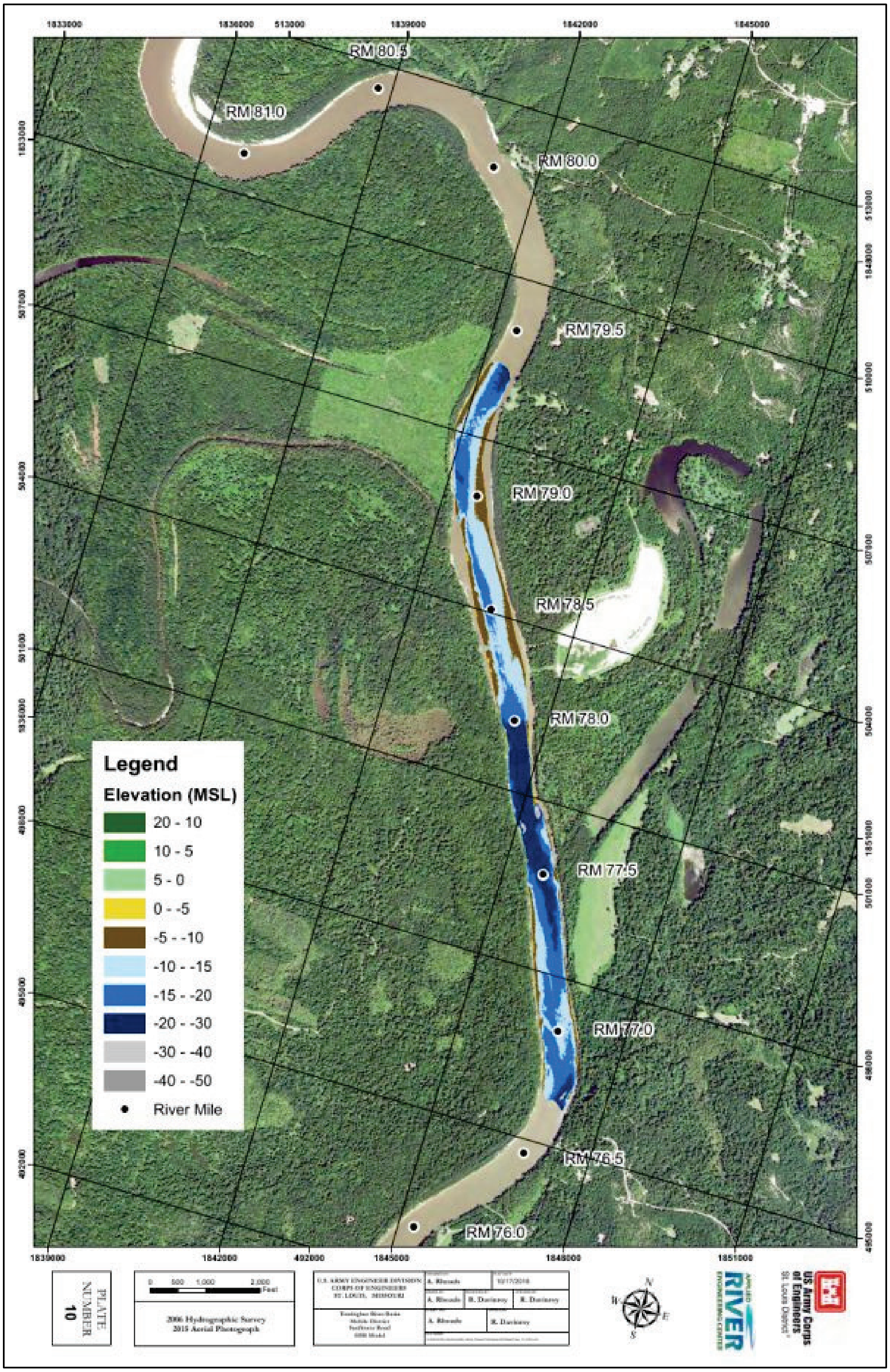


Plate 11. 2007 Survey.

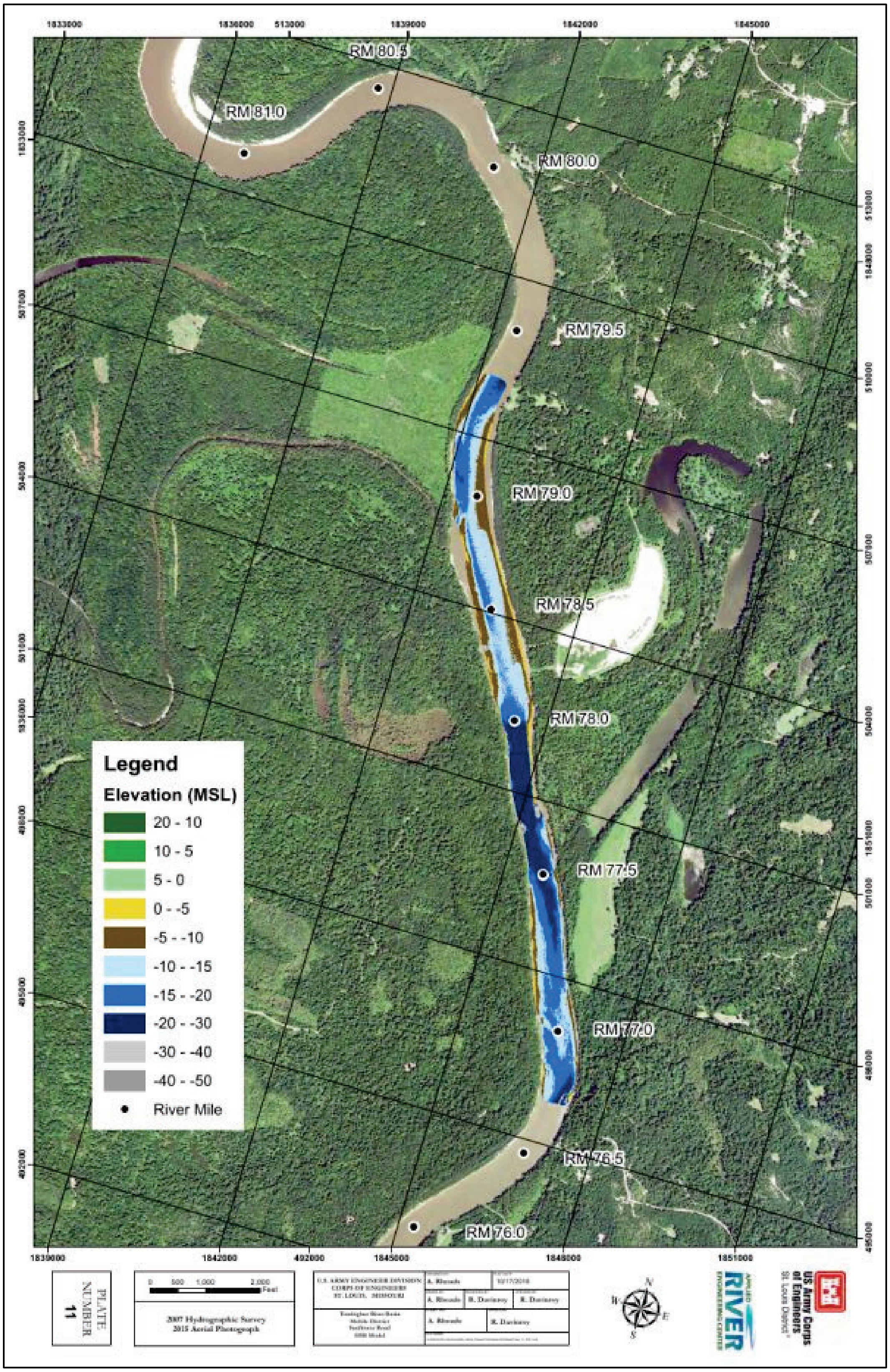


Plate 12. 2008 Survey.

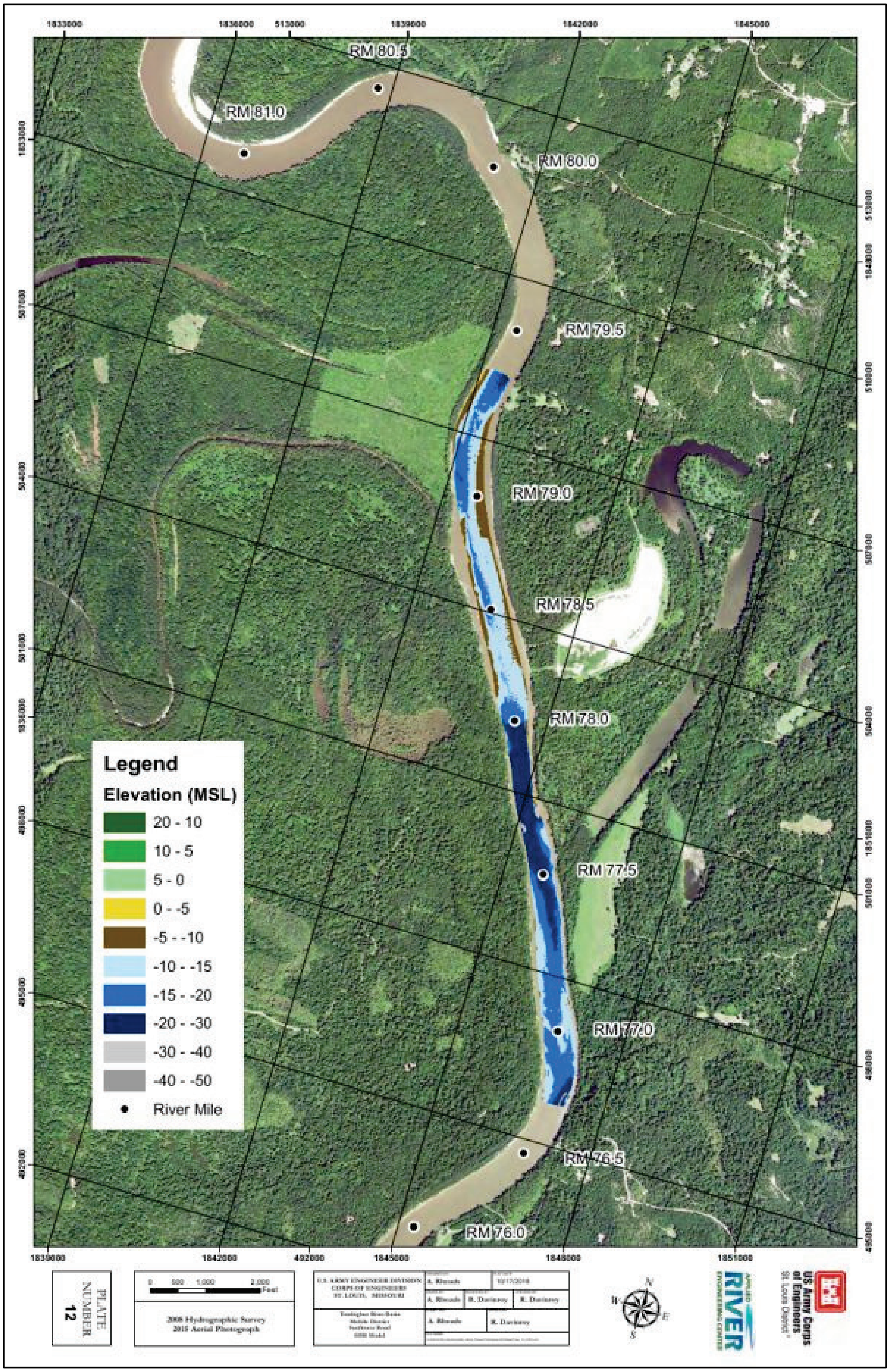


Plate 13. 2011 Survey.

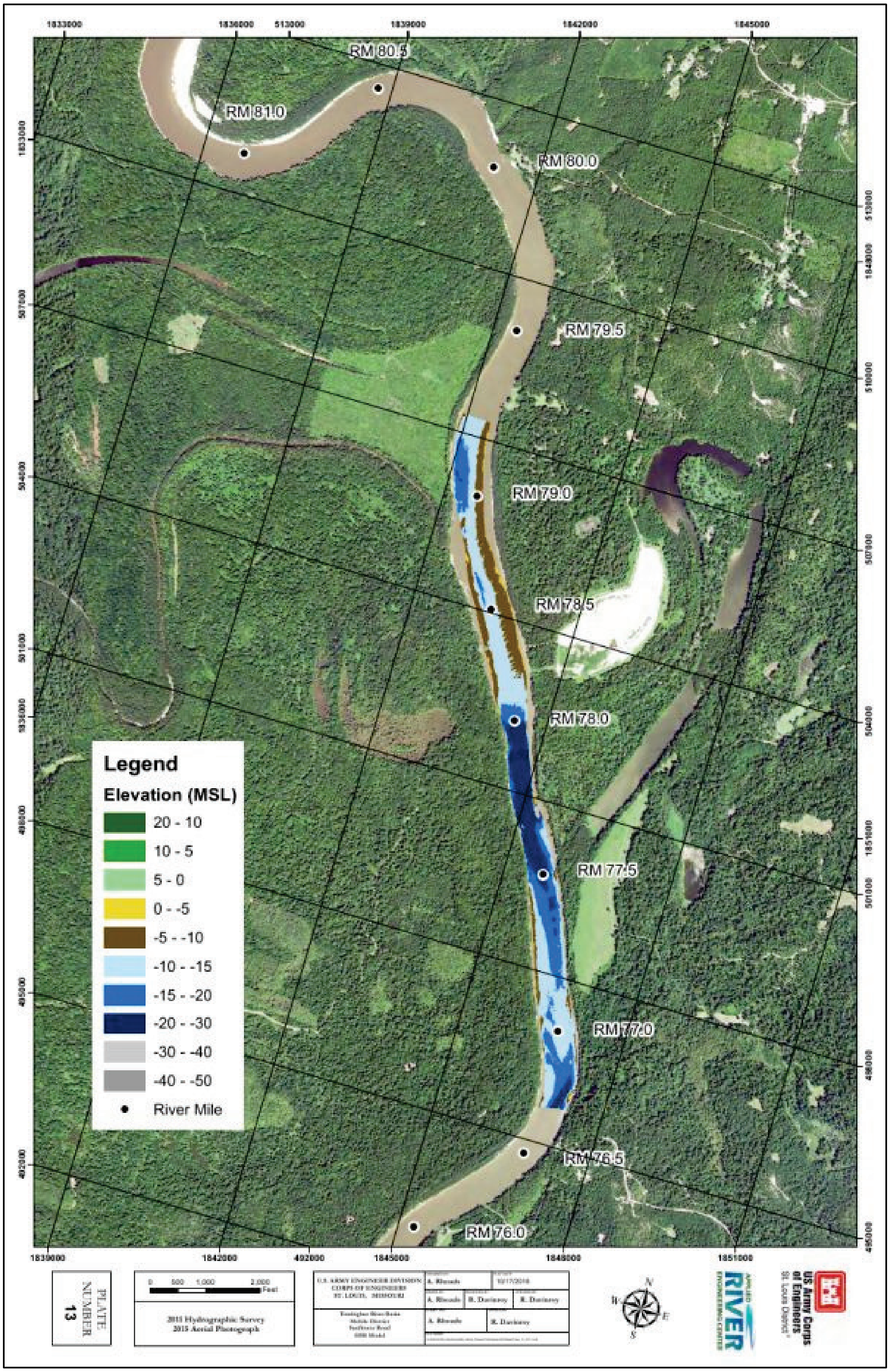


Plate 14. 2012 Survey.

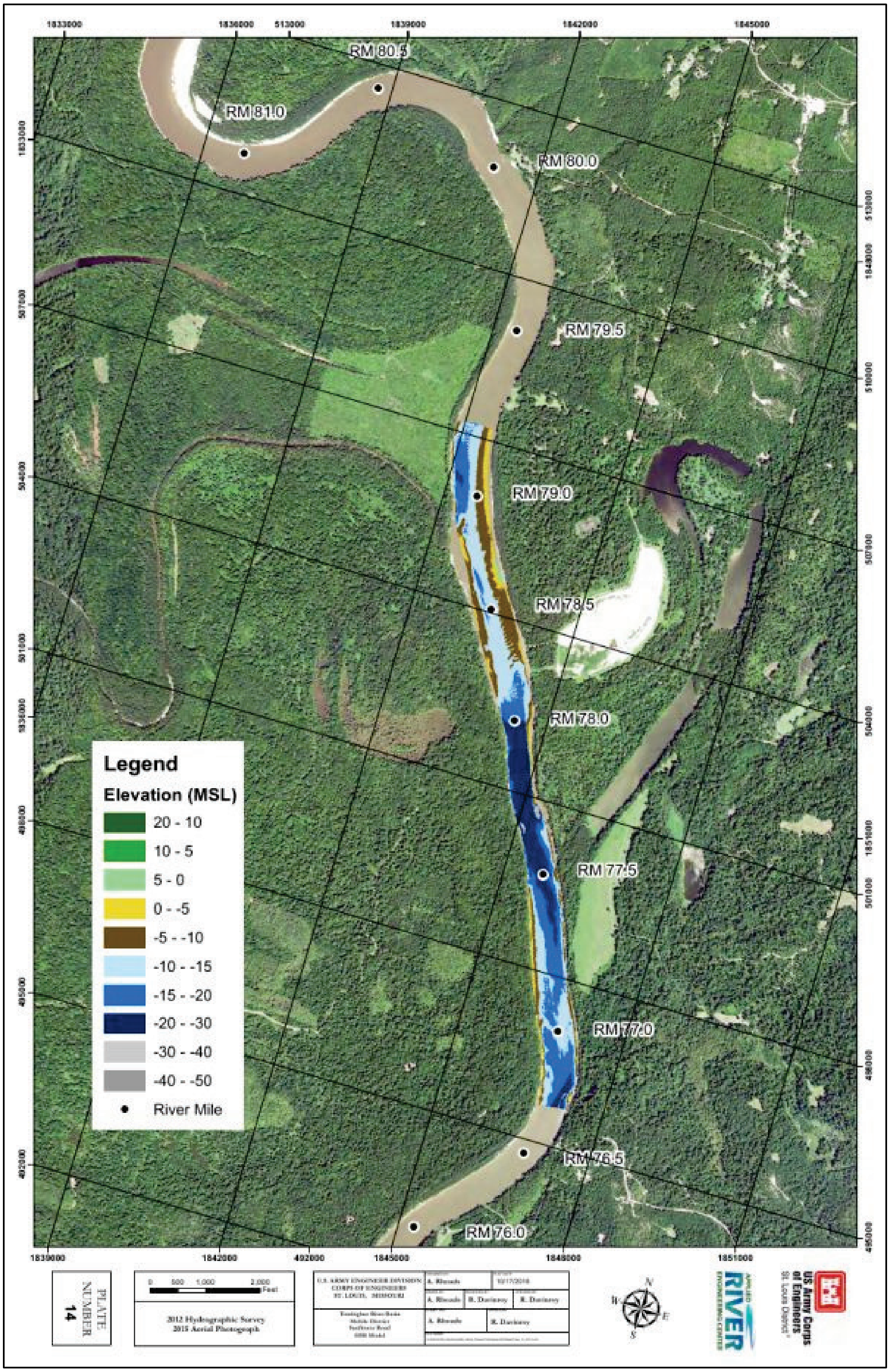


Plate 15. 2015 Survey.

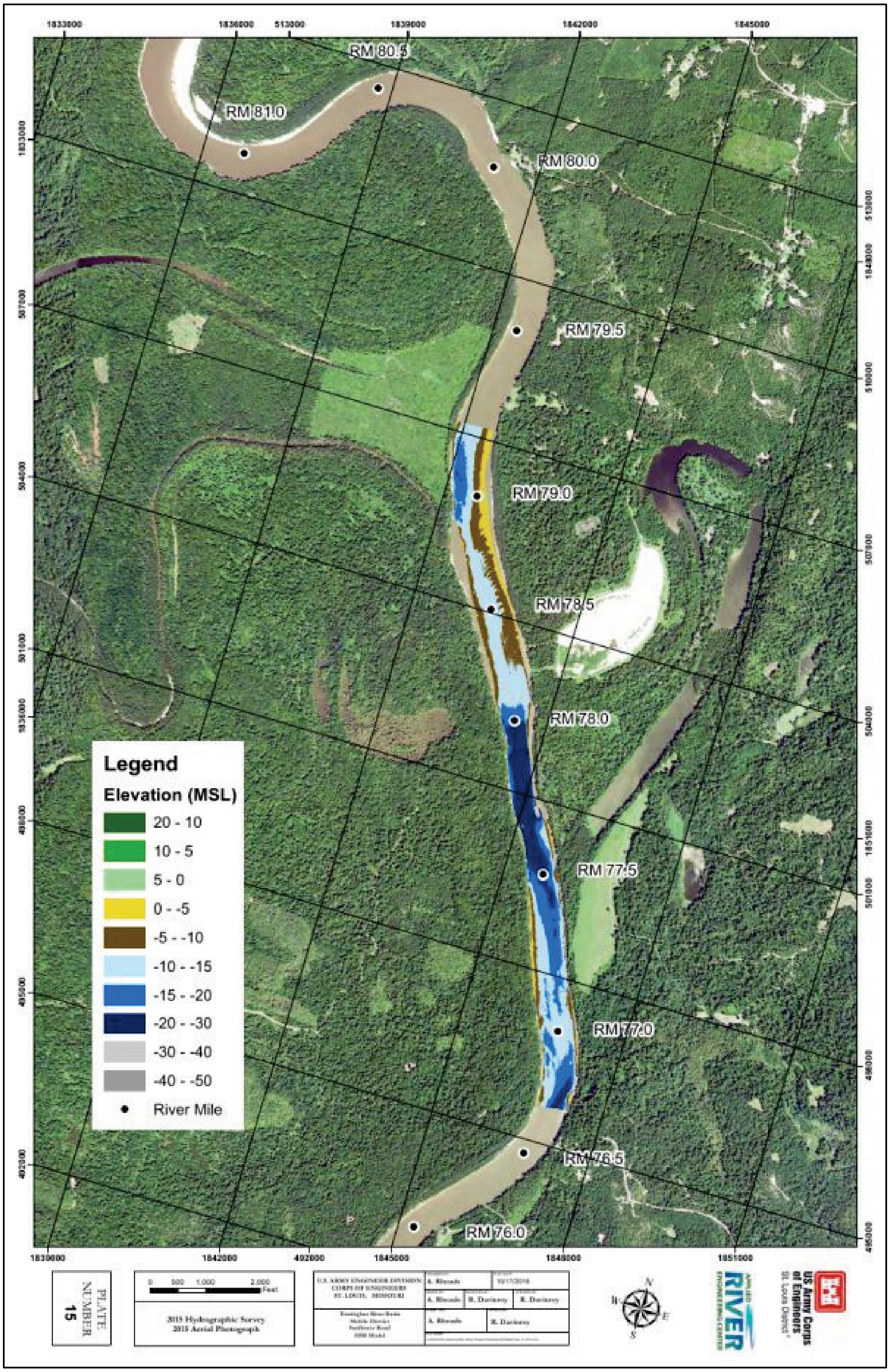


Plate 16. Alternative 1: Bathymetry results.

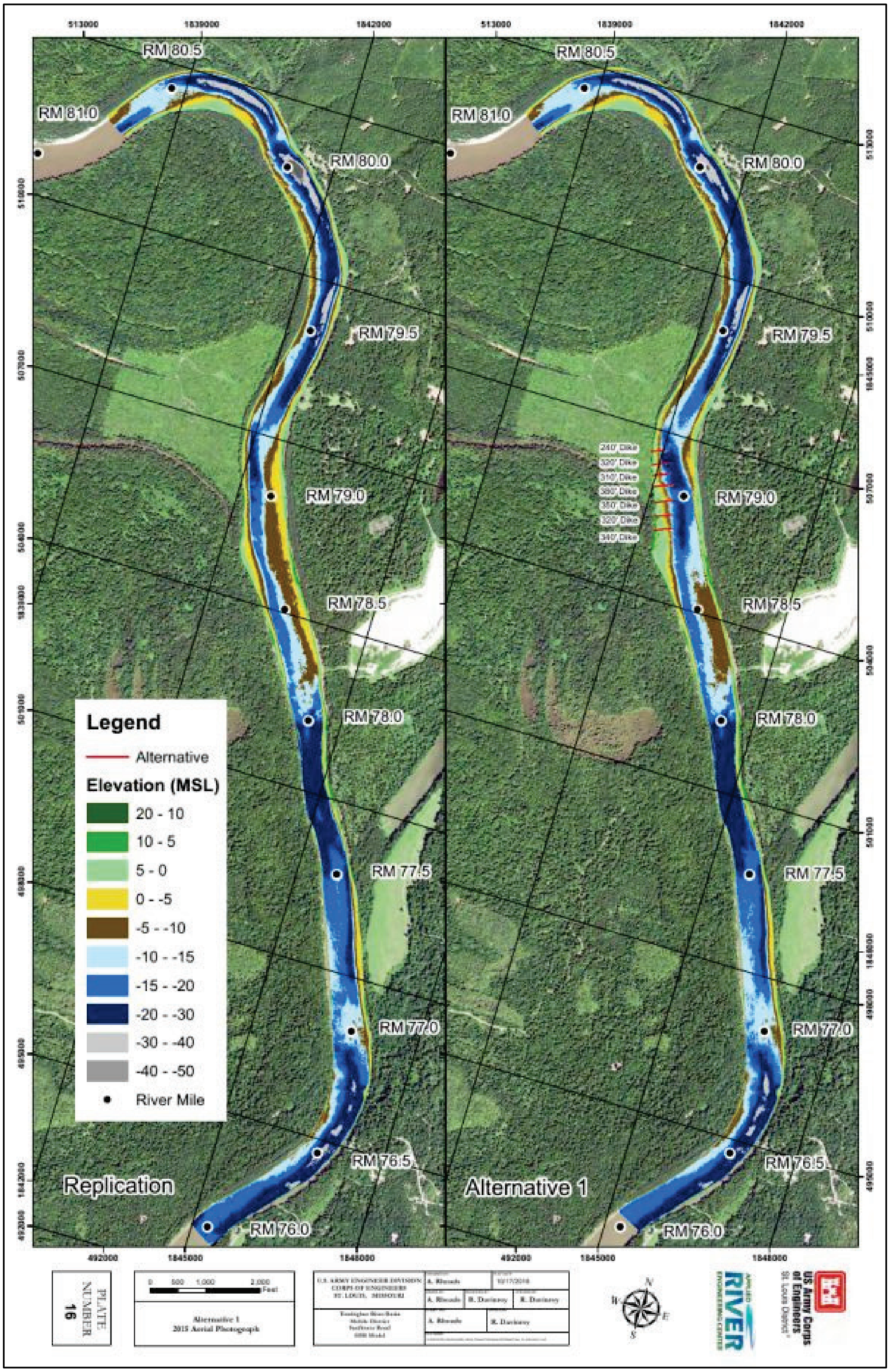


Plate 17. Alternative 2: Bathymetry results.

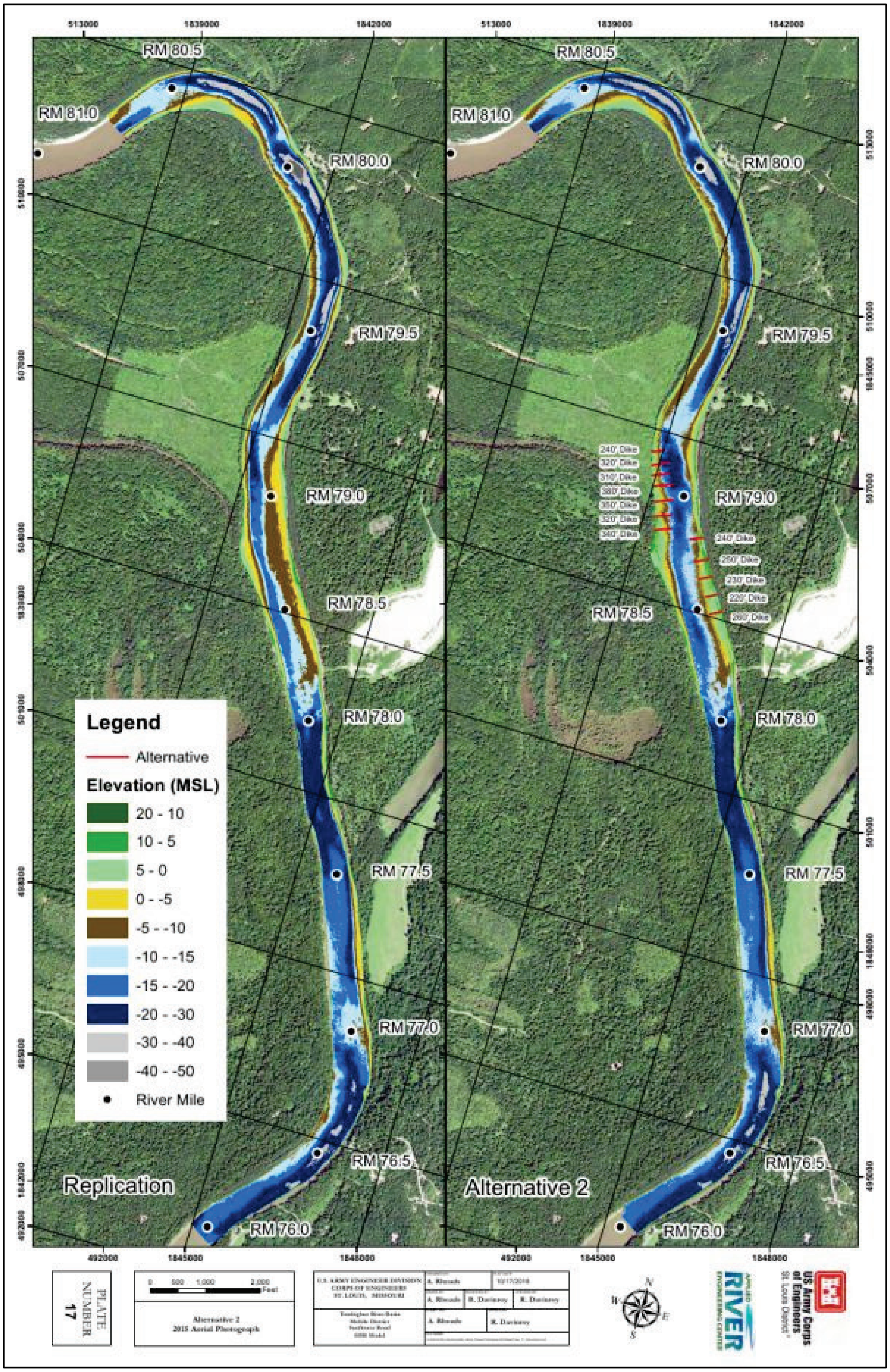


Plate 18. Alternative 3: Bathymetry results.

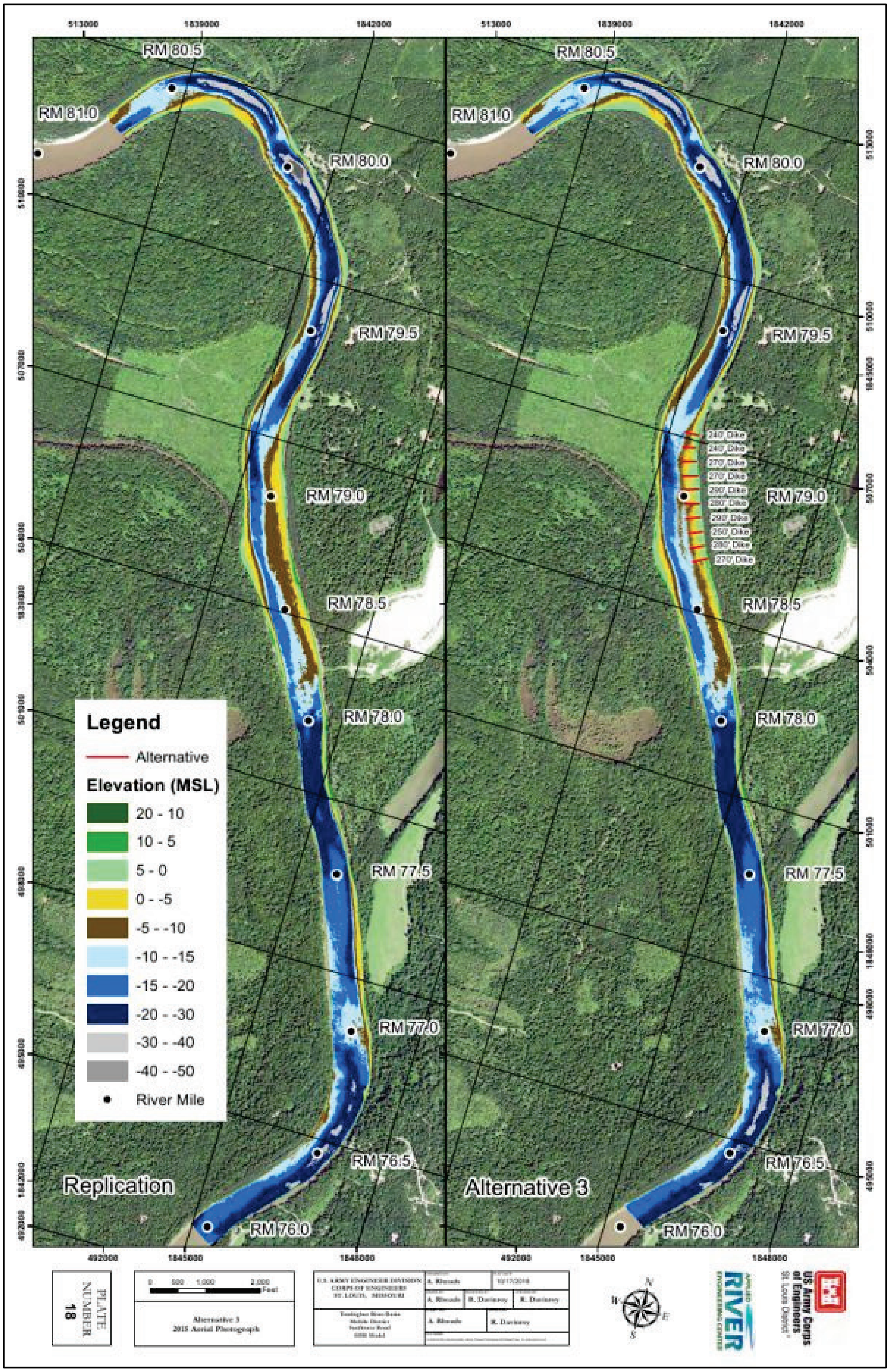


Plate 19. Alternative 4: Bathymetry results.

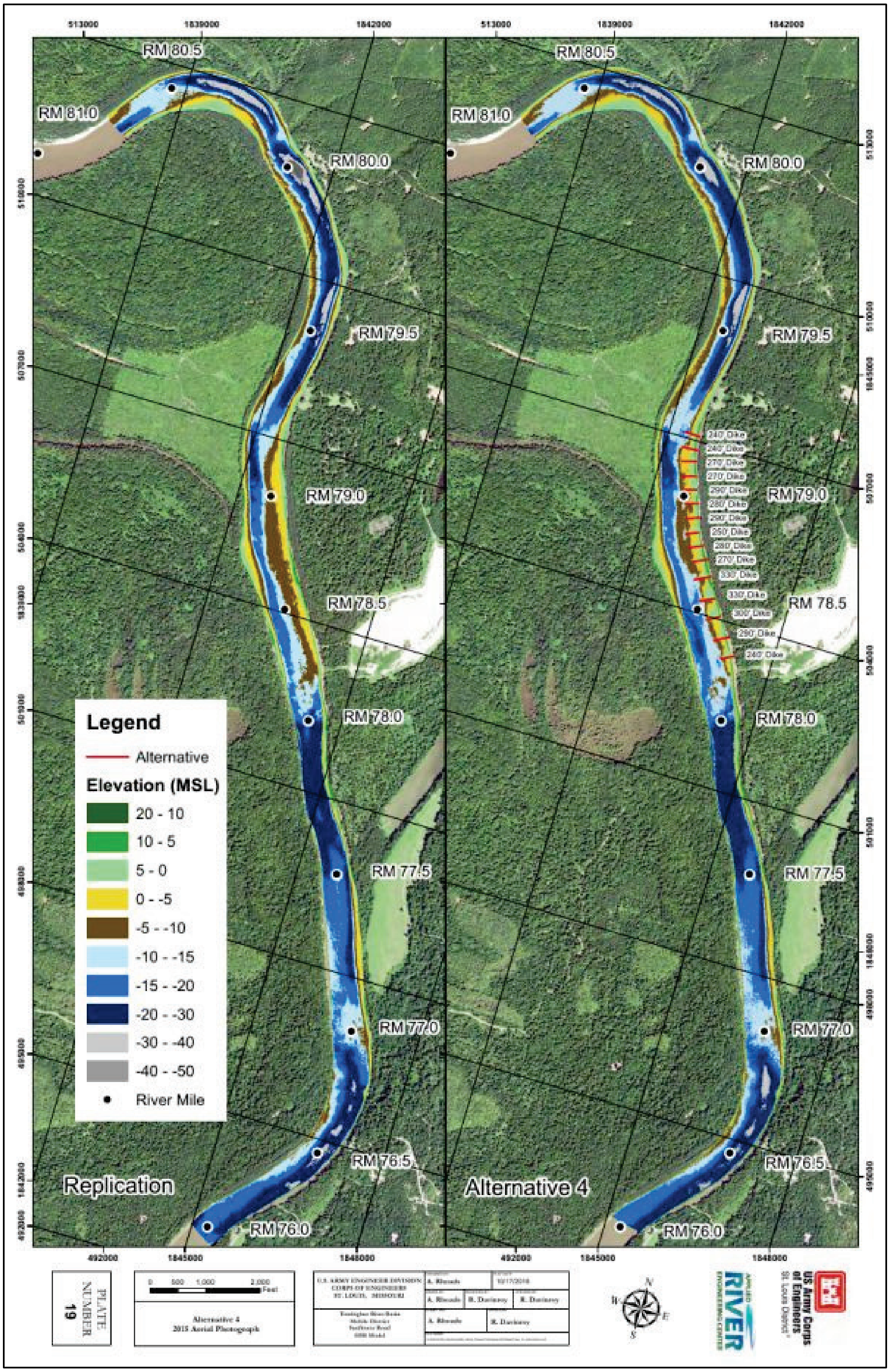


Plate 20. Alternative 5: Bathymetry results.

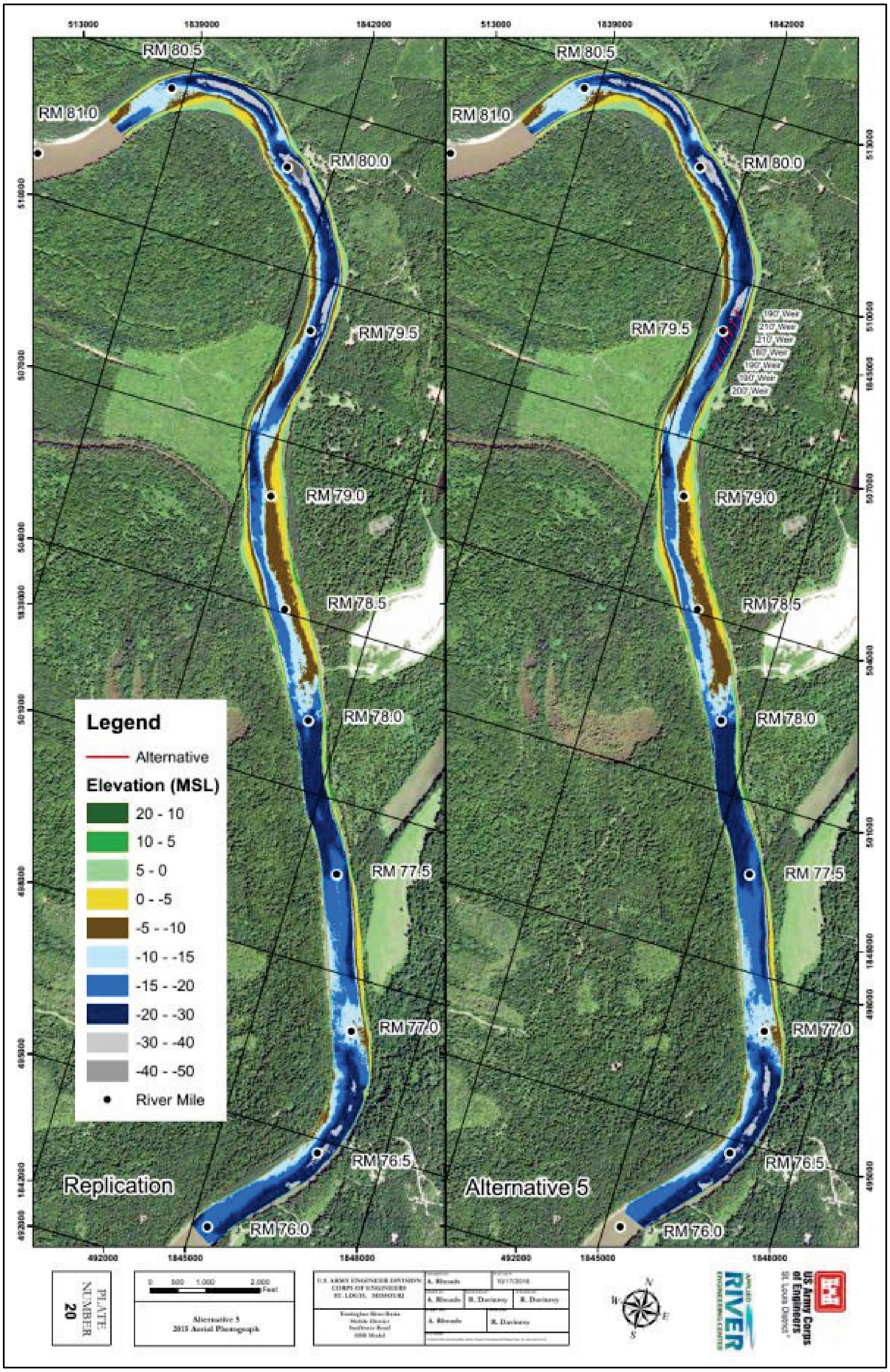


Plate 21. Alternative 6: Bathymetry results.

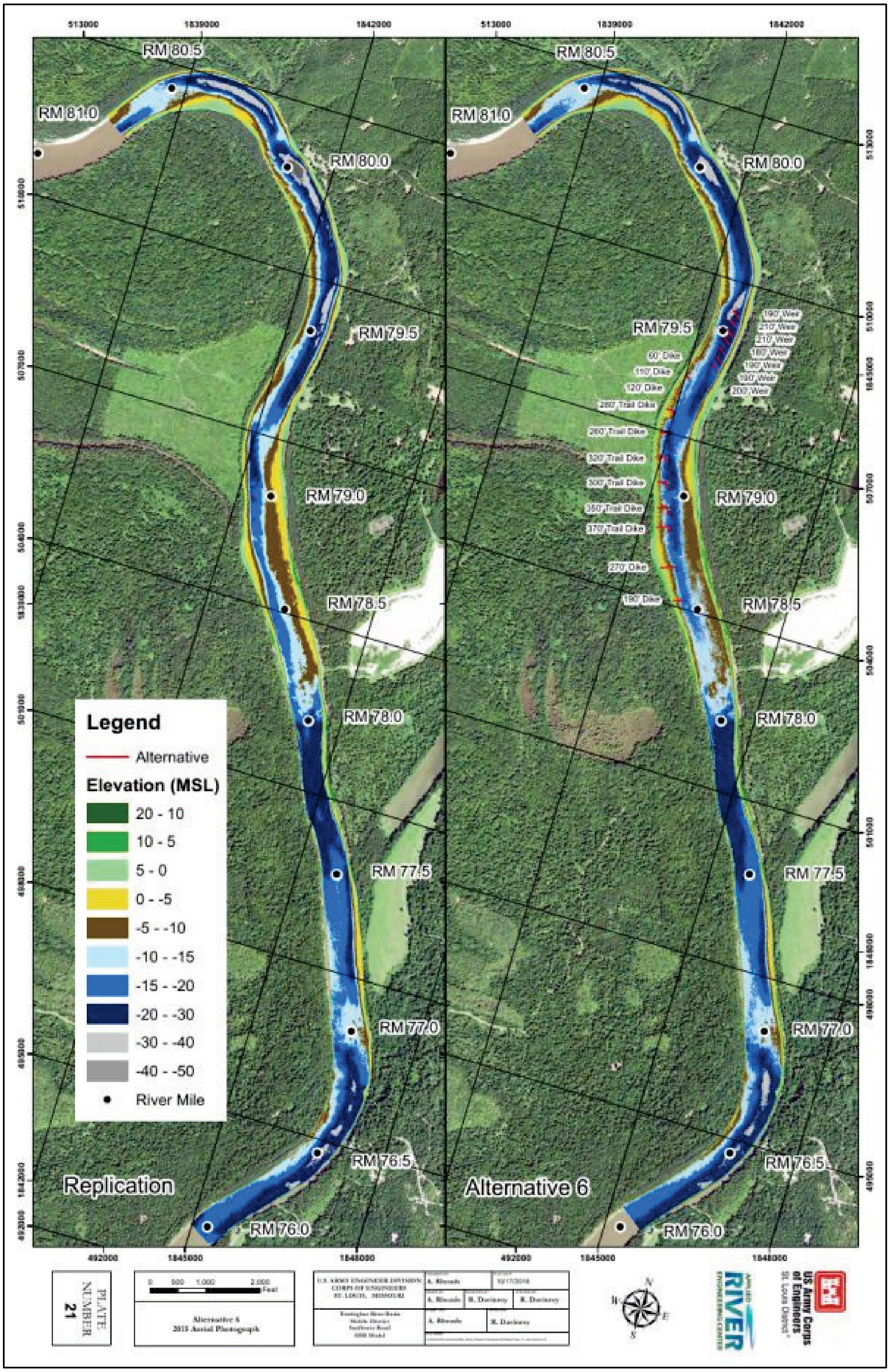


Plate 22. Alternative 7: Bathymetry results.

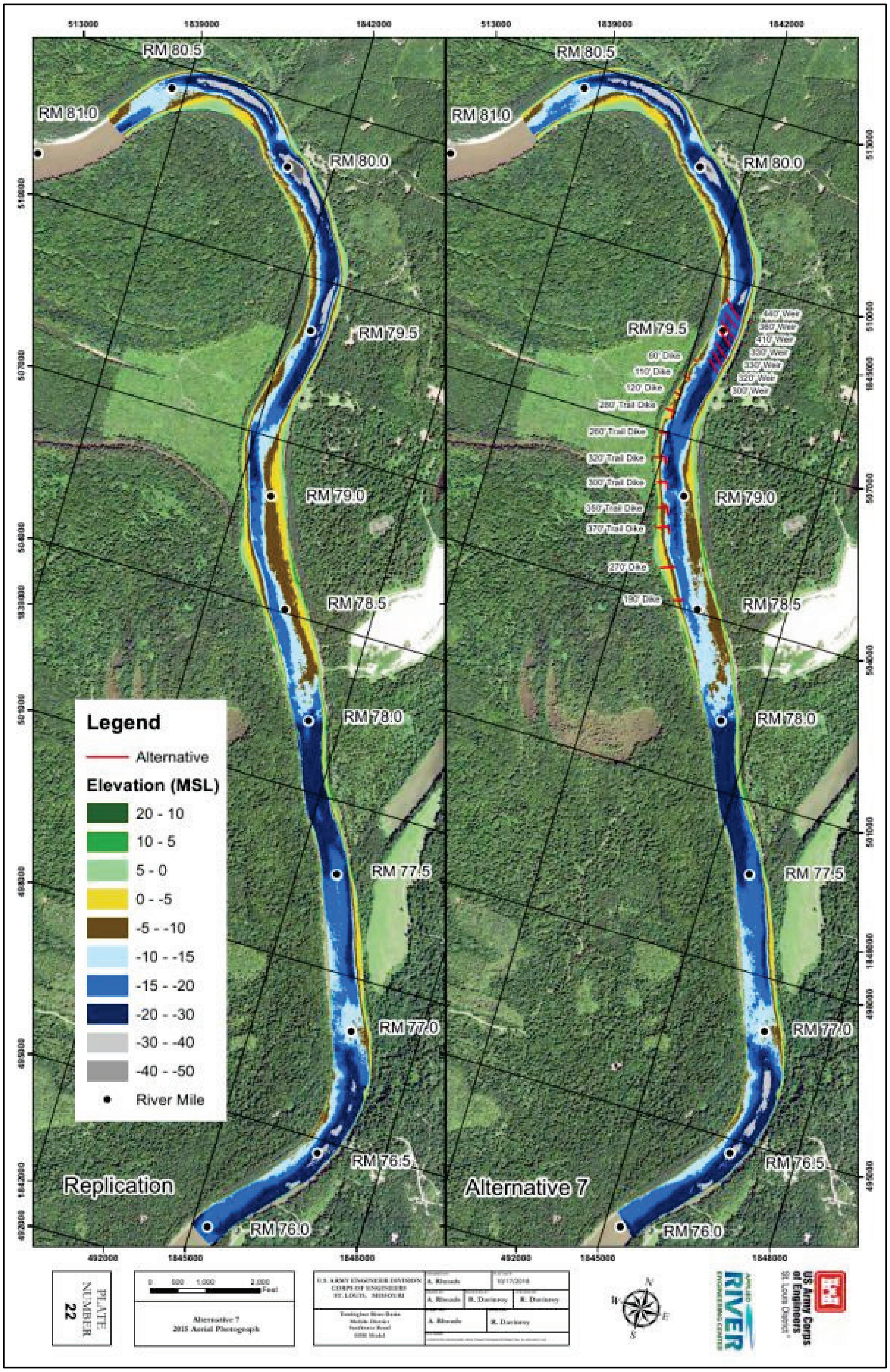


Plate 23. Alternative 8: Bathymetry results.

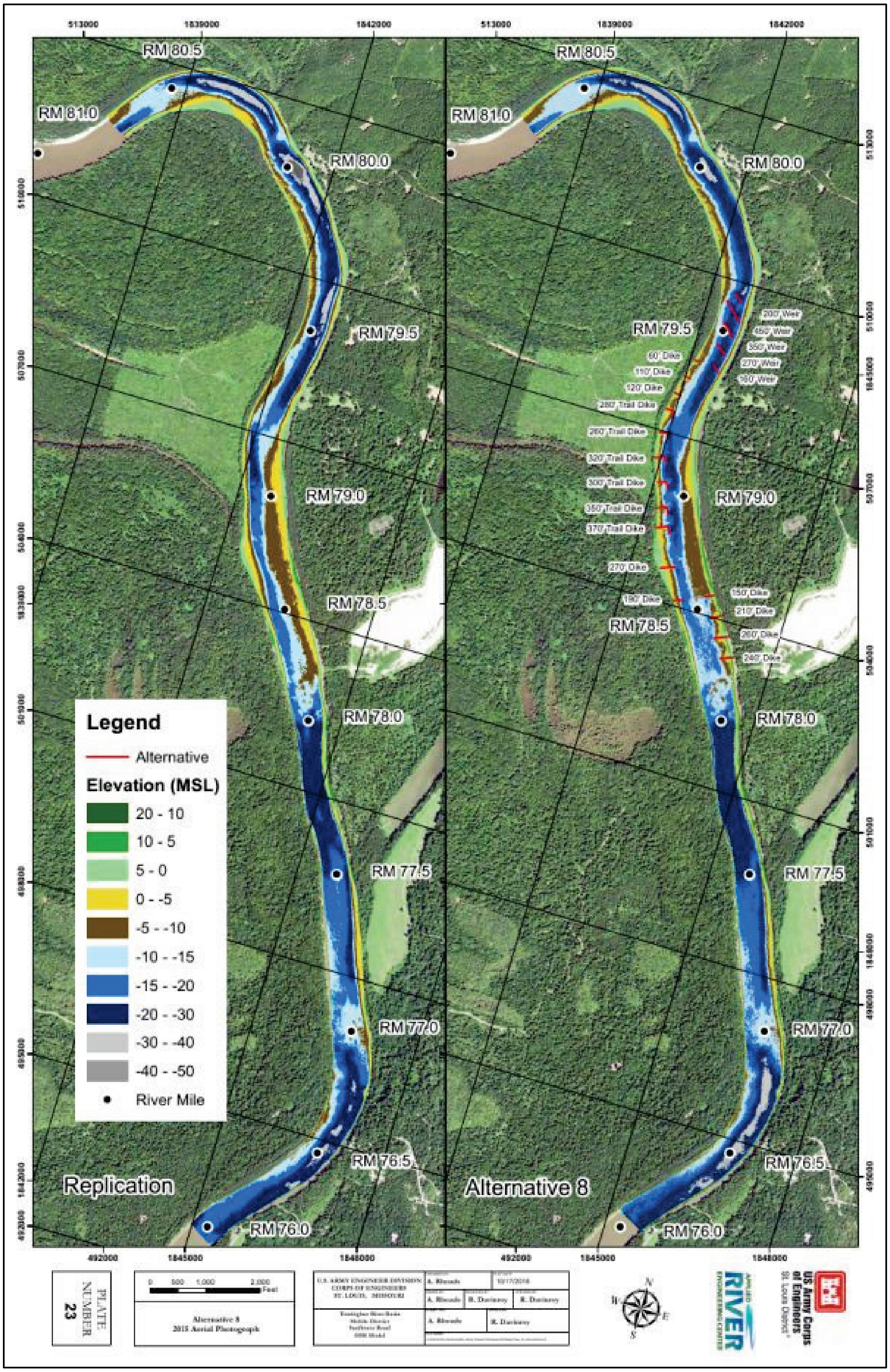


Plate 24. Alternative 9: Bathymetry results.

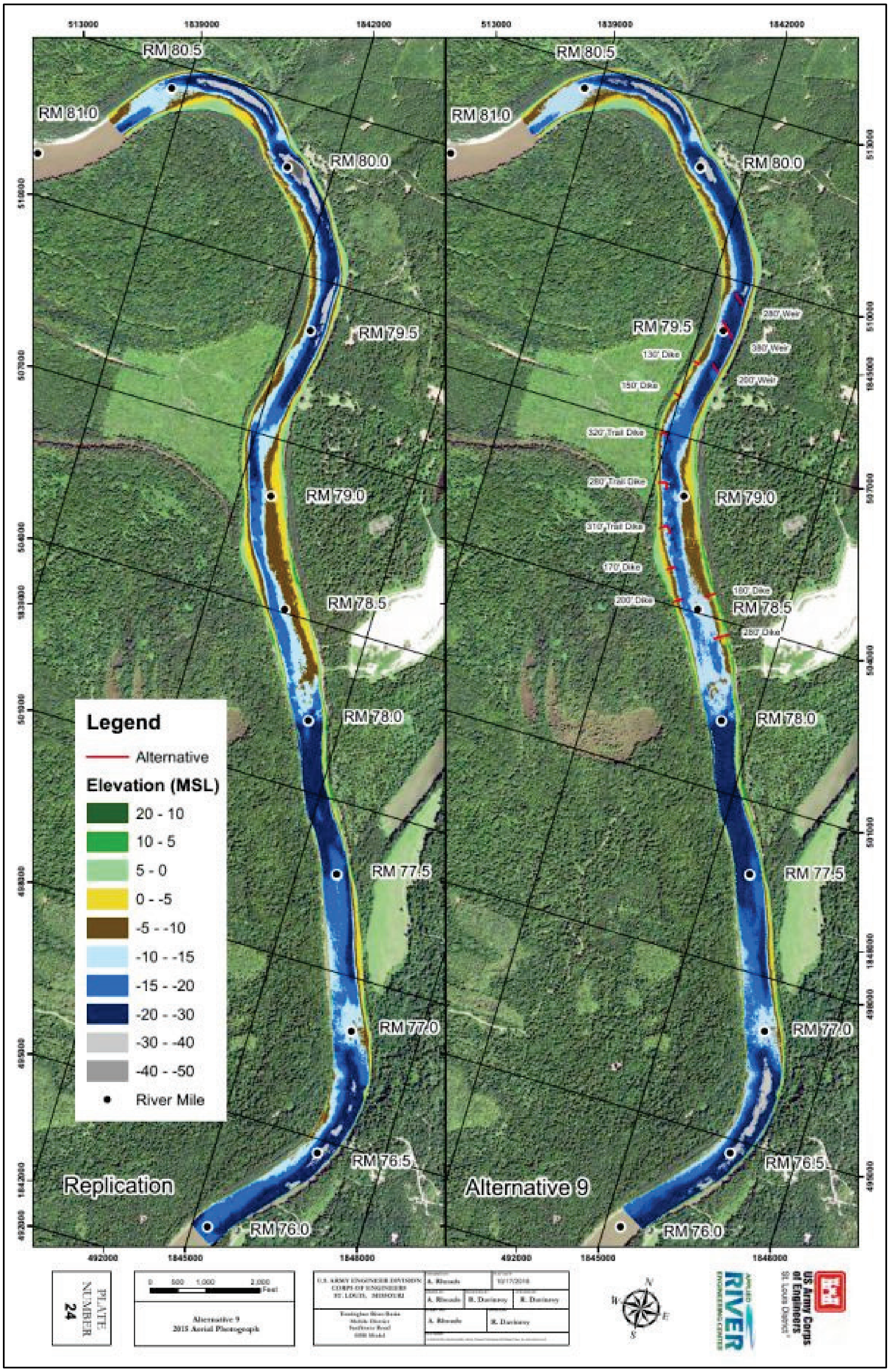


Plate 25. Alternative 10: Bathymetry results.

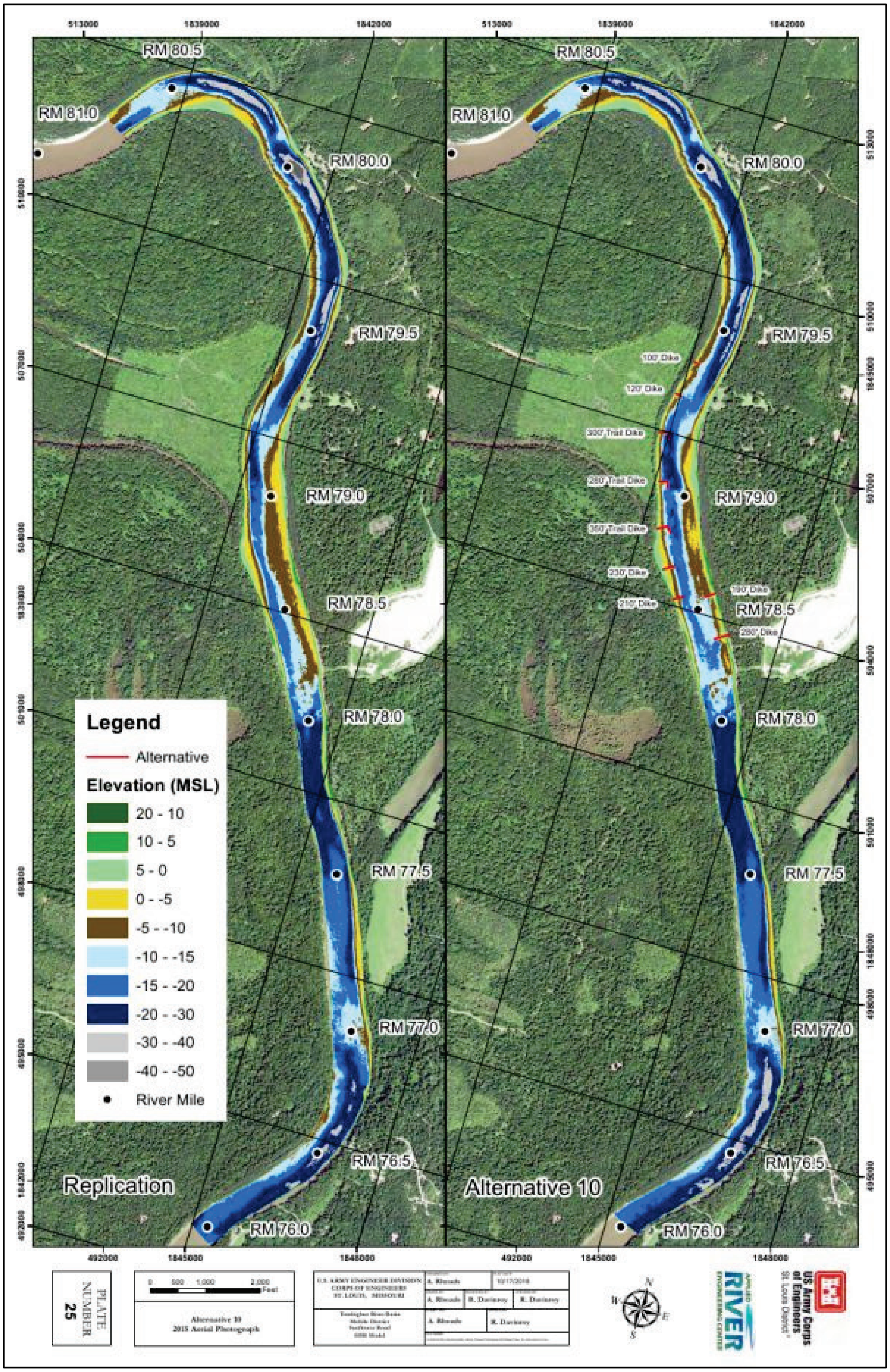


Plate 26. Alternative 11: Bathymetry results.

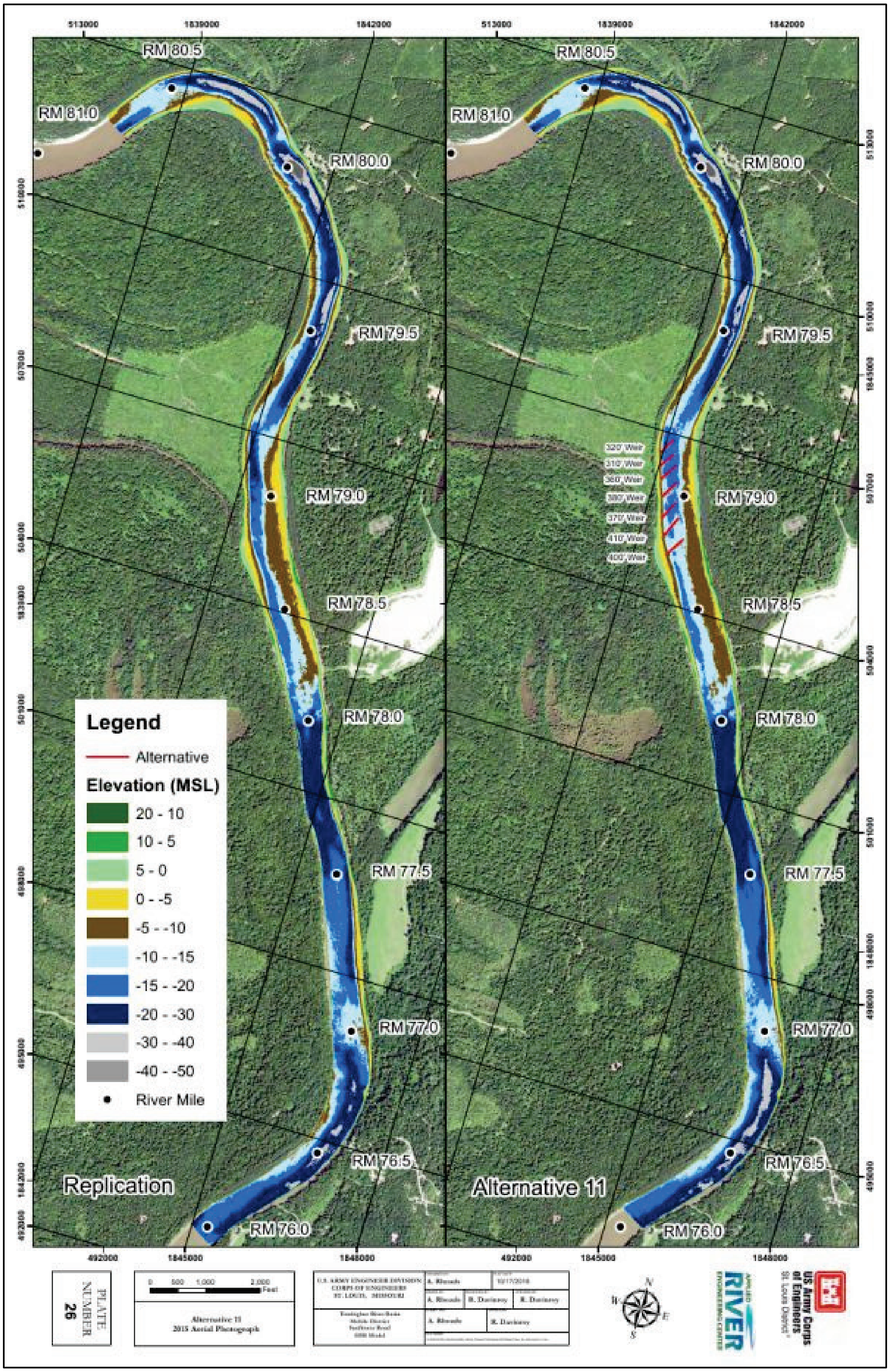


Plate 27. Alternative 12: Bathymetry results.

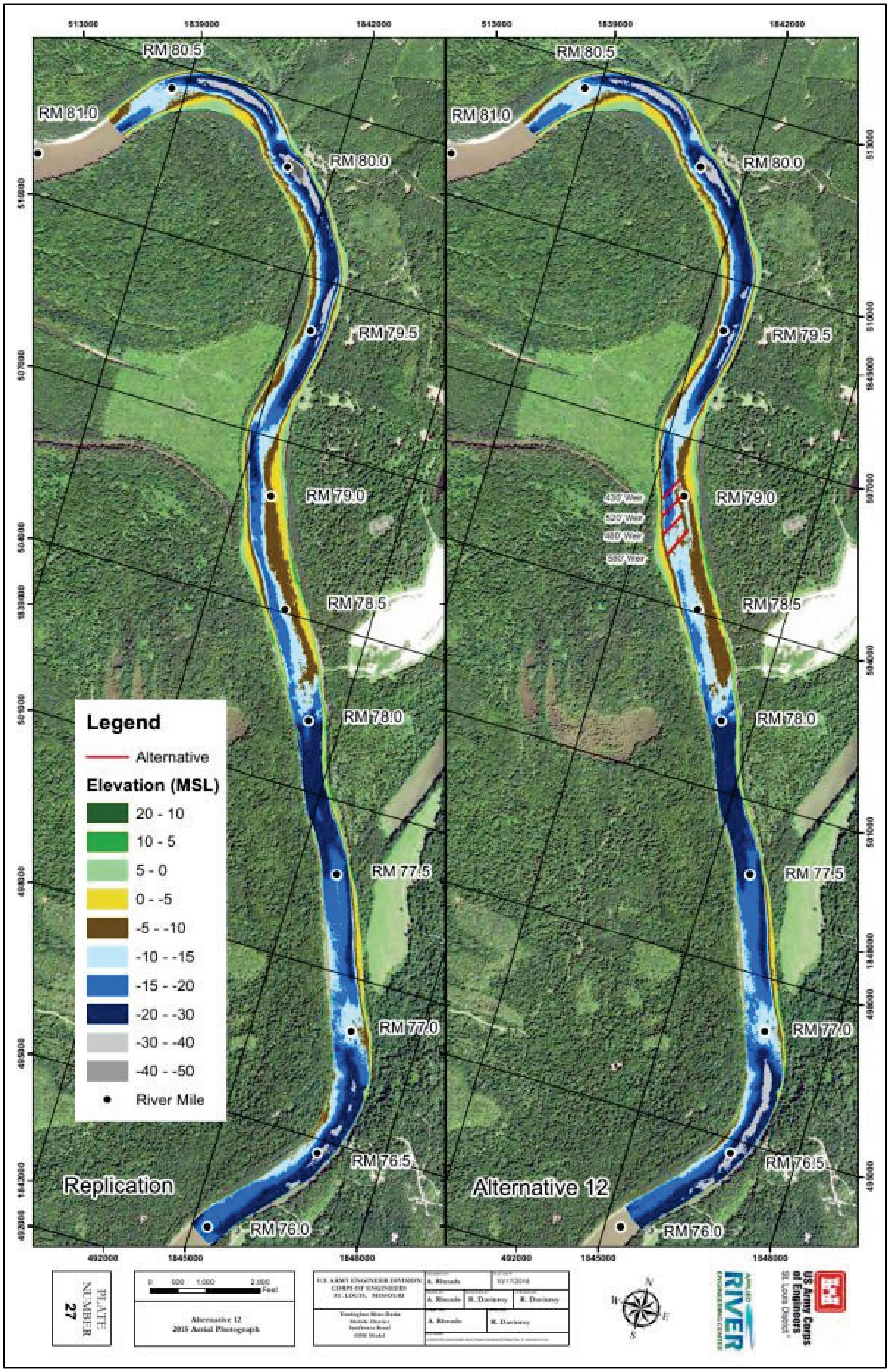


Plate 28. Alternative 13: Bathymetry results.

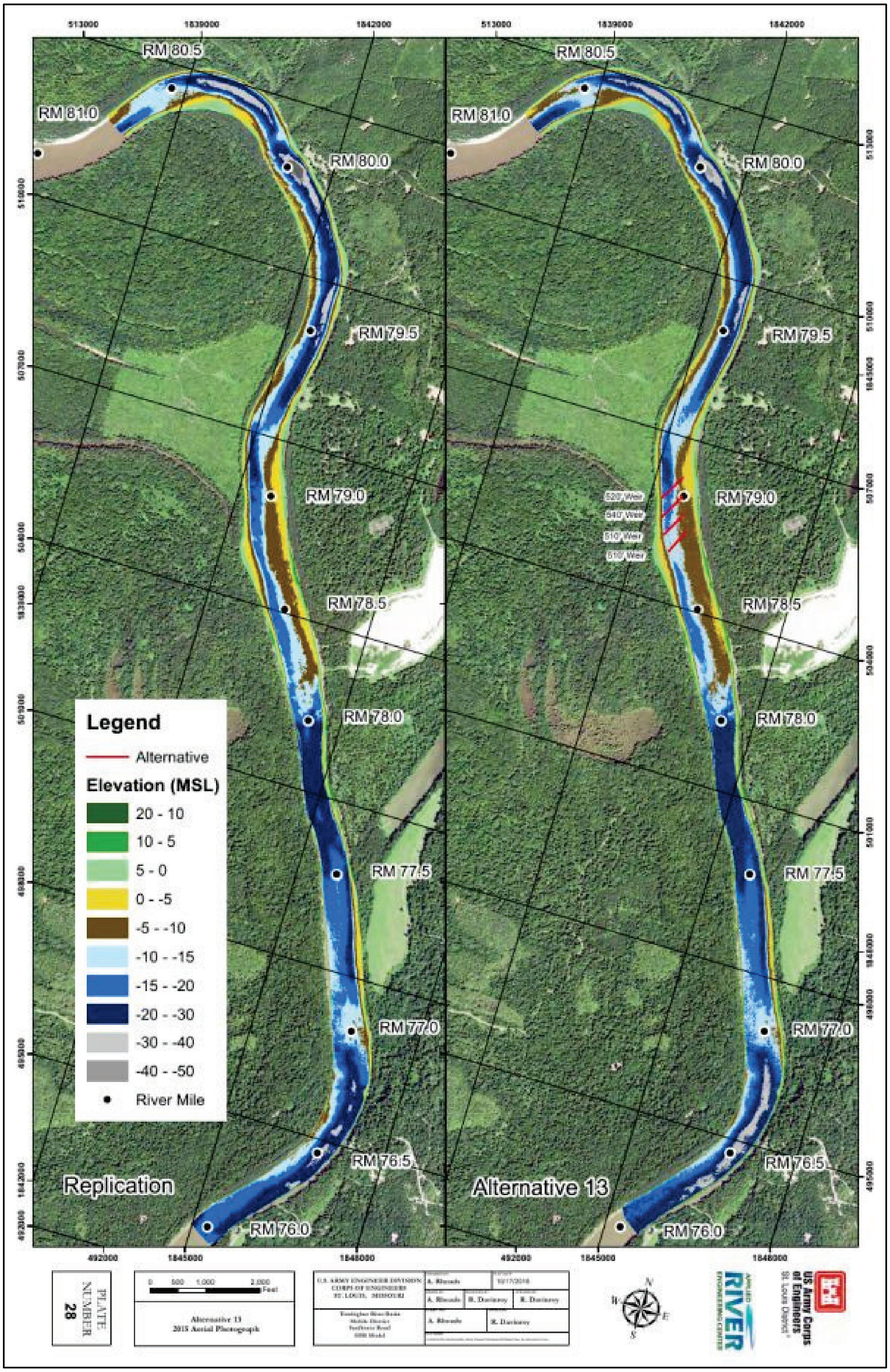


Plate 29. Alternative 14: Bathymetry results.

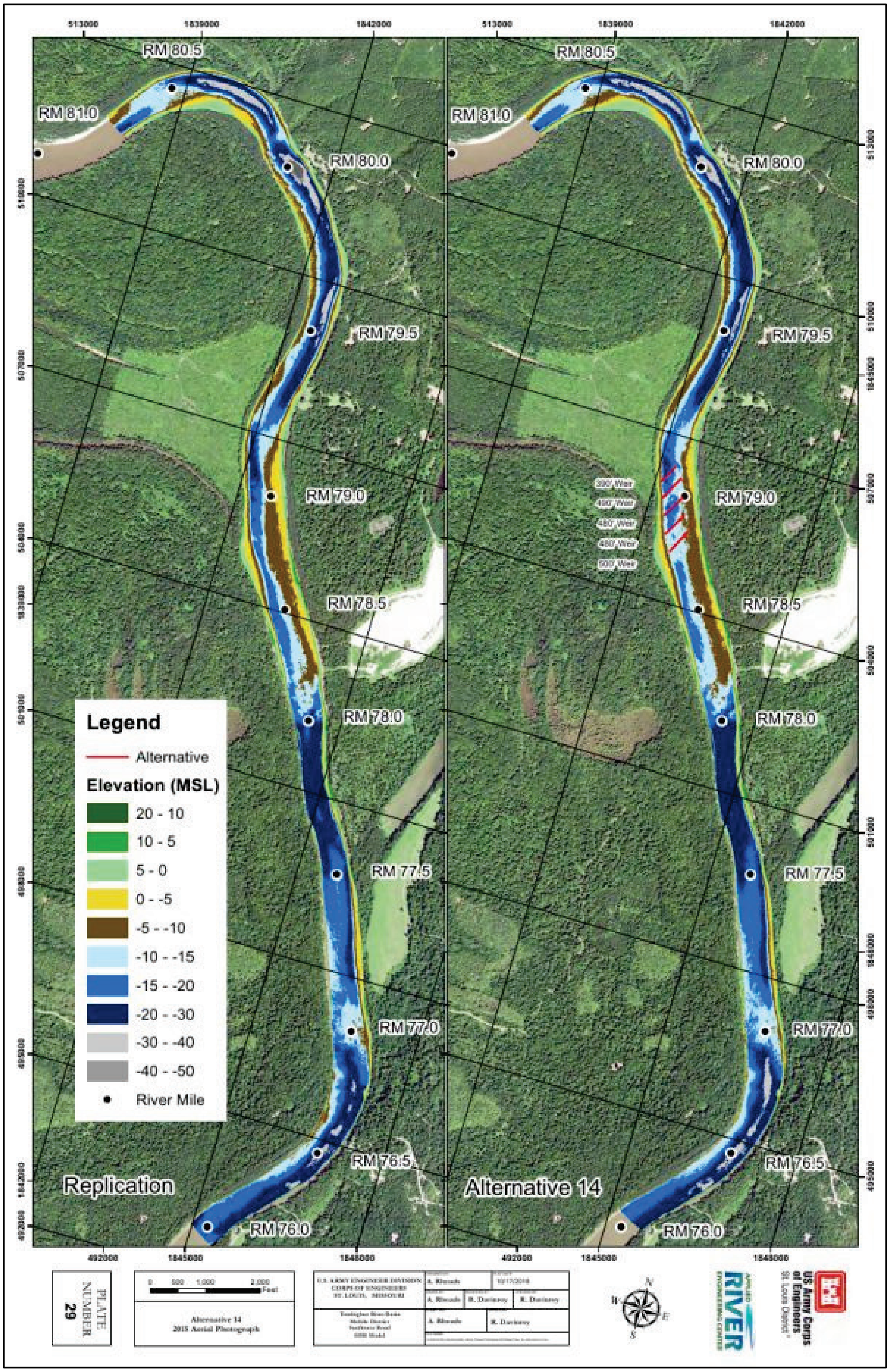


Plate 30. Alternative 15: Bathymetry results.

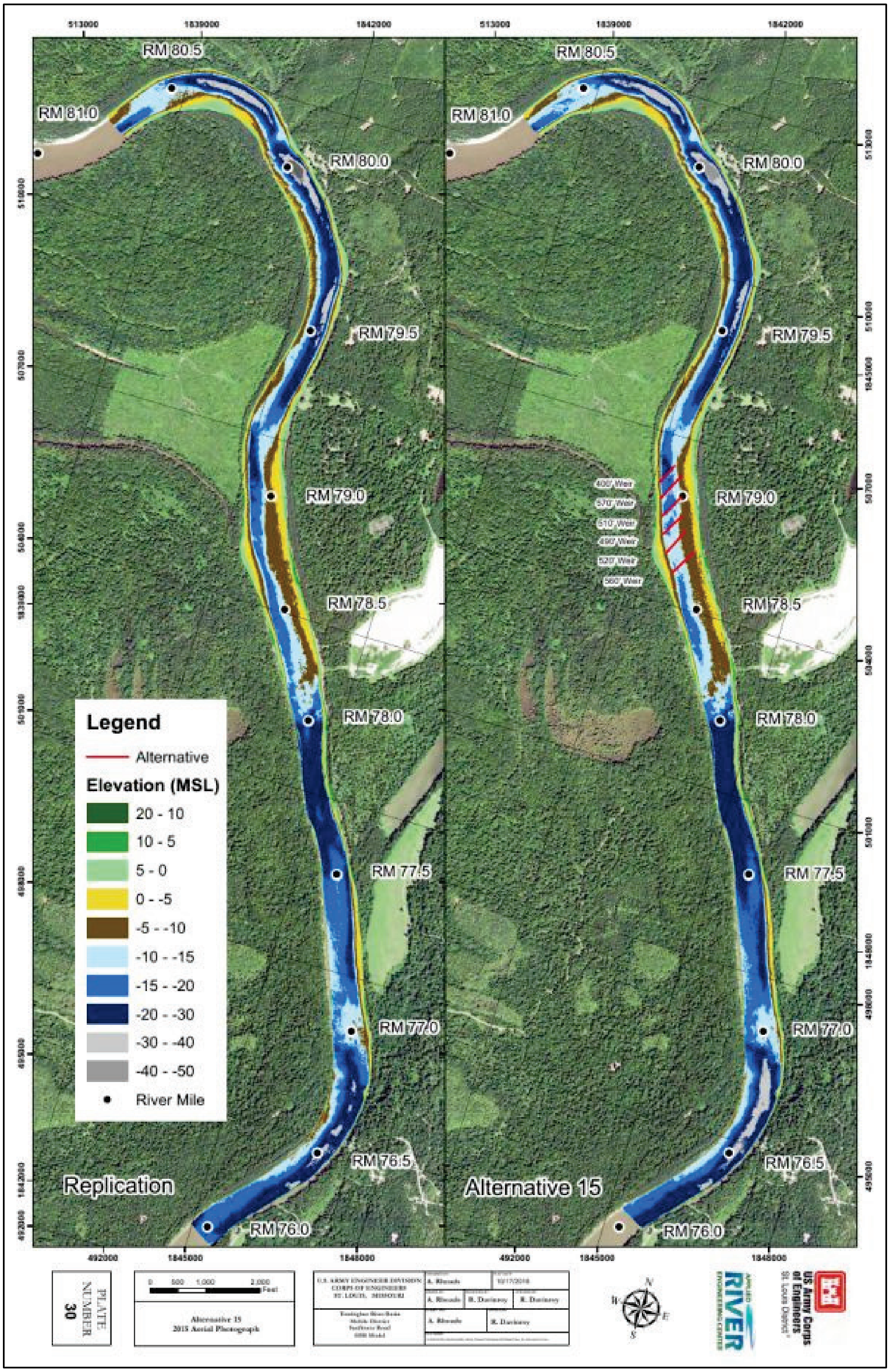


Plate 31. Alternative 16: Bathymetry results.

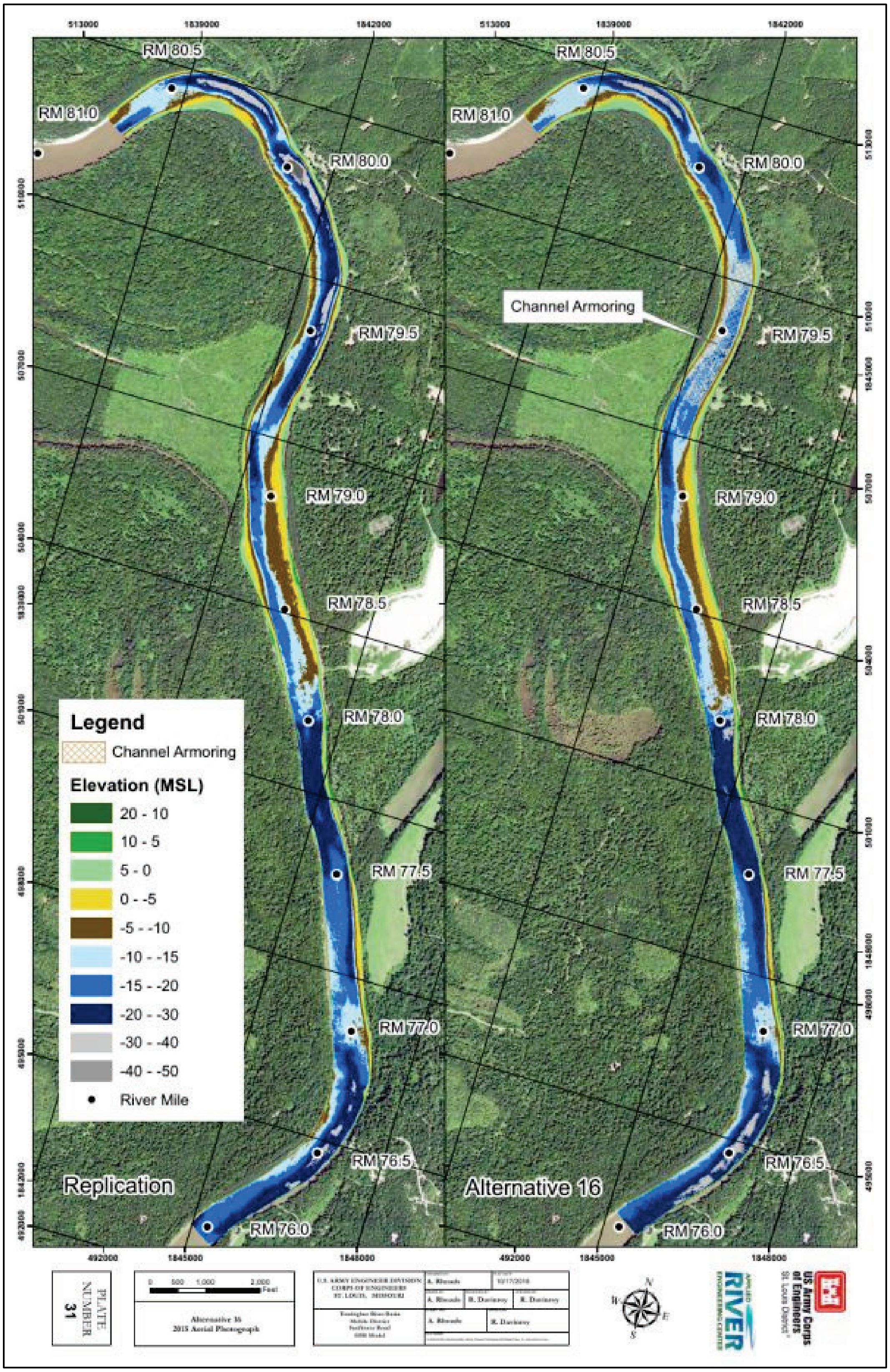


Plate 32. Alternative 17: Bathymetry results.

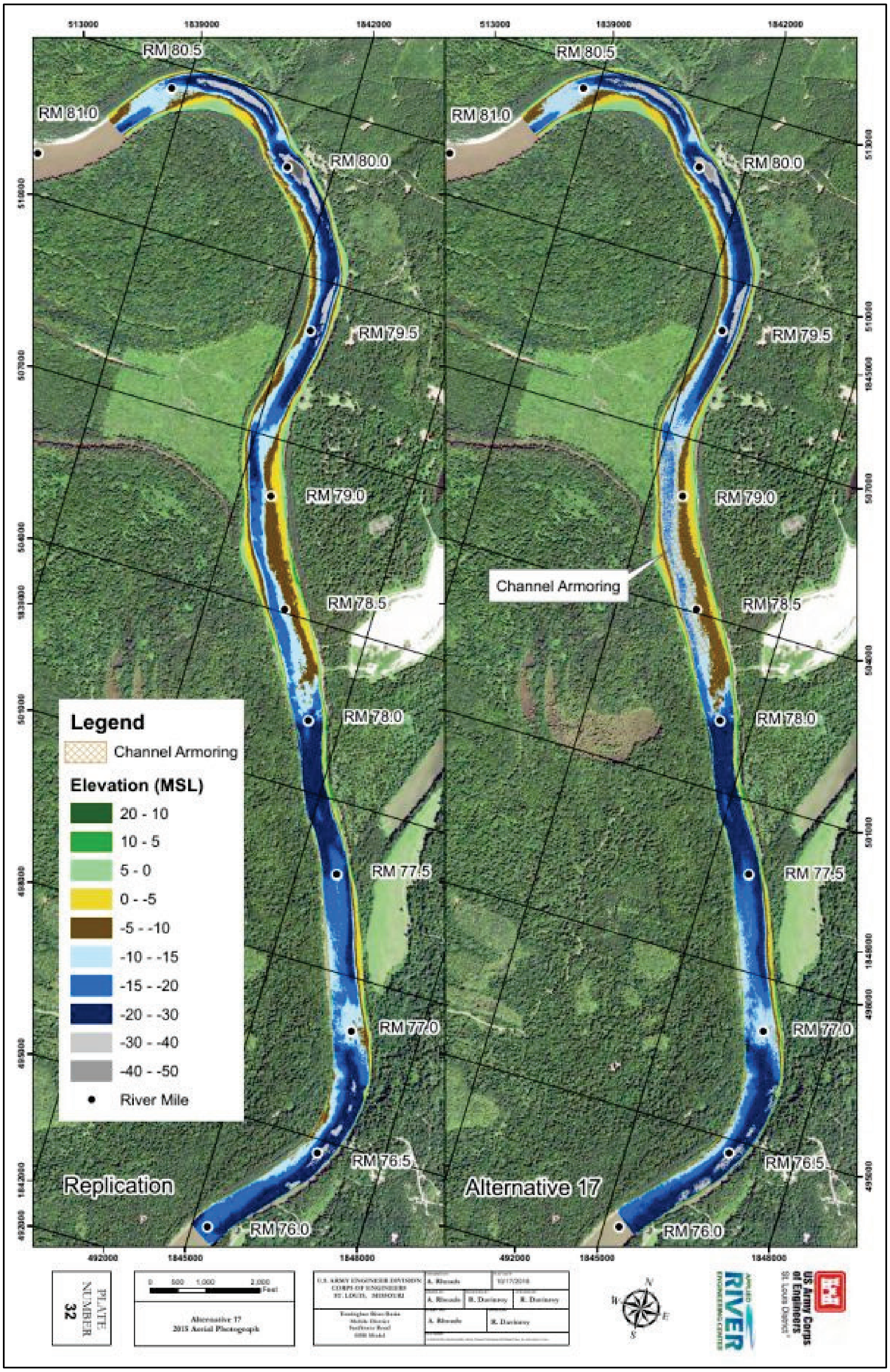


Plate 33. Alternative 18: Bathymetry results.

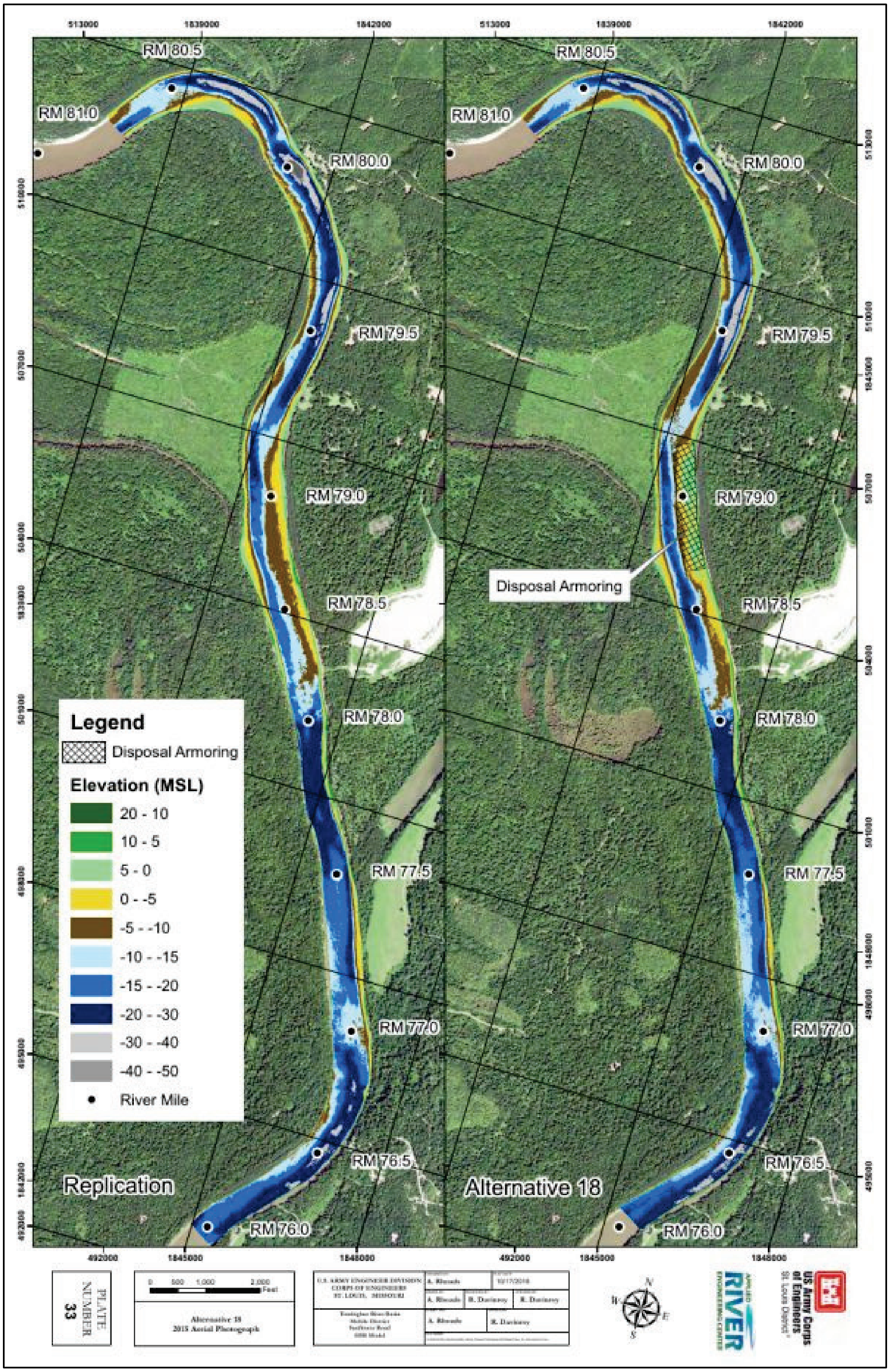


Plate 34. Alternative 19: Bathymetry results.

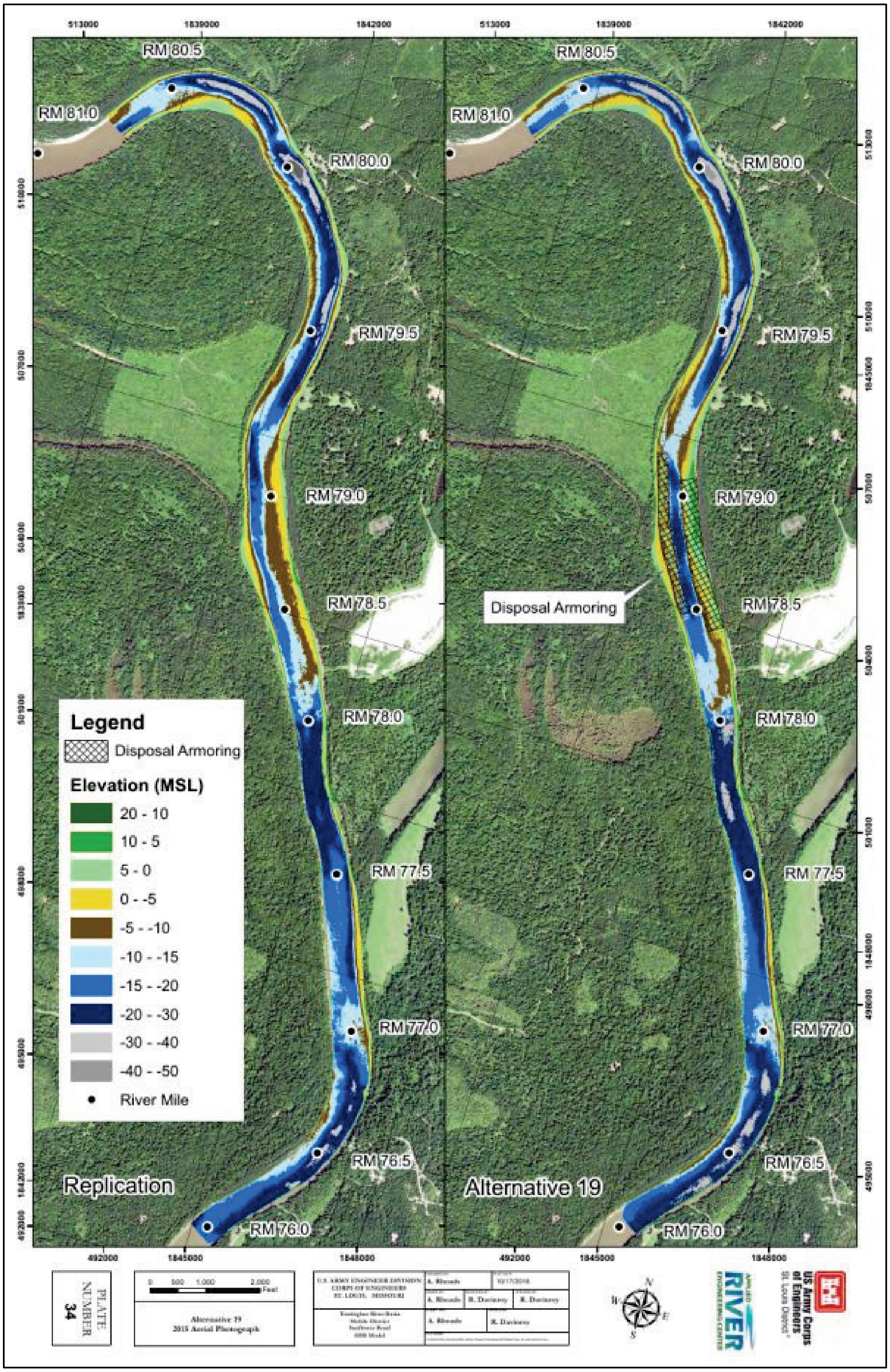


Plate 35. Alternative 20: Bathymetry results.

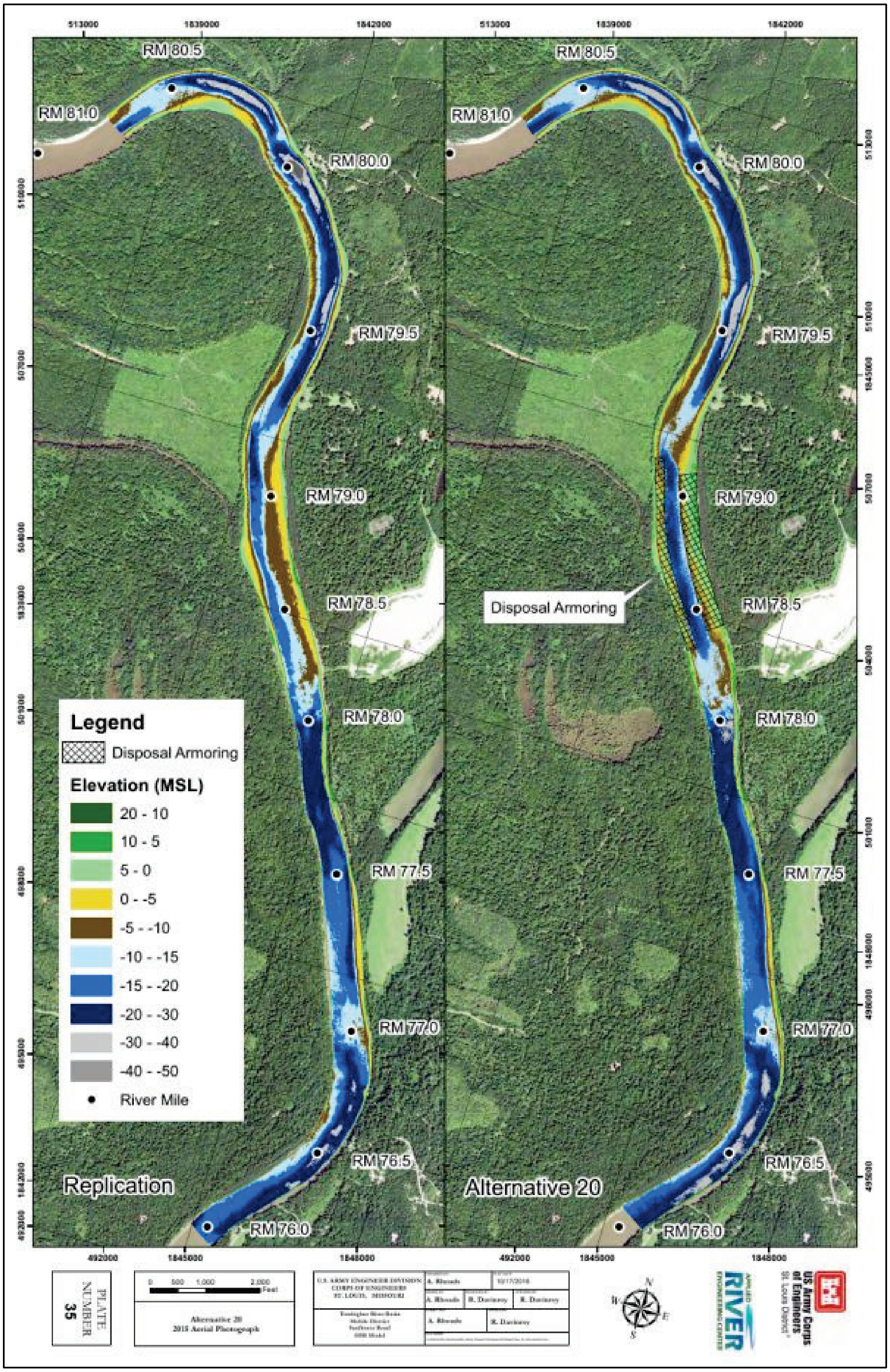


Plate 36. Alternative 21: Bathymetry results.

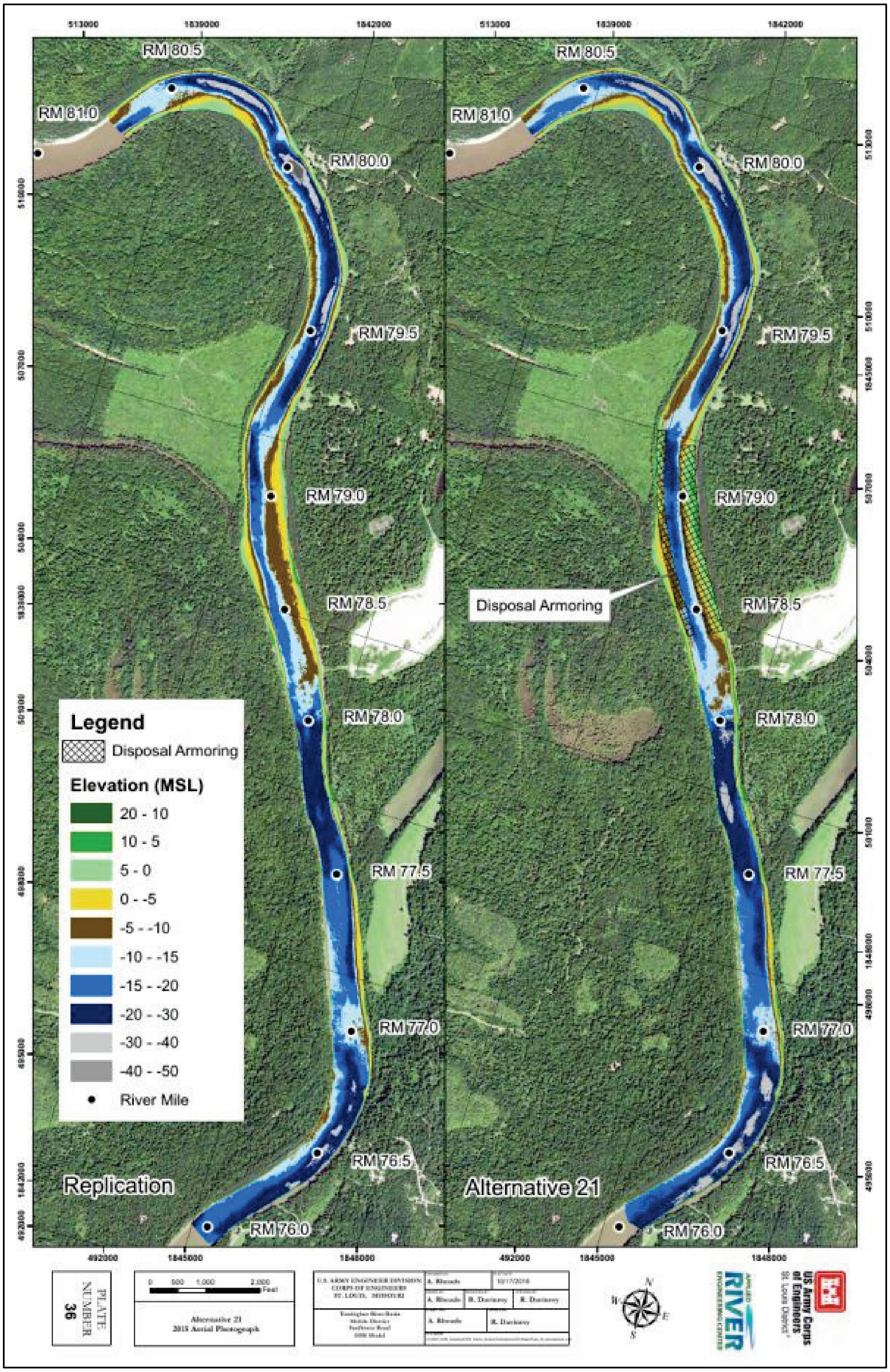


Plate 37. Alternative 22: Bathymetry results.

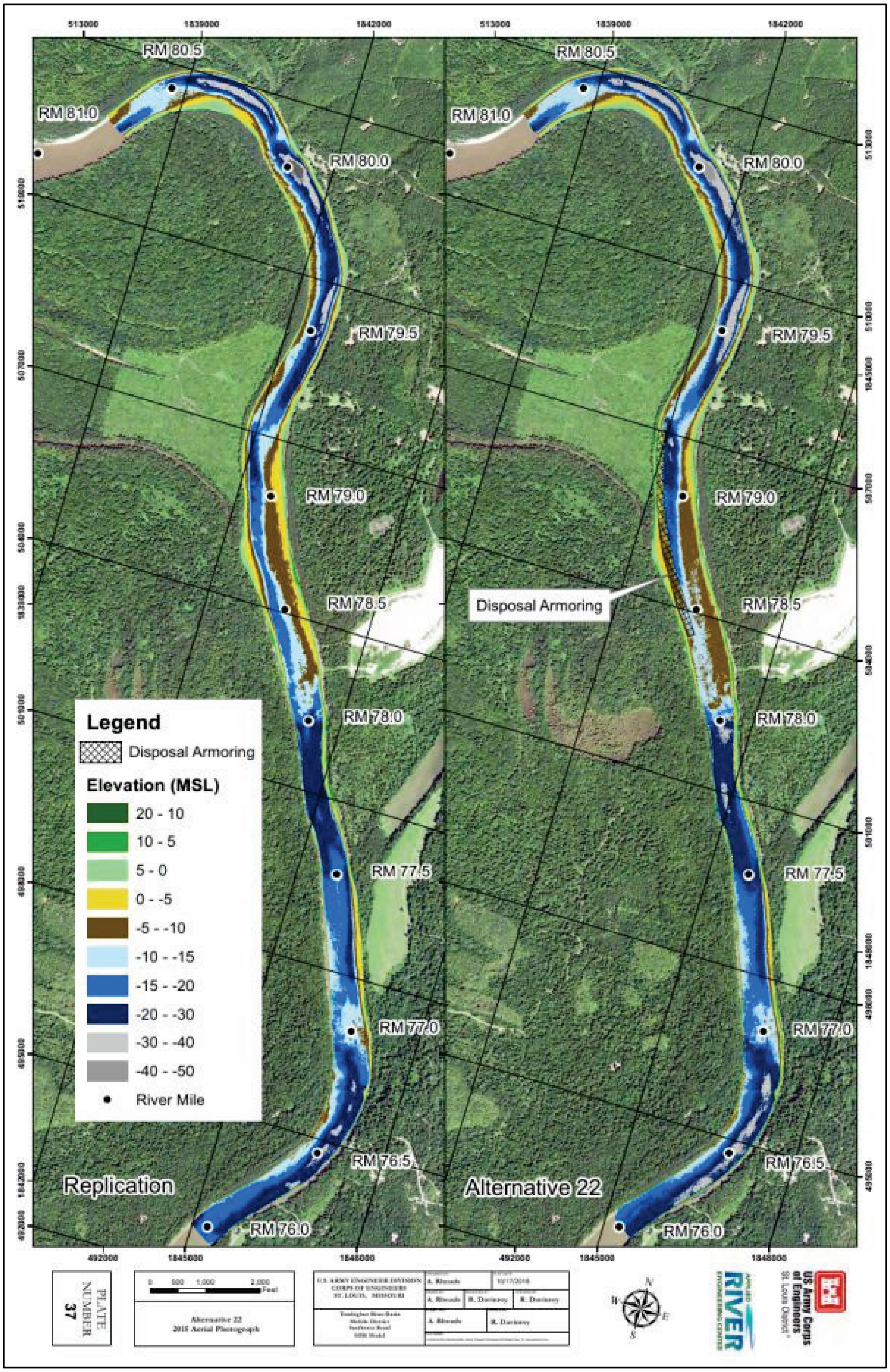


Plate 38. Alternative 23: Bathymetry results.

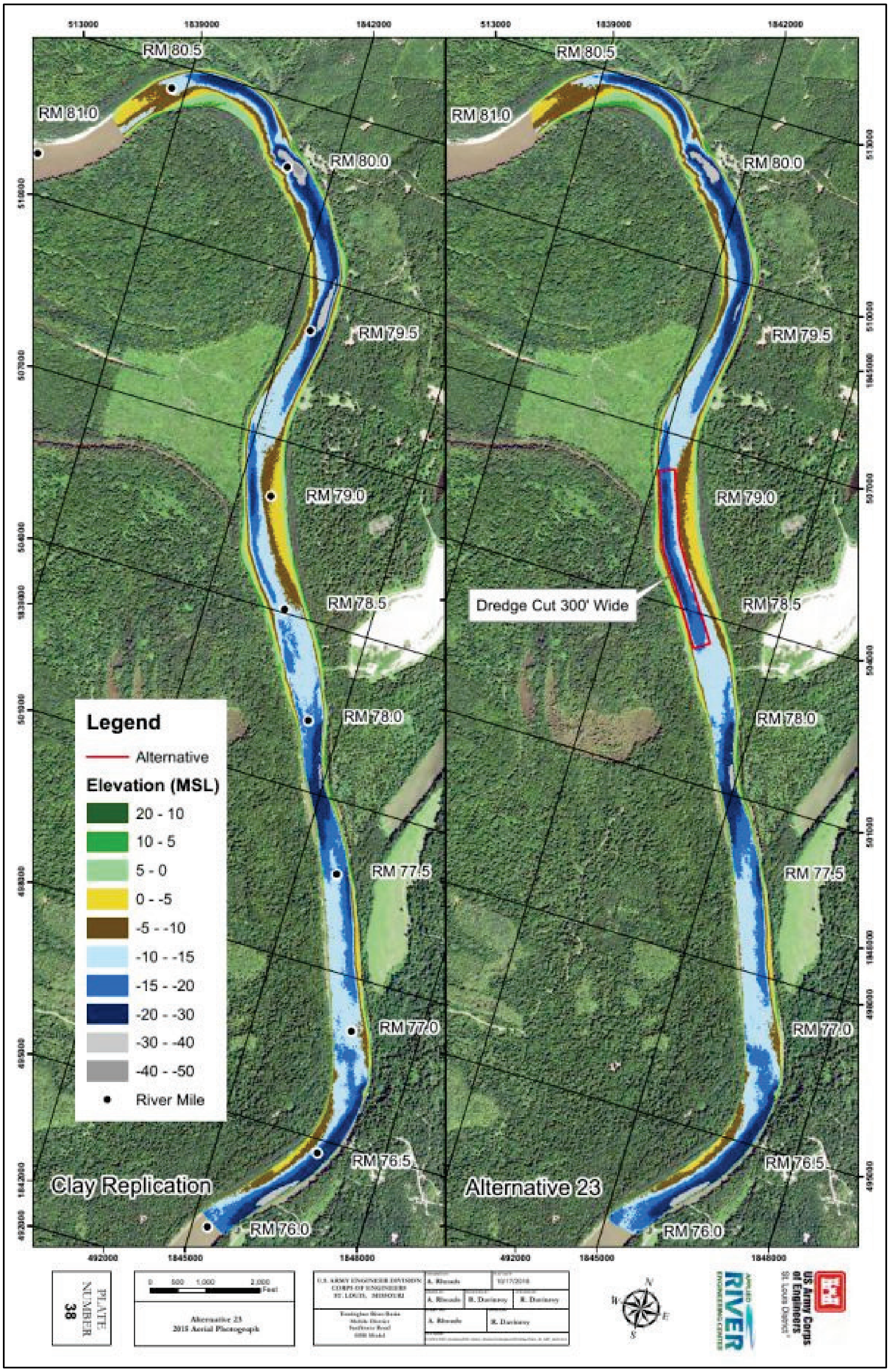


Plate 39. Alternative 24: Bathymetry results.

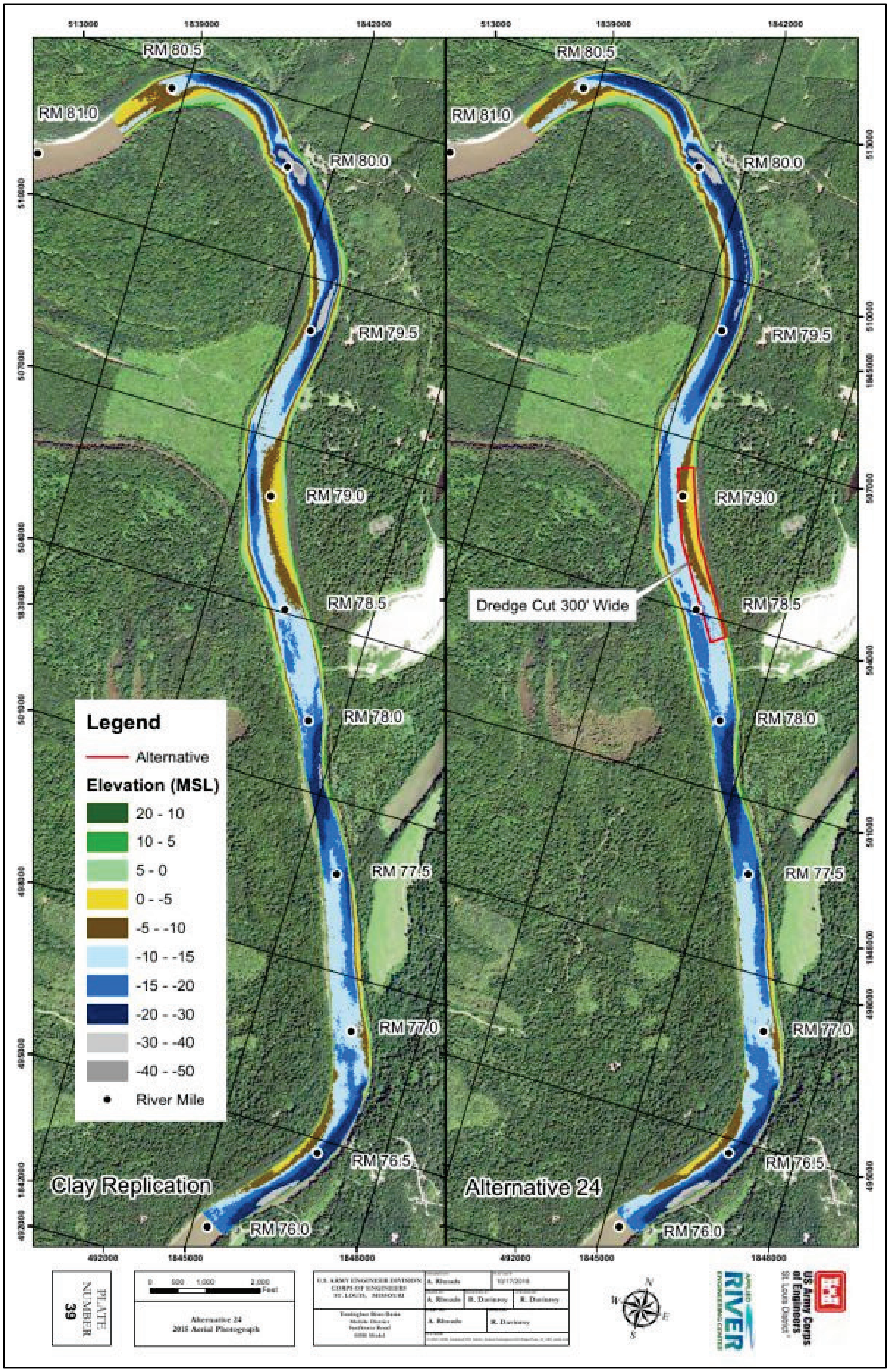


Plate 40. Alternative 25: Bathymetry results.

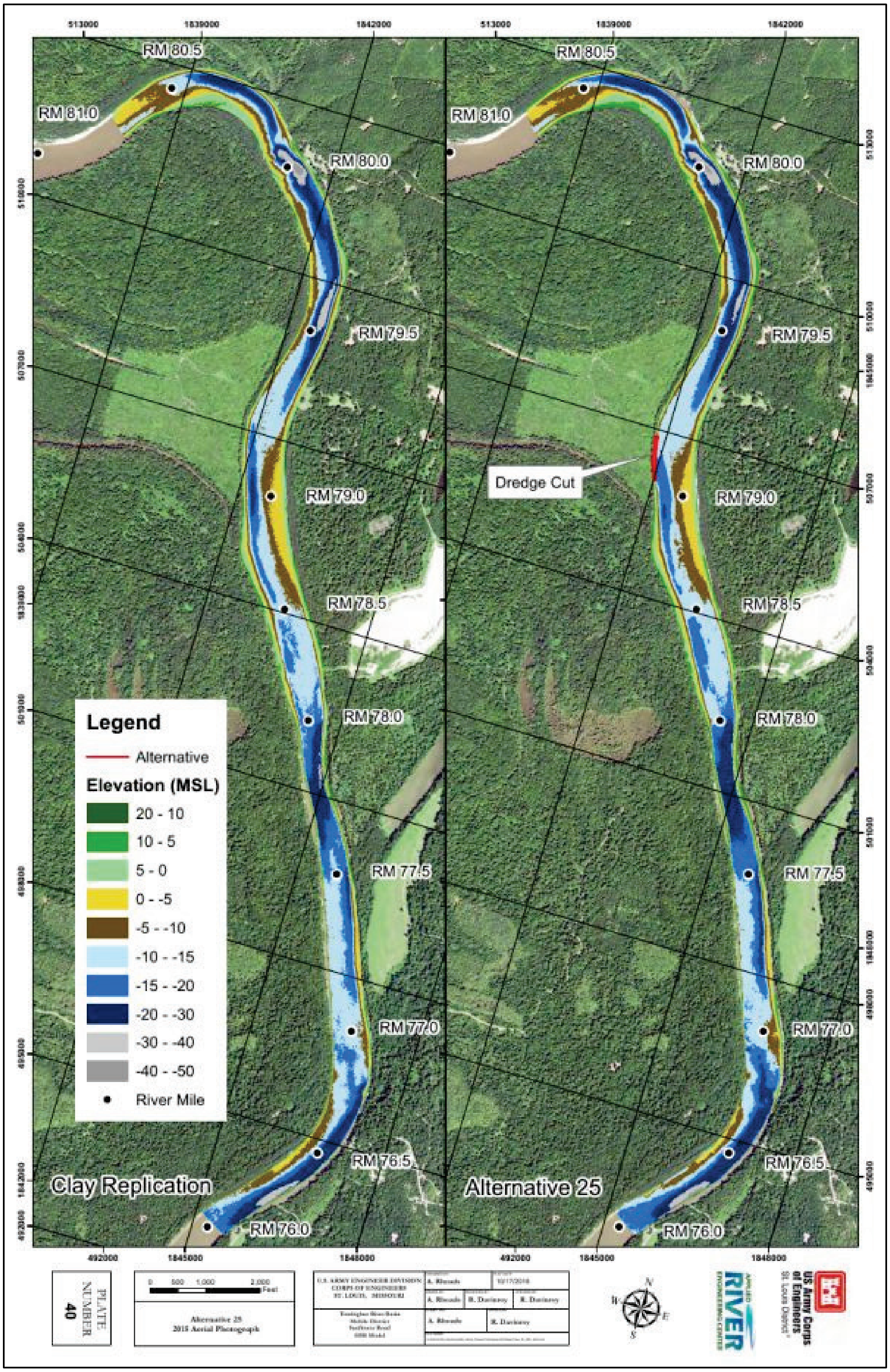


Plate 41. Alternative 26: Bathymetry results.

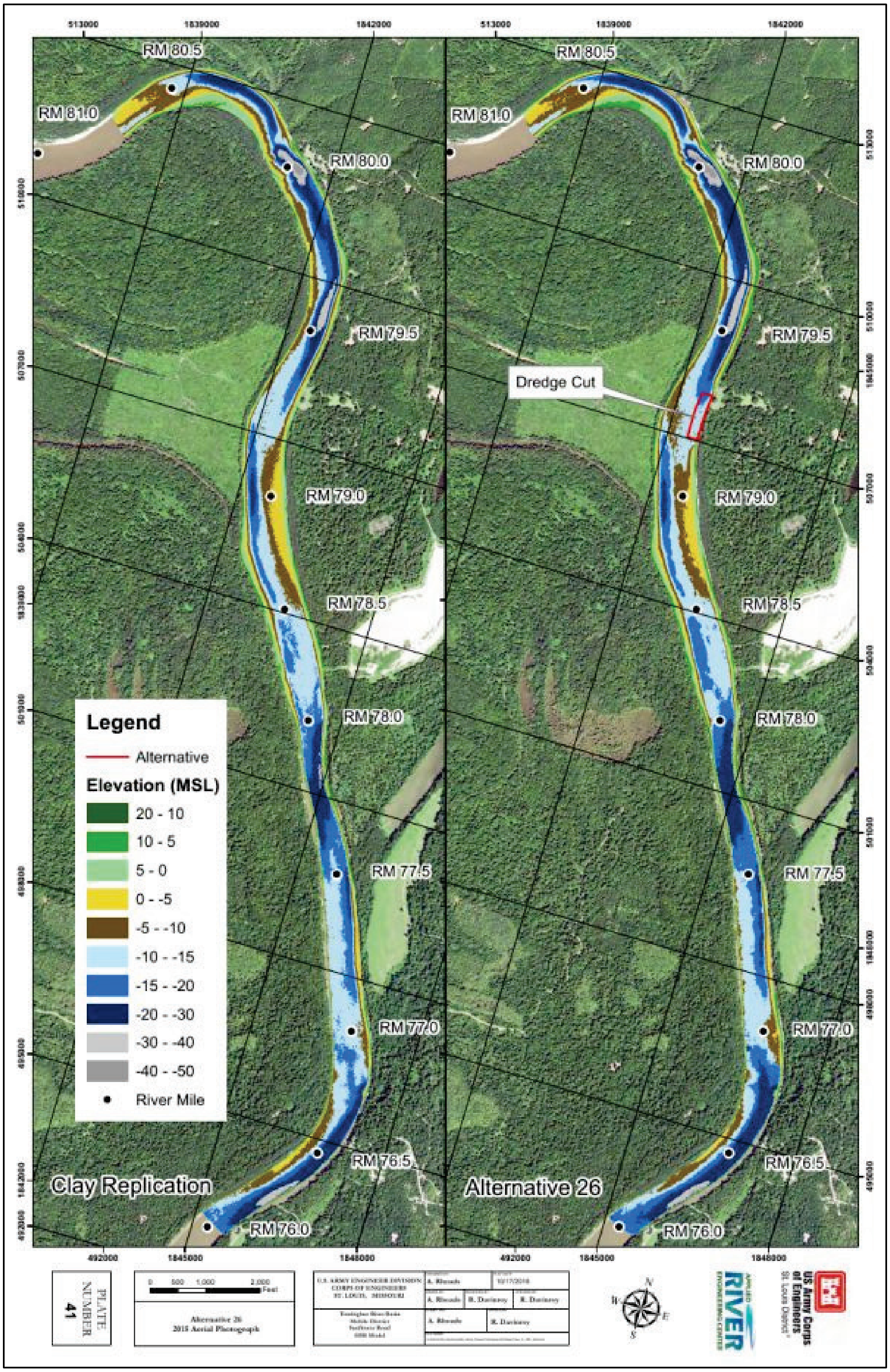


Plate 42. Alternative 27: Bathymetry results.

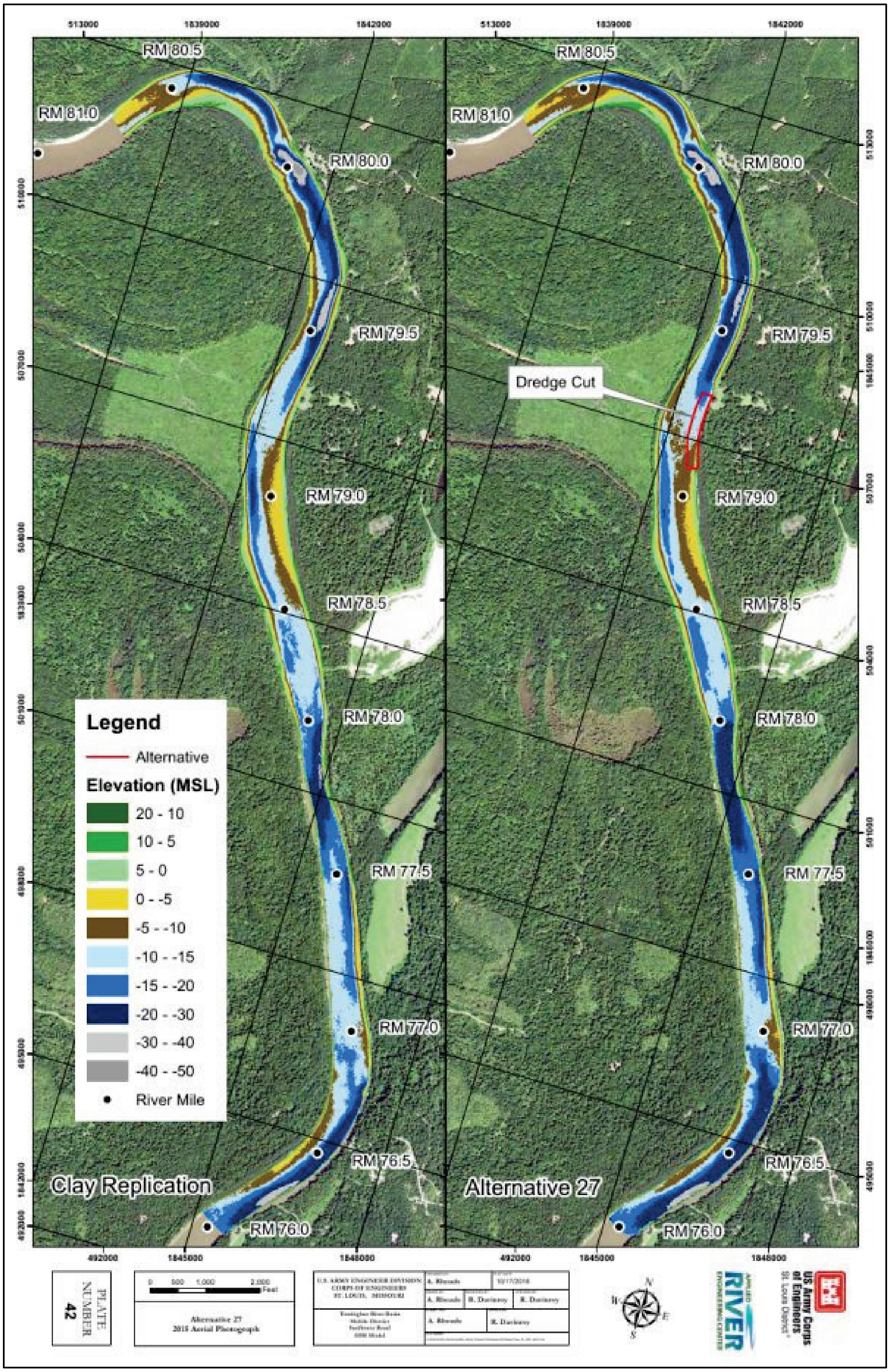


Plate 43. Alternative 28: Bathymetry results.

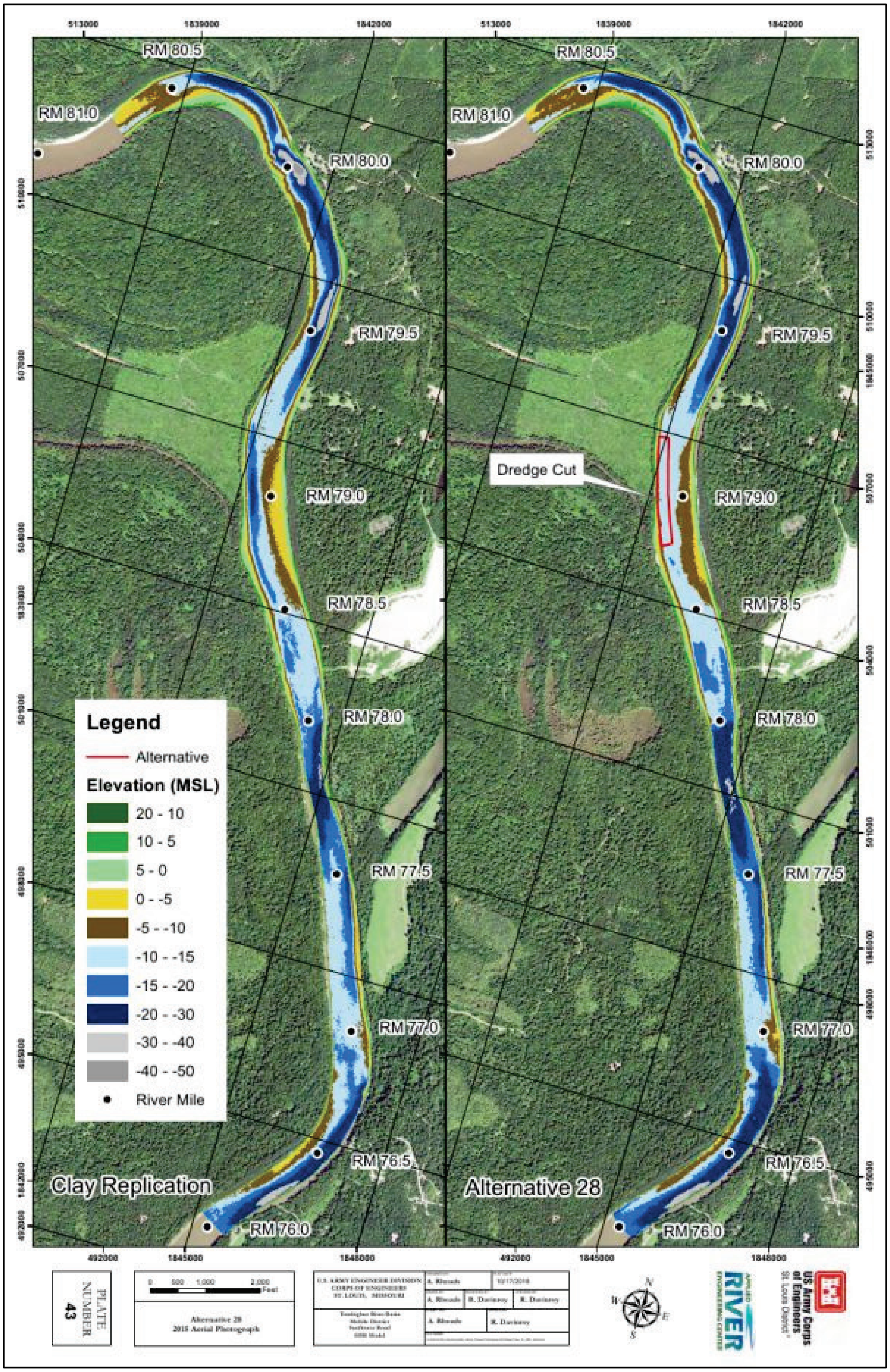


Plate 44. Alternative 29: Bathymetry results.

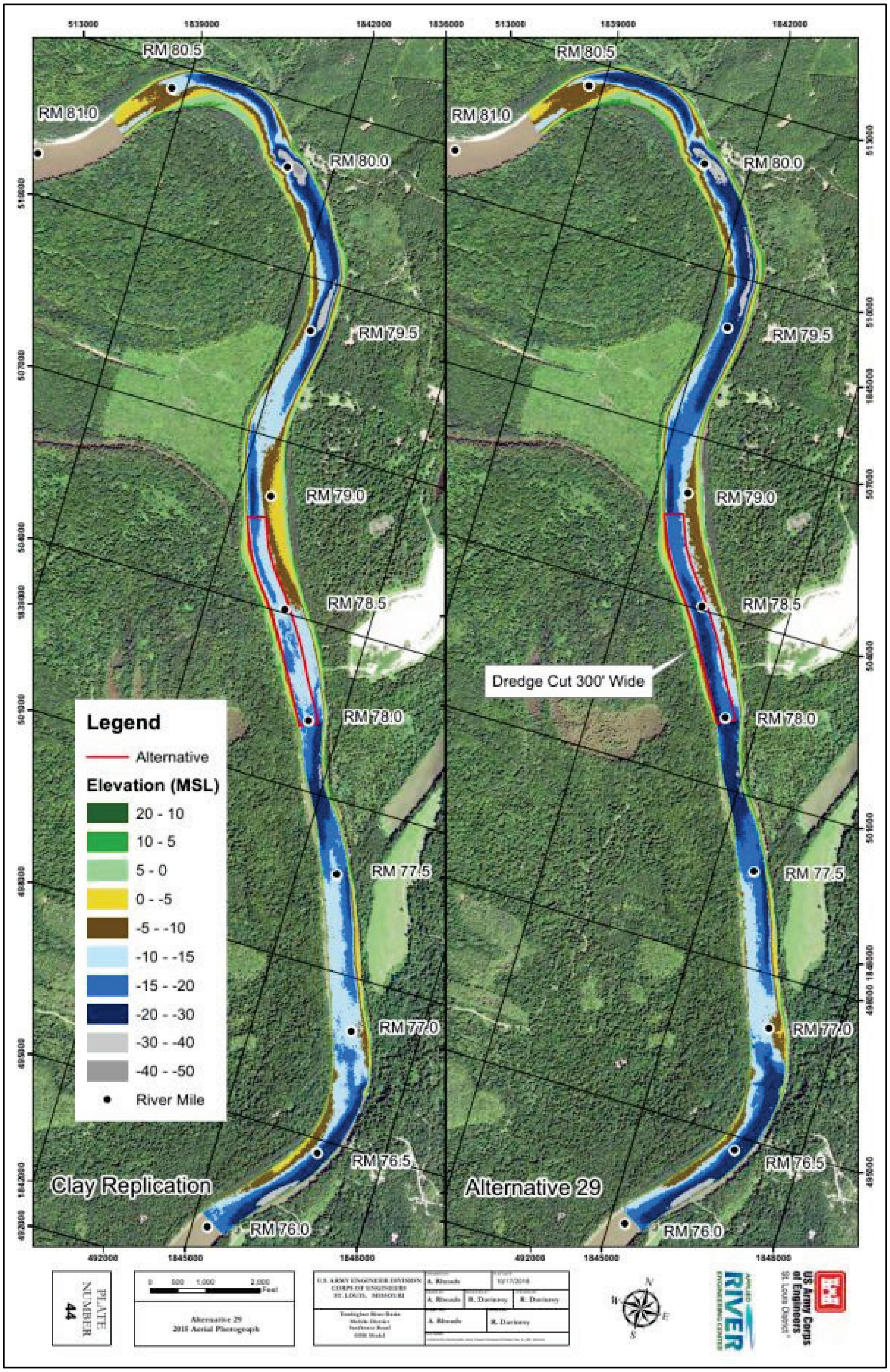


Plate 45. Alternative 30: Bathymetry results.

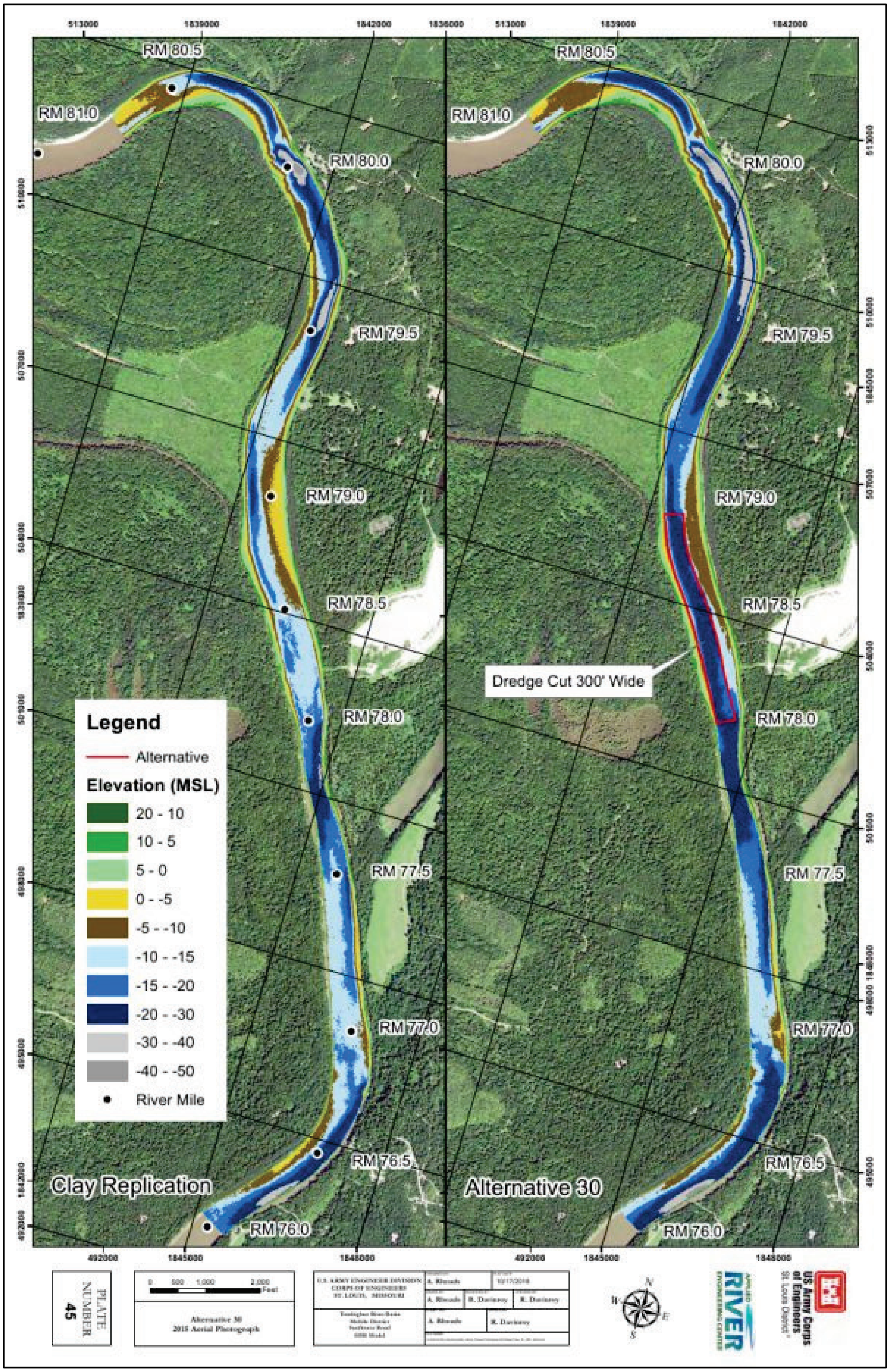
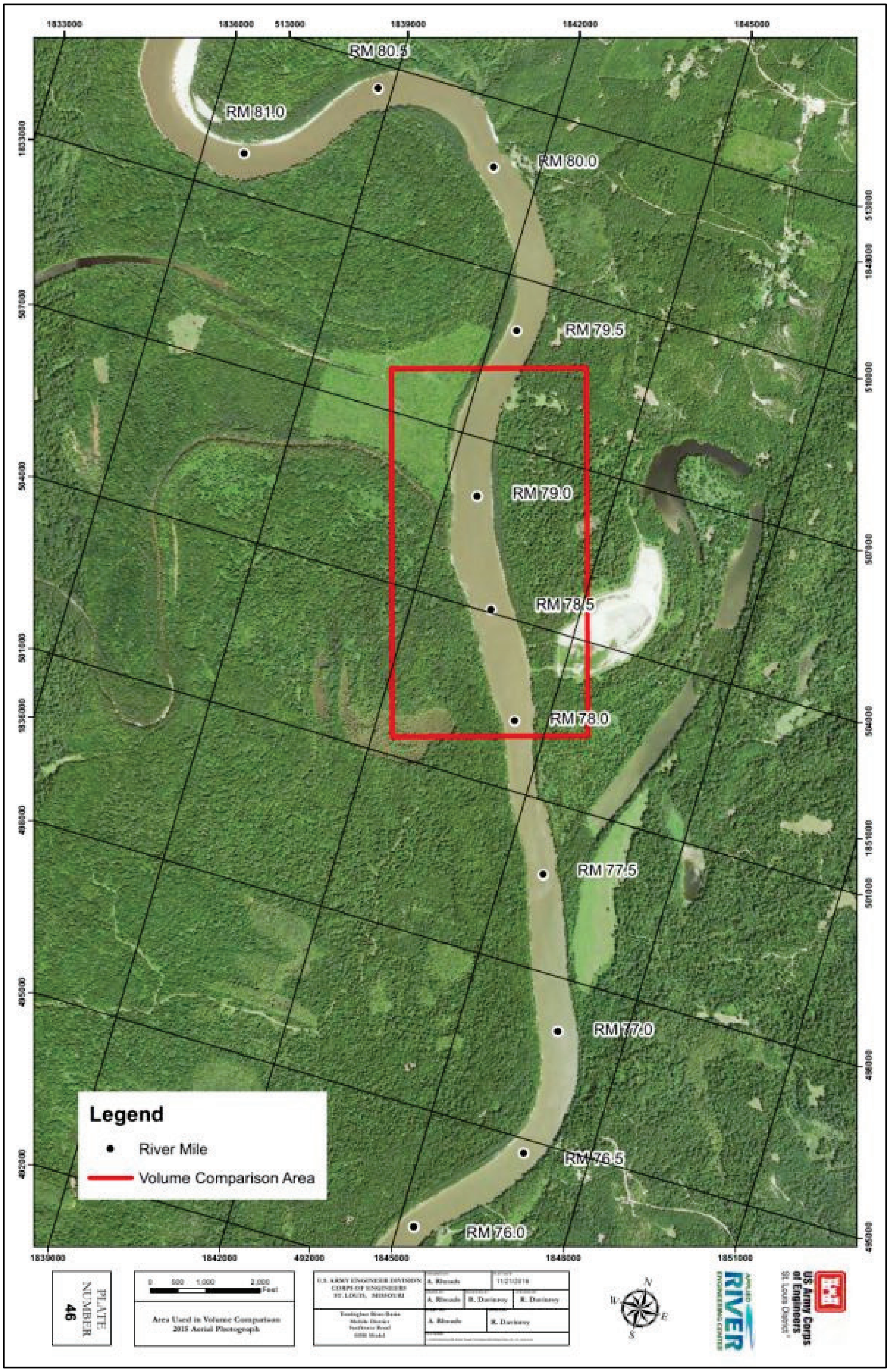


Plate 46. Volume comparison area.



Appendix B: Design Alternative Descriptions (Structure Information and Location)

Alternative 1 (Appendix A, Plate 16)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Dike	79.15	RDB	240	12
Dike	79.11	RDB	320	12
Dike	79.08	RDB	310	12
Dike	79.04	RDB	380	12
Dike	79.0	RDB	350	12
Dike	78.95	RDB	320	12
Dike	78.9	RDB	340	12

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	No	No

Alternative 2 (Appendix A, Plate 17)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Dike	79.15	RDB	240	12
Dike	79.11	RDB	320	12
Dike	79.08	RDB	310	12
Dike	79.04	RDB	380	12
Dike	79.0	RDB	350	12
Dike	78.95	RDB	320	12
Dike	78.9	RDB	340	12
Dike	78.73	LDB	240	12
Dike	78.66	LDB	250	12
Dike	78.6	LDB	230	12
Dike	78.54	LDB	220	12
Dike	78.48	LDB	260	12

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	No	No

Alternative 3 (Appendix A, Plate 18)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Dike	79.19	RDB	240	12
Dike	79.15	RDB	240	12
Dike	79.11	RDB	270	12
Dike	79.06	RDB	270	12
Dike	79.02	RDB	290	12
Dike	78.98	RDB	280	12
Dike	78.94	RDB	290	12
Dike	78.89	RDB	250	12
Dike	78.85	RDB	280	12
Dike	78.81	RDB	270	12

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	No	No

Alternative 4 (Appendix A, Plate 19)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Dike	79.19	LDB	240	12
Dike	79.15	LDB	240	12
Dike	79.11	LDB	270	12
Dike	79.06	LDB	270	12
Dike	79.02	LDB	290	12
Dike	78.98	LDB	280	12
Dike	78.94	LDB	290	12
Dike	78.89	LDB	250	12
Dike	78.85	LDB	280	12
Dike	78.81	LDB	270	12
Dike	78.61	LDB	330	12
Dike	78.53	LDB	330	12
Dike	78.47	LDB	300	12
Dike	78.41	LDB	290	12
Dike	78.35	LDB	240	12

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	No	No

Alternative 5 (Appendix A, Plate 20)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Weir	79.56	LDB	190	-15
Weir	79.53	LDB	210	-15
Weir	79.5	LDB	210	-15
Weir	79.47	LDB	180	-15
Weir	79.44	LDB	190	-15
Weir	79.41	LDB	190	-15
Weir	79.38	LDB	200	-15

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	Yes	No

Alternative 6 (Appendix A, Plate 21)

Type of Structure	River Mile	LDB/RDB	Dimensions (Feet)	Structure Top Elevation (feet in MSL)
Weir	79.56	LDB	190	-15
Weir	79.53	LDB	210	-15
Weir	79.5	LDB	210	-15
Weir	79.47	LDB	180	-15
Weir	79.44	LDB	190	-15
Weir	79.41	LDB	190	-15
Weir	79.38	LDB	200	-15
Dike	79.38	RDB	60	12
Dike	79.32	RDB	110	12
Dike	79.26	RDB	120	12
Trail Dike	79.2	RDB	280	12
Trail Dike	79.13	RDB	260	12
Trail Dike	79.05	RDB	320	12
Trail Dike	78.97	RDB	300	12
Trail Dike	78.89	RDB	350	12
Trail Dike	78.83	RDB	370	12
Dike	78.69	RDB	270	12
Dike	78.58	RDB	190	12

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
Yes	Yes	No

Alternative 7 (Appendix A, Plate 22)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Weir	79.56	LDB	440	-15
Weir	79.53	LDB	360	-15
Weir	79.5	LDB	410	-15
Weir	79.47	LDB	330	-15
Weir	79.44	LDB	330	-15
Weir	79.41	LDB	320	-15
Weir	79.38	LDB	300	-15
Dike	79.38	RDB	60	12
Dike	79.32	RDB	110	12
Dike	79.26	RDB	120	12
Trail Dike	79.2	RDB	280	12
Trail Dike	79.13	RDB	260	12
Trail Dike	79.05	RDB	320	12
Trail Dike	78.97	RDB	300	12
Trail Dike	78.89	RDB	350	12
Trail Dike	78.83	RDB	370	12
Dike	78.69	RDB	270	12
Dike	78.58	RDB	190	12

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
Yes	Yes	No

Alternative 8 (Appendix A, Plate 23)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Weir	79.62	LDB	200	-15
Weir	79.56	LDB	450	-15
Weir	79.5	LDB	350	-15
Weir	79.44	LDB	270	-15
Weir	79.38	LDB	160	-15
Dike	79.38	RDB	60	12
Dike	79.32	RDB	110	12
Dike	79.26	RDB	120	12
Trail Dike	79.2	RDB	280	12
Trail Dike	79.13	RDB	260	12
Trail Dike	79.05	RDB	320	12
Trail Dike	78.97	RDB	300	12
Trail Dike	78.89	RDB	350	12
Trail Dike	78.83	RDB	370	12
Dike	78.69	RDB	270	12
Dike	78.58	RDB	190	12
Dike	78.58	LDB	150	12
Dike	78.46	LDB	210	12
Dike	78.39	LDB	260	12
Dike	78.32	LDB	240	12

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
Yes	Yes	No

Alternative 9 (Appendix A, Plate 24)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Weir	79.61	LDB	280	-15
Weir	79.5	LDB	380	-15
Weir	79.38	LDB	200	-15
Dike	79.38	RDB	130	12
Dike	79.26	RDB	150	12
Trail Dike	79.13	RDB	320	12
Trail Dike	78.94	RDB	280	12
Trail Dike	78.79	RDB	310	12
Dike	78.65	RDB	170	12
Dike	78.54	RDB	200	12
Dike	78.54	LDB	180	12
Dike	78.4	LDB	280	12

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
Yes	Yes	No

Alternative 10 (Appendix A, Plate 25)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Dike	79.46	RDB	100	12
Dike	79.34	RDB	120	12
Trail Dike	79.22	RDB	300	12
Trail Dike	79.05	RDB	280	12
Trail Dike	78.85	RDB	350	12
Dike	78.65	RDB	230	12
Dike	78.55	RDB	210	12
Dike	78.54	LDB	190	12
Dike	78.44	LDB	280	12

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
Yes	No	No

Alternative 11 (Appendix A, Plate 26)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Weir	79.17	RDB	320	-15
Weir	79.12	RDB	310	-15
Weir	79.07	RDB	360	-15
Weir	79.0	RDB	380	-15
Weir	78.87	RDB	370	-15
Weir	78.77	RDB	410	-15
Weir	78.71	RDB	400	-15

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	No	No

Alternative 12 (Appendix A, Plate 27)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Weir	79.0	RDB	430	-15
Weir	78.94	RDB	520	-15
Weir	78.88	RDB	480	-15
Weir	78.82	RDB	580	-15

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	Yes	No

Alternative 13 (Appendix A, Plate 28)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Weir	79.0	RDB	520	-15
Weir	78.93	RDB	540	-15
Weir	78.87	RDB	510	-15
Weir	78.64	RDB	510	-15

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	Yes	No

Alternative 14 (Appendix A, Plate 29)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Weir	79.05	RDB	390	-15
Weir	79.0	RDB	490	-15
Weir	78.94	RDB	480	-15
Weir	78.88	RDB	480	-15
Weir	78.80	RDB	500	-15

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
Yes	Yes	No

Alternative 15 (Appendix A, Plate 30)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Weir	79.05	RDB	400	-15
Weir	79.0	RDB	570	-15
Weir	78.94	RDB	510	-15
Weir	78.88	RDB	490	-15
Weir	78.82	RDB	520	-15
Weir	78.75	RDB	560	-15

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	Yes	No

Alternative 16 (Appendix A, Plate 31)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Armored Existing Bed (feet in MSL)
Channel Armoring	Between 80.0 and 79.0	Entire Channel	500 x 2800	Varies

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	Yes	No

Alternative 17 (Appendix A, Plate 32)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Armored Existing Bed (feet in MSL)
Channel Armoring	Between 79.5 and 78.0	RDB	300 x 3900	Varies
Results				

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	Yes	No

Alternative 18 (Appendix A, Plate 33)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Disposal Armoring	Between 79.5 and 78.5	RDB	400 x 780	Varies
Results				

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	No	No

Alternative 19 (Appendix A, Plate 34)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Disposal Armoring	Between 79.5 and 78.0	RDB	200 x 3000	Varies
Disposal Armoring	Between 79.5 and 78.0	LDB	300 x 2800	Varies
Results				

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	Yes	No

Alternative 20 (Appendix A, Plate 35)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Disposal Armoring	Between 79.5 and 78.0	RDB	200 x 3570	Varies
Disposal Armoring	Between 79.5 and 78.0	LDB	300 x 2860	Varies

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	No	No

Alternative 21 (Appendix A, Plate 36)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Disposal Armoring	Between 79.5 and 78.0	RDB	150 x 3800	Varies
Disposal Armoring	Between 79.5 and 78.0	LDB	300 x 3460	Varies

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	Yes	No

Alternative 22 (Appendix A, Plate 37)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Disposal Armoring	Between 79.5 and 78.0	RDB	150 x 3800	Varies

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	No	No

Alternative 23 (Appendix A, Plate 38)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Dredge Cut Bottom Elevation (feet in MSL)
Dredge Cut	Between 79.5 and 78.0	RDB	300 x 3300	-15
Results				

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	Yes	Yes

Alternative 24 (Appendix A, Plate 39)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Dredge Cut Bottom Elevation (feet in MSL)
Dredge Cut	Between 79.5 and 78.0	LDB	300 x 3200	-17
Results				

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
Yes	Yes	Yes

Alternative 25 (Appendix A, Plate 40)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Dredge Cut Bottom Elevation (feet in MSL)
Clay Removal	Between 79.5 and 79.0	RDB	80 x 840	-15
Results				

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	No	No

Alternative 26 (Appendix A, Plate 41)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Clay Removal	Between 79.5 and 79.0	LDB	200 x 870	-15
Results				

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	No	Yes

Alternative 27 (Appendix A, Plate 42)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Clay Removal	Between 79.5 and 78.5	LDB	200 x 1430	-15
Results				

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	No	Yes

Alternative 28 (Appendix A, Plate 43)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Clay Removal	Between 79.5 and 78.5	RDB	200 x 1970	-15
Results				

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
No	Yes	Yes

Alternative 29 (Appendix A, Plate 44)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Dredge Cut	Between 79.0 and 78.0	RDB	300 x 3930	-15

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
Yes	Yes	Yes

Alternative 30 (Appendix A, Plate 45)

Type of Structure	River Mile	LDB/RDB	Dimensions (feet)	Structure Top Elevation (feet in MSL)
Dredge Cut	Between 79.0 and 78.0	RDB	300 x 3940	-20

Results

Improved Navigation Channel Crossing Depths at RM 79.2	Improved Navigation Channel Crossing Alignment at RM 79.2	Improved Navigation Channel Width at RM 79.1-78.0
Yes	Yes	Yes

Appendix C: HSR Model Theory

The principle behind the use of a hydraulic sediment response model is similitude, the linking of parameters between a model and prototype so that behavior in one can predict behavior in the other.

There are two different types of similitude: mathematical similitude and empirical similitude. Mathematical similitude is founded on the scale relationship between all linear dimensions (geometric similarity), a scale relationship between all components of velocity (kinematic), or both geometric and kinematic similarity with the ratio of all common point forces equal (dynamic similarity).

In contrast to mathematical similitude, empirical similitude is based on the belief that the laws of mathematical similitude can be relaxed as long as other more fundamental relationships are preserved between the model and the prototype. All physical models used in the past by the US Army Corps of Engineers employed, to some degree, empirical similitude. Numerous definitions of what relationships must be preserved have been put forward concerning physical sediment models. These relationships often deal with the scalability of elements of sediment transport processes or surface or structure roughness. Hydraulic sediment response models depend on similitude in the morphologic response (i.e., the ability of the model to replicate known prototype parameters associated with the bed response in the river under study). Bed response includes thalweg location, scour and deposition within the channel and at various river structures, and the overall resultant bed configuration. These parameters are directly compared to what is observed from prototype surveys.

Detailed cross-sectional analysis of prototype and model surveys defining bed response and bed configuration have shown that HSR model variation from the prototype is often approximately that of the natural variation observed in the prototype. This correspondence allows hydraulic engineers to use the HSR model with confidence and introduce alternatives in the model to approximate the bed response that can be expected to occur in the prototype.

Unit Conversion Factors

Multiply	By	To Obtain
cubic yards	0.7645549	cubic meters
feet	0.3048	meters
inches	0.0254	meters
gallons (US liquid)	3.785412 E-03	cubic meters
miles (US statute)	1,609.347	meters
tons (2,000 pounds, mass)	907.1847	kilograms

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE
April 2022

2. REPORT TYPE
Final Report

3. DATES COVERED *(From - To)*

4. TITLE AND SUBTITLE
Tombigbee River: River Miles 81.0–76.0 Sediment Management Study

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Jasen L. Brown, Robert D. Davinroy, Ivan H. Nguyen, Aron M. Rhoads, Nathan D. Lovelace, Emily R. Russ, and Jessamin A. Straub

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
See next page.

8. PERFORMING ORGANIZATION REPORT NUMBER
ERDC TR-22-5

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
US Army Corps of Engineers
Washington, DC 20314-1000

US Army Corps of Engineers, Mobile District
Mobile, AL 36602

10. SPONSOR/MONITOR'S ACRONYM(S)
USACE, SAM

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES
Funding Account Code U4381265; AMSCO Code 008303

14. ABSTRACT
The US Army Corps of Engineers, St. Louis District, Applied River Engineering Center (AREC), in cooperation with the Operations Branch of the Mobile District, conducted a sediment management study of the Sunflower Bend reach of the Tombigbee River, between River Miles 81.0 and 76.0, near Jackson, AL. The objective of the study was to look at sediment management alternatives to alleviate or eliminate repetitive maintenance dredging. These alternatives involved various river engineering measures including dikes, weirs, channel armoring, disposal armoring, and combinations thereof. A physical Hydraulic Sediment Response model was used to examine the sediment response resulting from these alternatives. During model testing, and after discussions with AREC and Mobile Operations Division staff, a second objective was established to define existing non-erodible bed materials that were located throughout the reach. This was conducted to examine the merits of strategically removing these erosion resistant materials in the river as an additional dredging/excavation alternative. The most favorable alternatives involved removing bedload sand and consolidated clay material from between River Miles 79.1 and 78.0 to improve navigation.

15. SUBJECT TERMS
Dredging, Jackson, (Ala.), Sedimentation and deposition, Sediment transport, Tombigbee River (Miss. and Ala.)

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Emily R. Russ
Unclassified	Unclassified	Unclassified	SAR	88	19b. TELEPHONE NUMBER *(Include area code)* 202-761-0204

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) (continued)

Applied River Engineering Center
US Army Corps of Engineers, St. Louis District
Foot of Arsenal Street
St. Louis, MO 63118

US Army Corps of Engineers, Mobile District
109 St. Joseph Street
Mobile, AL 36602

Environmental Laboratory
US Army Engineer Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 31980-6199

Coastal and Hydraulics Laboratory
US Army Engineer Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 31980-6199