Implementation of the Biological Opinion

Annual Progress Report
Fiscal Year 2013

U.S. Army Corps of Engineers
Mississippi Valley Division
St. Louis District

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Background:

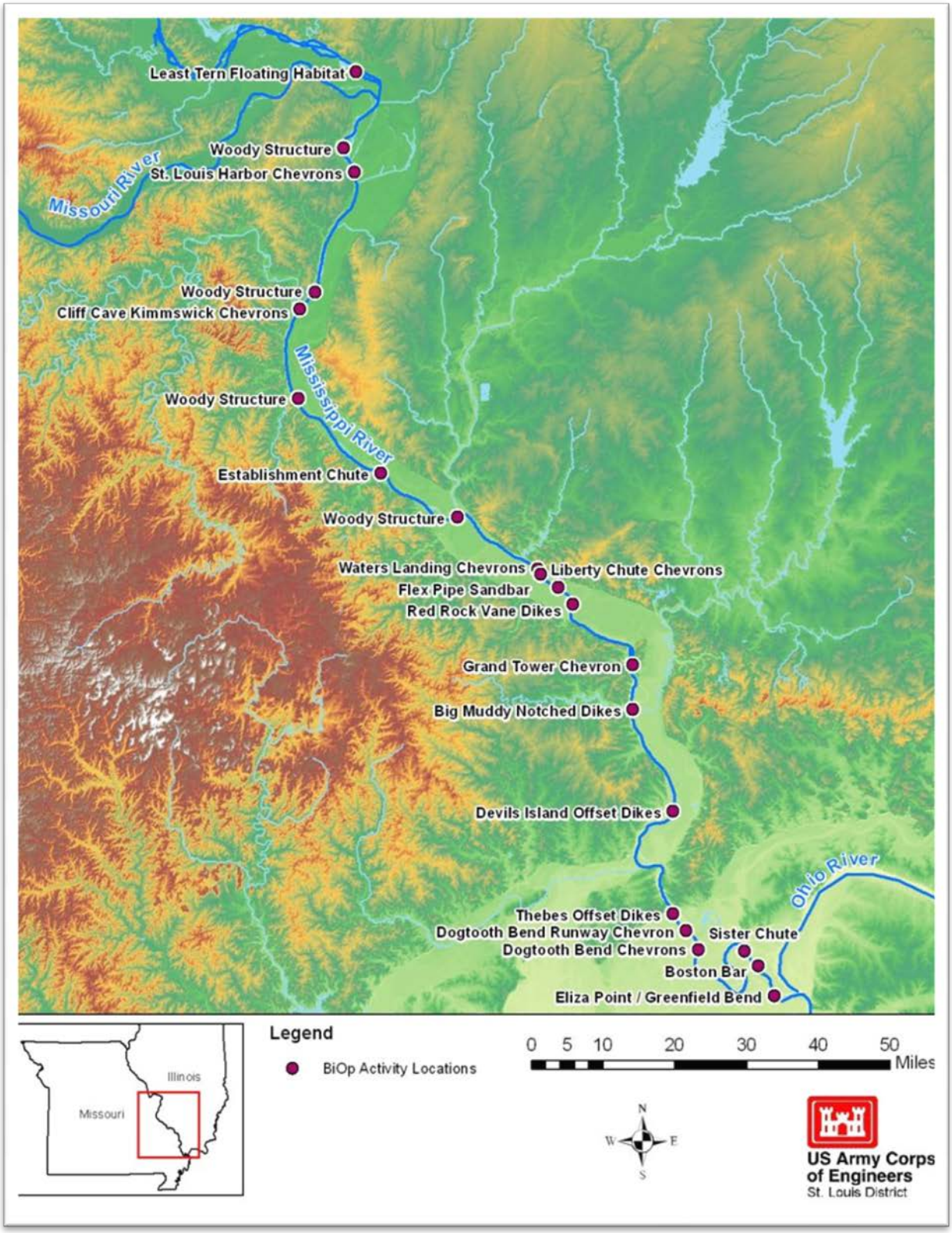
In April 1998, Region 3 of the U.S. Fish and Wildlife Service (FWS) and Mississippi Valley Division (MVD) of the U.S. Army Corps of Engineers (Corps) entered into formal Section 7 consultation under the Endangered Species Act. The consultation covered the continuation of operation and maintenance activities on the Upper Mississippi River Nine Foot Navigation Channel. Specifically addressed within the consultation were operation and maintenance direct effects, navigation traffic indirect effects, recreation indirect effects, and cumulative effects. The direct effects of operation and maintenance included navigation channel dredging, dike and revetment maintenance, water level management, and management of Corps lands. A 1998 baseline was established for the effects and a fifty-year evaluation period (to 2048) was used.

Formal consultation was concluded in August 2000, when the MVD Commander sent a letter to the Director of Region 3 FWS setting forth an implementation plan for the Corps project that would accommodate the findings of the FWS's Biological Opinion. The species of concern covered in the biological opinion that are germane to the St. Louis District include:

Decurrent False Aster – Likely to be adversely affected, but not jeopardized
Indiana Bat – Impacts negligible or offset by management actions; No incidental take
Interior Least Tern – Incidental take with Reasonable and Prudent Measures (RPM)
Pallid Sturgeon – Jeopardy with Reasonable and Prudent Alternatives (RPA), incidental take, and RPMs.

FY13 Activities:

The following is an outline of St. Louis District activities for fiscal year 2013. This was the thirteenth year of implementation activities under the Biological Opinion. For the immediate future, funding and manpower requirements will continue to be addressed on a year by year basis.



Locations of Biological Opinion activities covered in this report

1. **River Resources Action Team (RRAT) - Executive Team (Pallid Sturgeon - RPA 2 & 4, Terms and Conditions 4; Least Tern - Terms and Conditions 4).** The RRAT held a formal Executive Team meeting on 15 May 2013. Topics of discussion included the 2014 EMP budget, Strategic Plan, rock removal, A&M program, BiOp and flex pipe program, interagency coordination, Crawford Towhead, FY13 Work Plan, AREC large scale-model, FY 14 Regulating Works, Programmatic Environmental Assessment, status of monitoring by USACE, partner agency updates.

2. **River Resources Action Team – Technical Team (Pallid Sturgeon - RPA 2 & 4, Terms and Conditions 4; Least Tern - Terms and Conditions 4).** The Technical Team considered the August 14-15, 2013 site visit coordination trip as its yearly meeting. The RRAT annual coordination boat trip was held on a covered barge pushed by the MV Pathfinder as they traveled from the St. Louis District Service Base to the confluence of the Ohio River. Topics discussed included: river training structure construction and modification projects, supplemental environmental impact statement, new endangered mussel species (sheepnose and spectaclecase), mussel habitat studies, ecosystem restoration projects, regulating works and associated environmental assessments, dredging program and flexible dredge pipe update, hydropower, HSR model efforts, A&M program update, NESP status, Upper Mississippi River Restoration Program (UMRR formerly EMP) and LTRM updates, BiOp program status and pallid sturgeon studies update, paddlefish, least tern nesting, Indiana and northern long ear bat monitoring, ARRA-funded fish sampling, PL84-99 flood assistance, Rivers Project office updates, pinnacle rock removal, River des Peres Watershed Coalition, floodplain sampling and connectivity, Gulf restoration, Landscape Conservation Cooperative, Corps EOP's and climate change, Restoring America's Rivers, Middle Mississippi River Partnership update, woody structure update, UMRCC update, bald eagle lead poisoning, and general partner agency updates.

3. **Pallid Sturgeon Habitat, Life History, and Population Demographics work (Pallid Sturgeon - RPA 1, RPM 4, Terms and Conditions 9).** Funding was provided to the FWS, MDC, and ERDC for population monitoring of pallid sturgeon in the MMR during FY14. Trotlines will be used to collect juvenile and adult sturgeon. Trotlines will be standardized *a priori* by hook type and size, and bait, based on the Missouri River Population Assessment program and the most recent version of the Biological Procedures and Protocols for Researchers and Managers Handling Pallid Sturgeon (USFWS 2012).

   A summary report describing research activities conducted in 2010 and 2011 under RPA 1 was completed in January 2013 entitled "Pallid Sturgeon Reproduction in the Middle Mississippi River: Inferences from Age-0 Associations with Habitat." The report amassed 14 years of continuous larval sturgeon (*Scaphirhynchus*) data for the MMR including data from a near-record flood year (2011) and record drought year (2012). The report ultimately presumed that restoration of mid-channel islands would increase conditions that promote growth and survival and improve sturgeon recruitment. This report was provided to the FWS.

Recent publications associated with District-funded pallid sturgeon research:

Boley, R.M. and E.J. Heist. 2011. Larval surveys indicate low levels of endangered pallid sturgeon reproduction in the Middle Mississippi River. Transactions of the American Fisheries Society 140:1604-1612.

Garvey, J.E., W. Hintz, Q.E. Phleps, S.J. Tripp, R. Hrabik, D. Herzog, and E. Heist. 2013. Pallid sturgeon reproduction in the Middle Mississippi River: Inferences from Age-0 Associations with Habitat. Report to the St. Louis District, U.S. Army Corps of Engineers. January 2013.

Hintz, W.D., A.P. Porreca, J.E. Garvey, Q.E. Phelps, S.J. Tripp, R.A. Hrabik, and D.P. Herzog. 2014. Abiotic attributes surrounding alluvial islands generate critical fish habitat. River Research Application DOI: 10.1002/rra.2829

Koch, B., R.C. Brooks, A. Oliver, D. Herzog, J.E. Garvey, R. Hrabik, R. Colombo, Q. Phelps, and T. Spier. 2012. Habitat selection and movement of naturally occurring pallid sturgeon in the Mississippi River. Transactions of the American Fisheries Society 141:112-120.

Phelps, Q.E., G.W. Whitledge, S.J. Tripp, K.T. Smith, J.E. Garvey, D.P. Herzog, D.E. Ostendorf, J.W. Ridings, J.W. Crites, R.A. Hrabik, W.J. Doyle, and T.D. Hill. 2012. Identifying river of origin for age-0 *Scaphirhynchus* sturgeons in the Missouri and Mississippi rivers using fin ray microchemistry. Canadian Journal of Fisheries and Aquatic Sciences 69:1-12.

Sechler, D.R., Q.E. Phelps, S.J. Tripp, J.E. Garvey, D.P. Herzog, D.E. Ostendorf, J.W. Ridings, J.W. Crites, and R.A. Hrabik. 2012. Habitat for age-0 shovelnose sturgeon and pallid sturgeon in a large river: interactions among abiotic factors, food, and energy intake. North American Journal of Fisheries Management 32:24-31.

Seibert, J.R., Q.E. Phelps, S.J. Tripp, and J.E. Garvey. 2011. Seasonal diet composition of adult shovelnose sturgeon in the Middle Mississippi River. The American Midland Naturalist 165(2):355-363.

4. **Pallid Sturgeon Conservation and Restoration Plan (Pallid Sturgeon - RPA 1 & 2, RPM 2, Terms and Conditions 3, 4).** The development of this plan continued in FY13. Draft chapter status:

Chapter	**Status**
Introduction	In progress: Has not been reviewed at this point.
Shallow Sandbar and Island Habitat Restoration	In progress: A draft was provided to the Service and they commented on 23 March 2012.
Side Channel Restoration	In progress: A draft was provided to the Service and they commented on 9 April 2013.
Stone Dike Alterations	Completed. Vetted through the RRAT

Chapter	Status
Fish Monitoring Plan	In progress. The monitoring plan dated 1 May 2013 was reviewed prior to FY14 sampling. Modifications to the plan were also made in September 2013 after further coordination with the FWS and MDC.
Habitat Monitoring Plan	In progress. A pre-draft was provided to the Service and they commented on 3 June 2013.

5. **St. Louis Harbor chevrons, UMR River Miles (RM) 183.0-182.4(R) (Pallid Sturgeon - RPA 3 & 4, Terms and Conditions 2; Least Tern -Terms and Conditions 2).** No further fish monitoring is planned. The following is the abstract from a Master's Thesis by Brandon Schneider entitled *"Changes in Fish Use and Habitat Diversity Associated with Placement of Three Chevron Dikes in the Middle Mississippi River."* An online version of Brandon's thesis is available here

"The Mississippi River system is third largest watershed in the world and comprises a vast number of unique habitats from ephemeral wetlands to backwaters to island complexes of the main channel. Over the years, a variety of changes in land use and construction projects have modified the river into more of a navigation channel and less of an ecosystem. The United States Corps of Engineers (USACE) may have the authority for maintaining a 2.7-meter (9-foot) navigation channel throughout the Mississippi River; however, USACE also has several mandates to work under to improve ecosystem function. One of these unique ecosystem restoration projects undertaken by the USACE was constructing three, large chevron dikes in the St. Louis Harbor. The unique dike structures were designed to reduce dredging and improve flows as barges enter and exit the Chain of Rocks canal, but also potentially to create new habitats in the Middle Mississippi River by modifying flows to create not only changes in flow but also changes in bathymetric diversity.

To evaluate changes in the fish community resulting from chevron dike construction a variety of techniques including benthic trawling and day time electrofishing were conducted from 2003 to 2007. A total of 1,987 fishes were collected from 477 samples from the St. Louis Harbor during the four years of monitoring comprising 14 families and 35 species of fish. Catch per unit efforts ranged from 0.0 fish/min to 73.7 fish/min for trawling and between 0.0 fish/min to 8.14 fish/min for electrofishing. Electrofishing showed unique statistical differences between pre- and post-construction sites. While in electrofishing there was an increase in number of fish caught per minute, trawling showed a general decrease in the total number of fish caught per minute from pre-to post-construction between the experimental and control locations.

Also, while benthic chubs (Macrhybopsis and Hybopsis) were fairly abundant in pre-construction samples, they were somewhat scarce in post-construction samples and caught with great irregularity. This was one of the reasons why it was determined, at the beginning of the study, that ordinations with appropriate Analyses of Similarities (ANOSIM) would have Indicator Species Analyses (ISA) completed on them. If species

that appeared to be unique to a habitat were lost or gained, the ordinations, ANOSIMs and ISAs could determine the true differences. These could be used to determine the fish communities and find the species that typify each of these communities.

Overall, the fish community changed due to habitat modifications from the chevron dikes from pre- to post-construction in favor of the post-construction sites. The new fish community is more diverse with stable populations being shown on most samples and the habitat has become quite diversified from the initial surveys with the two dominant habitat types of main channel and main channel border existing. Although the trawling pre-construction samples showed greater CPUE, this may have been due to very few samples that dominated the remainder of the samples where few fish, if any, were captured. While some negative impacts of the dikes were shown such as the loss of benthic chubs, the chevron dikes in the St. Louis Harbor of the Middle Mississippi River have shown several positive impacts that could aid the USACE in the future for developing ecosystem-friendly structures while maintaining the navigation channel."

6. **Carondelet HSR Model Study, RM 181.0 - 165.0 (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** This study began in October 2011 and was completed in March 2013 (on-line report available here). The study comprised a 16.0 mile stretch of the Mississippi River, between RM 181.0 and RM 165.0 in Madison, St. Clair, and Monroe Counties in Illinois and St. Louis County and St. Louis City in Missouri. The objective of the model study was to produce a report that outlined the results of an analysis of various river engineering measures intended to reduce or eliminate the need for repetitive maintenance dredging within the Carondelet reach. Coordination to minimize environmental impacts with the recommended alternative took place with biologists from USACE, IDNR, MDC, and USFWS. The recommended design is the construction of a single rootless dike at RM 173(L).

7. **Mouth of the Meramec HSR Model Study, RM 165.0 - 156.0 (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** These studies began in November 2012, aimed at reducing or eliminating dredging between RM 162.0 - 160.0 and improving the natural habitat along the RDB near RM 158.4 by implementing various river engineering structures. The study continued in the replication phase (replication is a calibration process designed to produce the general conditions in the river at the time of the model study) through FY13.

8. **Cliff Cave – Kimmswick dike alteration and chevron construction site, RM 168.0 - 156.6 (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** During FY12, re-dressing of structures was completed and additional material was removed from the notches. Post-construction physical monitoring is scheduled for FY14.

   General Background: An HSR model study for this reach was completed in FY06 (on-line report available here). The Biological Assessment for this contract has been completed. This project was selected from the Corps' 2002 Stone Dike Alteration

Project Report. The purpose of the HSR study was to design structural modifications to the existing dike fields to enhance the aquatic habitat diversity and flow dynamics within the reach. The study was performed to address two separate sediment transport goals. The first goal was to create island and side channel aquatic habitat within the dike field. The second goal was to maintain current depths in the navigation channel to assure the need for additional dredging would not arise. A team participation meeting was held at the Applied River Engineering Center in St. Louis, Missouri, prior to the testing of alternatives to outline objectives and concerns in the study reach. It was brought to the team's attention that the bar on the right descending bank between RM 165.0-164.0(R) contained unique Pallid Sturgeon habitat. It was recommended that, if at all possible, no structures detrimental to this habitat be used in the final design. At this meeting the team decided on two areas of emphasis. These two areas were along the left descending bank (LDB) downstream of dike 163.0(L) and on the LDB downstream of dike 160.9(L). Alternative design analysis concluded that at Cliff Cave, the Corps should notch a number of existing dikes and construct four chevrons; and at Kimmswick, three chevrons should be constructed. Construction of the three Kimmswick chevrons was completed in 2009. Construction of the four Cliff Cave chevrons was completed in 2011.

9. **Salt Lake Chute HSR Model Study, RM 143.0 - 134.0 (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** This study was initiated in June 2012 and was continued through FY13. The objective of the model study was to produce a report that outlined the results of an analysis of various river engineering measures intended to enhance the environmental diversity of the reach around Salt Lake Chute, including but not limited to, island creation and sandbar separation. The purpose of this study was to find a solution to enhance the environmental diversity near the Salt Lake Chute complex. Coordination to minimize environmental impacts with the recommended alternative took place with biologists from USACE, IDNR, MDC, and USFWS.

10. **Fort Chartres/Establishment Island new chevrons and rootless dike between RM 132.5-129.5(R) (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** Post-construction monitoring by the MDC began in February of FY09 and continued thru 2011. A draft summary report was received by the Corps in July of FY13 and is currently under review.

    General Background: This reach of the river has been experiencing a dredging problem for many years. This contract was awarded in FY06 and five of six structures were completed. The two blunt-nosed chevrons were constructed at RM 130.05(R) and 129.9(R). The spur dikes and rootless dike were constructed between RM 132.0(R) and 132.5(R). No further construction is planned for this phase of the project after construction of a rootless dike at RM 130.2(R) was completed in FY07. This structure was planned to be a chevron; however, construction difficulties necessitated the change to a rootless dike. This change was coordinated with all partners. This work is intended to eliminate the need to dredge and add environmental features. Recent data shows that the scour holes that develop when the chevrons get over-topped are occupied by a number of fish species throughout the

year. Fishes and the associated physical characteristics (depth, velocity, and substrate) were sampled seasonally in the Establishment Island Complex (impacted site; location of channel realignment structures) and the Kaskaskia Island Complex (control site; location of no perturbations) from fall 2002 through summer 2004 (pre-impact) and fall 2008 through summer 2010 (post impact) using seining, day-time electrofishing, and Missouri Trawling. Results of the pre- and post-construction report will be forthcoming.

11. **Establishment Chute HSR Study, RM 134.0-128.0 (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1 and 3, Terms and Conditions 2).** This study was completed in September 2011 (on-line report available here). The recommended design includes placement of a 1,400-foot Side Channel Enhancement Dike (SCED) upstream of Establishment Chute to facilitate water movement through the chute; notching existing dikes 132.6(R) and 132.5(R) at the upper end of the chute; and notching closure structures 131.9(R) and 131.0(R) in the middle and lower end of the chute. Construction started in FY12 with the partial notching of dike 132.5(R), but only approximately 10% of the notch was completed due to low river levels. In FY13, the dike at RM 132.6(R) was notched and a portion of the SCED at RM 132.65(R) was constructed. In addition, revetment was placed in the chute between RM's 131.9 and 132.0 (Figure 1). The remainder of the project is expected to be completed in FY14.

    General Background: The St. Louis District initiated this study of the Middle Mississippi River between Miles 134.0 and 128.0, in January 2010. This study was funded by the Avoid and Minimize Program. The objective of the study was to evaluate environmental design alternatives for diversifying aquatic habitat within and around Establishment Chute without negatively impacting the adjacent point bar or the navigation channel. The selected alternative is projected to provide increased depth and depth diversity within the chute.

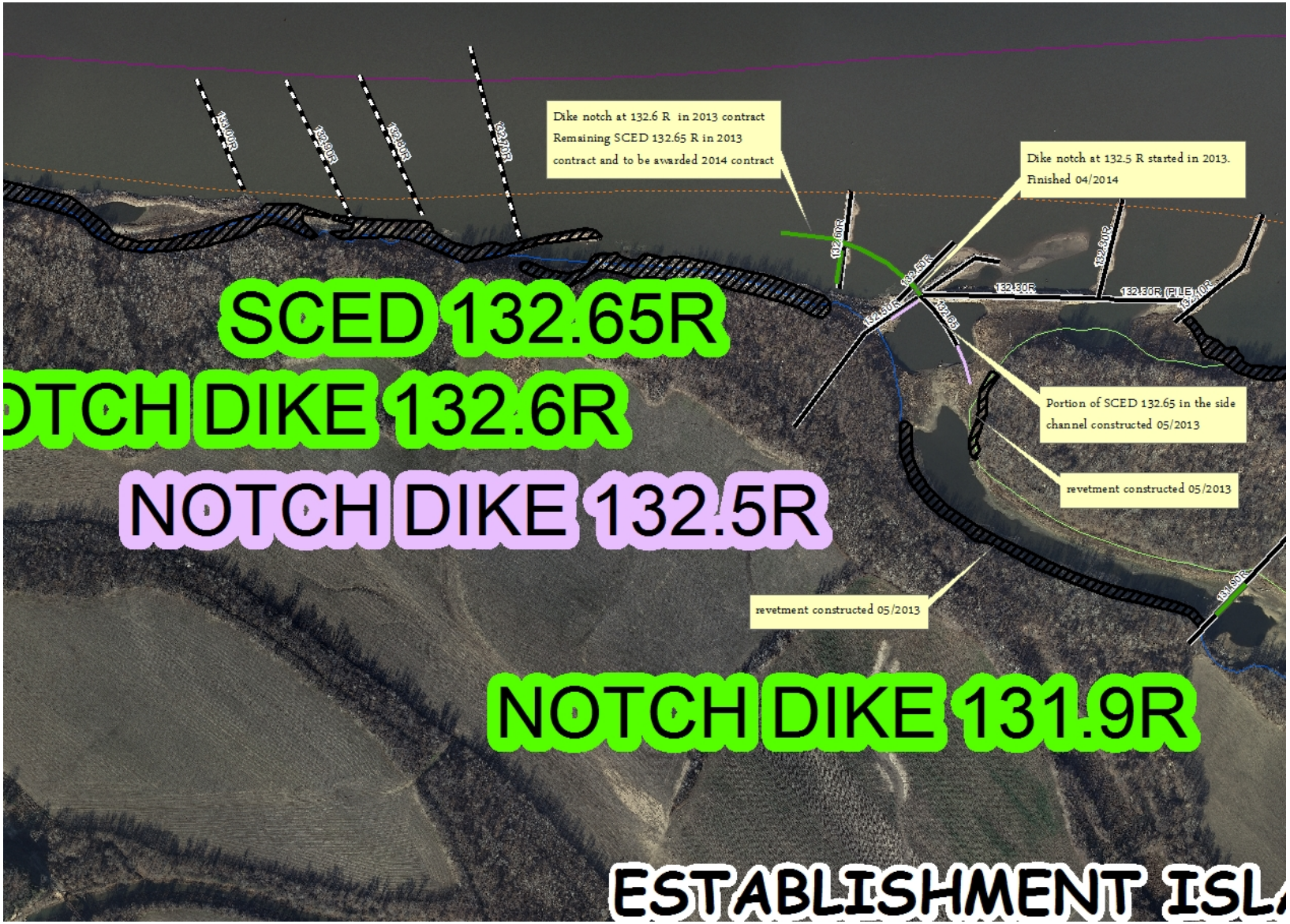


Figure 1. Establishment Chute design.

12. **Moro Chute HSR Model Study, RM 125.0 - 117.0 (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** This study began in October 2012. The objective of the model study was to produce a report that outlined the results of an analysis of various river engineering measures without negatively affecting the navigation channel. It was also intended for the development of side channel habitat and to enhance the environmental diversity along the left descending bank of Moro Island, primarily by increasing flows in the chute. Coordination to minimize environmental impacts with the recommended alternative took place with biologists from USACE, IDNR, MDC, and USFWS. The study continued in the replication phase through FY13.

13. **Waters Landing HSR Study, RM 106.0-100.0 (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2; Least Tern - RPM 1, Terms and Conditions 2 &4).** This HSR study was completed in January 2009 (on-line report available here). The recommended design included removal of existing dike 104.4(R), construction of three chevrons at RM 104.4, 104.0, and 103.7(R), and extension and notching of dikes 104.0 and 103.5(R). Dikes 104.0 and 103.5(R) were extended and notched in FY10. Dike 104.4(R) was shortened and chevrons 104.4(R), 104.0(R), and 103.7(R) were constructed in FY11 and FY12 (Figure 2). This completed construction activities associated with this study.

    General Background: The St. Louis District initiated this sedimentation improvement study of the Water's Landing reach of the Middle Mississippi River between RM 106.0 and 100.0 near Chester, Illinois, in May 2008. This study reach was selected from the Stone Dike Alterations Project Report and funded by the Biological Opinion Program. The main objective of the study was to develop and evaluate design alternatives that would enhance the environmental diversity within the dike fields, in particular around RM 104.0 – 102.5(R). A number of fish species use deep pools, slow, shallow channels, and bar formations to fulfill various life history requirements. This type of habitat can be cultivated by altering existing dikes, i.e. notching, increasing or decreasing length and/or height, or by adding new structures, i.e. dikes, chevrons, weirs, or by using a combination of alterations and new structures. Along with the primary objective, a secondary goal was to alleviate repetitive channel maintenance dredging.

Figure 2. Waters Landing chevrons (RM 104R) during low-water fly-over September 2012 (river level -2.5 on St. Louis gage).

14. **Flexible/floating pipe for dredging, RM 103 (Pallid Sturgeon - RPA 3 & 4, RPM 2, Terms and Conditions 4; Least Tern – RPM 2, Terms and Conditions 4.** In FY09, the St. Louis District purchased approximately 2600 ft of flexible floating dredge disposal pipe with the intention of improving the efficiency of dredge operations and using dredge material to create sandbar and island habitat because of its potential to increase overall riverine habitat diversity. The floating flexible pipe can be used to create islands and/or sandbars near shore or behind chevrons and generally gives more options for placing dredged material for ecological benefits. Work was completed in FY11 on creating a temporary spill barge necessary to support the dredge pipe at the point of discharge. The spill barge was successfully tested in September 2011. A permanent spill barge is currently in the process of being procured.

    In order to prioritize locations where the flexible pipe might be used for a pilot project to create shallow sandbar or island habitat, St. Louis District personnel coordinated with agency stakeholders and Corps dredge personnel in FY11. Manskers Landing (RM 104) and Vancil Towhead (RM 67.5) were determined to be the best potential locations for a pilot project to be executed in Fall 2011 based on dredging needs, operational considerations, and compatibility with river training structures. Accordingly, flex pipe was used to create an ephemeral island at RM 104(R) in early November 2011. Approximately 100,000 cubic yards of material was utilized to create the island which was initially constructed to a maximum elevation of approximately 352 feet (approximately +15 LWRP) and approximately 10 acres in size.

Pre- and post-construction bathymetric surveys were conducted to track erosion of the habitat over time. The island was inundated briefly in late December 2011 and briefly again in early February 2012. Field observation of the island in late February showed erosion of the island down to an approximate maximum elevation of 348 feet. River levels then rose and inundated the island for approximately four consecutive months. Bathymetric surveys and field observation of the island in May, July, and September 2012 all showed approximate maximum elevations of 342 feet (from the +15 above LWRP to +5). Additionally, in April 2013, a bathymetric survey was conducted at the RM 104(R) site and still showed a maximum elevation of the island to be at +5 Low Water Reference Plane (Figure 3).

Fish sampling was conducted post-construction to characterize fish use of the habitat. The site was sampled four times post-construction: 22 February 2012 (island exposed), 25 May 2012 (island submerged), 9 July 2012 (island submerged), and 10 September 2012 (island exposed). During each sample, four trawl runs and four electrofishing runs were made, two on the navigation channel side of the island and two on the bank side. A total of 625 fish representing 18 species from 8 families were collected (see FY2012 BiOp Annual Report).

The flex pipe test operation was considered successful and confirmed the viability of the flex pipe as a tool for habitat creation while maintaining the navigation channel. The District hopes to utilize the flex pipe on a more regular basis for habitat creation projects, either as part of regular maintenance dredging activities or for restoration-specific purposes. The desire for the near future is to select a site for a longer-term, larger-scale biological and bathymetric study to determine the impacts of island/sandbar creation on the fish community and associated habitat. Close coordination between District personnel and agency partners will be required in selection of a study site and design of study protocols.

In September 2013, again at Manskers, roughly 100,000 cubic yards of dredge material was placed inside the chevron at RM 103.7(R) (Figure 4), and another 300,000 cubic yards was placed as an island below the chevron near RM 103(R) (Figure 5). Also in September 2013, the flex pipe was used to place 113,000 cubic yards near Liberty Island at mile 100(R). Post-placement bathymetric surveys for the September placements will be scheduled in FY14.

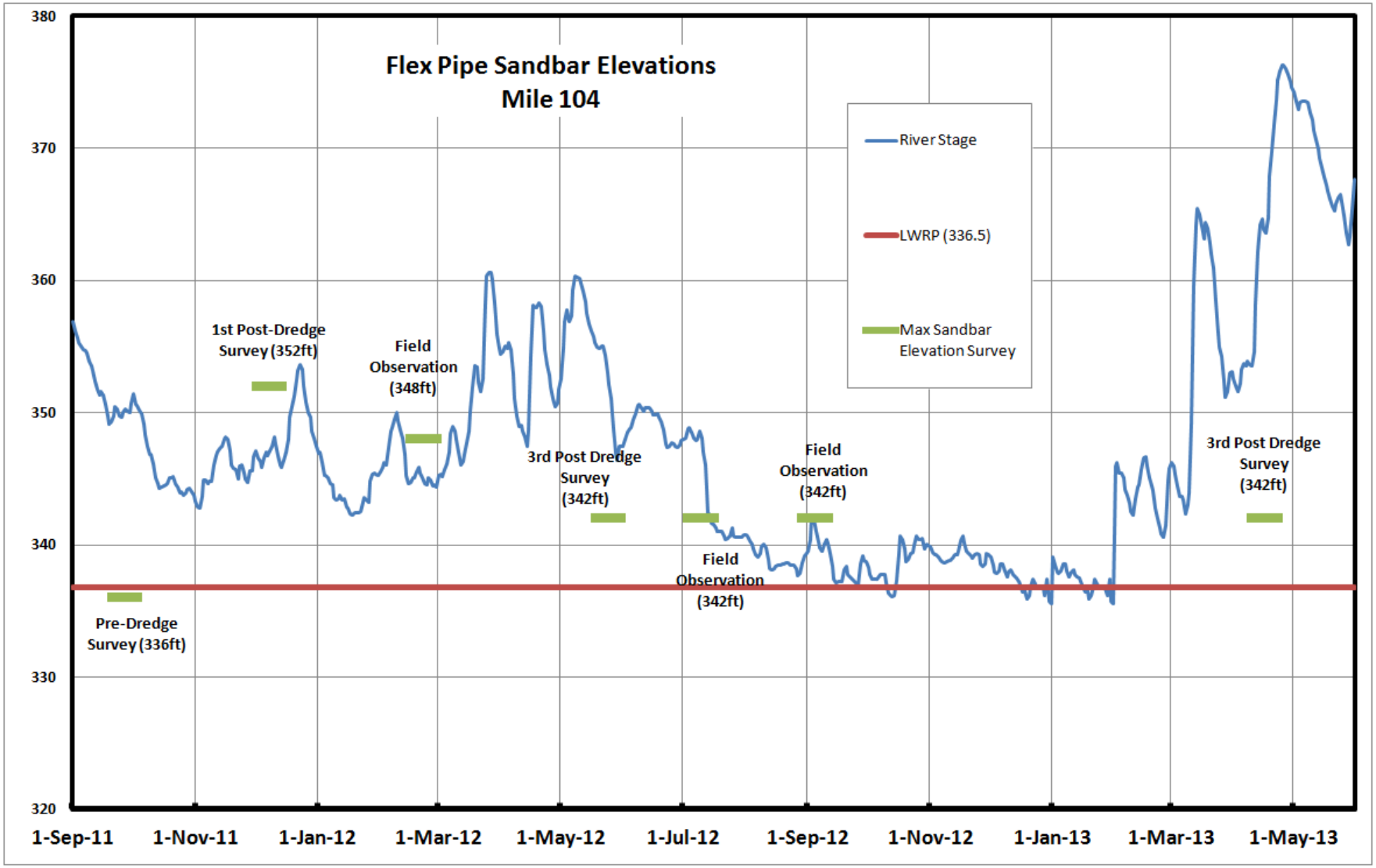


Figure 3. Flex pipe sandbar elevations through time in relation to river stage and low water reference plane.

Figure 4. In September 2013, again at Manskers, roughly 100,000 cubic yards of dredge material was placed inside the chevron at RM 103.7(R).

Figure 5. Roughly 300,000 cubic yards of dredge material was placed as an island at RM 103.0(R).

15. **Grand Tower HSR Study RM 84.0-79.0 . (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** Based on this study, chevron 82.0(L), weirs 82.5(R) and 82.4(R), and dikes 81.85(L) and 81.65(L) were constructed during FY09. This HSR study was conducted in 2004 to evaluate and propose design modification to existing stone dike and/or weir structures and the introduction of new structures for the purpose of improving navigation conditions and reducing dredging through the Grand Tower area (on-line report available here). An alternative that included the construction of two weirs, extending an existing dike but leaving a notch, construction of three new dikes and construction of one chevron was recommended. This alternative created the most environmental benefits with the possible creation of a secondary channel that has both upstream and downstream connectivity with the main channel.

16. **Vancill Towhead HSR Model Study, RM 72.0 - 65.0 (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** This study began in October 2011 and was completed in September 2012 (on-line report available here). The purpose of this study was to find a solution to reduce or eliminate repetitive channel maintenance dredging from RM 68.00 to RM 67.00, enhance the environmental diversity at Vancill Towhead, and produce a report that communicates the results of the HSR model study to all project stakeholders. Coordination to minimize environmental impacts with the recommended alternative took place with biologists from USACE, IDNR, MDC, and USFWS. The recommended design at the Vancill Towhead portion, which is located between RM 70.0 and 67.0, includes construction on the left descending bank of 3 weirs at RM 69.15, 68.95, and 68.75, 3 diverter dikes (S-dikes) at RM 68.10, 67.80, and 67.50, repair of dike 67.8, revetment at dike 67.3 and the shortening of dikes 67.3 and 67.1.

17. **Devils Island – Phase 4. (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** During FY11, construction of offset dikes 59.8(R), 59.6(R), 59.5(R), 59.3(R), 59.0(R), 58.7(R), and 58.3(R) was completed (Figure 6). This stretch of river has a history of chronic dredging problems. The offset dikes are expected to improve navigation, add environmental diversity, and reduce the need to dredge at this site. Post-construction biological and physical monitoring took place in FY12 (on-line report available here). Although it is difficult to draw conclusions from the limited sampling that has taken place, the offset dikes appear to be creating some unique flow and sedimentation patterns when compared to traditional wing dikes which may benefit the MMR fish community by adding habitat diversity.

Figure 6. Devils Island offset dikes (RM 59-58R) during low-water fly-over September 2012 (river level -2.5 on St. Louis gage).

18. **Thebes Reach HSR Study RM 46-36 (Pallid Sturgeon – RPA 3 & 4, RPM 1; Least Tern – RPM 1).** In FY07 the St. Louis District initiated a study of the Upper Mississippi River between RM 43.0 and 35.0, approximately nine miles downstream of Cape Girardeau, Missouri. The final report was completed in April 2010 (on-line report available here). Alternative 5 offset dikes 39.4(R), 39.1(R), 38.9(R), and 38.6(R) were constructed in FY12 (Figure 7).

    Thebes Reach/Burnham Island Flex Pipe long-term monitoring site - During FY13, St. Louis District personnel, through coordination with agency stakeholders and Corps dredge personnel (project delivery team [PDT]), chose this site for long-term pre- and post flex pipe placement bathymetric surveys and fish monitoring primarily to evaluate potential benefits to larval/pallid sturgeon. Mulit-beam bathymetry, Light Detection and Ranging (LiDAR) will be conducted pre-placement as close to the actual placement time as practicable. Post-placement multi-beam and LiDAR monitoring will occur after the first high water event to record any changes in size due to sediment transport. Additional post-placement monitoring will be coordinated through the PDT. Monthly fish monitoring began in September 2013 and is planned to continue through FY15. Trawling is conducted between the dikes at 8 upper "experimental" sites (yellow, targets for dredge placement) and 7 lower control sites (green) (Figure 8). In addition, four additional control transects are being sampled at the Devils Island offset dikes - between upper dikes one and two, and between 3 and 4 (Figure 6). These stretches were chosen because they most closely resemble river characteristics of the experimental sites.

Flexible dredge pipe provides the District with the opportunity to use the dredged material to create a diversity of aquatic habitat types, including sand bars (ephemeral sand islands) and shallow water habitat. The FWS has indicated that these habitat types are essential for larval and juvenile pallid sturgeon. In addition, island/sand bar restoration would be expected to provide nesting and forage habitat for the least tern.

Objectives:

The proposed study includes 2 primary objectives:

Objective 1: Monitor flex pipe placement and control sites to evaluate potential benefit to larval/juvenile pallid sturgeon.

Objective 2: Monitor flex pipe placement and control sites to evaluate potential benefit to prey resources of the pallid sturgeon. That is, do ephemeral islands appear to increase localized populations of prey that could be utilized by pallid sturgeon?

Figure 7. Thebes Reach offset dikes at RM 39(R) during low-water fly-over September 2012 (river level -2.5 on St. Louis gage).

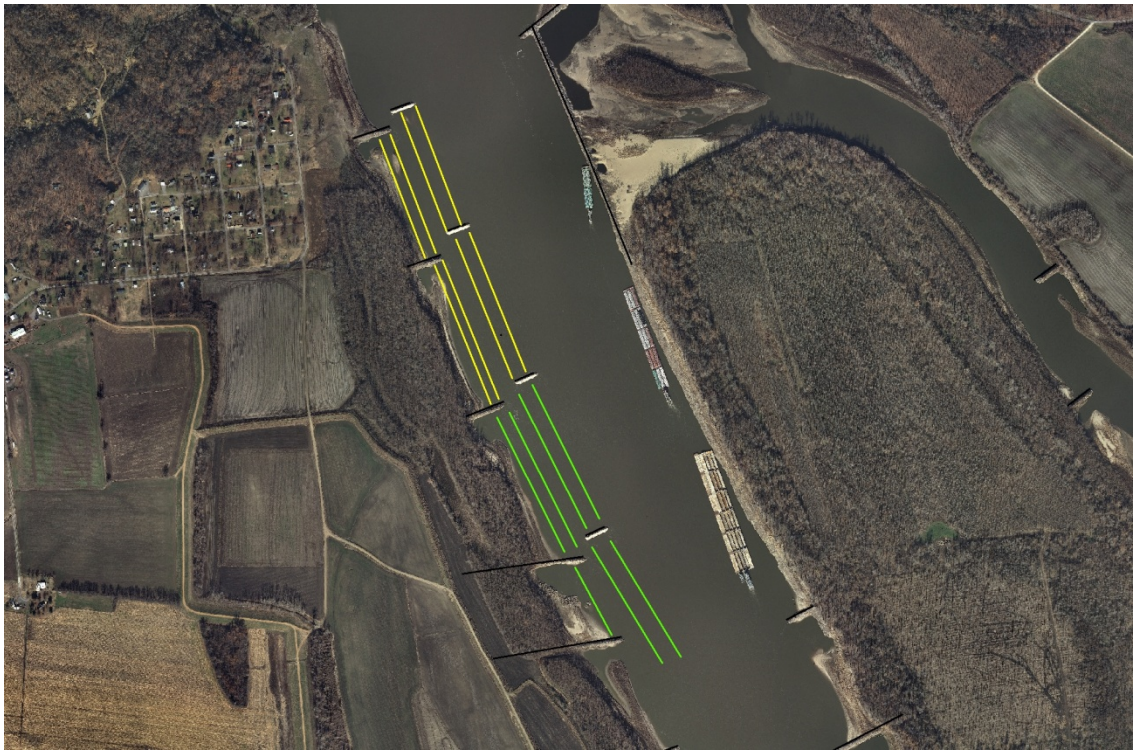


Figure 8. Experimental (yellow) and Control (green) transects at the Thebes/Burnham Island long-term flex pipe placement site.

19. **Dogtooth Bend – Phase 3, RM 40.0-20.0. (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** During FY10, construction of chevrons 36.7(L), 36.5(L), 36.2(L), 35.9(L), 32.8(R), 32.6(R), and 32.4(R) took place (Figure 9). No new construction took place in FY11. This reach of the river has been experiencing a dredging problem for many years. This work is expected to improve navigation, add environmental features, and eliminate the need to dredge at this site. Post-construction biological and physical monitoring took place in FY12 (on-line report is available here). A report summarizing the results will be distributed when complete. Although it is difficult to draw conclusions from the limited sampling that has taken place, the chevron dikes appear to be creating some unique flow and sedimentation patterns when compared to traditional wing dikes, which may benefit the MMR fish community by adding habitat diversity. Runway chevron 36.2(L) in particular appears to be creating diverse flow and sedimentation patterns (a runway chevron differs from a traditional chevron in having extended, notched legs as seen in the figure below).

Figure 9. Dogtooth Bend chevrons at RM 36(L) during low-water fly-over September 2012 (river level -2.5 on St. Louis gage).

20. **Bumgard HSR Model Study, RM 36.0 - 25.0 (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** This study began in April 2012 and was completed in September 2013 (online report available here. The purpose of this study was to find a river engineering solution to reduce or eliminate dredging at RM 34.50 to 27.20 while protecting the environmental diversity at the Bumgard Island complex, and produce a report that communicates the results of the HSR model study to all project stakeholders. Coordination to minimize environmental impacts with the recommended alternative took place with biologists from USACE, IDNR, MDC, and USFWS.

21. **Environmental dredging at Sister Chute RM 14.5-12.0(R) (Pallid Sturgeon - RPA 3 & 4, Terms and Conditions 4; Least Tern - Terms and Conditions 4).** Dredging at the lower end of Sister Chute, RM 12.0(R) was completed in FY07 (October 2006). The side channel was dredged between the downstream closure dike and the confluence with the main channel (Figure 10). After the side channel was dredged, material started to re-deposit. Post-construction bathymetric surveys took place in 2006, 2008, 2009, and 2011 (Figure 11) and a summary report was completed in FY13 by Peter Russell of the St. Louis District Hydraulic Design Section. General conclusions were:
    - Surveys showed that the side channel remained relatively stable upstream of the closure dike.
    - Because of its elevation, the closure dike strongly influences flows and channel geometry of the chute.
    - Approximately 4.5 years after the dredge event, two thirds of the volume dredged had re-deposited.
    - The high elevation closure dike prevented sediment transport into the dredged area from upstream about 70% of the time.
    - Without the high elevation closure dike, sediment would have re-deposited much sooner.
    - Sediment will continue to deposit in the dredge-cut section until it reaches equilibrium with the upstream section although the amount of time before the dredge-cut section fills in is dependent on the river stage.
    - The post-dredge section is unsustainable and will continue to aggrade until it reaches an equilibrium with the section.

    General Background: After initial coordination and evaluation with state and federal stakeholders, it was decided to dredge the lower end of Sister Chute with the primary purpose of creating overwintering fish habitat. The project is also being conducted to specifically benefit the pallid sturgeon by providing backwater habitat that is anticipated to provide an improved food base. The dredge cut created a channel to connect the open river area at the lower end of the chute to the deep water hole below dike 12.4(R) for better connectivity throughout critical over wintering timeframes. The dredge cut is also anticipated to provide other aquatic species with greater potential use of the side channel for resting, spawning, and feeding opportunities. Restoration of side-channels is one of the seven types of habitat restoration suggested by the FWS in the Biological Opinion.

Figure 10. Lower end of Sister Chute (RM 12R) during low-water fly-over September 2012 (river level -2.5 on St. Louis gage) – highlighted area was dredged in October 2006.

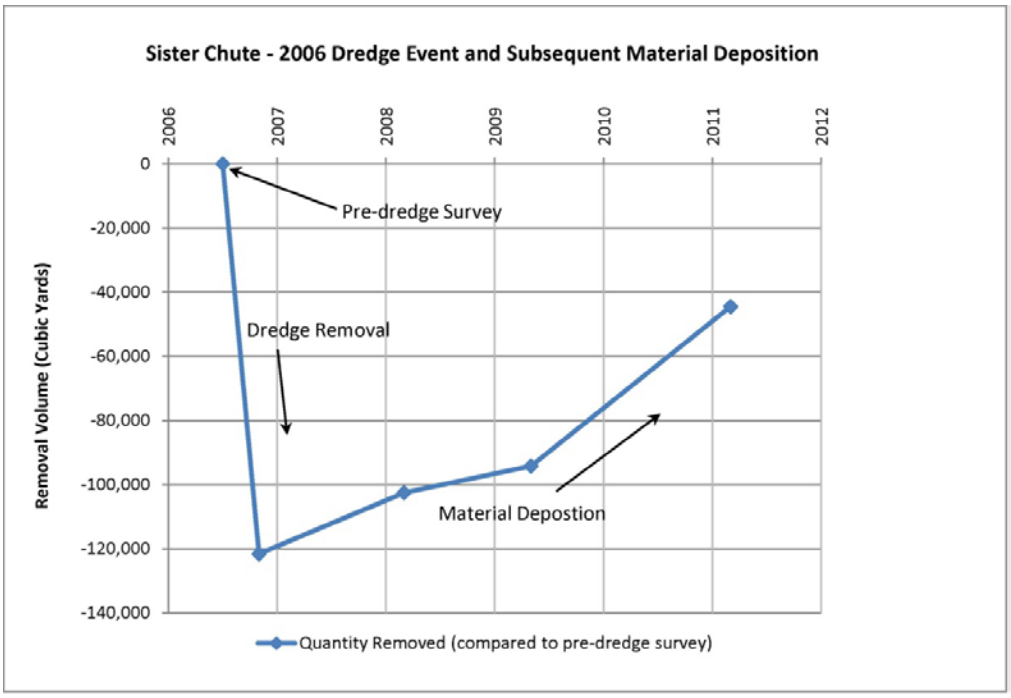


Figure 11. Results of post-dredging bathymetric surveys

22. ***Boltonia decurrens* (Decurrent False Aster).** A summary report of ten years of decurrent false aster inventory surveys is expected to be completed by Southern Illinois University Edwardsville personnel in FY14.

23. **Interior Least Tern (Terms and Conditions 3, least tern).** Educational outreach for the Least Tern Floating Habitat Project and partnership continued with the Audubon Society in FY13. Barge monitoring and driving surveys were conducted for arriving least terns in April/May and continued throughout the summer. Least terns first arrived on May 8 of 2013. Nesting on the barge was confirmed on June 11 when 17 nests and 36 eggs, and 25 adults were observed. On June 18, no least terns were seen using the barges during the daily survey. The same day, it was confirmed that the previous night, a predator most likely entered the barges. There were numerous broken eggs on the barge and no adults using the barge. It is believed that the predator was most likely mammalian.

24. **Emergency Dredging Biological Assessment (Pallid Sturgeon - Terms and Conditions 5**). The Biological Opinion contains Terms and Conditions to be implemented should dredging become necessary during the 12 April through 30 June timeframe. No dredging was required during this period for FY13.

25. **Indiana Bat Survey.** No Indiana bat surveys were conducted in FY13.

26. **Woody Structure Monitoring (Pallid Sturgeon - RPA 4 and RPM 1).** In September 2012, St. Louis District personnel conducted 10-year follow-up monitoring of wooden pile dikes, wood bundles, and woody debris in dikes that were constructed in 2001 and 2002 (Figure 12 and table below) in order to increase habitat diversity and address a perceived lack of woody debris in the MMR. Overall, the pile dikes and woody bundles appeared to be relatively intact after 10 years and are providing fish and macroinvertebrate habitat, catching and retaining drifting organic debris, and increasing overall habitat diversity within the MMR. The wood logs placed within dikes appear shorter-lived, with only 6 of the original 12 logs being re-located during the 2012 survey. However, the logs whether still in place or not, do not appear to have compromised the integrity of the dikes. A summary report of the 2012 woody structure monitoring is available on-line here.

Figure 12. Wood pile dike at RM 187.3L in 2003 (left) and 2012 (right).

Woody structure placement locations in the Middle Mississippi River.

Site #	River Mile	Location	Structure	Placement Date
1	187.3L	Between dikes	23 log pile "dike"	December 2001
2	186.0L	Between dikes	35 bundles	Dec 2001, March 2002
3	165.5R	Behind L-dike	9 bundles	August 2001
4	165.1R	Between dikes	6 bundles	August 2001
5	165.0R	Between dikes	23 log pile "dike"	August 2001
Site #	**River Mile**	**Location**	**Structure**	**Placement Date**
6	163.6R	Sandbar	27 log pile "dike"	August 2001
7	148.3-147.3L	Calico chute	12 bundles	July 2001
8	119.2R	In upstream side of dike	1 log	January 2002
9	119.0R	In upstream & downstream side of dike	2 logs	January 2002
10	118.3R	In downstream side of dike	2 logs	January 2002
11	118.1R	In downstream side of dike	2 logs	January 2002
12	117.9R	In downstream side of dike	2 logs	January 2002
13	117.6R	In downstream side of dike	2 logs	January 2002
14	117.5R	In upstream side of dike	1 log	January 2002

Projected FY14 Activities

Based on current projections of FY14 funding in the St. Louis District, we anticipate proceeding with the following work. However, these are projections only, and may require adjustment in the event adequate funding cannot be maintained, water levels are not in the range needed for construction, etc. Not all of these items will be completed in the next FY as some of them are multi-year continuing efforts and others may require extensive outside coordination.

1. Continue coordination with the **RRAT Technical Team** and **RRAT Executive Team**. Continue work on refining coordination efforts through the RRAT framework.

2. The **Pallid Sturgeon Conservation and Restoration Plan** effort will continue in cooperation with MDOC, IDNR and FWS. A draft conservation and restoration plan is expected to be completed in late FY14 or early FY15.

3. **Pallid Sturgeon Habitat, Life History, and Population Demographics work.** (ERDC/MDC/FWS) adult and juvenile sampling, along with habitat data collection will begin late autumn through the end of the spring season. Semi-monthly adult/juvenile sampling is proposed for the months of November - May for a total of fourteen sampling events per year. If water temperature falls below 5°C or flood stages occur during the adult/juvenile season, sampling can be re-allocated to those months when catch efficiency is higher (i.e., 10 – 20 °C).

4. **Mouth of the Meramec HSR Model Study, RM 165.0 - 156.0 (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** This study began in November 2012 and is expected to be completed in FY14.

5. **Cliff Cave – Kimmswick dike alteration and chevron construction site, RM 168.0-156.6. (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** Post-construction physical monitoring is scheduled for FY14.

6. **Salt Lake Chute HSR Model Study, RM 143.0 - 134.0 (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** This study was initiated in June 2012 and is planned for completion in FY14.

7. **Fort Chartres/Establishment Island new chevrons and rootless dike between RM 132.5-129.5(R). (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** A post-construction monitoring report by the Missouri Department of Conservation is expected to be through final review in FY14 or early FY15.

8. **Establishment Chute HSR Study, RM 134.0-128.0. (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** Construction on Establishment Chute is expected to continue and possibly be completed in FY14 contingent on adequate river levels.

9. **Moro Chute HSR Model Study, RM 125.0 - 117.0 (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** This study began in October 2012 and is planned for completion in FY14

10. **Waters Landing HSR model study, RM 106-100.** Dike notches need to be lowered.

11. **Flexible/floating pipe for dredging, RM 103 (Pallid Sturgeon - RPA 3 & 4, RPM 2, Terms and Conditions 4; Least Tern – RPM 2, Terms and Conditions 4).** Post-placement bathymetric surveys for the September placements at Manskers will be scheduled in FY14.

12. **Dike modifications at Big Muddy River confluence, RM 75.5-75.2(L).** Dike notches may be lowered.

13. **Vancil Towhead HSR Model Study, RM 72.0 - 65.0 (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** Beginning in FY14, one additional year of pre-construction monitoring is planned to be conducted.

14. **Devils Island – Phase 4. (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** Post-construction biological monitoring is expected to take place as part of the flex-pipe Burnham Island study. Bathymetric surveys will continue periodically.

15. **Thebes Reach HSR model study, RM 46.0-36.0**. **(Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** Monthly monitoring is expected to begin late in FY14 and planned to continue through FY15. Bathymetric surveys will be conducted around the newly constructed offset dikes at some point in the future.

16. **Dogtooth Bend – Phase 3, RM 40.0-20.0**. **(Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** No further post-construction biological monitoring is expected to take place. Bathymetric surveys will continue periodically.

17. **Bumgard HSR Model Study, RM 36.0 - 25.0 (Pallid Sturgeon - RPA 3 & 4, RPM 1, Terms and Conditions 2 & 4; Least Tern - RPM 1, Terms and Conditions 2 & 4).** Bathymetric surveys are planned for FY14 at the upper end of the island.

18. **Environmental dredging at Sister Chute RM 14.5-12.0(R). (Pallid Sturgeon - RPA 3 & 4, Terms and Conditions 4; Least Tern - Terms and Conditions 4).** To be determined after further coordination with partner agencies.

19. **Flexible/floating pipe for dredging. (Pallid Sturgeon – RPA 3 & 4, RPM 2, Terms and Conditions 2 & 4; Least Tern – RPM 2).** Continued opportunistic use of the flexible

dredge pipe during routine maintenance dredging is expected to continue in FY14. Use of the flexible dredge pipe specifically for habitat restoration will also be considered.

20. ***Boltonia decurrens* (Decurrent False Aster).** A summary report of ten years of inventory surveys should be completed in FY14.

21. **Least Tern**. Educational outreach and monitoring with the Audubon Society is expected to continue in FY14. The floating island will continue to be monitored for successful nesting and fledging.

22. **Indiana Bat.** Plans for FY14 include revising the SOW for the FY13 surveys and adding radio telemetry for a monitoring contract to be performed in FY14.