

FOX ISLAND DIVISION

OPERATION AND MAINTENANCE MANUAL

**CLARK COUNTY, MISSOURI MISSISSIPPI RIVER
RIVER MILES 353.6 TO 358.5**

**UPPER MISSISSIPPI RIVER RESTORATION PROGRAM
HABITAT REHABILITATION AND ENHANCEMENT PROJECT**

MARCH 2016



**US Army Corps
of Engineers** ®
Rock Island District

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PREFACE

This Operation and Maintenance (O&M) manual is for the Fox Island Division Habitat Rehabilitation and Enhancement Project (HREP) located in the U.S. Fish and Wildlife Service (USFWS) Great River National Wildlife Refuge in Clark County, Missouri, on the Mississippi River. This O&M manual has been compiled by the U.S. Army Corps of Engineers (Corps), Rock Island District, to assist project sponsors in complying with the requirements for operating and maintaining the Fox Island Division HREP (Project).

The O&M manual provides essential operation and maintenance instructions and references to be used by personnel knowledgeable of the Project. The routine inspection program of the completed Federal project administered under the UMRR Program by the Corps is detailed in Section 10. Local inspection requirements and follow-up corrective action reporting are also listed. Additionally, the O&M manual serves as a reference document containing descriptions of the features involved in the original construction of the Project, the construction history, a copy of the Memorandum of Agreement between the USFWS and the Corps, and a listing of project points of contact.

Included within this O&M manual are copies of as-built drawings, a blank annual inspection report form and other references related to the Project.

The O&M manual should be periodically updated by the USFWS to incorporate best professional practices. The O&M manual will be updated by the Corps only following Federal action at the Project. All points of contact, websites and supplier information should be checked and verified on a yearly basis by the USFWS. Physical modifications and any operational changes impacting the Project must be approved and documented by the Corps. A copy of the routine inspections should also be attached to the O&M manual.

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1. GENERAL

1.1. Purpose. This Operation and Maintenance (O&M) manual describes the operation, maintenance and upkeep responsibilities for the Fox Island Division (FID) Habitat Rehabilitation and Enhancement Project (HREP). The instructions are consistent with the general procedures presented in the February 2008 Definite Project Report.

This manual serves to furnish the U.S. Fish and Wildlife Service (USFWS) with information and guidance to assist in the orderly and efficient use of the constructed features to meet project goals and objectives. Likewise, adequate maintenance of HREPs is required to ensure serviceability of project features. The intent of the maintenance instructions is to present preventative maintenance information consisting of systematic inspections and subsequent corrective actions, which should ensure long-term use. A timely preventative maintenance program reduces and prevents major damage to constructed features. The USFWS must maintain the Project in an acceptable condition as defined in this O&M manual and must conduct annual inspections.

This manual was written for personnel familiar with the FID HREP (Project) and does not contain detailed information which is common to site personnel or which is presented in other existing manuals or regulations. This manual provides the general standards of maintenance and establishes an initial frequency of maintenance inspections that should ensure satisfactory Project performance. Although this document is intended to call out the most salient issues, additional guidance for proper operation and maintenance is present in Corps guidance and policy documents.

Additionally the Corps provides clarification of proper operation and maintenance of Project features that may require efforts that are additional to those stated in this document. The Corps encourages an active dialogue between the Corps and the USFWS to indicate Corps policy clarifications that may have O&M implications for the Project.

Table 1.1 gives a brief history of the planning and construction process of the Project.

Table 1.1. Summary of Planning and Construction Activities

Project Phase	Purpose	Project Milestone	Date Completed
Pre-Project	Identify and define problems and establish need of project	Fact Sheet	Aug 2004
Engineering and Design	Quantify project objectives, perform preliminary design, satisfy NEPA ³ and permit requirements, develop performance evaluation plan, obtain project approval for construction	SHPO ¹ Concurrence	Dec 2005
		Draft DPR	Oct 2003
		DPR Public Review & EA ²	Jan 2005
		NEPA ³ Public Review	Feb 2005
		Obtain Section 401/404 Permits	Apr 2006
		Final DPR & EA	Feb 2008
		DPR Approval	Sep 2009
		Approve Plans and Specifications	July 2010
		OA with USFWS	Jun 2010
Construction	Finalize plans and specifications, obtain O&M agreement, advertise and award construction contracts, construct project	Request for Proposals	Sep 2010
		Award Contract	Oct 2010
		Notice to Proceed	Oct 2010
		Construction Substantially Complete	Jan 2015
		Final Inspection	Feb 2015

¹ State Historical Preservation Office

² Environmental Assessment

³ National Environmental Policy Act

Table 1.2 details the goals, objectives and features of the Project as laid out in the DPR. The DPR was prepared by Stanley Consulting in conjunction with the Corps project development team. Contract details are as follows:

Contract: Fox Island DPR

Number: DACW25-01-D-0008

Started: August 2002

Completed: February 2008

Contract Cost: \$205,954.00

Contractor: Stanley Consultants, Inc.
225 Iowa Avenue
Muscatine, Iowa 52761

Table 1.2. Project Goals, Objectives, and Features

Goals	Objectives	Project Features
Rehabilitate & Enhance Wildlife Habitat	Increase quality & quantity of existing wetlands	Construct channels connecting discrete sloughs, ponds, & swales Install two high-flow wells Construct water control structures for water control
	Reduce forest fragmentation & enhance species diversity	Plant 215 acres of container grown stock Plant 60 acres of direct seeding Allow natural reforestation in low-lying areas
	Restore native grassland	Seed part of Logsdon Tract with native grasses & forbs

The restoring native grasslands feature was not included in the construction contract.

1.2. Project Features. This section describes the Project, as it exists at the time of the O&M manual's printing. See Section 5 for a discussion on the history of the Project including construction and post- flood rehabilitation. The primary Project features are listed below. These features are shown generically in Figure 1.1 and more specifically in the plates found in Appendix A.

- **Access Roads.** Because the Fox River divides the Project site, two access roads were required. Abandoned County Road 322 was improved on the north end of the east side of the complex for access to Well H and Stoplogs A, B, C, and D. Abandoned County Road 317 was improved on the south end of the west side of the complex for access to Well G and Stoplog E.
- **Streambank Stabilization.** There were two areas adjacent to the Fox River that required streambank stabilization. There is approximately 600 feet of riprap on the right descending bank of the Fox River on the Mississippi-Fox River Drainage and Levee District levee. There is approximately 200 feet of riprap on the left descending bank of the Fox River adjacent to Stoplog C.
- **Wells, Pumps, and Turnarounds.** Well G is located on the west side of the complex. It has a design capacity of 1650 GPM. Well H is located on the east side of the complex. It has a design capacity of 1700 GPM.
- **Diesel Engine and Trailer.** There are two diesel engines to run the wells. The well pump drivers are trailer mounted. The trailer mounted engines are stored at the Clarence Cannon USFWS Refuge Office.
- **Water Control Structures.** There are three 36-inch reinforced concrete pipe (RCP) stoplogs on the east side of the Project (Stoplogs A, B, and D). There is one 36-inch RCP stoplog on the west side of the Project (Stoplog E). There is one 5-foot concrete box culvert where the entire east side of the complex drains into the Fox River (Stoplog C). The aluminum stoplogs

for all of the water control structures are stored at the Clarence Cannon USFWS Refuge Office when not in use.

- **Channels.** Channels A, B, C, and D on the east side of the complex allow water from Well H to reach Coin Pond, Slim Slough, and Old Lake. These channels also allow the ponds to be drained to Stoplog C. Channel F allows water from Well G to reach Logsdon Slough where it will ultimately drain to Stoplog E.
- **Ponds.** Pond excavation was performed in Coin Pond, and parts of Slim Slough and Old Lake. These trapezoidal channels varied in bottom width from 6' to 50'.
- **Mast Tree Plantings.** 241 acres of the Project site were planted with container grown tree stock (191 acres) and direct tree seed (50 acres). This was slightly less than the 275 acres laid out in the DPR and Table 1.2. Site conditions required some reconfiguring of the tree planting areas during construction.

1.3. Project Function. The Project is classified as a Habitat Rehabilitation and Enhancement Project that was federally constructed and is federally maintained. It was designed to expand and enhance existing wetlands by: constructing channels and wells to provide a reliable water source to the low lying areas of the Project site and constructing water control structures to control the water depth within those same areas. In addition, the objective to reduce forest fragmentation and enhance species diversity was achieved through planting 191 acres of container grown stock and planting 50 acres of direct seeding. These changes will increase the capability of USFWS to manage the FID for enhanced habitat.

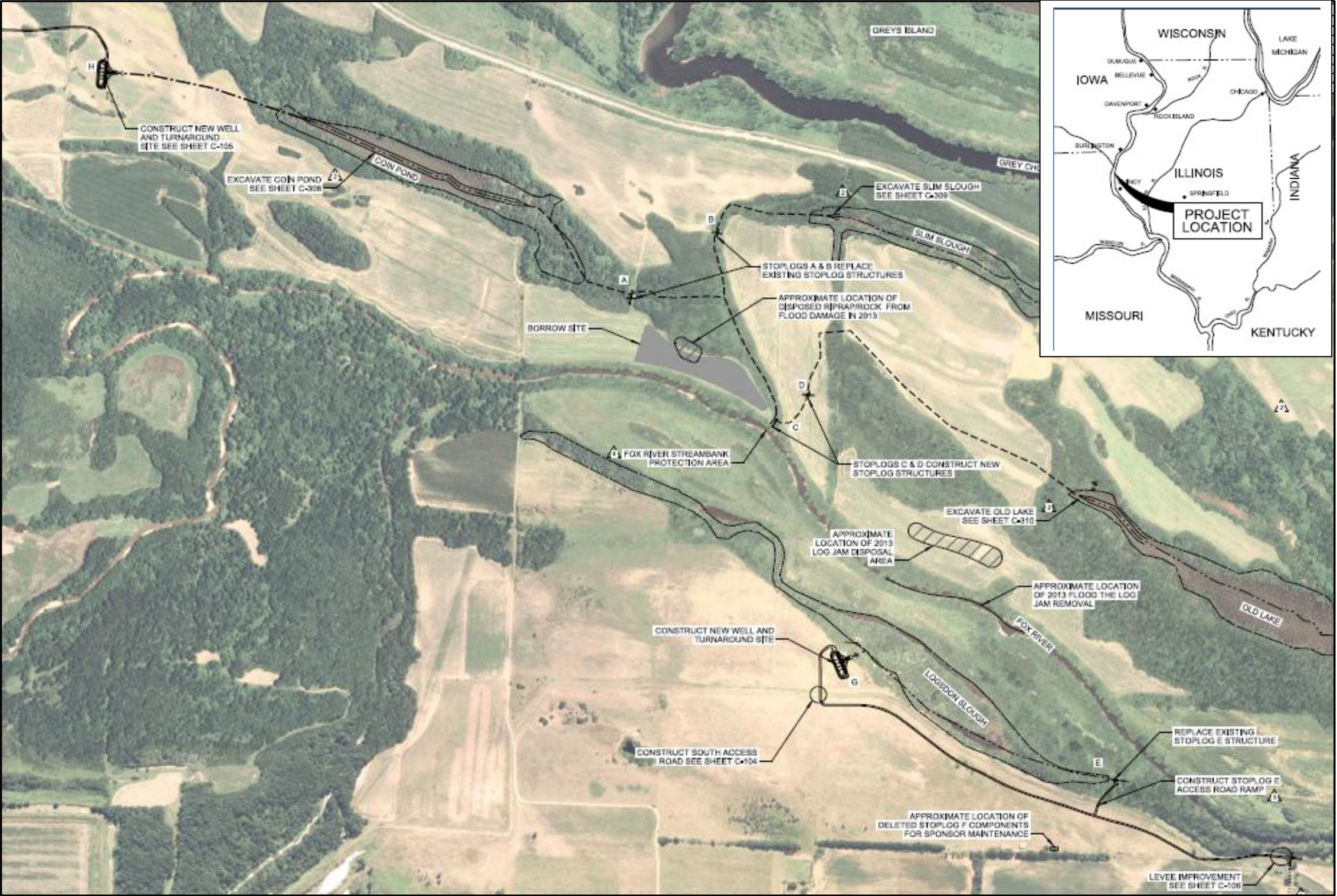


Figure 1.1. Fox Island Division Project Overview Map

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2. AUTHORIZATION

This O&M manual serves to meet the Department of the Army's requirements under:

- the 1985 Supplemental Appropriations Act [Public Law (PL) 99-88];
- Section 1103 of the Water Resources Development Act (WRDA) of 1986 (P.L. 99-662);
- Section 405 of WRDA 1990 (P.L. 101-640);
- Section 107 of WRDA 1992 (P.L. 102-580);
- Section 509 of WRDA 1999 (P.L. 106-53); and
- Section 8004 of WRDA 2007 (P.L. 110-114).

The U.S. Army Corps of Engineers, Rock Island District (District), funded and constructed the Project under these authorizations.

3. LOCATION

The Project is located on the USFWS's Great River National Wildlife Refuge. It is located in Clark County, Missouri, on the west bank of the Mississippi River, in Pool 20, approximately one mile downstream of Alexandria, Missouri. The Project extends from Mississippi River, river miles (RM) 353.6 to 358.5. The Project is in a rural setting. The constructed features of the Project lie within Township 64 North, Range 5 West, Clark County, Missouri. The 2,033 acre FID is made up of bottomland forests, fields, and sloughs. All Project lands are in Federal ownership and are managed by the USFWS as part of the National Wildlife Refuge System.

4. PERTINENT INFORMATION

4.1. References. Goals and objectives for habitat restoration at the Project were determined during the Corps planning phase and documented in the DPR (*Upper Mississippi River System Environmental Management Program Definite Project Report with Integrated Environmental Assessment, Stage II. Fox Island Division Habitat Rehabilitation and Enhancement Project*, February 2008). Manufacturer data sheets for the project components can be found in Appendix G. Refer to them when determining O&M requirements for the wells and trailer mounted pump drivers.

4.2. Hydrologic Data. Table 4.1 shows how river elevation (stage) for the FID and the surrounding areas relates to flooding potential. The record flood heights are listed in Table 4.2. The FID is bounded on the east by the Mississippi River. The Mississippi River at Gregory Landing, Missouri gage is 0.7 miles downstream of the Project. The Mississippi River at Lock and Dam 19 (Keokuk, Iowa) is 5.7 miles upstream of the Project. The closer gage should be used to aid in flood forecasting and preparation. In addition, the Fox River runs through the Project. The Fox River gage near Wayland, Missouri, can be used to monitor water levels in the Fox River; however, due to the nature of the Fox River watershed, water levels of the Fox River can rise rapidly and it is unlikely that there would be time for flood preparations to be made. It should be noted that the Mississippi River gages

are referenced to Mean Sea Level (MSL) 1912 datum and the tributary gage is referenced to National Geodetic Vertical Datum (NGVD) 1929 datum. The most accurate datum is North American Vertical Datum 1988. Each of these data is slightly different from the other, varying by a few tenths of a foot in elevation. For conversions from 1912 to one of the other data, use the values in Figure 4.1 with a River Mile of 358. The National Weather Service provides an online conversion tool between 1929 and 1988 data at the following location: <https://www.ngs.noaa.gov/TOOLS/Vertcon/vertcon.html>.

Table 4.1. River Elevation Effects¹

River Elevation (Stage)	Affected Areas
503.0 (30.29)	Top of Well G and Well H berms
498.0 (25.29)	Approximate height of Mississippi-Fox Levee
497.71 (25.0)	Major Flood Stage
490.71 (18.0)	Moderate Flood Stage
487.71 (15.0)	Flood Stage
487.0 (14.29)	Bottom of Well G discharge pipe
486.71 (14.0)	Action Stage
486.0 (13.29)	Bottom of Well H discharge pipe

¹ Based on the Mississippi River at Gregory Landing, Missouri gage, datum 472.71 ft MSL 1912

Table 4.2. Historical Top Five Crests

Date	Stage (ft)
07/09/1993	28.49
06/18/2008	27.6
04/24/1973	24.6
05/15/2001	24.04
04/20/2013	23.5

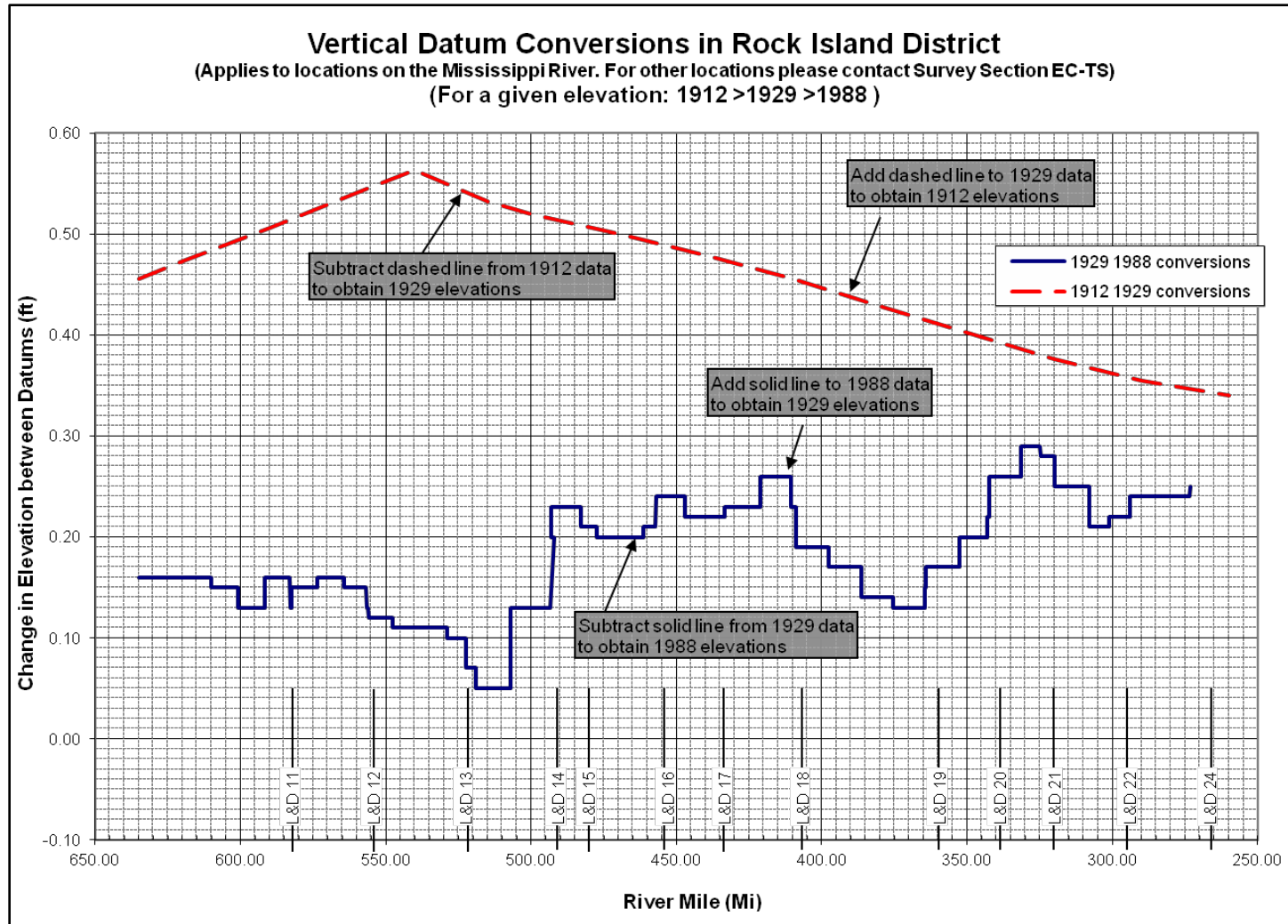


Figure 4.1. Approximate Vertical Datum Conversions in Rock Island District

4.3. River Gages Information. Information on current and future water levels can be obtained from the Corps website: **Error! Hyperlink reference not valid.** To select one of the Mississippi River gages, first select “Rock Island District” from the “Water Level By” drop down menu; then select “Mississippi River and Passes” from the “Rock Island District Basins” drop down menu; then select the desired gage from the list. The gages are listed from upstream to downstream.

Mississippi River at Gregory Landing, Missouri

- Gage Datum (zero elevation): 472.71 feet MSL 1912
- Flood Stage @ Gage: 15.0 feet
- River Mile: 352.9
- Location: Located on the downstream side of Gregory Landing, Missouri. On the right bank 40 feet riverward from the centerline of the levee.

To select the Fox River gage first select “Rock Island District” from the “Water Level By” drop down menu; then select “NE Missouri Rivers” from the “Rock Island District Basins” drop down menu; then select the “Fox River near Wayland, MO” gage.

Fox River near Wayland, Missouri

- Gage Datum (zero elevation): 501.52 feet NGVD29
- Flood Stage @ Gage: 15.0 feet
- River Mile: 15.2 miles above the mouth of the Fox River
- Location: Located in Clark County, Missouri. 0.8 miles west of Wayland on the left bank, 30 feet downstream of the bridge on U.S. Highway 136 and 5 miles downstream of Brush Creek.

4.4. National Weather Service Information. The National Weather Service also provides information on current and forecasted river levels. Their contact information is as follows:

National Weather Service – Quad Cities, IA/IL Weather Forecast Office

9050 Harrison Street
Davenport Municipal Airport
Davenport, IA 52806-7326
<https://www.weather.gov/dvn/>

5. CONSTRUCTION HISTORY

The Project was designed by the Corps. Design considerations and investigations are presented in the DPR dated February 2008. Goals and objectives were formulated during the DPR phase. Table 1.2 provides a summary of Project goals, objectives, and features. The Corps funded 100% of the Project construction. The As-Built drawings are in Appendix A.

Contract: *Fox Island Division Habitat Rehabilitation and Enhancement, Pool 20, Mississippi River, Clark County, Missouri*

Number: W912EK-10-C0122

Contractor: Kolb Grading, LLC
5731 Westwood Drive
Saint Charles, MO 63304

Started: October 29, 2010

Completed: February 20, 2015

Construction Cost: \$3,979,492.22

Contracting Officer's Representative: Rod Clausen

Design Engineers: Major Phil Valenti, Erica Stephens

Construction Engineers: DeWayne Diestelhorst, Mike Edwards

Eastern Area Resident Engineers: Jack McDaniel, Jeff Scukanec, Mike Edwards

5.1. Project Construction Modifications. There were 12 modifications to the original design that required engineering input. The following sections describe required changes to project features from the original design.

5.1.1. Mod 0028-North Access Road Improvement. The access road on the north end of the east side of the complex was re-routed from its original route along the rail road track due to a train derailment. The new route followed CR-322 (an abandoned county road) to access the site. The road design cross section was the same as the original plans.

5.1.2. Mod 0031-Revised Well Installation. Drill logs taken as part of the preparation of the plans and specifications showed fine to medium sand with gravel at the well sites. Based on these boring logs the well drilling subcontractor had planned to use the reverse rotary method. However, when drilling began at the wells, the subcontractor encountered large cobbles and boulders 10-12 inches in size. The well drilling subcontractor recommended switching to a dual rotary drilling process to better drill through the larger sub-surface material. The wells were successfully drilled with the dual rotary drilling process; however, this was an increased cost.

5.1.3. Mod 0033-Clay Liner Channel C. When excavating at Channel C a sand layer was observed. In order to ensure that Channel C would be able to convey water to Old Lake a 2-foot clay layer was added.

5.1.4. Mod 0034-Pond Channel Excavation. To account for additional sedimentation at the site since the design phase survey, excavation was performed in Coin Pond, Slim Slough, and Old Lake. To determine the amount of excavation needed, the Sponsor was consulted to determine the minimum water depth desired. Through a combination of raising the water control structures and additional excavation, the depth of water required for habitat requirements was achieved. Stoplog F and the channel connecting Old Lake and Slim Slough were also removed as part of this modification due to sedimentation in that area. Stoplog F had already been delivered before this modification was processed; it is located in a shed on the Logsdon Slough side of the project to be used for parts.

5.1.5. Mod 0035-Stoplog E Access Ramp. The original contract assumed access to Stoplog E would be possible between the toe of the Mississippi-Fox Levee and Drainage District and Logsdon Slough. However, when Logsdon Slough is at high water conditions access along the toe of the levee is not possible. This modification was to build a ramp over the Mississippi- Fox levee adjacent to the Stoplog E location.

5.1.6. Mod 0036-Streambank Protection. During construction it was observed that high water on the Fox River was eroding the streambank adjacent to the location of Stoplog C. To protect Stoplog C approximately 200 feet of riprap was added in this area.

5.1.7. Mod 0037-Upgrading County Road 317 Site Access. During construction it was determined that the sponsor would have difficulty accessing the west side of the Project due to the poor condition of the abandoned county road. A modification was completed to allow the sponsor an adequate access road for the west access point as well.

5.1.8. Mod 0038-Miscellaneous Site Changes. This modification was to address three issues that came up late in Project construction. First, the original design for the well discharge pipes at the well head included metal straps. It was determined that the straps were not sufficient to support the well head assembly. The design was revised to include an adjustable rigid pipe support anchored to a concrete pier. Second, the grate to access the aluminum stoplogs was lacking a handle so it was difficult to lift and was a pinch hazard if it fell while accessing the stoplogs. The contractor provided two lifting devices with a chain and hook to secure the grate in the open position. The third item was also added to improve safety for USFWS staff. The PTO shaft on the trailer that drives the well pump was originally uncovered, however, when the pump tests were being performed it was determined that a cover was needed to prevent the user from being caught in the turning shaft.

5.1.9. Mod 0039-Logjam Removal. The spring 2013 flood created a logjam just downstream of Stoplog C. This caused the inundation of the east side of the construction site. The logjam was removed in order to allow water to drain from the east side of the site and allow repairs from the flooding to be completed.

5.1.10. Mod 0040-First Season Containerized Tree Repairs. The spring 2013 flood event created flows that caused 40% of the first season of containerized mast tree stock to be damaged. Many of the trees were partially to entirely uprooted. An 80% establishment was needed to achieve the habitat goals of the Project. This modification allowed for the replanting of 1,200 containerized trees to replace those that did not survive the flooding. The replacement trees were 800 persimmon and 400 northern pecan.

5.1.11. Mod 0042-Stoplog C Berm and Channel Excavation. The spring 2013 flood caused significant erosion where the Fox River overtopped near Stoplog C. There was also siltation within the channels. This modification covered these repairs and added a berm between Stoplog C and the Fox River so overtopping events in the future would not damage project features.

5.1.12. Mod 0043-Grouted Riprap and Miscellaneous Site Repairs. In order to have the water control structures be more resilient when the Project floods, grout was added to the surrounding riprap.

5.2. Project Costs. Table 5.1 is an inventory of the final project costs.

Table 5.1. Actual Project Costs

Item	Description	Quantity	U/M	Unit Price	Amount
Contract Line Items					
0001	Clearing and Grubbing	1	LS ¹		\$350,000.00
0002	Abandon Existing Well	1	LS		\$7,515.00
0003	Excavation				
0003AA	First 64,000 CY	57,979	CY ²	\$7.50	\$434,842.50
0003AB	Over 64,000 CY	0	CY	\$7.50	\$0.00
0004	Remove Existing Stoplog Structure A	1	LS		\$10,000.00
0005	Remove Existing Stoplog Structure B	1	LS		\$10,000.00
0006	Remove Existing Stoplog Structure E	1	LS		\$10,000.00
0007	Construct New Stoplog Structure A	1	LS		\$50,000.00
0008	Construct New Stoplog Structure B	1	LS		\$52,893.63
0009	Construct New Stoplog Structure C	1	LS		\$60,000.00
0010	Construct New Stoplog Structure D	1	LS		\$52,893.63
0011	Construct New Stoplog Structure E	1	LS		\$50,000.00
0012	Construct New Stoplog Structure F	1	LS		\$17,316.14
0013	Stone Protection, Bedding Stone				
0013AA	First 450 Tons	450	TN ³	\$30.00	\$13,500.00
0013AB	Over 450 Tons	59.62	TN	\$50.00	\$2,981.00
0014	Stone Protection, Riprap				
0014AA	First 1,500 Tons	1,150.25	TN	\$40.00	\$46,010.00
0014AB	Over 1,500 Tons	0	TN	\$40.00	\$0.00
0015	Construct New Well G	1	LS		\$214,718.46
0016	Construct New Well H	1	LS		\$216,157.46
0017	Concrete Pads and Bollards at Wells	1	LS		\$25,000.00
0018	New Access Road Construction	1	LS		\$66,746.79
0019	New Access Road Separation Fabric	1	LS		\$74,333.20
0020	New Access Road Granular Surfacing				
0020AA	First 6,000 Tons	5,768.40	TN	\$17.30	\$99,793.32
0020AB	Over 6,000 Tons	577.61	TN	\$17.30	\$9,992.65
0021	Seeding	1	LS		\$190,000.00
0022	Provide New Pump Drivers	2	EA ⁴	\$25,000.00	\$50,000.00
0023	Cover Crop Grass Seeding				
0023AA	First 230 Acres	230	AC ⁵	\$650.00	\$149,500.00
0024	Containerized Tree Planting, First Season				
0024AA	First 85 Acres	85	AC	\$1,900.00	\$161,500.00
0024AB	Over 85 Acres	15	AC	\$1,900.00	\$28,500.00

¹LS=Lump Sum

²CY=Cubic Yard

³TN=Ton

⁴EA=Each

⁵AC=Acre

Item	Description	Quantity	U/M	Unit Price	Amount
0025	Direct Tree Seeding, First Season				
0023AB	Over 230 Acres	37	AC	\$650.00	\$24,050.00
0025AA	First 25 Acres	25	AC	\$1,350.00	\$33,750.00
0025AB	Over 25 Acres	0	AC	\$1,350.00	\$0.00
0026	Containerized Tree Planting, Second Season				
0026AA	First 85 Acres	76.05	AC	\$1,900.00	\$144,500.00
0026AB	Over 85 Acres	15	AC	\$1,900.00	\$28,500.00
0027	Direct Tree Seeding, Second Season				
0027AA	First 25 Acres	24.80	AC	\$1,350.00	\$33,480.00
0027AB	Over 25 Acres	0	AC	\$1,350.00	\$0.00
Contract Modifications					
0028	North Access Road Improvement	1	LS		\$34,154.54
0029	In House Surveying Effort	1	LS		\$1,800.00
0030	Pond Survey	1	LS		\$46,516.83
0031	Revised Well Installation	1	LS		\$174,904.15
0032	Pond Channel Excavation-Tree Clearing	1	LS		\$16,000.30
0033	Clay Liner Channel C	1	LS		\$215,690.06
0034	Pond Channel Excavation	1	LS		\$121,237.18
0035	Stoplog E Access Ramp	1	LS		\$15,501.30
0036	Streambank Protection	1	LS		\$56,930.50
0037	Upgrading County Road 317 Site Access	1	LS		\$65,500.00
0038	Miscellaneous Site Changes	1	LS		\$5,500.00
0039	Logjam Removal	1	LS		\$234,835.35
0040	First Season Containerized Tree Repairs	1	LS		\$48,850.28
0042	Stoplog C Berm and Channel Excavation	1	LS		\$107,391.95
0043	Grouted Riprap and Misc Site Repairs	1	LS		\$120,506.00
0044	Delete Mulch (20 AC) Due to Weather	1	LS		\$-4,000.00
Construction Total					\$3,979,792.22
Definite Project Report					\$1,264,680.82
Plans and Specifications					\$183,839.61
Engineering and Design During Construction					\$326,438.92
Construction Management					\$673,782.84
O&M Manual					\$43,460.421
PROJECT TOTAL					\$6,471,994.83

¹LS=Lump Sum² CY=Cubic Yard³ TN=Ton⁴ EA=Each⁵ AC=Acre

6. PROJECT PERFORMANCE

The extent and quality of bottomland forests, wetlands, and floodplain grasslands along the UMR have been steadily declining due to past and ongoing pressure from human development of the floodplain and hydrologic alteration of the UMR and its basin tributaries. Historically, the Project

area has provided substantial benefits to waterfowl and other wetland wildlife. Prior to construction, the Project area's wetlands and water bodies had filled with sediment from floodwaters of the Mississippi and Fox Rivers, reducing their size and habitat value. Many forested areas and native grasslands in the floodplain were cleared to create farmland prior to USFWS management, resulting in reduced species diversity and smaller tract size, which contributed to habitat fragmentation and degradation of their function as wildlife habitat.

The goal of this Project was to rehabilitate and enhance wildlife habitat. The following objectives and enhancement measures were implemented to achieve this goal.

Objective 1: Reduce Forest Fragmentation and Enhance Species Diversity

Enhancement Feature 1: Establish hardwood, mast producing forests

Performance Status 1: 241 acres of mast trees were planted using container grown stock and direct seeding. These trees will serve as a seed source for natural re-vegetation, improve floodplain habitat for resident and migratory birds, and expand habitats for mast consuming species.

Enhancement Feature 2: Allow natural reforestation in low-lying areas

Performance Status 2: 580 acres of low-lying cropland and open land were allowed to naturally reforest, which will reduce forest fragmentation and benefit forest dwelling species that require larger continuous tracts of forest.

Objective 2: Increase Quality and Quantity of Existing Wetlands

Enhancement Feature 3: Enhance water supply, distribution, and control for wetlands. Logsdon Slough, Coin Pond, Slim Slough, and Old Lake were enhanced by providing two wells, improving channels, and installing five water control structures

Performance Status 3: Channels were constructed to connect the existing wetlands to each other and the new wells. This will increase the wetlands at Fox Island from 15 acres to 78 acres. These expanded wetlands will provide additional protected resting and feeding areas for resident and migratory birds. Many of the wetlands in the Project area are also capable of sustaining perennial aquatic habitat. This has resulted in an abundance of fishes, frogs, and turtles, as well as the birds and mammals that feed on them. The increased water control made possible through this Project would ensure that those populations can survive dry spells.

Objective 3: Restore Native Grassland

Enhancement Feature 4: This project feature was not constructed.

Performance Status 4: None

7. PROJECT COOPERATION AGREEMENT

The Corps and the USFWS have entered into a Memorandum of Agreement (MOA) for this Project on June 25, 2010 as required by P.L. 99-662. A copy of the duly executed MOA is included in Appendix B.

As set forth in the MOA, the USFWS has agreed to maintain and operate, at no cost to the Corps, the Project including all the repaired or restored Project features in accordance with Section 107(b) of the WRDA of 1992, P.L. 102-580.

8. OPERATION

8.1. Operation Responsibilities

8.1.1. U.S. Fish and Wildlife Service Responsibilities. The USFWS is responsible for the operation of all Project features in accordance with the MOA and the environmental management regulations contained in WRDA 2007. The USFWS shall be responsible for developing and sustaining a program that will operate the Project and its features.

8.1.2. U.S. Army Corps of Engineers Responsibilities. The Corps is responsible for administration of the HREP Rehabilitation Program in accordance with current laws and Corps policies.

8.2. Project Features Requiring Operation. Operation of water supply and water control equipment is primarily intended to mimic the historic hydrologic regime in the UMR. This regime is normally characterized by a high spring flood pulse, followed by a period of low flow and low water levels during the summer months, and then a second, smaller flood pulse in the fall. To that effect, the wetlands may be partially drained after spring floods to allow plant growth to provide food for waterfowl. These areas would then be re-flooded in the fall to provide protected resting and feeding areas. Fluctuating water levels will provide a wider variety and more dependable supply of food. Widely varying flow conditions and events as well as fall rain conditions would result in variations in operations.

8.2.1. Wells. The well pumps are operated by trailer mounted diesel engines and fuel tanks. The step by step instructions for operating the pump drivers were provided to the sponsor after their training by the construction contractor. They are also provided in Appendix G.

8.2.1.1. Well G. In order to inundate the 25 acres of Logsdon Slough at elevation 484.5, Well G will need to be operated for approximately 7 days.

8.2.1.2. Well H. In order to inundate the 53 acres of the Coin Pond-Slim Slough-Old Lake Complex at elevation 484.0, Well H will need to be operated for approximately 15 days.

8.2.2. Water Control Structures

8.2.2.1. Stoplog E. In order to inundate Logsdon Slough, the aluminum stoplogs will need to be installed prior to pumping at Well G. The aluminum stoplogs will need to be removed to allow Logsdon Slough to be drained.

8.2.2.2. Stoplogs A, B, D, and C. In order to inundate the Coin Pond-Slim Slough-Old Lake Complex, the aluminum stoplogs will need to be installed at Stoplog C prior to pumping at Well H. Stoplogs A, B, and D can be left open if a consistent water level is desired on the east side of the Project, or can be installed to allow for a variety of water levels.

9. EMERGENCY OPERATIONS

The Project is designed to utilize natural flood events to create the desired habitat benefits; therefore, the features are designed to withstand high water with minimal damages. The trailer mounted pump drivers should be removed from the floodplain area prior to anticipated high water events of greater than El 487.71.

10. MAINTENANCE AND INSPECTION

10.1. Maintenance Responsibilities

10.1.1. U.S. Fish and Wildlife Service Responsibilities. The USFWS is responsible for the maintenance of all Project features in accordance with the MOA and the environmental management regulations contained in WRDA 2007. The USFWS shall be responsible for developing and sustaining a program that will operate and maintain the Project and its features.

10.1.2. U.S. Army Corps of Engineers Responsibilities. The Corps is responsible for administering the HREP in accordance with current laws and Corps policies.

10.2. Maintenance. An active preventative maintenance program reduces damage to existing Project features by taking early corrective action. Additional costs associated with repair and rehabilitation can also be avoided. Regular maintenance repair measures will be accomplished during the appropriate season as scheduled by the refuge manager to ensure structure serviceability. Table 10.1 establishes an estimated O&M cost for the Project. It includes both the O&M agreed on in the DPR and additional recommended O&M actions due to changes to the Project during construction.

10.2.1. Tree Planting Area-Weed Control (first 3 years). To maximize survival rates for the tree planting areas, it is recommended that both the direct seed and containerized tree planting areas be mowed or sprayed regularly to prevent weeds from overwhelming the new saplings. Tree plantings took place in late fall 2012 and late fall 2013. See Appendix A for the layout of plantings. The construction contractor performed maintenance mowing until the final inspection in February 2015.

At that point weed control became the responsibility of the USFWS.

10.2.2. Pump Equipment. The pumps, trailer mounted diesel engines, and right angle drives will need regular maintenance to ensure proper operation for the life of the project. See manufacturer's Operations and Maintenance requirements in Appendix G for each component of the pump drive systems.

10.2.3. Roadway Surface. The Project access roads were improved during the construction contract. Regular grading and gravel replacement will be needed to provide continuous access to the site.

10.2.41. Water Control Structures. In order for the wetland features to be filled and drained the stoplogs need to be unobstructed. This will require that debris be removed from the gates prior to operating the wells.

10.2.5. Well Maintenance. The two project wells require annual maintenance in order to perform properly for the life of the Project.

- Perform annual well and pump performance tests to evaluate the hydraulic performance of both the wells and the pumping equipment.
- Collect annual biological activity reaction test system samples and evaluate the presence, absence, and extent of slime forming, sulfate reducing or iron forming bacteria which can be naturally present in the aquifer.
- Evaluate the accuracy and functionality of instrumentation including gauges, meters, air lines, check valves, gate valves, etc.
- Check and record vibration of the rotating equipment, pump, and gear drive.

10.2.6. Channel and Pond Clean Out/Excavation. The refuge manager shall make annual observations of the channels, Coin Pond, Old Lake, Slim Slough, and Logsdon Slough to determine the approximate depth and to observe any significant sedimentation. Some excavation in the channels may be required to allow for water exchange throughout the system. Care needs to be taken to ensure that excavation in Channel C does not go through the clay liner and into the sand lens below.

10.2.7. Weed Control. While growth of trees may be beneficial throughout much of the Project, the channels and riprap areas should be managed to ensure the Project will function as designed. Suggested methods for management include spraying to minimize growth in riprap and cutting trees less than 12 inches in diameter.

10.2.8. Riprap-Replacement. The riprap areas adjacent to the Fox River and at the water control structures are designed for the 50 year life of the Project. Therefore, approximately 20% of the riprap will need to be replaced every 10 years.

Table 10.1. Estimated Annual O&M Costs

Item	Quantity (2008)	Unit (2008)	Unit Price (2008)	Total Cost (2008)	Quantity (2015)	Unit (2015)	Unit Price (2015)	Total Cost (2015)
Operation								
Pump Operation	1,400	Hr	\$2.50	\$3,500.00	1,400	Hr	\$9.40	\$13,160.00
Stoplog Installation					20	Hr	\$33.00	\$660.00
Maintenance								
Tree Planting Area-Weed Control (first 3 yrs)	275	Acre	\$20.00	\$5,500.00	241	Acre	\$30.50	\$7,350.50
Pump Equipment	60	Hr	\$25.00	\$1,500.00	60	Hr	\$33.00	\$1,980.00
Roadway Surface	1250	LF	\$5.00	\$6,250.00	1310	LF	\$8.00	\$10,480.00
Water Control Structures	84	Hr	\$25.00	\$2,100.00	84	Hr	\$33.00	\$2,772.00
Well Maintenance					10	Hr	\$33.00	\$330.00
Well Maintenance-BARTS					1	Test	\$1,000.000	\$1,000.00
Well Maintenance-Pump Test					1	Test	\$2,500.00	\$2,500.00
Channel and Pond Clean Out/Excavation	80	Hr	\$90.00	\$7,200.00	80	Hr	\$104.00	\$8,320.00
Weed Control					40	Hr	\$36.00	\$1,440.00
Riprap-Replacement					39.4	TN	\$40.00	\$1,576.00
Rehabilitation¹								\$0
SUBTOTAL				\$26,050.00			SUBTOTAL	\$51,568.50
Contingencies (20%)				\$5,210.00			Contingencies (20%)	\$10,313.70
TOTAL				\$31,260.00			TOTAL	\$61,882.20

¹ Rehabilitation cannot be accurately measured. Rehabilitation is the reconstructive work that significantly exceeds the annual O&M requirements identified above and that is needed as a result of major storms or flood events.

10.3. Inspections. Routine inspections can aid USFWS officials in discovering deficiencies within the Project. They can also provide USFWS officials with baseline condition data. The two types of inspections for the Project are: (1) routine inspections by the refuge manager and (2) joint inspections by the refuge manager and the Corps following a flood event.

Steps will be taken by the refuge manager to correct conditions disclosed by routine inspections and joint inspections.

10.3.1. Routine Inspections. The Project inspection should be performed by the refuge manager or an appropriate representative for the purpose of noting routine deficiencies and initiating corrective actions. This inspection will be performed at periods not exceeding 12 months and will follow inspection guidance presented in subsequent sections of this manual. It is suggested that the inspection be conducted every June, which is representative of after-spring flood conditions. Additional Project inspections should occur as necessary after high water events or as scheduled by the refuge manager. A Project inspection checklist is included in Appendix D. The refuge manager shall furnish a copy of the completed checklist immediately following each Project inspection to:

U.S. Army Corps of Engineers, Rock Island District
Clock Tower Building
ATTN: HREP Manager, CEMVR-PM-M
P.O. Box 2004
Rock Island, Illinois 61204-2004

10.3.2. Post-Flood Inspections. USFWS shall compile a post-flood report and forward one copy to the District Engineer, indicating in writing an official request for assistance if needed. This report shall serve as a request for assistance to receive rehabilitation support from the Corps under the HREP program. The report shall include:

- a complete history of the flood event, including any damages sustained to the Project;
- all operation and maintenance logs;
- a daily tabulation of river stages (river stages can be calculated by installing a gaging station, checking the nearest river gage, or using a level rod off the side of the bridge);
- a discussion of pertinent factors in operating and maintaining the Project, such as problems encountered during operation and maintenance, weather conditions (including ice effects), damage incurred, and repairs required;
- a summary of the number, time, and cost of manpower and the quantities and costs of supplies and equipment the risk management effort required;
- any other useful information.

The refuge manager shall also request a joint inspection with the District immediately following a specific storm or flood event which causes damage exceeding the annual O&M as specified in this manual and the DPR. The purpose of this inspection is to assure that adequate maintenance is being performed as presented in the DPR and this manual. The District Engineer or authorized representative should have access to all portions of the constructed Project upon coordination with the refuge manager for this purpose. The routine inspections by the refuge manager, joint post-flood inspections results, and the post-flood report will be the basis for determining maintenance responsibility and potential rehabilitation by the District. The Corps will maintain records of all inspection reports for a minimum of 10 fiscal years, or longer if warranted or needed for historical purposes.

10.3.3. Inspection Timeline. Table 10.2 presents a general guideline of the proposed schedules for inspection of the Project. The actual schedule will vary due to unforeseen conflicts, individual schedule constraints, and weather.

Table 10.2. Inspection Timeline

Timeframe	Action
Late spring/summer	USFWS routine inspection
45 days after inspection	USFWS forwards report to the Corps
After all major flood events	Corps and USFWS joint, post-flood event damage inspection

11. MONITORING PLAN

An effective monitoring program is required to determine whether the Project outcomes are consistent with original Project goals and objectives. The DPR included a post-construction evaluation plan which is summarized in Table 11.1. However, site conditions experienced during construction as well as project modifications required a revised monitoring plan. This is shown in Table 11.2.

Table 11.1. Post-Construction Evaluation Plan (2008)

Objective	Enhancement Feature	Unit	Year 1	Year 25	Year 50	Feature Measurement
Increase quality and quantity of existing wetlands	Enhance water supply, distribution, and control for wetlands	Acres	78	75	70	Aerial photo of inundated area on October 31
Reduce forest fragmentation and enhance species diversity	Plant container-grown trees	% Survival	95	45	40	Tree Count
	Direct seed hardwood trees	% Survival	65	15	4	Tree Count
	Allow natural reforestation in low-lying areas	Acres	50	200	345	Aerial photo of reforestation
	Bank Protection	Linear feet of bank protection	50	50	50	Surveys, inspection, and mapping

Table 11.2. Post-Construction Evaluation Plan (2015)

Objective	Enhancement Feature	Unit	Year 1	Year 10	Year 25	Year 50	Feature Measurement
Increase quality and quantity of existing wetlands	Enhance water supply, distribution, and control for wetlands	Acres	78	76	75	70	Estimate of inundated area at end of seasonal pumping based on LIDAR and water level elevation
							Pump/Seep analysis to determine loss to groundwater
							Survey to establish channel/pond sedimentation rate
							Moist Soil monitoring (Invasive Species Assessment)
Reduce forest fragmentation and enhance species diversity	Plant container grown trees	% Survival	95	60	45	40	Tree Count and HEC-EFM analysis
							Moist Soil monitoring (Invasive Species Assessment)
	Direct seed hardwood trees	% Survival	65	30	15	4	Tree Count and HEC-EFM analysis
							Moist Soil monitoring (Invasive Species Assessment)
	Natural reforestation	Stems/acre	NA	75	350	100	Aerial photo of reforestation pre-inundation and HEC-EFM analysis
							Moist Soil monitoring (Invasive Species Assessment)
	Bank protection	% Intact riprap if no repairs are made	98	80	50	0	Inspection of riprap areas
							Survey of riprap areas

The following monitoring plan covers the first 10 years of project operation. At the end of this initial monitoring period, the Project Development Team will use the collected data to determine the monitoring for years 10-20 and make recommendations for monitoring through year 50.

11.1. Enhancement Feature Details

11.1.1 Enhance Water Supply, Distribution, and Control for Wetlands

Feature Measurement 1 - Estimate inundated area at the end of seasonal pumping based on LIDAR, ground survey, and water level elevation. This evaluation will be completed at years 1, 3, 5, and 10 post-construction.

Criteria. The wetland component will be determined to be successful if the following amounts of inundated acres are achieved: 78 acres by year 1; 75 acres by year 25; and 70 acres by year 50.

Monitoring Design. Maximum water level elevations will be recorded at the end of the seasonal pumping.

Analysis and Use of Monitoring Results. The maximum water elevations will be overlaid on the survey data (within the channels and ponds) and LIDAR (in areas where the water overflows the channels) to create a model of the inundated volume in MicroStation. The top of the surface created will then be measured to capture the maximum inundated area.

Feature Measurement 2 - Perform a pump/seepage analysis to determine the loss of pumped water to the groundwater table. This evaluation will be completed at years 1, 3, 5, and 10 post-construction.

Criteria. The design pumping rates should allow for the filling of Logsdon Slough in 7 days and the Coin Pond-Slim Slough-Old Lake Complex in 15 days. The channels and sloughs should be capable of maintaining the water levels until the end of the fall waterfowl migration period.

Monitoring Design. Once the wetlands are filled to the desired elevation, the water levels will be recorded daily until the end of the fall waterfowl migration period—at which time the stoplogs will be removed—or until the water level within the complexes equalizes with the water table.

Analysis and Use of Monitoring Results. The daily water elevations will be overlaid on the survey data (within the channels and ponds) and LIDAR (in areas where the water overflows the channels) to create a model of the inundated volume in MicroStation. The daily elevations will allow the CADD technician to calculate the change in water volume. This difference will be attributed to water loss to the groundwater table.

Feature Measurement 3 - Survey the ponds and channels to determine the sedimentation rate.

This evaluation will be completed at years 3, 5, and 10 post-construction.

Criteria. The sedimentation rate at Fox Island was calculated to be 2/3" per year in the DPR. Periodic surveys will allow for verification of this over the first 10 years of project operation.

Monitoring Design. Cross sections of the channels and sloughs will be performed at 200-foot increments.

Analysis and Use of Monitoring Results. The cross sections will be used to determine areas of sedimentation that will need to be cleared in order to maintain hydraulic function of the wetland areas. The sponsor will complete this channel clean out/excavation as part of their operation and maintenance responsibilities.

Feature Measurement 4 - Invasive plant species monitoring will be performed. This evaluation will be completed at years 5 and 10 post-construction. Invasive plant species potentially occurring in the Project area are mostly non-native, but native species that have the potential to form monotypic stands resulting in decreased overall species diversity also may be considered invasive as related to this feature measurement.

Criteria. Moist soil management areas and active reforestation sites will be inspected to identify the presence or absence of invasive plant species and estimate the percent coverage of invasives if present. Invasive species reduction/management will be determined successful if coverage of all invasive species present does not exceed 30% by year 5 or 25% by year 10.

Monitoring Design. Moist soil management units and reforestation sites will be monitored by ground inspection and/or aerial photography as practicable. Invasive species coverage will be estimated by separate tract. Monitoring strategies and sample designs should be designed to generally follow guidelines being developed by the USFWS's National Wildlife Refuge System for collecting information to be used in assessing and prioritizing the management of invasive plants on their lands. At present the Refuge does not have a formalized protocol or plan for monitoring or managing invasives, but uses mowing or chemical applications to control them when/where they occur. It is anticipated that invasives will not be a problem in the wetland/moist soil management feature, and that water level management or targeted chemical applications could be used to control any invasives that may occur there.

Analysis and Use of Monitoring Results. The results of this monitoring effort will be used to assess the success of the biological response to the physical restoration measures implemented as part of this restoration project and to evaluate the level of success in meeting project goals and objectives during the first decade after construction. The information obtained during this monitoring also should provide an indication of the Project's potential for meeting goals and objectives over the long term (25-50 years).

11.1.2. Plant Container-Grown Trees

Feature Measurement 1 - Container-grown tree count and HEC-EFM analysis. This evaluation will be completed at years 1 and 10 post-construction.

Criteria. The container-grown tree component will be determined to be successful if the following survival rates are achieved: 95% by year 1; 60% by year 10; 45% by year 10 and 40% by year 50.

Monitoring Design. This site has risk to tree survivorship for planted tree stock and natural tree recruitment due to soil conditions, elevation change, and hydraulic variability. Tree species were planted randomly and evenly across the entire planting area without directive to avoid species being planted in specific locations. All eight tree species that were selected for planting on these sites are suitable for establishment and survivorship under the planting sites normal conditions and rain events. Environmental extremities of drought and severe flooding will greatly reduce the survivability of any of the selected tree species planted in direct correlation to duration of the flood event and change to localized soil conditions and elevation change. To best capture the planting site's capabilities and limits to tree survivorship of planted stock, sampling will be done in a transect pattern across the entire site. Transects will be stratified prior to data collection in the field. The field crew will sample the nearest two rows of planted trees to the predetermined transect. All planted trees in the determined transect row will have the following information collected: tree species, height category, health, development condition, and GPS location.

Natural tree recruitment will be sampled by stratified, fixed 1/1000th acre plots across the entire site. These plot locations will be predetermined prior to data collection in the field. The location of these plots will be evenly distributed directly on the transect lines; 40 plots will be sampled in total. All trees greater than 1' in height will have the following information collected: tree species, height category, health, and development condition. Additionally, at each fixed plot location a soil sample will be collected; 40 soil samples in total. The elevation information for the planting sites will be found using LiDAR remote sensing information. The LiDAR will be validated from work conducted during survey efforts pre- and post-construction of the Project.

Analysis and Use of Monitoring Results. The results of this monitoring effort will be used to determine reforestation survival and condition to date for the 191 acres of planted RPM containerized tree stock and to determine what factors most affected tree survival on the containerized tree stock and provide tree survival numbers by significant factor/stratification. Examples include species utilized, flood duration/elevation, soil type/parameter, and/or year planted. The results will be used to calibrate HEC-EFM to determine if the model would have been a good predictor of survival at Fox Island.

Feature Measurement 2 - Invasive plant species monitoring will be performed. This evaluation will be completed at years 5 and 10 post-construction. Invasive plant species potentially occurring in the Project area are mostly non-native, but native species that have the potential to form monotypic stands resulting in decreased overall species diversity also may be considered invasive as related to this feature measurement.

Criteria. Moist soil management areas and active reforestation sites will be inspected to identify the presence or absence of invasive plant species and estimate the percent coverage of invasives if present. Invasive species reduction/management will be determined successful if coverage of all invasive species present does not exceed 30% by year 5 or 25% by year 10.

Monitoring Design. Moist soil management units and reforestation sites will be monitored by ground inspection and/or aerial photography as practicable. Invasive species coverage will be estimated by separate tract. Monitoring strategies and sample designs should be designed to generally follow guidelines being developed by the USFWS's National Wildlife Refuge System for collecting information to be used in assessing and prioritizing the management of invasive plants on their lands. With regard to the reforestation areas, specifically reed canary grass is expected to invade these areas, but for the actively planted areas with the taller container-grown trees, canary grass is not anticipated to be an impediment to their survival or growth. Canary grass is much more likely to be a problem in the natural reforestation areas, where the species may need to be controlled by selective mowing or chemical application.

Analysis and Use of Monitoring Results. The results of this monitoring effort will be used to assess the success of the biological response to the physical restoration measures implemented as part of this restoration project, and to evaluate the level of success in meeting project goals and objectives during the first decade after construction. The information obtained during this monitoring also should provide an indication of the Project's potential for meeting goals and objectives over the long term (25-50 years).

11.1.3. Direct Seed Hardwood Trees

Feature Measurement 1 - Direct tree count and HEC-EFM analysis. This evaluation will be completed at year 10 post-construction.

Criteria. The direct tree component will be determined to be successful if the following survival rates are achieved: 65% by year 1; 30% by year 10; 15% by year 25; and 4% by year 50.

Monitoring Design. This site has risk to tree survivorship for direct seeded trees and natural tree recruitment due to soil conditions, elevation change, and hydraulic variability. Tree species were planted randomly and evenly across the entire planting area without directive to avoid species from being planted in specific locations. All tree species that were selected for planting on these sites are suitable for establishment and survivorship under the planting site's normal conditions and rain events. Environmental extremities of drought and severe flooding will greatly reduce the survivability of any of the selected tree species planted in direct correlation to duration of the event and change to localized soil conditions and elevation change. To best capture the planting site's capabilities and limits to tree survivorship of planted stock, sampling will be done in a transect pattern across the entire site. Transects will be stratified prior to data collection in the field. The field crew will sample all planted trees 3 feet out from both sides of the predetermined transect. All planted trees in the determined transect row will have the following information collected: tree species, height category, health, development condition, and GPS location.

Natural tree recruitment will be sampled by stratified, fixed 1/1000th acre plots across the entire site. These plot locations will be predetermined prior to data collection in the field. The location of these plots will be evenly distributed directly on the transect lines; 12 plots will be sampled in total. All trees greater than 1 foot in height will have the following information collected: tree species, height category, health, and development condition. Additionally, at each fixed plot location a soil sample will be collected; 12 soil samples in total. The elevation information for the planting sites will be found using LiDAR remote sensing information. The LiDAR will be validated from work conducted during survey efforts pre and post construction of the Project.

Analysis and Use of Monitoring Results. The results of this monitoring effort will be used to determine reforestation survival and condition to date for the 60 acres of direct seeded tree stock and to determine what factors most affected tree survival on the direct seeded trees and provide tree survival numbers by significant factor/stratification. Examples include species utilized, flood duration/elevation, soil type/parameter, and/or year planted. The results will be used to calibrate HEC-EFM to determine if the model would have been a good predictor of survival at Fox Island.

Feature Measurement 2 - Invasive plant species monitoring will be performed. This evaluation will be completed at years 5 and 10 post-construction. Invasive plant species potentially occurring in the Project area are mostly non-native, but native species that have the potential to form monotypic stands resulting in decreased overall species diversity also may be considered invasive as related to this feature measurement.

Criteria. Moist soil management areas and active reforestation sites will be inspected to identify the presence or absence of invasive plant species and estimate the percent coverage of invasives if present. Invasive species reduction/management will be determined successful if coverage of all invasive species present does not exceed 30% by year 5 or 25% by year 10.

Monitoring Design. Moist soil management units and reforestation sites will be monitored by ground inspection and/or aerial photography as practicable. Invasive species coverage will be estimated by separate tract. Monitoring strategies and sample designs should be designed to generally follow guidelines being developed by the USFWS's National Wildlife Refuge System for collecting information to be used in assessing and prioritizing the management of invasive plants on their lands. With regard to the reforestation areas, specifically reed canary grass is expected to invade these areas, but for the actively planted areas with the taller container-grown trees, canary grass is not anticipated to be an impediment to their survival or growth. Canary grass is much more likely to be a problem in the natural reforestation areas, where the species may need to be controlled by selective mowing or chemical application.

Analysis and Use of Monitoring Results. The results of this monitoring effort will be used to assess the success of the biological response to the physical restoration measures implemented as part of this restoration project, and to evaluate the level of success in meeting project goals and objectives during the first decade after construction. The information obtained during this monitoring also should provide an indication of the Project's potential for meeting goals and objectives over the long term (25-50 years).

11.1.4. Natural Reforestation

Feature Measurement 1. Aerial photo and HEC-EFM analysis. This would restore the extent of forested area on the FID to predevelopment levels, providing habitat for woodland wildlife and improving conditions for forest dwelling birds that require larger continuous tracts. The soft-mast varieties that would dominate the forest would not provide as much food value or diversity as the hard-mast forest, but they are much more capable of withstanding flood events.

Criteria. The natural reforestation will be considered a success if those areas have 75 stems/acre by year 10, 350 stems/acre by year 25, and 100 stems/acre by year 50.

Monitoring Design. The determination of the success of reforestation will be observed by taking an aerial photo of the reforestation area pre-inundation in year 10. This will be done as part of regular UMRR-HREP documentation and therefore will not be a project cost.

Analysis and Use of Monitoring Results. The results will be used to calibrate HEC-EFM to determine if the model would have been a good predictor of survival at Fox Island.

Feature Measurement 2 - Invasive plant species monitoring will be performed. This evaluation will be completed at years 5 and 10 post-construction. Invasive plant species potentially occurring in the Project area are mostly non-native, but native species that have the potential to form monotypic stands resulting in decreased overall species diversity also may be considered invasive as related to this feature measurement.

Criteria. Moist soil management areas and active reforestation sites will be inspected to identify the presence or absence of invasive plant species and estimate the percent coverage of invasives if present. Invasive species reduction/management will be determined successful if coverage of all invasive species present does not exceed 30% by year 5 or 25% by year 10.

Monitoring Design. Moist soil management units and reforestation sites will be monitored by ground inspection and/or aerial photography as practicable. Invasive species coverage will be estimated by separate tract. Monitoring strategies and sample designs should be designed to generally follow guidelines being developed by the USFWS's National Wildlife Refuge System for collecting information to be used in assessing and prioritizing the management of invasive plants on their lands. With regard to the reforestation areas, specifically reed canary grass is expected to invade these areas, but for the actively planted areas with the taller container-grown trees, canary grass is not anticipated to be an impediment to their survival or growth. Canary grass is much more likely to be a problem in the natural reforestation areas, where the species may need to be controlled by selective mowing or chemical application.

Analysis and Use of Monitoring Results. The results of this monitoring effort will be used to assess the success of the biological response to the physical restoration measures implemented as part of this restoration project, and to evaluate the level of success in meeting project goals and objectives during the first decade after construction. The information obtained during this monitoring also should provide an indication of the Project's potential for meeting goals and

objectives over the long term (25-50 years).

11.1.5. Streambank Protection

Feature Measurement 1 - Inspection of riprap areas. This evaluation will be completed at years 1, 3, 5, and 10 post-construction.

Criteria. The riprap areas will be considered successful if the maintenance requires replacement of 20% or less of the riprap every 10 years.

Monitoring Design. District personnel will perform inspections looking for the following concerns: embankment eroding from under the riprap, woody vegetation growing through the riprap, displaced riprap, and significant deterioration of the riprap.

Analysis and Use of Monitoring Results. District personnel will recommend operation and maintenance procedures to the sponsor.

Feature Measurement 2 - Survey of riprap areas. This evaluation will be completed at year 10 post-construction.

Criteria. The riprap areas will be considered successful if the maintenance requires replacement of 20% or less of the riprap every 10 years.

Monitoring Design. Cross sections of the riprap areas will be performed at 100-foot increments.

Analysis and Use of Monitoring Results. District personnel will recommend operation and maintenance procedures to the sponsor.

11.2. Implementation Schedule, Costs, and Responsibilities for Monitoring Schedule.

11.2.1 Schedule. A summary of the Feature Measurement schedule is included in Table 11.3.

11.2.2. Costs and Responsibilities. The annual monitoring costs for the Project were estimated as in the DPR using January 2005 price levels. Table 11.4 reflects these costs.

The revised monitoring costs and responsibilities for the Project due to site conditions and modifications are listed in Table 11.5.

Table 11.3. Implementation Schedule

Timeframe	Action
Estimate of inundated area at end of seasonal pumping based on LIDAR and water level elevation	1, 3, 5, 10
Pump/Seep analysis to determine loss to groundwater	1, 3, 5, 10
Survey to establish channel/pond sedimentation rate	3, 5, 10
Container Grown Tree count and HEC-EFM analysis	1, 10
Direct Seed Tree count and HEC-EFM analysis	10
Aerial photo of reforestation pre-inundation and HEC-EFM analysis	10
Moist Soil monitoring (Invasive Species Assessment)	5, 10
Inspection of riprap areas	1, 3, 5, 10
Survey of riprap areas	10

Table 11.4. Annual Monitoring Costs

Item	Annual Cost
Engineering Data	\$4,000.00
Natural Resource Data	\$2,000.00
Subtotal	\$6,000.00
Contingencies (20%)	\$1,200.00
Data Subtotal	\$7,200.00
Planning, Engineering, Design	\$1,500.00
Total	\$8,700.00

Table 11.5. Revised Monitoring Costs and Responsibilities ¹

Year	Enhancement Feature	Feature Measurement Number	Feature Measurement Details	Cost
1	Enhance water supply, distribution, and control for wetlands	1	Estimate of inundated area at end of seasonal pumping based on LIDAR and water level elevation (Corps)	\$7,974.00
	Enhance water supply, distribution, and control for wetlands	2	Pump/Seep analysis to determine loss to groundwater (Corps)	\$7,174.00
	Plant container grown trees	1	Container Grown Tree count and HEC-EFM analysis (Corps)	\$15,140.00
	Bank protection	1	Inspection of riprap areas (Corps)	\$929.00
			Subtotal	\$31,217.00
3	Enhance water supply, distribution, and control for wetlands	1	Estimate of inundated area at end of seasonal pumping based on LIDAR and water level elevation (FWS field/Corps processing)	\$2,400.00
	Enhance water supply, distribution, and control for wetlands	2	Pump/Seep analysis to determine loss to groundwater (FWS field/Corps processing)	\$1,600.00
	Enhance water supply, distribution, and control for wetlands	3	Survey to establish channel/pond sedimentation rate (Corps)	\$49,000.00
	Bank protection	1	Inspection of riprap areas (Corps)	\$929.00
			Subtotal	\$53,929.00
5	Enhance water supply, distribution, and control for wetlands	1	Estimate of inundated area at end of seasonal pumping based on LIDAR and water level elevation (FWS field/Corps processing)	\$2,400.00
	Enhance water supply, distribution, and control for wetlands	2	Pump/Seep analysis to determine loss to groundwater (FWS field/Corps processing)	\$1,600.00
	Enhance water supply, distribution, and control for wetlands	3	Survey to establish channel/pond sedimentation rate (Corps)	\$49,000.00
	Enhance water supply, distribution, and control for wetlands	4	Moist Soil Monitoring (Invasive Species Assessment) (Corps)	\$9,961.00
	Plant container grown trees	2	Moist Soil Monitoring (Invasive Species Assessment) (Corps)	
	Direct seed hardwood trees	2	Moist Soil Monitoring (Invasive Species Assessment) (Corps) ²	
	Natural reforestation	2	Moist Soil Monitoring (Invasive Species Assessment) (Corps) ²	
	Bank protection	1	Inspection of riprap areas (Corps)	\$929.00
			Subtotal	\$63,890.00
10	Enhance water supply, distribution, and control for wetlands	1	Estimate of inundated area at end of seasonal pumping based on LIDAR and water level elevation (FWS field/Corps processing)	\$2,400.00
	Enhance water supply, distribution, and control for wetlands	2	Pump/Seep analysis to determine loss to groundwater (FWS field/Corps processing)	\$1,600.00
	Enhance water supply, distribution, and control for wetlands	3	Survey to establish channel/pond sedimentation rate (Corps)	\$49,000.00
	Plant container grown trees	1	Container Grown Tree count and HEC-EFM analysis (Corps)	\$15,140.00
	Direct seed hardwood trees	1	Direct Seed Tree count and HEC-EFM analysis (Corps)	\$13,590.00
	Enhance water supply, distribution, and control for wetlands	4	Moist Soil Monitoring (Invasive Species Assessment) (Corps)	\$9,961.00
	Plant container grown trees	2	Moist Soil Monitoring (Invasive Species Assessment) (Corps) ²	
	Direct seed hardwood trees	2	Moist Soil Monitoring (Invasive Species Assessment) (Corps) ²	
	Natural reforestation	2	Moist Soil Monitoring (Invasive Species Assessment) (Corps) ²	
	Bank protection	1	Inspection of riprap areas (Corps)	\$929.00
	Bank protection	2	Survey of riprap areas (Corps)	\$5,000.00
			Subtotal	\$97,620.00
			Total	\$246,656.00

¹ USFWS will provide raw data to the Corps for the completion of monitoring items: “Estimate of inundated area at end of seasonal pumping based on LIDAR and water level elevation” and “Pump/Seep analysis to determine loss to groundwater” after Year 1.

² Moist soil monitoring costs for all enhancement features are included in the “Enhance water supply, distribution, and control for wetlands” feature.

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12. REPAIR, REPLACEMENT & REHABILITATION

Repairs. Repairs are those activities of a routine nature that maintain the Project in good condition after it has been damaged by a flood event.

Replacement. Replacement covers features that no longer operate or function as designed and must be replaced.

Rehabilitation. Rehabilitation refers to a set of activities necessary to restore the Project to its pre-flood event condition.

Repair, Replacement and Rehabilitation actions are to conform to the Project as-builts unless otherwise approved by the Corps. 33 USC 408 (Section 408) provides authority solely to the Secretary of the Army for modifications or alterations to Corps projects. According to Army policy, there is very limited delegated authority to District Commanders to approve minor, low impact modifications to projects operated and maintained by sponsors.

Approval from the District Engineer is required prior to any minor improvement or change in any feature of the Project. In addition, no encroachment shall be made on Project rights-of-way without prior determination that the proposed work will not adversely affect the Project. Before starting work on any such improvements, changes, or encroachments, USFWS officials shall submit for consideration and approval a complete set of the proposed plans to the U.S. Army Corps of Engineers, Rock Island District, ATTN: CEMVR-EC-DN. After a sufficient review period, the Corps shall notify the USFWS by letter of the findings and if approval is granted. If approval is granted, and after the work is completed, the USFWS will update the O&M manual to reflect the modification to the Project and provide a copy to the CEMVR-EC-DN. Additionally, the sponsor shall furnish the Corps drawings, which show the new "as-built" condition.

Should inspection of the Project area following a major flood or natural disaster disclose substantial damage to any of the major components of the Project that appears to exceed the annual O&M as specified in this manual and the DPR, the District and the USFWS shall meet and discuss the appropriate course of action in light of the original Project design. The inspections by the refuge manager (as summarized in the submitted checklist) and the joint inspections with the District will be the basis for determining maintenance responsibility by the USFWS versus potential rehabilitation by the District. Repair of damage attributable to lack of maintenance is a USFWS responsibility.

The options of rehabilitation or abandonment of the Project may be considered at such time that damage exceeds O&M requirements. Any decision would be carried forth only upon written mutual agreement of the USFWS and the Corps. Included within such agreement would be a description of the agreed-upon course of action and funding responsibilities, if any.

13. PROJECT CONTACTS

Upper Mississippi River National Wildlife and Fish Refuge

Jason Wilson, Refuge Manager
Great River National Wildlife Refuge
37599 County Rd. 206, P.O. Box 88
Annada, Missouri 63330
Office (573) 847-2333
Fax (573) 847-2269
Email jason_wilson@fws.gov

U.S. Army Corps of Engineers

Clock Tower Building PO Box 2004
Rock Island IL 61204-2004
Website – <http://www.mvr.usace.army.mil>
Website – <http://www.rivergages.com>

Marvin Hubbell, UMRR-HREP Regional Program Manager
Office (309) 794-5428
Email marvin.e.hubbell@usace.army.mil

Erica Stephens, Environmental Engineering Lead
Office (309) 794-5925
Email erica.l.stephens@usace.army.mil