UPPER MISSISSIPPI RIVER RESTORATION

ENVIRONMENTAL MANAGEMENT PROGRAM

POST-CONSTRUCTION

FINAL PERFORMANCE EVALUATION REPORT

2013

POOL 9 ISLAND

HABITAT REHABILITATION AND ENHANCEMENT PROJECT

US Army Corps of Engineers
St. Paul District

POOL 9

RIVER MILE 655 TO 656

CRAWFORD COUNTY, WISCONSIN

USACE-MVP-0000120541

ACKNOWLEDGEMENTS

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POINTS OF CONTACT

Many individuals of the St. Paul District, U.S. Army Corps of Engineers; U.S. Fish and Wildlife Service, and Wisconsin Department of Natural Resources, contributed to the development of this Post-Construction Performance Evaluation for the Pool 9 Island Habitat Rehabilitation and Enhancement Project. These individuals are listed below:

U.S. Army Corps of Engineers, St. Paul District				
Name	Position	Address	Phone	Email
Jon Hendrickson, P.E.	Hydraulic Engineer	180 East 5th St. St. Paul, MN 55101	651-290-5634	Jon.s.hendrickson@usace.army.mil
Tom Novak	Project Manager	180 East 5th St. St. Paul, MN 55101	651-290-5524	Tom.novak@usace.army.mil
Shahin Khazrajafari		180 East 5th St. St. Paul, MN 55101	651-290-5219	Shahin.khazrajafari@usace.army.mil
USFWS				
Name	Position	Address	Phone	Email
Clyde Male	Supervisory Wildlife Refuge Specialist	401 Bus. Hwy 18 North, McGregor, IA 52157 Office	563-873-3423	Clyde_male@fws.gov
Sharonne N. Baylor, P.E.	Environmental Engineer	51 East Fourth Street, Room 101, Winona, MN 55987	507-494-6207	Sharonne_baylor@fws.gov
Brian Stemper	Fish and Wildlife Biologist	51 East Fourth Street, Room 100, Winona, MN 55987	507-494-6221	Brian_Stemper@fws.gov
Pam Thiel	Manager	555 Lester Avenue # 17. Onalaska, WI 54650	608-783-8431	Pam_Thiel@fws.gov
Phil Delphey	Fish and Wildlife Biologist	4101 E. 80th Street. Bloomington, MN 55425	612-725-3548	Phil_Delphey@fws.gov
WDNR				
Name	Position	Address	Phone	Email
Jeff Janvrin	Mississippi River Habitat Specialist	3550 Mormon Coulee Road La Crosse, WI 54601	608-785-9005	Jeff.Janvrin@Wisconsin.gov

EXECUTIVE SUMMARY

General. The design of the Pool 9 Island Project was to provide the physical conditions necessary to improve and enhance aquatic plant bed habitat quality. As stated in the Definite Project Report, the Pool 9 Island Habitat Rehabilitation and Enhancement Project (HREP) was undertaken to address the following primary problems: the loss of island landmass, river currents, wave action, and sediment transport as well as the uproot and reduction of aquatic vegetation. These problems were contributing to the direct loss of submersed aquatic and emergent vegetation, and fish habitat with secondary adverse effects to migrating waterfowl and fish.

Purpose. The purposes of this Performance Evaluation Report (PER) are as follows:

1. Document the pre- and post-construction monitoring activities for the Pool 9 Island HREP.
2. Summarize and evaluate project performance on the basis of project goals and objectives as stated in the Definite Project Report (DPR).
3. Summarize project operation and maintenance efforts to date.
4. Provide recommendations concerning future project performance evaluations.
5. Share lessons learned and provide recommendations concerning the planning and design of future HREP projects.

Project Goals and Objectives. The Pool 9 Islands Project had one goal with both primary and secondary objectives listed in the DPR:

1. Goal - Preserve, enhance, and restore the existing aquatic plant beds which provide diverse habitat for fish and wildlife.

   Primary Objectives:
   a. Reduce flow through the backwater area.
   b. Provide protected, shallow habitat in the backwater area for vegetation.

   Secondary Objectives:
   c. Protect the backwater area from wind- and boat-generated waves.
   d. Provide island habitat for migratory waterfowl.
   e. Provide additional deep water fish habitat.

Near the end of planning the project underwent a value engineering (VE) study to address project design and cost changes. The VE team was designated to analyze the plan and develop an alternative design to prevent sediment from entering the backwater area and to reduce wave action in the backwater area. Although island configuration was altered after the VE study, the project objectives remained unchanged.

Project Performance Monitoring. Pre- and post-project monitoring, both qualitative and quantitative, were performed in accordance with the Habitat Evaluation Procedures in Appendix C from the original DPR. Monitoring and performance evaluations were conducted by the U.S. Army Corps of Engineers (Corps), U.S. Fish and Wildlife Service (USFWS), and the Wisconsin Department of Natural Resources (WDNR). The period of data collection covered in this report includes the pre-project monitoring from 1987, quantitative and qualitative post-project monitoring through 2011, and anecdotal information through 2011.

Evaluation of Project Objectives. For the evaluation period of 1995 to 2011, observations were made with regard to the efficacy of the objectives in meeting the project goal and objectives. Not all of the objectives were clearly defined in the DPR and therefore the determination of whether or not the objectives were reached successfully was difficult to determine. In addition, general conclusions were drawn regarding project measures that may affect future project design.

1. Preserve, enhance, and restore the existing aquatic plant beds which provide diverse habitat for fish and wildlife.
    a. Reduce flow through the backwater area
        i. Evaluation Criteria: Reduce flow velocity through the backwater with a 3,000 foot structure near the main channel, where the highest flow from the river enters the project area.
        ii. General Observation: Based on aerial images of the site, in addition to land cover data, it appears that aquatic vegetation has stabilized, and increased throughout the area protected from direct flow by the island.
        iii. Results: The stabilization of aquatic vegetation suggests the island has caused sufficient reduction in the sediment-laden flow entering the project area.
        iv. Success: The rockfill island barrier has been built along the main navigation channel, and in combination with the upper island, has successfully reduced flow and sediment transport into the project area. This has led to the development and stabilization of the aquatic plant bed.
        v. Conclusion: The project has been successful in achieving the project objective and goal.
        vi. Lessons Learned & Recommendations: There are no records showing any flow velocity measurements conducted at this island. The development and growth of vegetation in the protected zones of the island do show by evidence that the objective has been successful and effective. Although little flow measurement data can be found on the area of this island, the structure should continue to be evaluated visually for its structural condition and integrity.
    b. Provide protected, shallow habitat in the backwater area for vegetation
        i. Evaluation Criteria: Provide 40 acres of protected area in the backwater for aquatic vegetation growth.

ii. General Observation: The island structure provides protection from northwestern and southeastern wave action. Based on the available aerial images, more than 40 acres of vegetative coverage has developed in the shallow protected areas.
iii. Results: The growth and development of vegetation in the protected shallow area suggests that the island complex has been effective in reducing wave action within the project area and allowing over 130 acres of vegetation growth in the island complex. In addition to the vegetation in the inner protected zone of the island, land cover models and aerial images also show over 60 acres of aquatic vegetation in the outer portion of the protected downstream end.
iv. Success: The evaluation criteria of this objective have been met, with more than 40 acres of vegetation coverage in the project area.
v. Conclusion: The project is considered successful in achieving the objective of shallow habitat development.
vi. Lessons Learned & Recommendations: This was the first island complex constructed to address prevailing winds during the growing season for aquatic vegetation (May-mid September). Observations by agency personnel and air photo comparisons showed a faster vegetation response than previous projects. Vegetation surveys and aerial imagery allowed for sufficient evaluation of the project's performance throughout its lifetime. The criteria are measurable and can continue to be used for future monitoring and/or evaluations of the project's performance. Wind fetch data helps evaluate the impact of wind-induced waves on the project area, and compare to pre-construction data available.

c. Protect the backwater area from boat-generated waves
i. Evaluation Criteria: Reduce wave action in the project area by creating 100 acres of protection.
ii. General Observation: It appears the island complex has been successful in preventing waves generated in the main navigation channel from entering the protected area.
iii. Results: Year 2000 land cover shows over 130 acres of aquatic vegetation covering the inner portion of the island.
iv. Success: The evaluation criteria of this objective have been met with more than 100 acres of protection from wave action.
v. Conclusion: The project has successfully met its objective of reducing wave impact on 100 acres in the project area.
vi. Lessons Learned & Recommendations: There is no data available on boat-generated waves and it is difficult to perform a quantitative measurement of this criteria. Wave action can continue to be monitored over time as the pool conditions continue to change.

d. Provide island habitat for migratory waterfowl

i. Evaluation Criteria: Provide 10 acres of island habitat for migratory waterfowl flying through the area.
ii. General Observation: Sea gulls, eagles, pelicans, and diving ducks have been observed using the island structure and the surrounding areas. Diving ducks have been observed, by the USFWS, using the island every year between late October and November. The USFWS has also observed the increased presence of duck hunters on and around the island.
iii. Results: GIS analysis shows 5.65 acres of island after project completion. There are no exact numbers or waterfowl surveys at this specific location of the island. Anecdotal information and visual observations of waterfowl, as well as duck hunters in the project area, suggest that the island has been providing habitat for waterfowl. There is broader Waterfowl Use Day (WUD) survey information available showing the overall waterfowl migration throughout the Pool 9 refuge. This survey divides the Pool 9 refuge into 4 units, and the Pool 9 Island falls into the Sugar Creek Unit. Waterfowl data from 1997 to 2011 shows the waterfowl traffic through the Sugar Creek Unit to be relatively steady in comparison to the other units and the overall refuge.
iv. Success: The island structure is utilized by various types of waterfowls and continues to provide a suitable staging area. The evaluation criteria, however, called for 10 acres of island habitat and only 5.65 acres currently exists. Therefore, the objective cannot be considered completely successful.
v. Conclusion: The project provides habitat to migratory waterfowl but did not meet the evaluation criteria. The post-construction WUD data available for the Pool 9 refuge shows the Sugar Creek region, where the Rockfill Island is located, to be relatively steady though with a noticeable decline in bird usage between 2008 and 2011. This decline could be to due to Harpers Slough's significantly larger area of influence south of the Rush Creek unit and the recent increase in growth and development of vegetation in the Harpers Slough unit. It could also be attributed to Harpers Slough being a closed hunting area, which may be making it a more attractive staging area for waterfowl during the day than the Sugar Creek unit. The establishment of shallow aquatic habitat is expected to be a suitable and attractive for migratory waterfowl. Therefore it can be assumed the island structure, individually, is performing as intended. This conclusion can be further validated based on observations made by the USFWS, and of both waterfowl and duck hunters in the project area.
vi. Lessons Learned & Recommendations: The criterion for performance of this objective was not clearly defined, but appears to be based on

the terrestrial area of the constructed island. Future objectives should be more clearly defined and more appropriate for quantifying habitat. The island specifically, should be surveyed in order to obtain a better understanding of the project's current performance.

e. Provide additional deep water fish habitat
    i. Evaluation Criteria: Create 7 acres of habitat for fish.
    ii. General Observation: There is a 6 foot channel along the outer alignment of island D and adjacent to the main channel, but there is no deep water in the interior of the island complex.
    iii. Results: Bathymetry models from 1998 indicate that the entire interior area of the island complex has a depth of 2-4 feet. During construction, the access channels along the interior side of islands A and B were not dredged to the depth of 6 feet as planned. It was determined by the contractor that minimal dredging was needed for construction access to the area.
    iv. Success: Available bathymetry data show there is a channel along the middle island, totaling up to nearly 10 acres of depths between 6-8 feet. This however, is the secondary channel and not deep backwater habitat. The flow through this channel is considered too high to provide good overwintering. Since deep water habitat requires a depth greater than 5 feet in this area the dredged access channels along islands A and B are not deep enough to provide such habitat. Without depths greater than 5 feet occurring in the interior of the island complex the deep water fish habitat objective was unsuccessful.
    v. Conclusion: The project was not successful in creating additional deep water fish habitat where the construction access channels were dredged. Bathymetric data, as well as construction records, suggests that these channels were not dredged deep enough for such habitat.
    vi. Lessons Learned & Recommendations: It is recommended that future contracts specify dredging depth when it is critical to the project objective. The contract indicated there would be access dredging but did not have specific depth requirements.

Evaluation of Project Operation and Maintenance. The O&M manual has been prepared and completed for this project. There are no structures that need to be operated for the project. Inspections should be made after any flood whose elevation exceeds 626.0 feet above mean sea level (MSL) at the Lock 9 headwater gage. The general condition of the island complex should be noted. The frequency for inspection will be subject to review by the USFWS and the Corps and could change upon mutual agreement of both parties. The timing of the inspection can be made at the discretion of the USFWS District Manager in charge of that portion of the appropriate National Wildlife Refuge. Maintenance of the project features is accomplished on

an as needed basis by the Corps, such that their structural integrity is maintained and they continue to function in the manner for which they were designed. Aside from inspection costs, there have been no O&M costs accrued for this project. Although it has been noted that settling of the island has occurred in a few areas allowing a small amount of flow over the structure, this has not compromised the projects function in regards to the final objectives.

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POST-CONSTRUCTION
PERFORMANCE EVALUATION REPORT

2012

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POOL 9
RIVER MILE 655 TO 656
CRAWFORD COUNTY, WISCONSIN

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POOL 9 ISLAND HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 9

RIVER MILE 655 TO 656

CRAWFORD COUNTY, WISCONSIN

INTRODUCTION

The Upper Mississippi River Restoration Environmental Management Program (UMRR-EMP) is a Federal-State partnership to manage, restore, and monitor the UMR ecosystem. The UMRR-EMP was authorized by Congress in Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662) and reauthorized in 1999. Subsequent amendments have helped shape the two major components of EMP – the Habitat Rehabilitation and Enhancement Projects (HREPs) and Long Term Resource Monitoring (LTRM). Together, HREPs and LTRM are designed to improve the environmental health of the UMR and increase our understanding of its natural resources.

Habitat Rehabilitation and Enhancement Project (HREP) construction is one element of the UMRR-EMP. In general, the projects provide site-specific ecosystem restoration, and are intended and designed to counteract the adverse ecological effects of impoundment and river regulation through a variety of modifications. These modifications include flow introductions or reductions, modification of channel training structures, dredging, island construction, and water level management. Interagency, multi-disciplinary teams work together to plan and design these projects.

The Pool 9 Island Construction HREP is part of the UMRR-EMP. This project consisted of island construction to reduce inflows and wave action to restore habitat. These measures were designed to preserve, enhance, and restore the existing aquatic plant beds which provide diverse habitat for fish and wildlife.

1. Purpose of Project Evaluation Reports

The purposes of this Project Evaluation Report for the Pool 9 Island Construction are to:

1. Document the pre- and post-construction monitoring activities for the Pool 9 Island Construction.

2. Summarize and evaluate project performance on the basis of project goals and objectives as stated in the Definite Project Report (DPR).
3. Summarize project operation and maintenance efforts, to date.
4. Provide recommendations concerning future project performance evaluation.
5. Share lessons learned and provide recommendations concerning the planning and design of future HREP projects.

2. Scope

This report summarizes available monitoring data, operation, maintenance, repair information, and project observations made by the Corps, USFWS, and WDNR. The period of data collection covered in this report includes the pre-construction monitoring from1987 to post-construction monitoring as of 2011.

3. Project References

Published reports which relate to the Pool 9 Island Construction HREP are presented below.

1. Definite Project Report/Environmental Assessment (SP-3), U.S. Army Corps of Engineers, St. Paul District, June 1989.
2. Supplemental Definite Project Report/Environmental Assessment (SP-3A), U.S. Army of Engineers, St. Paul District, July 1993.
3. Operation and Maintenance Manual, U.S. Army Corps of Engineers, St. Paul District, June 1996.

4. Project Location

The Pool 9 Island Construction project is located in Crawford County, Wisconsin, on the left descending side of the Upper Mississippi River navigation channel, between river mile 655 and 656 (Figure 1 – project area). The project is maintained by the USFWS.

The site is a shallow water area approximately 1,500 feet off the main channel of the Upper Mississippi River. The shallow open water area has depths in the range of 1 to 5 feet. Parts of the rockfill islands were constructed along the edge of a submerged aquatic plant bed that covers a portion of the project area.

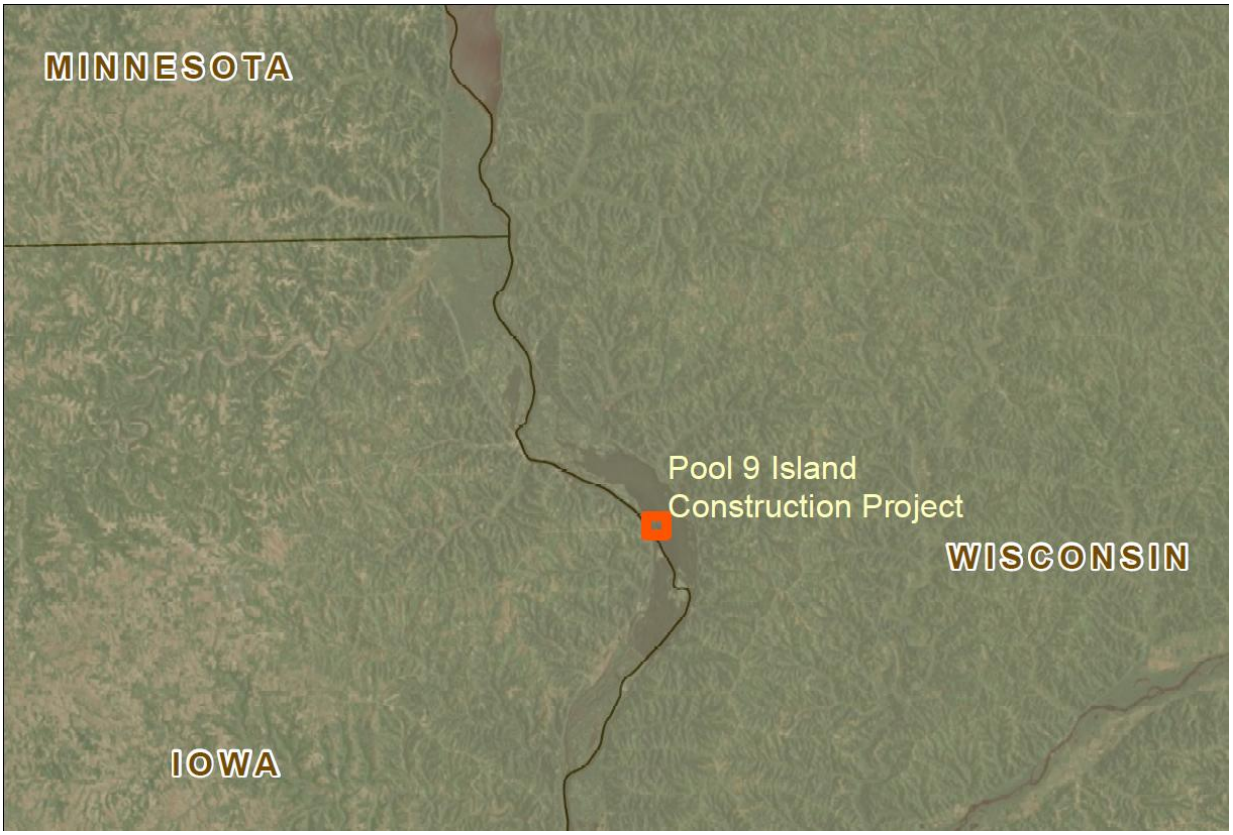

Figure 1. Pool 9 Island Construction HREP project area

PROJECT PURPOSE

1. Overview

The design of the Pool 9 Island Construction HREP was to provide the physical conditions necessary to improve and enhance aquatic plant bed habitat quality. The specific goals as stated in the DPR were to address the loss of landmass at the islands adjacent to the navigation channel, navigation-induced sediment movement in the backwaters, and the reduction of aquatic vegetation in the backwater of the site in order to achieve wildlife habitat restoration. These problems were contributing to the direct loss of migratory waterfowl habitat and fish habitat. Near the end of planning the project underwent a value engineering (VE) study to address project design and cost changes. The VE team was designated to analyze the plan and develop an alternative design to prevent sediment from entering the backwater area and to reduce wave action in the backwater area. Although island configuration was altered after the VE study, the project objectives remained unchanged. The problems, opportunities, goal, objectives and measures implemented to address the goals and objectives are listed in Table 1.

Table 1. Problems, opportunities, goals, objectives, and measures

<table>
<tr><th>PROBLEMS</th><th>OPPORUNTITIES</th><th>GOALS</th><th>OBJECTIVES</th><th>RESTORATION MEASURES</th></tr>
<tr><td>Island landmass loss</td><td rowspan="4">Use of remaining island landmass as buffer.
Nearby main channel was considered most economical material source. Transport of the material by barge was considered to be economical for this project.
Rock for islands may be available at no cost from a proposed stockpile area at Clayton, Iowa, in pool 10.</td><td rowspan="4">Preserve, enhance, and restore the existing aquatic plant beds which provide diverse habitat for fish and wildlife.</td><td>Protect the backwater area from boat-generated waves.</td><td rowspan="4">Construction of rockfill Islands A and B to a top elevation of 621.5, D to 620.5, and island markers to a top elevation of 626.0, with Islands A and B being perpendicular to Island D and each 1,900 ft and 1,600 ft in length, and with Island D being 3,000 ft.</td></tr>
<tr><td>Sediment movement</td><td>Reduce flow through a reach of the backwater area.</td></tr>
<tr><td rowspan="2">Uproot and reduction of aquatic vegetation</td><td>Provide protected, shallow habitat in the backwater area for vegetation.</td></tr>
<tr><td>Provide island habitat for migratory waterfowl.</td></tr>
<tr><td></td><td></td><td>Provide additional deep water fish habitat.</td><td></td></tr>
</table>

PROJECT DESCRIPTION

1. Project Measures

The Pool 9 Island Construction HREP included the construction of a C-shaped rockfill island complex (See Figure 2 for locations of measures). A detailed description of each of these measures is provided below.

Construction of a C-shaped rockfill island complex. The island complex parallels the main channel for 3,000 feet (Island D) and extends into the backwater about 1,600 feet at the upper end (Island B) and 1,900 feet at the lower end (Island A). Access channels were designed to be located within the interior of the island complex as they would provide additional deep water habitat for fish.

Figure 2. Pool 9 Island Construction HREP project measures.

2. Project Construction

The Pool 9 Island Construction HREP project was approved for construction in September 1994 at an estimated cost of $990,963 (equivalent to $1,684,055.20 in FY12). The contract included the construction of the rockfill islands as described above. The dredged material was barged to a temporary unloading facility at Interstate Power Company near Lansing, IA. The material was then hauled to the power company's ash piles where it was spread for topsoil and seeded. Rockfill was loaded at the temporary facility at the Interstate Power Company and transported by barge to the project site to build the island complex. Rock "humps" were included in the project design to provide a visual reference of the island layout for boaters during overtopping events. These rock humps were covered with fine material excavated from an area adjacent to the island.

3. Project Operation and Maintenance

General. In the original DPR it was estimated that the Pool 9 Island Construction HREP would require little or no maintenance. Operation and maintenance responsibilities for the Pool 9

Island Construction HREP were originally outlined in the DPR. The acceptance of these responsibilities was formally recognized by an agreement signed by the USFWS and the Corps-St. Paul District.

A detailed description of all operation and maintenance requirements can be found in the Project Operation and Maintenance Manual (O&M Manual). The O&M Manual for the project delegated responsibilities and procedures for post-project activities. Project operation and maintenance generally consists of the following:

1. Annual Inspection
2. Repair of displaced rockfill
3. Improvements or Alterations
4. Annual Reporting
5. Project Monitoring and Evaluation

Project Measures Requiring Operation and Maintenance. Maintenance of the project measures was to be completed on an as needed basis to maintain their structural integrity and continued function in the manner for which they were designed. Any significant loss of rockfill should be replaced to prevent further loss of rockfill and to provide protection of the interior area from external wave action. Any continuous openings created in the island that are greater than 10 feet wide at the average water surface elevation of 620.0 should be closed with rockfill. Some long term settlement of the rockfill mound is expected. However, if the elevation of the top of the mound falls below the average water surface of 620.0, the Corps' geotechnical staff should be consulted prior to proceeding with any repairs.

PROJECT PERFORMANCE MONITORING

1. General

Performance monitoring of the Pool 9 Island Construction HREP has been conducted by Corps to help determine the extent to which the design meets the habitat improvement objectives. Information from this monitoring will also be used, if required, for adaptive management when ascertaining whether rehabilitation or abandonment of portions of this project would be the wisest choice.

The monitoring and performance evaluation matrix is outlined in Table 3. Pre- and post-project monitoring, both qualitative and quantitative by each of the involved agencies is summarized below.

1. U.S. Army Corps of Engineers: The success of the project relative to original project objectives shall be measured utilizing data, field observations, and project inspections

provided by the USFWS and Corps. The Corps was responsible for post-project analyses of flow, sounding, and wave height measurements in the island complex area. The Corps of Engineers has overall responsibility to measure and document project performance.

2. U.S. Fish and Wildlife Service: The USFWS is responsible for operating and maintaining the Pool 9 Island Construction HREP. They were also responsible for pre- and post-project Sedimentation Problem Analysis, and Biological Response Analysis.
3. Wisconsin Department of Natural Resources: The Wisconsin DNR is a co-sponsor of the project. Its primary monitoring activities has focused on fisheries and waterfowl response to the project through collection of pre and post-project data.

Table 2. Monitoring and Performance Evaluation Matrix from DPR.

Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Remarks
Sedimentation Problem Analysis	System-wide problem definition. Evaluates planning assumptions.	USFWS	USFWS (EMTC)	LTRMP	Leads into pre-project monitoring; defines desired conditions for plan formulation.
Pre-project Monitoring	Identifies and defines problems at specific sites.	Sponsor	Sponsor	Sponsor	Attempts to begin defining baseline. See DPR.
Baseline monitoring	Establishes baselines for performance evaluation.	Corps	Field station or Sponsor through Cooperative Agreements or Corps	LTRM	See DPR for location and sites for data collection and baseline information. Actual data collection will be accomplished during Plans & Specification phase.
Data Collection for Design	1. Identify project objectives. 2. Design of project. 3. Develop Performance Evaluation Plan.	Corps	Corps	HREP	Comes after fact sheet. This data aids in defining the baseline.
Construction Monitoring	Assesses construction impacts; assess permit conditions are met.	Corps	Corps	HREP	
Performance Evaluation Monitoring	Determine success of project as related to objectives.	Corps (quantitative), Sponsor (field observations)	Field station or Sponsor through Cooperative Agreements or Corps	LTRMP Cooperative	Comes after construction phase of project.
Analysis of Biological Responses to Project	1. Determine critical impact levels, cause-effect relationships, and long-term losses of significant habitat. 2. Demonstrate success or response of biota.	USFWS Corps	USFWS (EMTC) Corps/USFWS (EMTC)/Others	LTRMP	Biological Response Study tasks beyond scope of Performance Evaluation, Problem Analysis, and Trend Analysis.

2. Project-Induced Habitat Changes

Pool 9 Island Construction habitat conditions have experienced some changes since the pre-project monitoring. The reduction in flow, combined with reduction in wave action, in the shallow zone protected by the island complex has led to the increased growth of submerged aquatic vegetation in that area to over 130 acres. The upper and lower wings of the island have also provided wave protection that has contributed to increased vegetation growth on the outer edge of the island.

PROJECT EVALUATION

1. Construction and Engineering

Construction began in April 1995 and final construction was completed in June 1995.

2. Costs

In the original DPR, cost estimates for the entirety of the project were $1,393,000 ($2,367,282.10, FY12). Initial construction costs were $990,963 ($1,684,055.20, FY12). As of the Pool 9 Island Construction 1995 Inspection Report, the total cost of the Pool 9 Island Construction HREP was $990,555.59 ($1,683,362.90, FY12).

3. Operation and Maintenance

In the original DPR the estimated cost was $75,000 (FY94) over the 50-year project life. From the estimate, an average annual operation and maintenance cost was projected to be $1,500. This amount included annual inspections and reports ($300) and an average of 20 cubic yards of rock replacement per year ($1,200). To date, the total O&M cost has been $2,249 associated only with annual inspections. The estimated average annual cost for this time period was $1,959, with the actual annual cost being less than $300. Table 3 provides the O&M history and costs for the Pool 9 Island Construction HREP.

History of Major Disturbances. Major floods occurred in 1997, 2001, 2010, and 2011. The flood of 2011 has been the highest flood event since the project was constructed, and the 2001 flood was the second highest. Neither event caused any damages to the project. Part of the reason for this is that during these large flood events the Pool 9 Island was submerged by five or more feet of water and was not exposed to wind-driven wave action.

Table 3. Operation and Maintenance History for the Pool 9 Island HREP

Year*	Years in O&M	Est. Annual Cost with Inflation	Actual USFWS Costs	Activities
1995	1	$1,582		
1998	4	$1,692	$230	Inspections
2003	9	$1,911	$503	Inspections, "do not build blinds with rock" sign, aquatic response survey
2004	10	$1,962	$500	Inspections, vegetation survey
2005	11	$2,029	$0	Inspections
2006	12	$2,094	$0	Inspections
2007	13	$2,157	$0	Inspections
2008	14	$2,241	$416	Inspections, report
2009	15		$600	Inspections
2010	16		$0	

* Costs before FY03 are not all well documented

4. Ecological Effectiveness

Table 4 summarizes the performance evaluation plan and schedule or Pool 9 Island Construction HREP goals and objectives.

Table 4. Performance Evaluation and Monitoring Schedule

Goal	Objective	Enhancement Measure	Units of Measure	Monitoring Target Values		Monitoring Schedule	Results	Extent to which objective was met
				Year 0 without project	Year 1 with project			
Preserve, enhance, and restore the existing aquatic plant beds which provide diverse habitat	[a.] Provide a stable barrier along the main channel (Reducing flow through a reach of the backwater area)	Islands	Feet	0	3,000	Once pre- and 1, 3, 10, 25 years post-construction	3,000 Feet	Met criteria
	[a.] Provide protected, shallow (<3') habitat in the backwater area for vegetation	Islands	Acres	0	40	Once pre- and 1, 3, and 10 years post-construction	>130 Acres	Exceeded
	[b.] Protect area from boat-generated waves	Islands	Acres	11	100	Once pre- and 1 and 3 years post-construction	>130 Acres	Exceeded
	[b.] Provide island habitat for migratory waterfowl	Islands placement site	Acres	0	10	Once pre- and 1, 3, and 10 years post-construction	5.65 Acres	Did not meet
	[b.] Provide deep water (>5') fish habitat	Access dredging	Acres	5	7	Once 1 and 10 years post-construction	<1 Acre	Did not meet

[a.] Indicates a primary objective

[b.] Indicates a secondary objective

A. Reduce flow through a reach of the backwater area

General. One of the primary project objectives for the Pool 9 Island Construction HREP was to reduce flow through backwater area. The rockfill island complex was constructed to reduce flow through a reach of 3,000 feet along the main channel in the backwater area.

Pre- and Post-Project Conditions. The plant beds and deeper areas in the project area were historically afforded protection by islands that bordered about 3,000 feet of the main navigation channel of the Mississippi River in the study area. The remaining islands prior to construction had an estimated total area of less than 1 acre at normal pool. Pre-project flow measurements obtained in 1992 indicated that 5- to 6-percent of the total river flow was conveyed through the project area. These measurements were taken along three transects within the project area; these were roughly parallel to and about the same length as Islands A and B. The flow direction observed during these measurements indicated that flow was from Winneshiek Lake and the upstream Capoli Slough area rather than from the main channel as had been the assumption. This was confirmed through the inspection of aerial photography. The velocity range for the low flow measurements on 27 August, 1992 was 0.2 to 0.5 fps, and for the higher flow measurements on 23 September it was 0.4 to 0.8 fps. The newly-constructed island complex parallels the main channel for 3,000 feet and extends into the backwater about 1,600 feet at the upper end and 1,900 feet at the lower end as shown in Figure 2. Post-project flow measurements have not been obtained in the project area. However, based on the fact that these islands are a barrier to flowing water, the amount of flow through the project area was certainly reduced for low flow conditions. Figure 3, which shows flow velocity for a moderate flow condition, indicates that velocity is reduced in the vicinity of the Pool 9 Islands compared to the areas around it. The reduction in flow has contributed to the expansion of SAV in the project area.

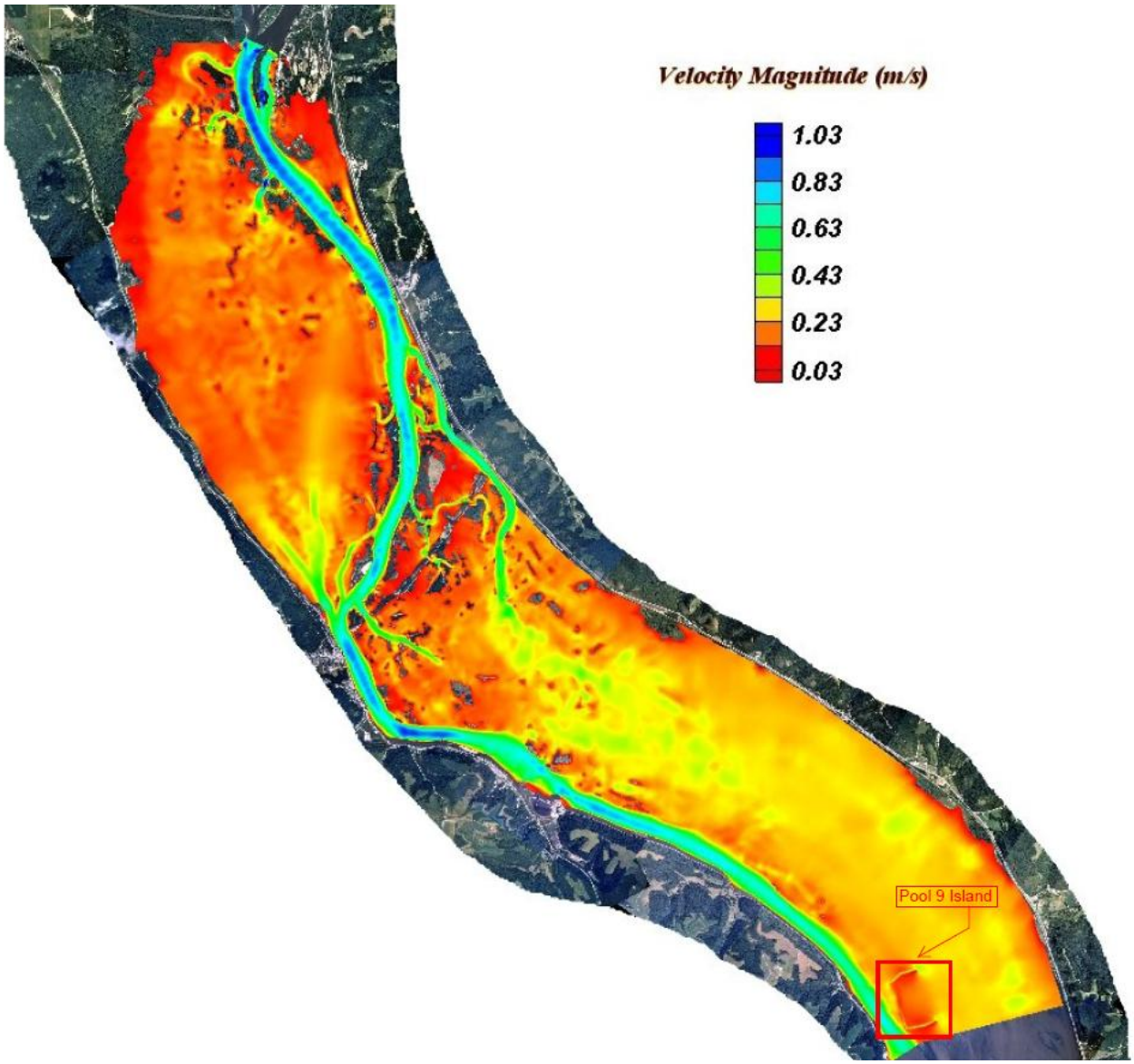

Figure 3. Pool 9 flow velocity with moderate flow conditions

Conclusion. The project measures were successful in reducing flows since the combination of the islands function as a barrier to flow. The island barrier has protected the plant beds in the project area from being uprooted by wave action and high sediment laden flows, and has allowed the vegetation to stabilize and grow. The measurable objectives have been achieved and no additional actions are required for this objective. The rockfill island complex has not required very much maintenance; although it should continue to be monitored periodically for repair and maintenance purposes.

B. Provide protected, shallow habitat in the backwater area for vegetation

General. The other primary objective for the Pool 9 Island Construction HREP was to provide protected, shallow habitat in the backwater area for vegetation. The rockfill island complex was constructed to provide 40 acres of protected, shallow habitat in the backwater area for vegetation.

Pre- and Post-Project Conditions. The continuing erosion of island landmass, as shown in Figure 4, was expected to contribute greatly and lead to the eventual loss of about 40 acres of submerged aquatic vegetation necessary in providing a shallow aquatic habitat for waterfowl and fish. This loss was being caused primarily by wave action and to a lesser extent from flow.

An analysis of wind-driven wave action conducted during project planning indicated that, within the 3 to 5 foot water depths that existed in this area, maximum bottom velocity and bottom shear stress due to wave action ranged from 0.77 to 0.93 fps and from 0.018 to 0.027 psf respectively. In other words, the orbital wave velocity for a 25 mph wind was greater than the measured flow velocities (0.2 to 0.8 fps) due to river currents. Comparing the bottom shear stresses to critical bottom shear stresses for sediment resuspension indicated that the potential for resuspension of bottom sediments was great. More recent wind fetch analysis indicated a significant reduction in wind-induced waves in areas protected by the island. Data from a 2008 Pool 9 wind fetch analysis (Figure 6) show the fetch inside the island complex to be in the range of 656 to3,600 feet, which is significantly lower than the surrounding area wind fetch of 9,800+ feet. The pre-construction wind fetch in this area had been recorded at 15,840 feet in both north and southeast directions, causing 0.9-1.1 foot high waves. With the island, wind fetch was expected to drop to around 2,000 feet in the project area.

Based on available land cover survey data and aerial photos of the site, both the protected inner zone of the island as well as the outer zone adjacent to the lower part of the island have seen significant submerged aquatic vegetation growth in the shallow water areas. USGS land cover data from the years 1975, 1989, and 2000 were compared using GIS software in the area influenced by the project (Figure 5 & Table 5). The area of influence was delineated as the general area around the project where there was a noticeable change in wind fetch (Figure 6). From the 2000 data it was calculated that 130 acres of aquatic vegetation exists in the area protected by the 3 islands, as well as over 60 acres of vegetation in the south exterior of the island. A total of approximately 290 acres of vegetation has developed within the project's area of influence. In comparison to the same data from 1989, the vegetation in this area has grown by about 64%, becoming more similar to its condition in 1975. The island has allowed the existing vegetation to develop and grow throughout the project area. The vegetation in this area primarily consists of submerged aquatic vegetation in the inner

protected zone of the island, and of rooted floating aquatic vegetation in the outer protected zone to the south of the island.

	1975	1989	1995 Construction	2000
Land	7.3	<1	5.65	5.65
Open Water	118.1	205.9	-	95.8
Submerged Aquatic Vegetation	247.2	182.2	-	278.7
Rooted Floating Aquatic Vegetation	3.9	0	-	12.13
Emergent Vegetation	0	4.1	-	0
Wet Forest/Shrub	3.2	0	-	0
Deep Marsh	19.8	0	-	0

Table 5. Land cover (acres) within the project's area of influence

Island configuration also aided in providing protected, shallow habitat in the backwater area by decreasing flows. Islands A and B are perpendicular to the dominant flow direction and Island D provides a barrier to the navigation channel. Based on aerial visuals and land cover data, the island seems to have protected the project area from wave action and sedimentation and has allowed the existing plant bed to stabilize.

Conclusion. The project measures were successful in providing the ability to protect more than 40 acres of shallow habitat in the backwater for vegetation. The protection of the existing plant beds from wave action was effective in creating a protected area for shallow habitat development. The growth of more than 130 acres of aquatic vegetation in the shallow areas has led to an increase of waterfowl habitat in and around the island complex. The criterion for this objective has been exceeded, and no additional actions are required. The vegetative habitat in and around the island has not required very much maintenance, although it should continue to be monitored periodically for evaluation purposes.

Figure 4. Island landmass in the 1950s (left), 1990s (middle), and 2009 (right)

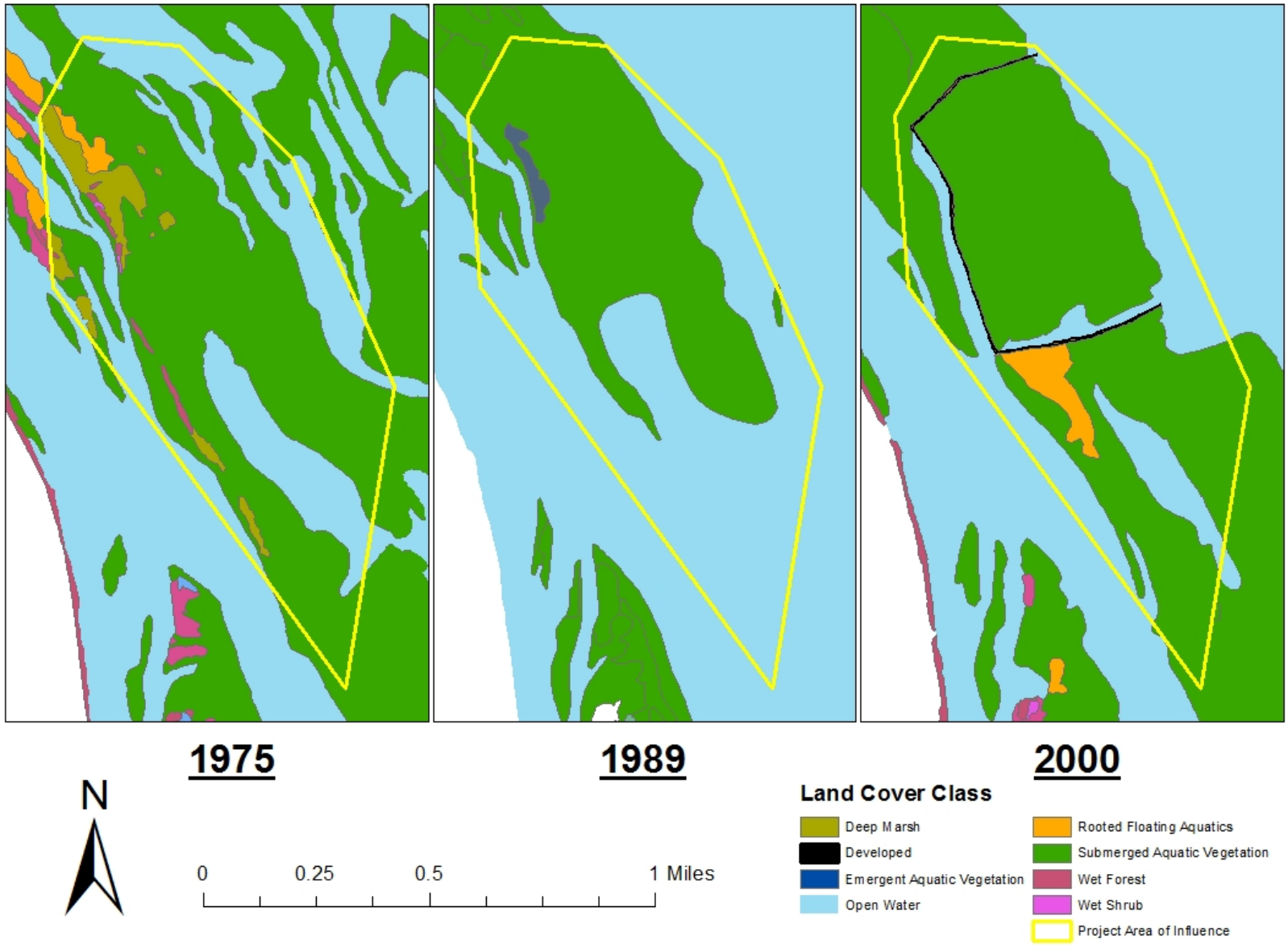

Figure 5. USGS land cover surveys of 1975 (left), 1989 (middle), and 2010 (right)

C. Protect area from boat-generated waves

General. One of the secondary project objectives for the Pool 9 Island Construction HREP was to protect the project area from boat-generated waves. The rockfill island complex was constructed to protect 100 acres of backwater area.

Pre- and Post-Project Conditions. The loss of island landmass contributed to the degradation of at least 90 acres of shallow aquatic habitat left unprotected from wave action. Some of this wave action could be attributed to boat-generated waves, the majority of which originated along the 9-foot navigation channel to the west of the project area. The C-shaped island complex surrounds and provides a barrier for more than 100 acres of habitat and aquatic beds from wave action. As discussed in the previous section, there has been an increase in aquatic vegetation since the construction of the project (see previous section, 1.B).

Conclusion. The project measures were successful in providing the ability to protect 100 acres of backwater area from boat-generated wave action. The stabilization and growth of the aquatic plant beds in the protected project zone are evidence to the effectiveness of this objective. There is limited information available on the impact of the island in reducing boat-generated waves in the area; however, Island D represents a complete barrier to boat-generated waves from passing boats in the adjacent navigation channel. Based on available vegetation data, it appears the island complex has been effective in reducing the wave impacts in the project area and has aided in the restoration of shallow aquatic vegetation.

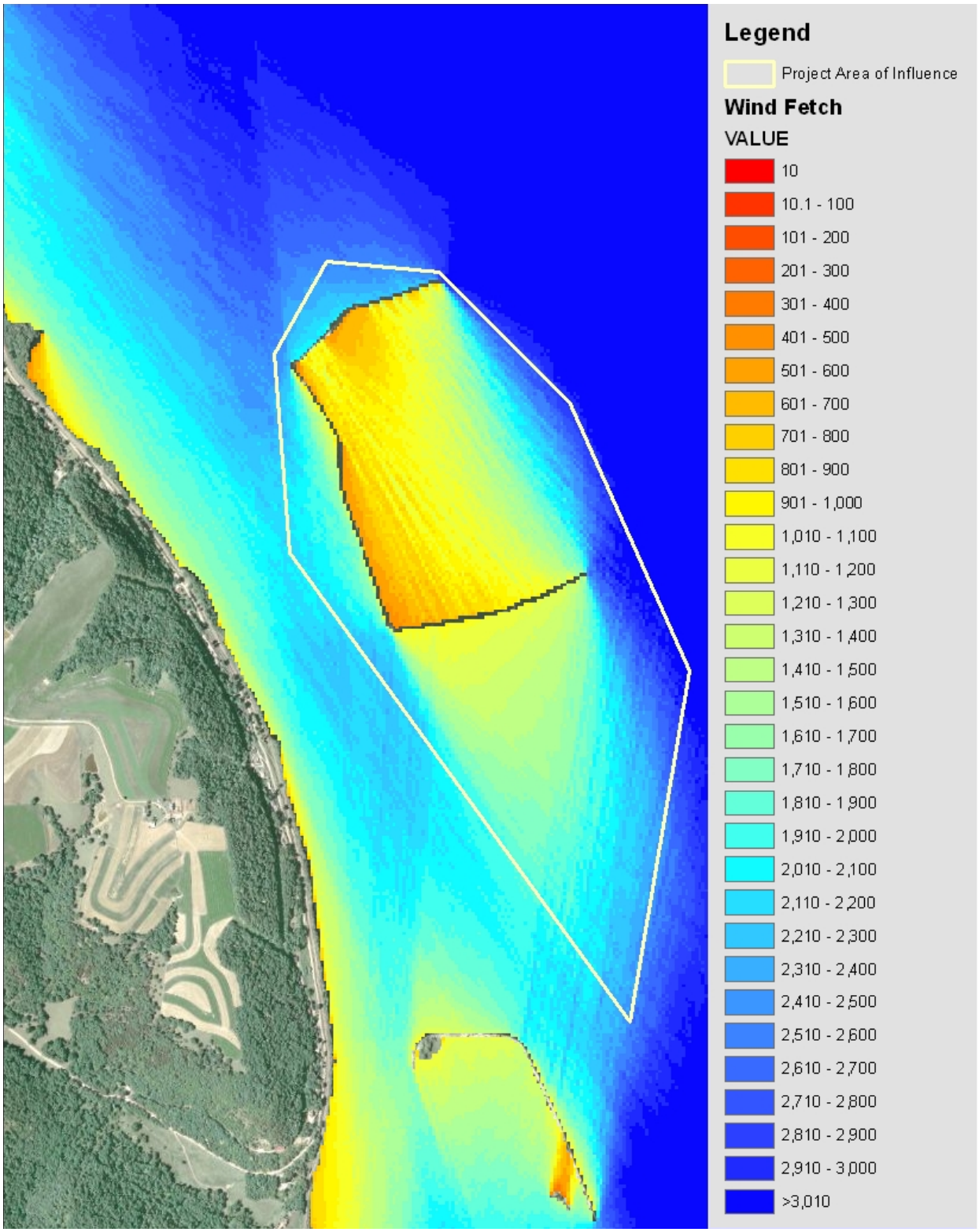

Figure 6. Pool 9 Wind Fetch, 2008

D. Provide island habitat for migratory waterfowl

General. Another secondary project objective for the Pool 9 Island HREP was to provide predator-free island habitat for migratory waterfowl. Evaluation criteria set for the objective was whether or not 10 acres of island habitat for migratory waterfowl had been created.

Pre- and Post-Project Conditions. The loss of landmass and shallow aquatic habitat in the project area were believed to have caused a reduction in the presence of migratory waterfowl in that area. There is no pre-construction waterfowl data available; however the reduction in waterfowl habitat was concluded to be one of the consequences of landmass and vegetation degradation in the project area.

In an attempt to create some nesting habitat the rock humps, which were built to show boaters the general island alignment when the island was flooded, were topped with fine borrow. This topsoil washed away within the first year post-project. Even though the island complex did not create any nesting habitat it likely functions as a staging area for migratory waterfowl.

The establishment of a shallow water habitat and the growth of submerged aquatic vegetation in the area are expected to create a suitable habitat for waterfowl. The USFWS has observed the presence of more diving ducks in the area each year during late October and November, as the island structure provides protection from the strong Northwestern winds. Sea gulls, eagles, and pelicans have also been observed loafing on the structure during recent inspections. Further observation that could suggest the success of improving waterfowl migration habitat is the sighting of waterfowl hunters on the island. Based on the recollection of one of the original Corps engineers on this project, rocks on the newly constructed island were later observed to have been rearranged by duck hunters to serve as blinds. As stated in USFWS inspection reports, “do not build blinds with rock” signs were also placed on the island in 2003 to discourage such actions. The presence of hunters on the island could suggest that the project has indeed been successful in providing a staging area for the waterfowl.

The Waterfowl Use Days (WUD) data provided by the USFWS from 1997 to 2011 (see Figure 7) shows a relatively steady waterfowl utilization of the general project area. The data splits the Pool 9 refuge into four units as Big Lake, Rush Creek, Sugar Creek, and Harpers Slough, with the Pool 9 Island located in the Sugar Creek unit (see Figure 8). It should be noted that the Sugar Creek unit has had a slight decline in WUDs between 2008 and 2011, in comparison to the significant increase in WUDs at Harpers Slough during the same period. This difference could be attributed to several factors. One of those may be due to Harpers Slough’s increased vegetative area of influence during that period, and due to the unexpected growth and improvement in the vegetation in this area. This development could be attracting more

waterfowl to this unit than the Sugar Creek Unit does. Another reason may be due to Harpers Slough being a closed area for hunting, while the rockfill island in Sugar Creek unit is open for hunting. This could have impacted waterfowl staging patterns, causing them to use Harpers Slough more during the day than the rockfill island. The data graphed in Figure 7 shows the refuge, as a whole, has seen a relatively steady increase in waterfowl numbers. The Sugar Creek unit should be evaluated and monitored at a closer level to measure the waterfowl utilization of the protected project area with respect to its immediate environment.

Conclusion. The evaluation criterion was not clearly defined in the DPR, but appears to indicate that the terrestrial area of the constructed island was to be measured. Though the project seems to have been somewhat successful in providing migratory waterfowl habitat, the measure for determining success was 10 acres of island habitat and, using GIS tools, only 5.65 acres of island habitat was measured post-project (Table 5). The project measures did not meet the objective of creating 10 acres of island habitat for migratory waterfowl and therefore was determined to be unsuccessful.

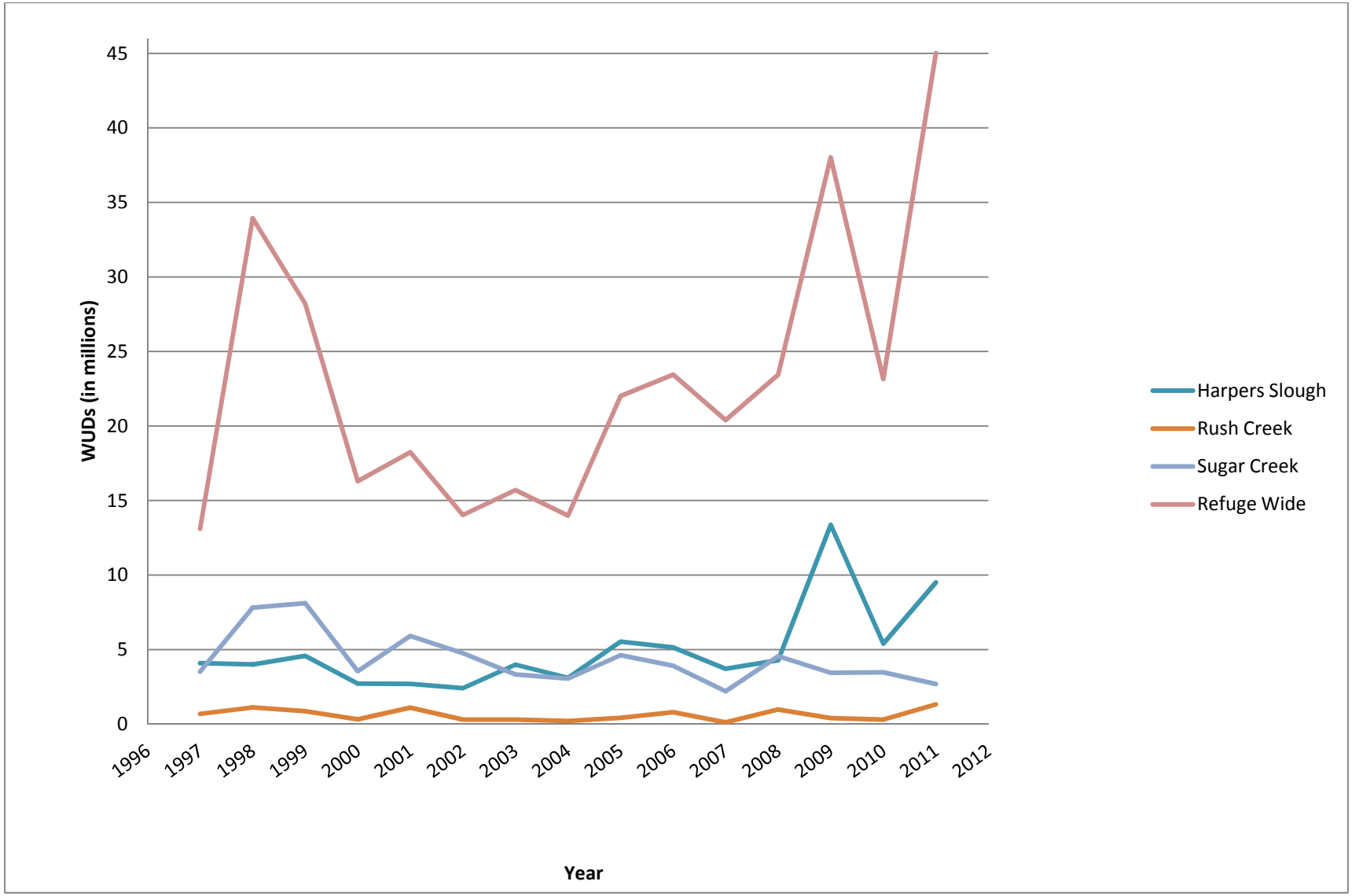

Figure 7. Waterfowl use at the lower Pool 9

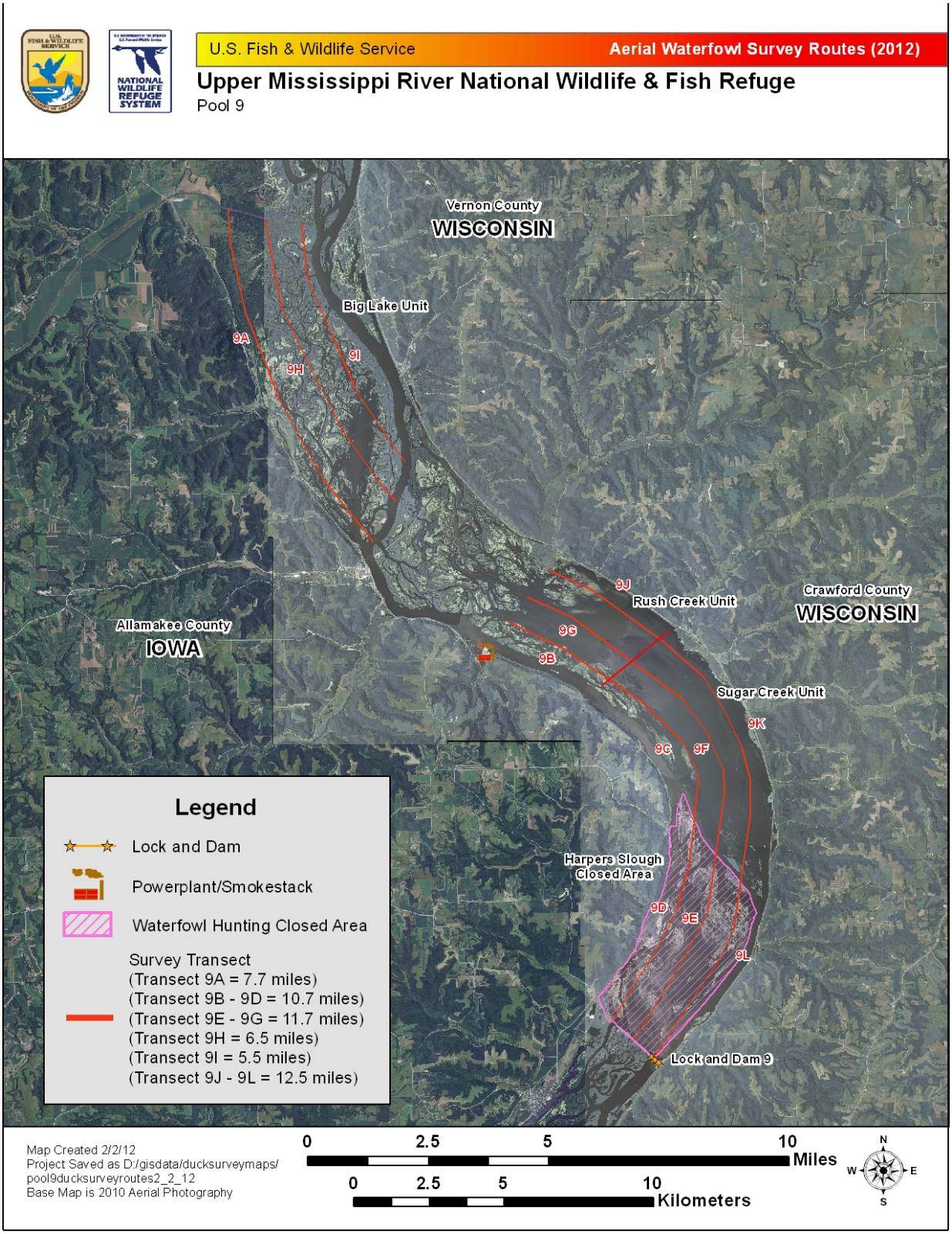

Figure 8. Pool 9 Refuge, divided into four units by USFWS for Waterfowl survey

E. Provide deep water fish habitat

General. One of the secondary project objectives for the Pool 9 Island Construction HREP was to provide deep water fish habitat. The VE design recommendation, which was implemented, incorporated this objective into optional access channels located within the interior of the islands. The dredging of the access channels was expected to be about 65 feet wide by 6 feet deep and would have provided an additional 7 acres of deep water fish habitat. However, since the item was not included as a paid feature, the access channels were not dredged to the anticipated depths.

Pre- and Post-Project Conditions. Prior to the island construction the average water depth in the area was recorded at 3 feet. The existing deep water habitat (depth of greater than 5 feet) prior to the project construction was considered to be about 5 acres, and was expected to decline to 0 without the project. The shallow areas were unsuitable for fish in the wintertime due to ice formation and possible oxygen deficiencies. The access channels, anticipated to be dredged for the island construction, were considered part of the design with the goal of providing deeper habitat for fish, and were specified to be about 65 feet wide and 6 feet deep. During construction however, the channels along the interior side of islands A and B were dredged to a depth of 4 feet because the contractor considered it to be sufficient for construction access. Furthermore, access to island D was provided through the old slough that existed adjacent to the channel. Bathymetry obtained in 1998 (Figure 9) shows the water depth to be in the 2 to 4 foot range throughout the backwater area protected by the island.

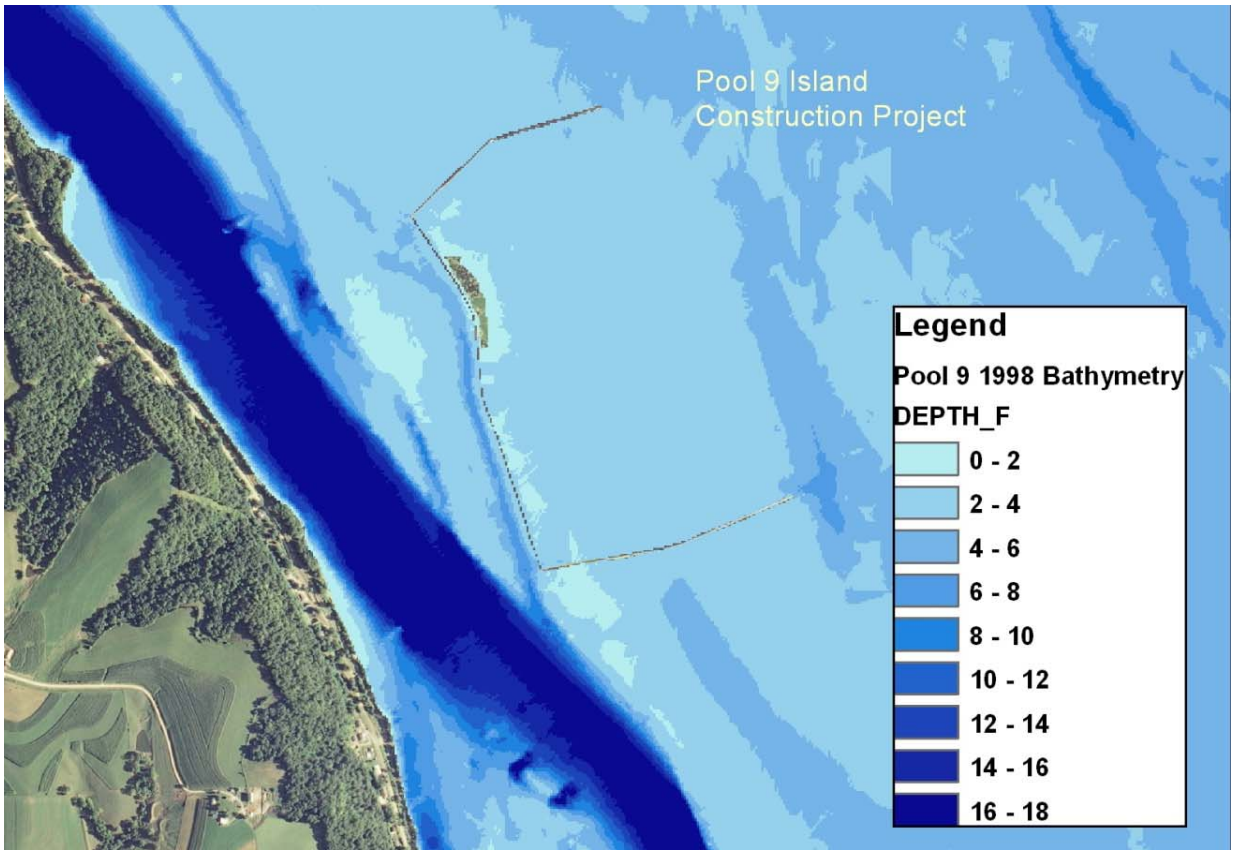

Figure 9. Bathymetry model at the Pool 9 island

Conclusion. The project measures were not effective in creating the desired 7 acres of deep water fish habitat. The channels dredged during construction of islands A and B were not dredged to the original design depth of 6 feet. The access channels were only dredged to 4 feet and do not meet the design depth requirement of greater than 5 feet for suitable deep water fish habitat. The 1998 bathymetry shows the depth throughout the entire protected region inside the island complex to be between 2-4 feet, which is essentially the same as pre project conditions.

The Wisconsin DNR conducted pre- and post-project fish surveys of the project area. The most recent surveys, conducted from 2007-2010 indicate limited fisheries use during late fall, and no indication that the protected backwaters are functioning as an overwintering site. Age 1+bluegill catches per unit effort over the 4 year time period averaged less than 10 fish per hour, compared to a 4 year average CPE of 130 per hour at Cold Springs, a known overwintering site (Wisconsin DNR, 2011). The age 1+ largemouth bass 4 year average CPUE was 0 per hour, compared to 344 at Cold Springs during the same time period (Wisconsin DNR, 2011). Therefore, available fish data and construction information provides evidence that the objective of creating a deep water habitat was not fulfilled due to minimal deep water dredging in the project interior and water seepage through the rock island.

PUBLIC SUPPORT

The island structure has been observed throughout the years to have become a very attractive location to the public for fishing and duck hunting.

LESSONS LEARNED AND RECOMMENDATIONS FOR FUTURE SIMILAR PROJECTS

Overall, the project has been successful at meeting the project goal and objectives related to aquatic vegetation and fall waterfowl migration habitat. It reduced flow in the project area, and created a protected zone against northwest and southeast winds. This project successfully enhanced the aquatic vegetation and shallow water habitat in the area, providing a suitable environment for waterfowl and spring/summer use by backwater fish. The rock structure has demonstrated to be effective both in cost and restoration of aquatic and vegetative habitats. However, the rock structure provides no waterfowl nesting habitat or terrestrial habitat that was once in the area. Periodic inspections conducted by the USFWS call for continued monitoring, and report of the island being thin on rocks in some areas. The loss of rocks is most likely caused by settling and possible displacement of rock by ice, and may eventually require maintenance work to ensure continued structural integrity of the island.

It could be speculated that the further development and restoration of Pool 9's habitat and environment north and south of the project area may be becoming more a attractive staging alternative to the migratory waterfowl flying through the refuge. Additionally, the absence of hunters at Harpers Slough may also be attracting the waterfowl more to this area as well. This attraction could have resulted in the gradual decline in the number of waterfowl being drawn to the island between 2008 and 2011. Anecdotal information, however, does not provide very much insight on such speculation, and further monitoring would be required.

The deep water fish habitat originally intended to be created by the dredging of access channels at islands A and B, was never provided due to changes in dredging plans during construction. The access channels along these islands were only dredged to 4 feet where needed, and that does not satisfy the objective of creating a habitat greater than 5 feet in depth. It was anticipated that dredging access near the islands would create fish habitat. However, the construction contract plans stated that the access channels were to be constructed as needed and thus the channels were not dredged.

Pre-construction and post-construction survey data is essential and greatly helpful in conducting a better quantitative analysis of the project's performance with respect to its pre-construction benchmarks. Existing data on periodic inspections does not extend as far back as the pre-construction days, or is not easily obtainable due to changes in software programs used for data collection. With limited survey data, the majority of the evaluation is based primarily

on qualitative observations. Post-construction flow measurement and current bathymetry would add to the quality of analysis when determining the project success.

The rockfill island complex is one of the smaller islands in the Pool 9 refuge. It has been highly effective in reducing flow and providing protection against wave action and sedimentation. The rocky composition of the island does not permit terrestrial vegetation cover, and is therefore not as effective as an island constructed from dredged material in providing a diverse and more desirable terrestrial habitat for migratory birds. The rocky structure is, on the other hand, a cost effective alternative if the only purpose of the island is to provide wind fetch protection and reduction in water velocities during average summer water discharge.

Lessons learned from this project include:

Clearly defining objectives during planning

Include desired construction features in contract documents

Trade-offs between constructed habitat and costs (such as access dredging depth and rock vs. earthen islands, aesthetics)

This was an early HREP and the Project Delivery Teams have since incorporated many of the lessons learned into recent projects.

References

U.S. Army Corps of Engineers. (1989). *Pool 9 Island Construction Habitat Rehabilitation And Enhancement Project Definite Project Report/Environmental Assessment (SP-3).* St. Paul: U.S. Army Corps of Engineers.

U.S. Army Corps of Engineers. (1996). *Pool 9 Island Construction Habitat Rehabilitation And Enhancement Project Operation and Maintenance Manual.* St. Paul: U.S. Army Corps of Engineers.

U.S. Army Corps of Engineers. (1993). *Pool 9 Island Construction Habitat Rehabilitation And Enhancement Project Supplemental Definite Project Report/Environmental Assessment (SP-3A).* St. Paul: U.S. Army Corps of Engineers.

U.S. Fish and Wildlife Service. (2008). *Pool 9 Islands HREP 2008 Annual Inspection Report.* Winona: U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. (2009). *Pool 9 Islands HREP 2009 Annual Inspection Report.* Winona: U.S. Fish and Wildlife Service.

Wisconsin Department of Natural Resources. (2011). *Pre-Assessment of Fisheries Response to Lower Pool 9 Environmental Management Program Habitat Rehabilitation and Enhancement Projects (2007-2010) (DRAFT).* Wisconsin DNR.