REPORT SUMMARY

MARSH LAKE ECOSYSTEM RESTORATION PROJECT

Feasibility Scoping Meeting:	11 DEC 2007
Alternative Formulation Briefing:	15 FEB 2011
AFB Guidance Memorandum:	10 FEB 2011
Draft Report Guidance Memorandum:	26 APR 2011
Division Engineer Transmittal:	25 AUG 2011
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30-Day S&A Review end:	02 NOV 2011
FEIS filed with EPA:	N/A

STUDY INFORMATION

Study Authority. The feasibility study is being conducted under the authority of the 10 May 1962 resolution of the Committee on Public Works of the U.S. House of Representatives. The resolution reads as follows:

> "Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the report of the Chief of Engineers on the Minnesota River, Minnesota, published as House Document 230, 74th Congress, First Session and other pertinent reports, with a view to determining the advisability of further improvements in the Minnesota River Basin for navigation, flood control, recreation, low flow augmentation, and other related water and land resources."

A December 2004 Reconnaissance Study determined there was a Federal interest in pursuing solutions to the problems identified within the Minnesota River Basin, including Marsh Lake and the tributary stream Pomme de Terre River.

Study Sponsor. State of Minnesota, Department of Natural Resources.

Study Purpose and Scope. The purpose of the Marsh Lake Ecosystem Restoration Feasibility Report and Environmental Assessment is to document the planning process for ecosystem restoration of the Marsh Lake area on the Minnesota River, to provide opportunity for participation in the planning process for river management partners and the public, to meet Corps of Engineers planning guidance and to meet National Environmental Policy Act (NEPA) requirements. The scope of the project is consistent with the original authorization in "determining the advisability of further

improvements in the Minnesota River Basin for navigation, flood control, recreation, low flow augmentation, and other related water and land resources."

Project Location/Congressional District. Marsh Lake comprises the upper portion of the Lac qui Parle reservoir located on the Minnesota River in western Minnesota. Lac qui Parle and Marsh Lake Reservoirs form boundaries for Lac qui Parle, Swift, and Big Stone Counties. The study area includes Marsh Lake, the lower reaches of the Pomme de Terre River, and the upper portion of the Lac qui Parle reservoir near the outlet of the Marsh Lake Dam. The study area is entirely located within the current boundaries of Minnesota Congressional District 7.

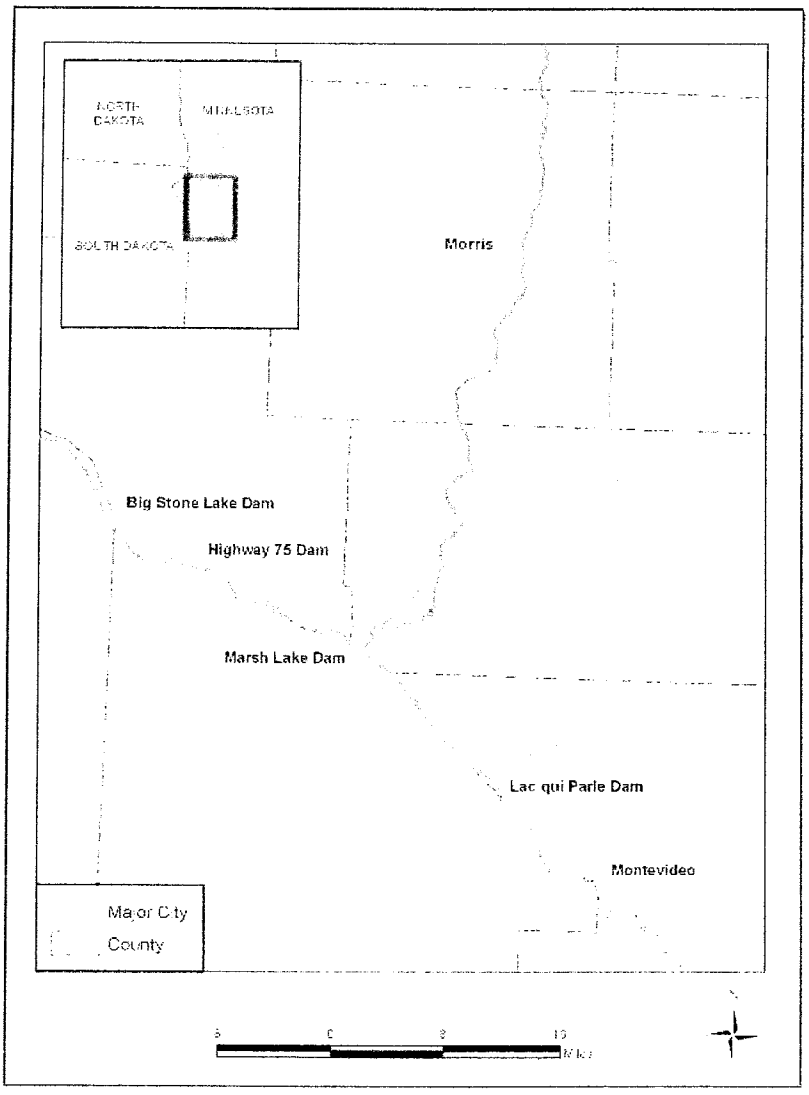

Figure 1. Marsh Lake Study Area Location

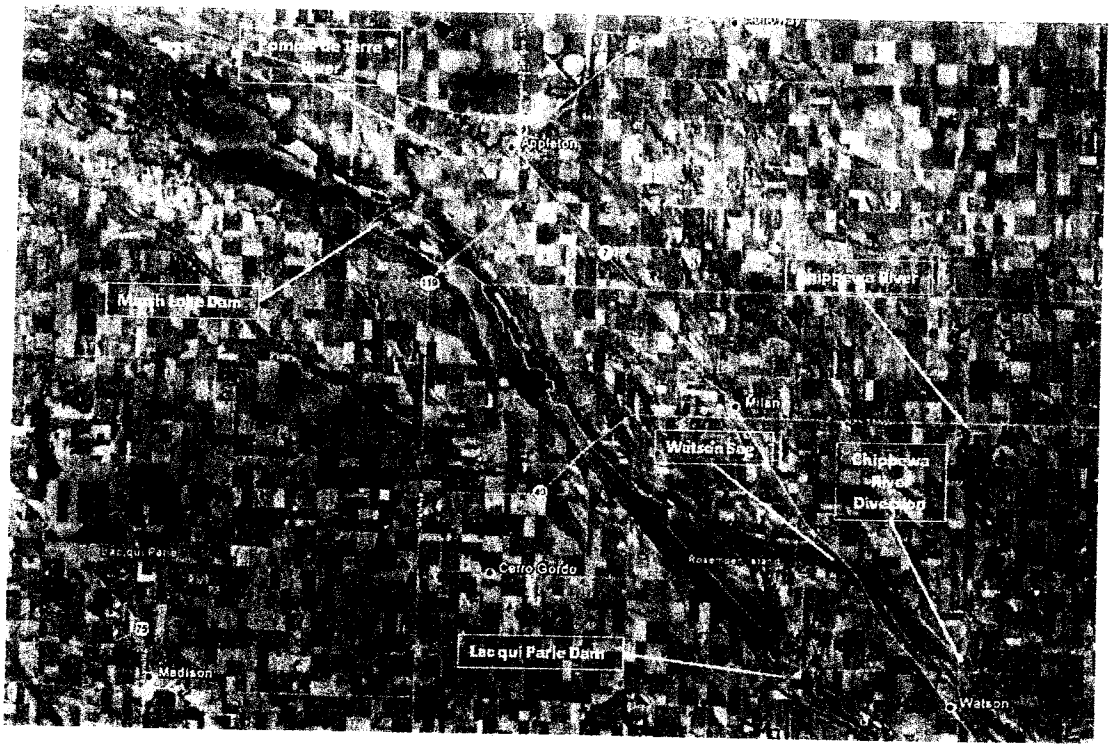

Figure 2. Lac qui Parle Project Features

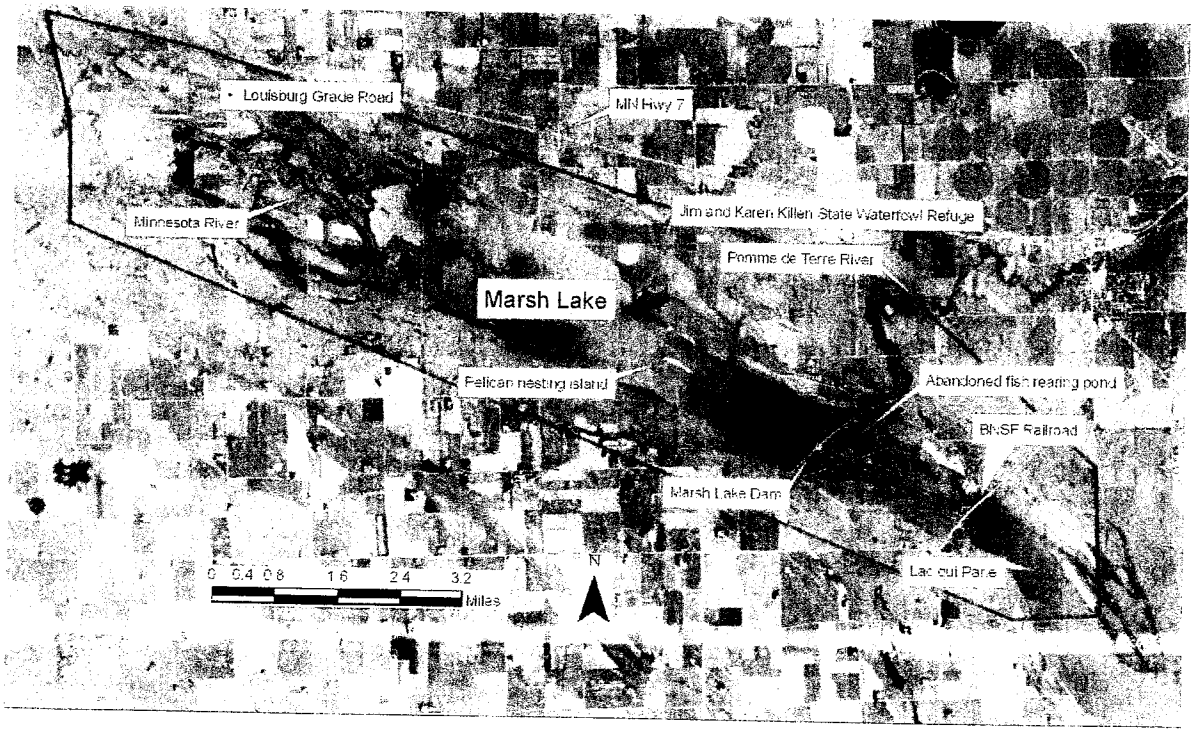

Figure 3. Marsh Lake Study Area

Prior Reports and Existing Water Projects. Construction o the Marsh Lake Dam initially began in the late 1930's by the State of Minnesota and the Federal Works Progress Administration as part of the multi-purpose Lac qui Parle Water Control Project. The project was authorized by the Flood Control Act of 1936, Public Law 74-738 and was partially constructed by the Works Progress Administration. The Corps of Engineers completed project construction between 1941 and 1951. Operation of the project was transferred from the State of Minnesota to the Corps of Engineers in 1950.

Components of the Lac qui Parle project include the Lac qui Parle Dam, the Chippewa River Diversion, and the Marsh Lake Dam. An overview of the project components is included in the figure above (Figure 2). Following completion of the Lac qui Parle Project, the Corps of Engineers constructed two additional impoundments upstream at Highway 75 as well as Big Stone Lake (Figure 1).

Federal Interest. Aquatic ecosystem restoration is a primary mission of the Corps of Engineers Civil Works program, and is defined as achieving a "return of natural areas or ecosystems to a close approximation of their conditions prior to disturbance, or to less degraded, more natural conditions" (EP 1165-2-502.) The original construction of the Marsh Lake Dam was intended to serve as a flood damage reduction measure as well as a recreational feature to the region, primarily through the creation of a static pool on the river. The intended flood damage reduction benefits provided by the Marsh Lake Dam are minor due to effectiveness of the Lac qui Parle Dam downstream. Marsh Lake is a popular recreation destination in the region as shown by visitor numbers. As with many projects constructed at the time, a full understanding of the ecology of the system was not of primary concern.

Since construction of the impoundment, Marsh Lake has undergone significant degradation of aquatic habitat due to a number of stressors including high sediment and nutrient loading, a fixed crest dam that prevents natural fluctuation in seasonal water levels, high turbidity from wind-driven sediment resuspension, and abundant common carp that increase turbidity and graze off submersed aquatic vegetation and macroinvertebrates. Although Marsh Lake provides an open water area for migratory waterfowl to rest and islands for nesting colonial waterbirds, degradation of the aquatic ecosystem limits habitat suitability for many species of fish and wildlife.

The stated goal of Marsh Lake Ecosystem Restoration Project is to "return the Marsh Lake area ecosystem to a less degraded and more natural condition by restoring ecosystem structure and functions." The intent of the Marsh Lake Ecosystem Restoration Project is to increase variability in ecosystem processes, restore a more natural water level regime, aquatic habitat connectivity, and a vegetated lake ecosystem state.

STUDY OBJECTIVES

Problems and Opportunities. Ecosystem restoration authority is the guiding authority for the Marsh Lake Ecosystem Restoration Project and objectives drafted for this study are primarily related to ecosystem outputs. As noted above, construction of the Marsh Lake Dam in 1939 inundated natural floodplain habitats, increased reservoir fish and wildlife habitat and created new colonial water bird nesting habitat by creating islands. However, it also disrupted natural river functions and processes, affecting sediment movement and floodplain function, blocking fish movements, and reducing river and floodplain habitats. Natural flooding and drying cycles were disrupted, reducing emergent aquatic plants and associated fish and wildlife habitats found in the area prior to the impoundment. Each of these problems are influenced by multiple stressors on the ecosystem resulting from anthropogenic activities and natural processes. These stressors include:

- Altered hydrologic regime – loss of natural fluctuation in water levels
- Sediment loading – concentrated flows from the rerouted Pomme de Terre River
- Sediment resuspension – shallow pool and long wind fetch increase resuspension frequency
- Invasive species - common carp are a dominant species in the structure of the fishery
- Loss of ecosystem connectivity – the dam serves as a physical barrier to migrating fish

Taking the existing and forecasted future conditions into consideration, the following problems were identified:

- Degraded Marsh Lake Ecosystem State - Marsh Lake has been subject to long-term degradation. Rapid delivery of water, sediment, and nutrients into the system due to land use changes in the watershed led to higher and faster fluctuations in water levels and degraded water quality. After spring runoff, water levels remain relatively stable due to the dam's fixed-crest design. The lake is very shallow, with more than 3,000 of its 5,000 acres less than 3 feet deep when the lake is at the spillway elevation. Shallow conditions and high sediment loads result in frequent sediment resuspension and high turbidity, reducing both emergent and submersed aquatic plant growth within the lake. The lack of aquatic plants has limited food available for migrating waterfowl.
- Low-Diversity Fish Community - The fish community in Marsh Lake is dominated by non-native common carp. Over two thirds of the biomass of fish in Marsh Lake is carp. Native game fishes like yellow perch, walleye, white bass, black crappies, and northern pike occur but in relatively low abundance. Carp exacerbate the turbidity problem in Marsh Lake by bioturbation of sediment. Carp graze submersed aquatic plants, helping maintain an unvegetated and turbid ecosystem state in the lake. Construction of the the Marsh Lake Dam and the rerouting of the Pomme de Terre River effectively limits connectivity of the ecosystem for fish by serving as a barrier to migrating fish from the downstream Lac qui Parle reservoir.

- Degraded Pomme de Terre River Ecosystem State - The Pomme de Terre River was diverted into Marsh Lake when the dam was built in the 1930's. The river diversion was intended to conserve water in Marsh Lake. Water and suspended sediment from the Pomme de Terre River short circuits to the Marsh Lake Dam. Sediment from the Pomme de Terre has been depositing to form a delta in Marsh Lake rather than replenishing the floodplain at its confluence with the Minnesota River at the upper end of Lac qui Parle.

The relationship between stressors, problems and opportunities are illustrated in the Table 1 below:

Goal	Problem	Stressors	Opportunity
A return of the Marsh Lake area ecosystem to a less degraded, more natural and functional condition.	Degraded Marsh Lake Ecosystem State	Sediment Loading	1. Restore Marsh Lake ecosystem function, processes and connectivity 2. Enhance recreational opportunities in and around Marsh Lake 3. Reduce public safety risks at the Marsh Lake Dam
		Sediment Resuspension	
		Altered Hydrologic Regime	
		Ecosystem Connectivity	
	Low-Diversity Fish Community	Invasive Species	1. Restore native fish community 2. Enhance recreational fishing opportunities in and around Marsh Lake
		Ecosystem Connectivity	
	Degraded Pomme de Terre Ecosystem State	Sediment Deposition	1. Restore Pomme de Terre ecosystem function, processes and connectivity 2. Enhance recreational opportunities on the Pomme de Terre River
		Ecosystem Connectivity	

Table 1. Plan Formulation Goal, Problems, Stressors and Opportunities

Planning Objectives.

1. Reduced sediment loading to Marsh Lake over the 50-year period of analysis

2. Restored natural fluctuations to the hydrologic regime of Marsh Lake over the 50-year period of analysis

3. Restored geomorphic and floodplain processes to the Pomme de Terre River over the 50-year period of analysis

4. Reduced sediment resuspension within Marsh Lake over the 50-year period of analysis

5. Increased extent, diversity and abundance of emergent and submersed aquatic plants within Marsh Lake over the 50-year period of analysis

6. Increased availability of waterfowl habitat within Marsh Lake over the 50-year period of analysis

7. Restored aquatic habitat connectivity between Marsh Lake, the Pomme de Terre River and Lac Qui Parle over the 50-year period of analysis

8. Reduced abundance of aquatic invasive fish species within Marsh Lake over the 50-year period of analysis

9. Increased diversity and abundance of native fish within Marsh Lake and the Pomme de Terre River over the 50-year period of analysis

Planning Constraints.

1. The planning process must be consistent with all applicable Federal laws, Executive Orders, Agency Regulations and other applicable policy.

2. The formulation of alternative measures should avoid, to the greatest extent possible, the reduction of the flood damage reduction benefits provided by the dams.

3. In its existing condition, Marsh Lake and the Pomme de Terre River provide functional habitat for a number of species. A universal constraint in the planning of ecosystem restoration projects is the maxim that the restoration activities should not degrade, but rather seek to improve, the existing function of the ecosystem from its current state. Consideration of the potential adverse impacts to species within the project area therefore imposes constraints on the development of alternative measures. Specific biotic considerations include:

a. American Pelicans – a colony of nesting and breeding pelicans inhabits Marsh Lake during the summer months. Pelicans seek refuge on islands in the lake. Changes to water levels within the lake should minimize the impact on the isolation of these islands.

b. Mussels – A diverse mussel community exists within the lower reaches of the Pomme de Terre River. Consideration of project alternatives should minimize the impacts to this community and its future viability.

c. Fish Community – while the community is primarily dominated by common carp (an invasive species), Lac qui Parle and Marsh Lake also support communities of native fish. Changes to water levels resulting from alternative measures must minimize negative impacts on the native fish community, particularly valuable northern pike spawning habitat in the upper end of Marsh Lake.

ALTERNATIVES

Plan Formulation Rationale.

The plan formulation process was guided primarily by the regulations set forth in ER 1105-2-100 Appendix E.V with the policy objective "to restore degraded significant ecosystem structure, function, and dynamic processes to a less degraded, more natural condition." The project team attempted to gauge the full range of problems and opportunities within the Marsh Lake area in order to develop a comprehensive plan to fully address systemic stressors affecting the ecosystem. In addition, given the existing public use at both the Marsh Lake Dam site as well as the State Wildlife Management Area (WMA), ancillary recreation features were incorporated into the plan formulation process to leverage opportunities to improve recreation within the study area. This broad comprehensive approach directed the identification of problems, opportunities, objectives and constraints which fed into the plan formulation process, focused analytically on maximizing ecosystem outputs throughout the site.

While the plan formulation process utilized a watershed approach towards addressing ecosystem objectives, given the joint ownership between the State and Federal government of the lands surrounding Marsh Lake and the number of stressors directly relating to the original construction of the dam, alternative measures outside of the Marsh Lake area were quickly screened out in favor of a focus on alternatives occurring directly within the Marsh Lake area. ER 1105-2-100 requires evaluation of the completeness, effectiveness, efficiency and acceptability of alternative measures as a primary method of comparison and evaluation of alternatives. In addition to these screening criteria, the following criteria were also taken into consideration:

- Could the alternative measure be implemented within the Marsh Lake area?
- Would the alternative measure be ecologically effective?
- Would the alternative measure be practicable from an engineering perspective?

Table 2 below summarizes the initial screening process for the study:

Table 2. Initial Screening of Marsh Lake Alternative Measures

Alternative Measures	Can be Implemented as part of Marsh Lake Project?	Ecologically Effective?	Practicable from Engineering Perspective?	Retain for Further Consideration?
No Action	Yes	No	Yes	Yes (for comparison with other alternatives)
Watershed BMPs	No	Yes	Yes	No
Wetland restorations in watershed	No	Yes	Yes	No
Streambank stabilization in watershed	No	Yes	Yes	No
Restore Pomme de Terre River to its former channel	Yes	Yes	Yes	Yes
Modify Marsh Lake Dam to attain target water levels/construct fishway	Yes	Yes	Yes	Yes
Drawdowns to restore emergent aquatic plants, control carp, modify Marsh Lake Dam	Yes	Yes	Yes	Yes
Install gated culverts Louisburg Grade Road	Yes	Yes	Yes	Yes
Install gated culverts and pump system in abandoned fish pond	Yes	No	No	No
Breach dike on abandoned fish pond	Yes	Yes	Yes	Yes
Breach or remove Marsh Lake Dam	Yes	Yes	No	No
Construct islands in Marsh Lake	Yes	Yes	Yes	Yes
Construct exclosures, plant submersed aquatic plants	Yes	Potentially	No	No

Management Measures and Alternative Plans. From the screening of the initial array of alternative measures a number of measures were retained for further consideration. These measures included:

1) No Action
2) Restore Pomme de Terre River to its former channel
3) Modify Marsh Lake Dam to attain target water levels, construct fishway
4) Construct a drawdown water control structure to enable water level drawdowns and restore aquatic plants
5) Install gated culverts in Louisburg Grade Road
6) Breach dike at abandoned fish pond
7) Construct islands in Marsh Lake

The costs and benefits of each alternative measure were calculated and the results were input into the Institute for Water Resources cost-effectiveness and incremental cost analysis planning software for ecosystem restoration projects (IWR-Plan). IWR Plan compares all of the potential combinations of management measures in various alternative plans. Based on the alternative measures identified through the initial screening process noted above IWR Plan identified 48 separate alternative plans for the Marsh Lake Ecosystem Restoration Project. Each alternative plan (i.e. combination of alternative measures) is evaluated for cost-effectiveness. The most cost-effective plans are identified as best-buy plans and are retained for the final array of alternative plans.

Final Array of Alternatives. IWR-Plan formulated five best buy plans along with a no-action alternative. Each alternative plan includes different combinations of measures retained through the screening process. Each increment progressively adds additional measures, increasing costs as well as benefits. The results of the IWR-Plan output are summarized in Table 3 below:

Table 3. Marsh Lake Final Array of Alternative Plans

No.	Restore Pomme de Terre	Modify Marsh Lake Dam, Fishway	Drawdown Structure	Louisburg Grade Road Gated Culverts	Modify Abandoned Fish Pond	Construct Islands in Marsh Lake	Average Annual Habitat Units (AAHU)	Average Annual Costs	Average Costs per AAHU
0							0	$ -	$ -
1	X						6567	$ 203,588	$ 31.00
2	X				X		6572	$ 204,009	$ 31.04
3	X		X	X	X		7907	$ 387,896	$ 49.06
4	X	X	X	X	X		8390	$ 473,278	$ 56.41
5	X	X	X	X	X	X	8508	$ 717,813	$ 84.37

Comparison of Alternatives. As noted above, alternative measures contained within the final array are not mutually exclusive, and subsequently alternative plans consist entirely of various combinations of alternative measures with increasing outputs and increasing costs. Tradeoffs between plans are primarily related to the effectiveness of the alternative plan in meeting the ecosystem objectives and cost-efficiency in the total cost required to implement the plan. In general, as ecosystem benefits increase, costs also increase. The incremental cost analysis played an important role in the selection of the recommended plan. It is also important to note that implementation of ecosystem restoration features on this site poses low risk to human health and public safety and therefore comparison of alternative plans relies little on the overall consideration of risk.

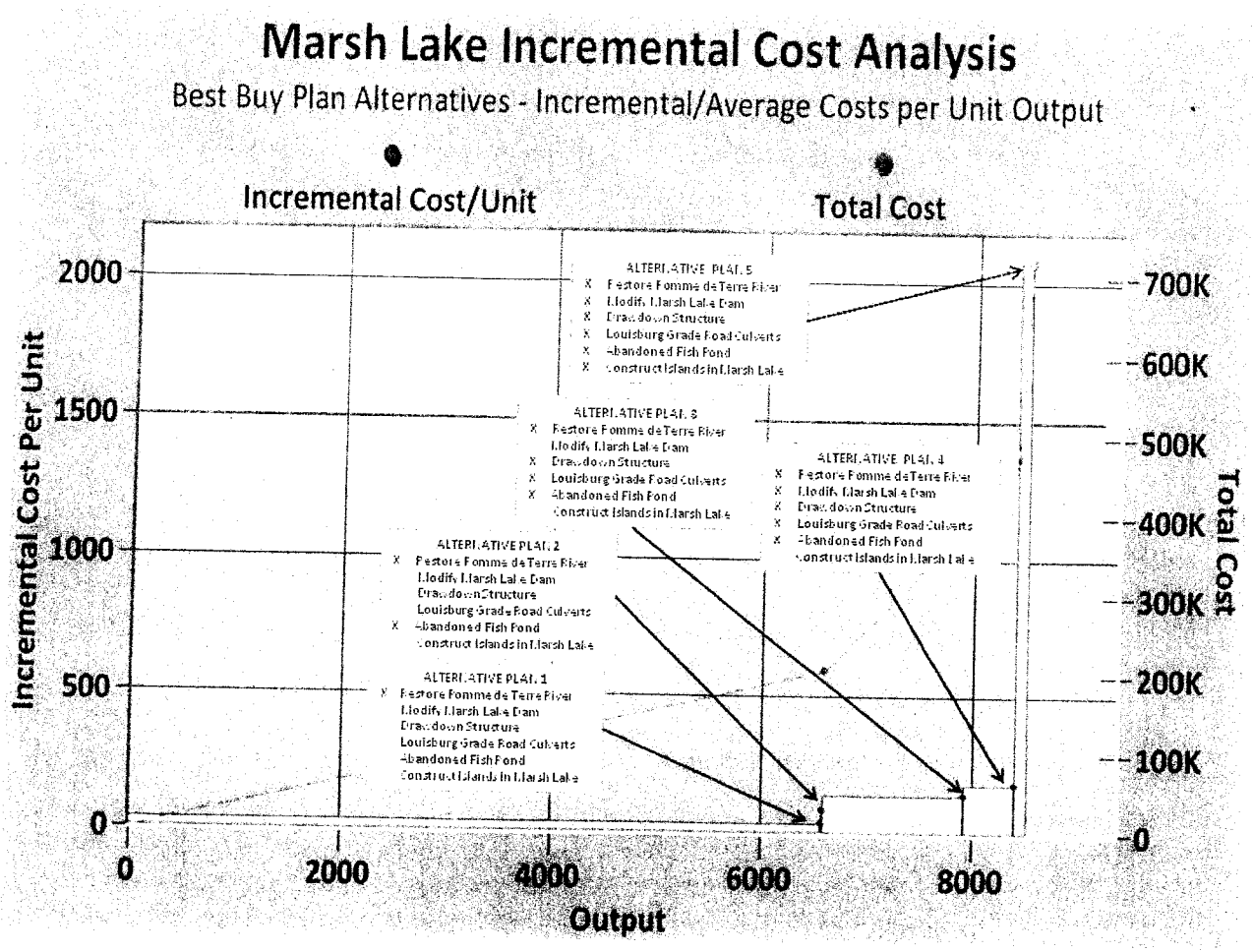

Figure 4. Marsh Lake Plan Alternatives Incremental Cost Analysis

- Alternative Plan 1, Restore Pomme de Terre River to its Historic Channel

Restoring the Pomme de Terre River to its former channel would reconnect aquatic habitat between Lac qui Parle and the Pomme de Terre River, reduce a major source of sediment loading, as well as oxygen for winter refuge for invasive carp within Marsh Lake. This measure provides the single highest level of benefit at the lowest cost per increment. The costs per average annual habitat unit (AAHU) for this alternative plan is $31.00 with a projected total benefit of 6567 AAHU. In terms of cost efficiency, Alternative Plan 1 provides the greatest incremental increase in benefits at the lowest costs per unit.

- Alternative Plan 2, Alternative Plan 1 with the Breaching of the Dike at the Abandoned Fish Pond

Alternative Plan 2 includes the additional measure of breaching the abandoned fish pond dike to provide an additional five acres of habitat. The incremental increase in costs per average annual habitat unit (AAHU) for this increment is $84.20 and a total cumulative benefit of 6572 AAHU.

- Alternative Plan 3, Alternative Plan 2 with Drawdown Structure and Gated Culverts at Louisburg Grade Road

Alternative Plan 3 includes the additional measures of a water control drawdown structure to lower lake levels periodically and construction of culverts at Louisburg Grade Road. These features allow for the operability of the Marsh Lake Dam and protection of northern pike spawning areas upstream of Louisburg Grade Road during drawdown conditions. The incremental increase in costs per average annual habitat unit (AAHU) for this increment is $137.74 and a total cumulative benefit of 7907 AAHU.

- Alternative Plan 4, Alternative Plan 3 with Modification to Marsh Lake Dam to Attain Target Water Levels and Construct Fishway

Alternative Plan 4 includes the additional measure of modification of the Marsh Lake dam for passive water level management and construction of a fishway. This feature will lower average annual water levels in the lake and provide for connectivity over the dam between Marsh Lake and Lac qui Parle. The incremental increase in costs per average annual habitat unit (AAHU) for this increment is $176.77 and a total cumulative benefit of 8390 AAHU.

- Alternative Plan 5, Alternative Plan 4 with the Construction of Islands in Marsh Lake

Alternative Plan 5 includes the addition of breakwater islands in Marsh Lake in combination with the full array of alternatives. The breakwater islands reduce the wind fetch across the lake and will assist in the reestablishment of submersed aquatic plants by reducing the sediment resuspension and turbidity of the water. The incremental increase in costs per average annual habitat unit (AAHU) for this increment is $2072.33 and a total cumulative benefit of 8508 AAHU.

An illustration of how each alternative plan addresses ecosystem stressors, objectives and desired outputs is included in the table below:

Problem	Ecosystem Stressor	Objective	Output	Alternative Plan 0 - No Action	Alternative Plan 1 - Restore Pomme de Terre River to its former channel	Alternative Plan 2 - Restore Pomme de Terre - Abandoned Fish Pond	Alternative Plan 3 - Restore Pomme de Terre - Drawdown Structure - Louisburg Grade Road Culverts - Abandoned Fish Pond	Alternative Plan 4 - Restore Pomme de Terre - Drawdown Structure - Louisburg Grade Road Culverts - Abandoned Fish Pond - Modify Dam/Fishway	Alternative Plan 5 - Combination of all measures including isalnds in Marsh Lake
				Addresses stressor, achieves objective and provides desired output?					
Marsh Lake Ecosystem State	Sediment Loading	Reduced sediment loading to Marsh Lake over the 50-year period of analysis	1. Reduced turbidity 2. Increased aquatic plan growth 3. Increased availability of forage for waterfowl	No	Yes	Yes	Yes	Yes	Yes
	Sediment Resuspension	1. Reduced sediment loading to Marsh Lake over the 50-year period of analysis 2. Increased extent, diversity and abundance of emergent and submersed aquatic plants within Marsh Lake over the 50-year period of analysis 3. Reduced sediment resuspension within Marsh Lake over the 50-year period of analysis 4. Increased availability of waterfowl habitat within Marsh Lake over the 50-year period of analysis	1. Reduced turbidity 2. Increased aquatic plan growth 3. Increased availability of forage for waterfowl	No	No	No	Yes	Yes	Yes
	Lake Level Variability	1. Restored natural fluctuations to the hydrologic regime of Marsh Lake over the 50-year period of analysis 2. Increased extent, diversity and abundance of emergent and submersed aquatic plants within Marsh Lake over the 50-year period of analysis	1. Increase light attenuation 2. Consolidation of bottom sediments 3. Germination of aquatic plan seedbed 4. Increased aquatic plant growth 5. Increased availability of forage for waterfowl	No	No	No	Yes	Yes	Yes
	Ecosystem Connectivity	Restored aquatic habitat connectivity between Marsh Lake, the Pomme de Terre River and Lac Qui Parle over the 50-year period of analysis	Increase the frequency of migration of native fish between Lac qui Parle and Marsh Lake	No	Partial	Partial	Partial	Yes	Yes
Low-Diversity Fish Community	Invasive Species	1. Reduced abundance of aquatic invasive fish species within Marsh Lake over the 50-year period of analysis 2. Increased diversity and abundance of native fish within Marsh Lake and the Pomme de Terre River over the 50-year period of	1. Increase availability of spawning habitat for northern pike 2. Increase availability of spawning habitat for walleye	No	Yes	Yes	Yes	Yes	Yes
	Ecosystem Connectivity	Restored aquatic habitat connectivity between Marsh Lake, the Pomme de Terre River and Lac Qui Parle over the 50-year period of analysis		No	Yes	Yes	Yes	Yes	Yes
Degraded Pomme de Terre Ecosystem State	Sediment Deposition	Reduced sediment loading to Marsh Lake over the 50-year period of analysis	1. Reduced turbidity 2. Increased aquatic plan growth 3. Increased availability of forage for waterfowl	No	Partial	Partial	Yes	Yes	Yes
	Ecosystem Connectivity	1. Increase the diversity and abundance of native fish in the Pomme de Terre River 2. Restored geomorphic and floodplain processes to the Pomme de Terre River over the 50-year period of analysis 3. Restored aquatic habitat connectivity between Marsh Lake, the Pomme de Terre River and Lac Qui Parle over the 50-year period of analysis	1. Increase the frequency of migration of native fish between Lac qui Parle and Marsh Lake 2. Increase availability of spawning habitat for walleye	No	Partial	Partial	Partial	Yes	Yes

Table 4. Evaluation of Alternative Plans in Achieving Ecosystem Objectives

Key Assumptions. A number of assumptions helped guide the plan formulation process and the overall recommendation:

1. The Lac qui Parle Flood Control Project (including the Marsh Lake Dam) will continue to be operated and maintained by the Corps of Engineers for the foreseeable future.

2. The hydrologic regime of the Minnesota and Pomme de Terre Rivers will remain within historic seasonal ranges of flow.

3. The Lac qui Parle Wildlife Management Area will continue to be maintained and managed by the DNR.

4. The beneficial uses of the Marsh Lake ecosystem (flood damage reduction, fish and wildlife management, recreation) will continue to provide benefit to the public.

5. The value of flood damage reduction to downstream urban and agricultural areas will continue or increase in the future.

6. Loss of habitat over time within the watershed will increase the value of Marsh Lake and Lac qui Parle as a protected area for wildlife.

7. The value of the project area for recreation and frequency of use is expected to be maintained over time.

Recommended Plan. The alternative plan that reasonably maximizes the benefits in relation to cost and meets the overall planning objects is Alternative Plan 4 which was selected as the National Ecosystem Restoration Plan (NER Plan). This plan includes the following:

- Restore the Pomme de Terre River to its historic channel - The Pomme de Terre River will be rerouted into its former channel in a meander loop upstream of Marsh Lake Dam and into the longer former channel downstream of the Marsh Lake Dam by constructing three earthen cut-off dikes (Figure 4-1). The total length of river channel that would be restored is approximately 11,500 feet. With an average 80-ft wide channel, approximately 21 acres of river channel would be restored. This action will reduce sediment loading, restore floodplain processes to the Pomme de Terre River delta downstream of the Marsh Lake Dam, a 293-acre area as well as restore connectivity between Lac qui Parle and the Pomme de Terre River.
- Breach dike at abandoned fish pond - Breaching the dike at the abandoned fish pond will allow water levels within it to be the same as in the upper end of Lac qui Parle, and would allow fish access to the area. The shallow abandoned fish pond area will also provide shorebird habitat during times when Lac qui Parle water level is low.
- Construct drawdown water control structure - A water control structure will be built in the existing overflow spillway area to provide controlled discharge capacity to enable a drawdown. Growing season drawdowns are typically conducted following spring high water into September when plants go senescent. Growing season drawdowns can be done in two consecutive growing seasons to allow plants germinated in the first year to grow to full size before flooding to normal water levels. Once established, perennial aquatic plants can persist for years, providing valuable food and habitat for fish and wildlife. The drawdown structure would be 113.5-feet wide with 10 bays. The water control structure would have a 16-ft wide walkway across the top that could serve a secondary purpose as part of a trail across the dam

in the future. Operation of the drawdown structure will be conducted consistent with the Monitoring and Adaptive Management Plan included in this report.

- Construct Louisburg Grade Road gated culverts - Water levels in the upper part of Marsh Lake will be managed separately from the main body of the lake, particularly in drawdown conditions. For example, high water levels can be maintained for a time in early spring to provide flooded marsh habitat upstream of the Louisburg Grade Road for spawning northern pike and to improve survival of young-of-year fish. The stop logs would subsequently be removed to allow the fish to return to Marsh Lake. Implementation of this measure is designed to enhance both the fishery throughout Marsh Lake and promote native fish dominance.

- Modify the Marsh Lake Dam, construct fishway - Marsh Lake Dam will be modified with a fishway structure to provide a passive weir that would increase water level variability on Marsh Lake, attain the target water level regime and to allow year-round fish passage (Figure 4-4). The fishway will be constructed in the existing fixed crest spillway in Marsh Lake Dam. Nature-like fishways are effective in re-establishing fish migration routes past dams and other hydraulic obstacles. Nature-like fishways simulate natural river channels and the hydraulic conditions that fish have evolved to swim through. Nature-like fishways can be simple rock ramps that look like natural rapids or bypass channels with riffles and pools. Many nature-like fishways have been constructed in Minnesota and have been very effective in restoring migratory fishes to stream networks. The fishway design contains a series of arched rock riffles that concentrate flow toward the middle of the fishway. Shallow areas on the sides would have slower current velocities and would allow upstream passage by smaller and weaker-swimming fish. The riffles would be made of boulders imbedded into smaller rock, with pools of deeper water between the riffles. Water would flow between the boulders in the riffles at velocities that fish could still swim through.

Alternative Plan 4 maximizes the net ecosystem benefits while retaining overall cost effectiveness. When viewed relative to the costs of similar ecosystem restoration projects, the average costs per habitat unit are relatively low (similar ecosystem restoration projects constructed by MVP have had costs of approximately $2000 per AAHU). The $56.41 per AAHU created by the project is extremely efficient in achieving the stated ecosystem objectives and therefore deemed reasonable in cost. While Alternative Plan 5 maximized ecosystem outputs, the last increment of $2072.33 was not found to be cost efficient for inclusion in the NER Plan. Future monitoring and adaptive management detailed in the report Appendix R provides information on the need for the last increment through future analysis. The NER Plan has strong support from the non-Federal sponsor and is consistent with regional and State planning for the area.

The Recommended Plan also includes a number of recreation features for the site, formulated through a stand-alone planning process. Recreation features include:

1. Construction of a pedestrian bridge across Marsh Lake Spillway for improved safety, to provide angler access to both sides of the river, and as a future state bike trail connection.
2. Upgrade U.S. Army Corps of Engineers day use facility at the Marsh Lake Dam to include a Pomme de Terre Canoe Access Point, a portage area, picnic tables, and shoreline fishing platforms.
3. Shoreline access upgrades to include shoreline fishing and interpretive signage.

A synopsis of the full costs and benefits of the recommended plan are included below under the Expected Project Performance. Project features associated with the recommended plan are included in the figures below:

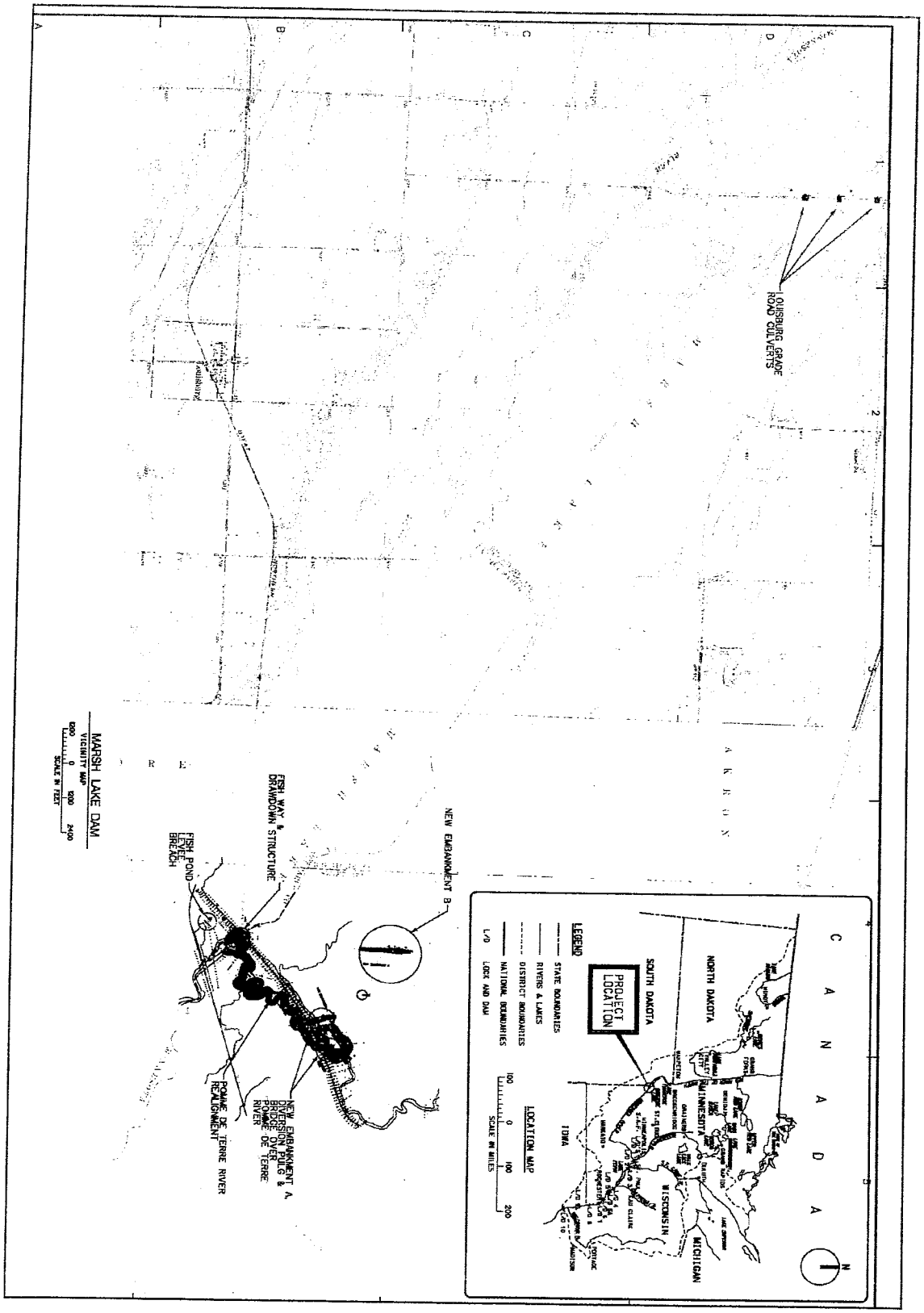

Figure 5. Ecosystem Restoration Features of the Recommended Plan

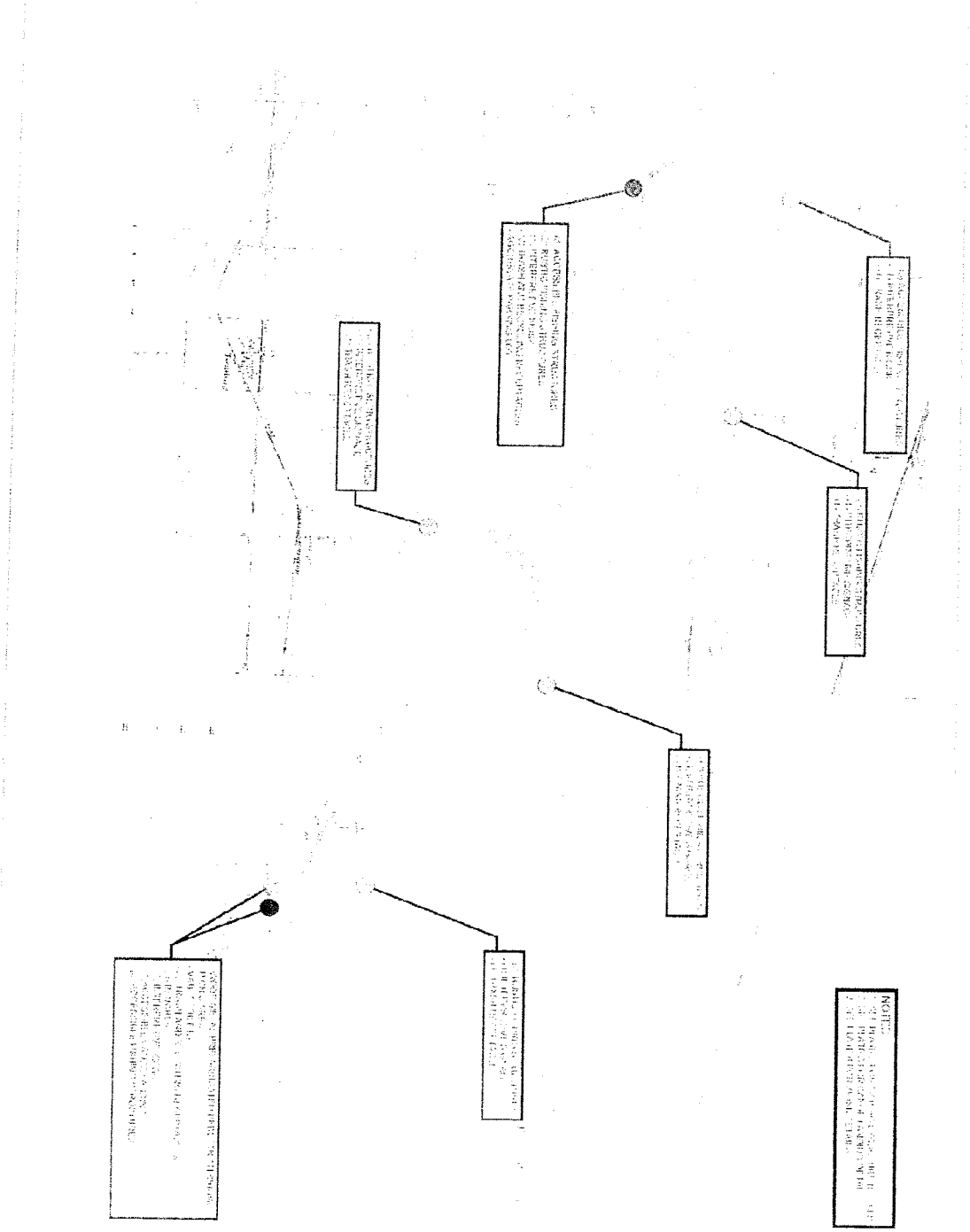

Figure 6. Recreation Features of the Recommended Plan

Systems / Watershed Context. As noted above, the project team utilized a broad comprehensive approach to identify a full range of ecosystem stressors which contribute to the current degraded state of the resource. While much of the surrounding agricultural watershed has been highly altered hydrologically, it was determined early in the planning process that many of the stressors identified at the site are directly related to the presence of the dam and alignment of the Pomme de Terre River which results in the stable degraded ecosystem state. A watershed study within the Minnesota River Basin is on-going which will simultaneously address watershed issues in areas surrounding the project, however, the Marsh Lake Ecosystem Restoration Project was determined to hold merit as a separable element from the watershed study as its own project. The Feasibility Study report illustrates the unique opportunity at the project site to work with a capable non-federal sponsor to modify an existing project to achieve significant benefits for the site and area resources. The non-federal sponsor engaged the Corps of Engineers following a detailed planning process which included substantial stakeholder input. Agencies have been highly supportive of the overall project.

Environmental Operating Principles. Properly formulated ecosystem restoration projects should be consistent with USACE Environmental Operating Principles. The analysis included in the Marsh Lake Ecosystem Restoration Project Feasibility Study report shows that implementation of the recommended plan will have a substantial benefit to the ecosystem of Marsh Lake while balancing the existing use and function of the previously authorized project. Environmental Operating Principles are listed below for reference:

1. Strive to achieve environmental sustainability. An environment maintained in a healthy, diverse and sustainable condition is necessary to support life.

2. Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of Corps programs and act accordingly in all appropriate circumstances.

3. Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.

4. Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems.

5. Seeks ways and means to assess and mitigate cumulative impacts to the environment; bring systems approaches to the full life cycle of our processes and work.

6. Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work.

7. Respect the views of individuals and groups interested in Corps activities, listen to them actively, and learn from their perspective in the search to find innovative win-win solutions to the nation's problems that also protect and enhance the environment.

Peer Review. In accordance with EC 1165-2-409, all technical, engineering and scientific work underwent an open, dynamic and vigorous review process to ensure technical quality. This included Agency Technical Review (ATR) and a Corps Headquarters policy and legal review. All concerns of the ATR have been addressed and incorporated into the final report. An exclusion from the Independent External Peer Review (IEPR) was granted by Corps Headquarters following a completion and review of risk assessment associated with the recommended project features.

EXPECTED PROJECT PERFORMANCE

Project Costs. Project costs by category, costs and benefits, economic cost and benefits, as well as cost allocations for the recommended plan are included in the tables below.

Table 5. Cost Summary

Marsh Lake Ecosystem Restoration Project		
October 2011 Price Levels		
Construction Item	Cost	
Lands & Damages	$	10,000
Elements		
Relocations	$	2,720,000
Reservoirs	$	3,994,000
Levees & Floodwalls	$	1,184,000
Recreation Facilities	$	425,000
Subtotal	$	8,323,000
Preconstruction Engineering & Design (PED)	$	1,004,000
Construction Management (E&D, S&A)	$	630,000
Total Project First Costs	$	9,967,000

Table 6. Equivalent Annual Benefits and Costs

Marsh Lake Ecosystem Restoration Project		
(October 2011 Price Level, 50-Year Period of Analysis, 4.125 Percent Discount Rate)		
Investment Costs		
Total Project Costruction Costs	$	9,967,000
Interest During Construction	$	214,000
Total Investment Cost	$	10,181,000
Average Annual Costs		
Interest and Amoritization of Initial Investment	$	465,000
OMRR&R	$	35,000
Total Average Annual Costs	$	500,000
Average Annual Benefits		
Monetary (Net Recreation Benefits)	$	199,000
Non-Monetary (Ecosystem Benefits)		8400
Benefit-Cost Ratio (Monetary Benefits)		8.6

Table 7. Economic Costs and Benefits of Recommended Plan

Item	Ecosystem Restoration		Recreation		Total Costs	
	Allocated Costs	Benefits	Allocated Costs	Benefits	Allocated Costs	Net Benefits
Investment Cost						
First Cost	$ 9,463,000		$ 504,000		$ 9,967,000	
Interest During Construction	$ 202,000		$ 12,000		$ 214,000	
Total	$ 9,665,000		$ 516,000		$10,181,000	
Annual Cost						
Interest and Amoritzation	$441,000		$ 24,000		$ 465,000	
OMRR&R	$33,000		$ 2,000		$ 35,000	
Subtotal	$474,000		$ 26,000		$ 500,000	
Annual Benefits						
Monetary (Recreation)				$ 225,000		$ 199,000
Non-monetary (Ecosystem)		8400 AAHU				8400 AAHU
Recreation Benefit-Cost Ratio				8.6		

Table 8. Apportionment of Project First Costs between Federal and Non-Federal Sponsors

	Federal	Non-Federal	Total
Ecosystem Restoration Features			
Preconstruction Engineering, Design	$ 619,000	$ 333,000	$ 952,000
Construction Management	$ 392,000	$ 211,000	$ 604,000
Construction	$ 5,133,000	$ 2,764,000	$ 7,897,000
LERRD	$ 7,000	$ 3,000	$ 10,000
Total Ecosystem Restoration	**$ 6,151,000**	**$ 3,311,000**	**$ 9,463,000**
Recreation Features			
Preconstruction Engineering, Design	$ 26,000	$ 26,000	$ 52,000
Construction Management	$ 13,000	$ 13,000	$ 26,000
Construction	$ 213,000	$ 213,000	$ 426,000
LERRD	$ -	$ -	$ -
Total Recreation Features	**$ 252,000**	**$ 252,000**	**$ 504,000**
Total First Project Costs	**$ 6,403,000**	**$ 3,563,000**	**$ 9,967,000**

Project Implementation. The State of Minnesota, Department of Natural Resources (DNR) served as the non-Federal sponsor for the Feasibility phase and will likely serve as the non-Federal sponsor for the Construction phase. Cost-sharing for plan implementation is subject to the rules for ecosystem restoration projects established in Section 210 of WRDA 1996. Accordingly, the non-Federal share will be 35 percent of the implementation costs. Recreation features would be cost shared 50%/50% with OMRR&R a local responsibility in accordance with the cost sharing established by WRDA 1986, as amended. Non-Federal sponsors are responsible for 100 percent of lands, easements, rights-of-way, utility or public facility relocations, and dredged or excavated material disposal areas (LERRD), and operation, maintenance, repair, rehabilitation, and replacement (OMRR&R). The value of LERRD is credited to the 35 percent share. An adaptive management and resource monitoring plan is included in the Feasibility Study Report. Monitoring will be performed by the Corps over time and the project features will be operated per the adaptive management plan.

Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R). As noted above, the non-Federal sponsor will be responsible for all operation, maintenance, repair, rehabilitation and replacement of both ecosystem restoration and recreation features constructed in conjunction with this project. The estimated costs of annual maintenance total $35,000. Maintenance responsibilities are detailed within the cost estimate and generally include inspection, vegetation maintenance, road and bridge maintenance, and other repairs and rehabilitation as necessary.

Key Social and Environmental Factors. The intent of the project is to provide ecosystem restoration to Marsh Lake, a part of the Lac qui Parle reservoir. The recommended plan involves modification of a dam at the Marsh Lake outlet, rerouting of the Pomme de Terre River, and associated hydrologic modifications in and around Marsh Lake for ecosystem benefit. The Environmental Assessment has concluded a finding of no significant impact is based on the following factors: the project would have no adverse impacts on fish and wildlife resources, and the project would have only short-term minor negative impacts on the social environment, State-listed threatened or endangered species and on air quality. The project would substantially benefit wetland habitat, habitat diversity and interspersion, biological productivity and surface water quality and have minor benefits to recreation, public health and safety, and public facilities and services. Mitigation through documentation of cultural features is required by the State Historic Preservation Office (SHPO) prior to any construction at the Marsh Lake Dam. Continued coordination, particularly regarding cultural resources, will be maintained with appropriate State and Federal agencies.

Stakeholder Perspectives and Differences. The State of Minnesota, Department of Natural Resources (DNR) has been actively involved in planning the Marsh Lake project over the course of the previous twelve years. Public involvement regarding conditions at Marsh Lake pre-dates the Marsh Lake Feasibility study. The Corps and the DNR worked together in 1999 and 2000 to consider potential modifications to the Marsh Lake Dam. As a part of that effort, approximately 50 citizens attended a public meeting on July 27, 2000 and provided 39 written comment sheets. No consensus was reached on desired actions at that time, but the public input was used to inform further discussions within the DNR. The DNR began a public planning process on November 9, 2000 to define problems and issues at Marsh Lake. This planning process ultimately served as the foundation for the current Corps Feasibility Study Report and State-Federal partnership.

A public review period was conducted from May 17, 2011 to June 25, 2011. A press release was issued, the project web site was updated with a copy of the project report and a video overview, and hard copies of the report were made available at two of the local libraries near the project location.

On May 26, 2011, project delivery team members conducted a series of meetings on site with stakeholders and the public to solicit input on the draft Feasibility Study Report during the public review period. Organizations in attendance included U.S. Fish and Wildlife Service staff, the Appleton Sportsman's Club, the Lac qui Parle Association, Coalition for a Clean Minnesota River (CCMR), Ducks Unlimited, the Upper Minnesota Valley Regional Development Commission, CURE (Clean Up the River Environment) as well as members of the general public. The project delivery team provided presentations about the project development process, the problems and opportunities, and the recommended plan. A question and answer period followed the presentation. The project was generally well-received with many of the participants showing support for the recommended plan. No negative comments were subsequently received during the review period and therefore no outstanding issues requiring resolution were identified during the review.

Environmental Compliance. The Feasibility Study Report contains an integrated Environmental Assessment. Cultural mitigation is required for alterations to the Marsh Lake Dam. No environmental mitigation is required. Comments from State and Federal Agencies, as well as Tribal representatives, were solicited and received during the public review period for the draft Feasibility Study Report. No substantive issues of concern were identified at that time. A draft Finding of No Significant Impact (FONSI) is included in the report for future execution.

State and Agency Review. [PLACEHOLDER – S&A REVIEW] S&A review will begin on October 3, 2011 and end on November 2, 2011. Identify the states and agencies that responded, identify any objections or issues that they expressed, and summarize the final resolution of any objections or issues. (To be inserted by HQUSACE after the S&A Review ends.)

Certification of Peer and Legal Review. The Feasibility Study Report has undergone an open, dynamic, rigorous third party review at multiple stages of development. These reviews include Value Engineering (VE), Independent Technical Review (ITR), and Agency Technical Review (ATR). All concerns of the ATR and legal review have been addressed and incorporated into the final report. An exclusion from the Independent External Peer Review (IEPR) was granted by Corps Headquarters following a completion and review of risk assessment associated with the recommended project features. Completion dates for peer and legal reviews are as follows:

- Value Engineering: October 1, 2007
- Independent Technical Review: October 1, 2007
- Agency Technical Review: December 16, 2010
- Cost DX Approval: June 9, 2011
- Legal Review: July 8, 2011

Policy Compliance Review. [PLACEHOLDER] Summarize the final results of the HQUSACE policy compliance review process. (To be inserted by HQUSACE when the Documentation of Review Findings are completed.)