STORM LAKE SECTION 206
PRELIMINARY RESTORATION PLAN (PRP)

I. AUTHORITY

A. Language. Section 206 of the Water Resources Development Act of 1996, as amended, provides that the Corps of Engineers is authorized to perform aquatic ecosystem restoration provided that the project has non-Federal sponsor, is in the best interest of the public, and is cost effective.

B. Funding. The U.S. Army Corps of Engineers, Rock Island District, received $9,000 in Federal Fiscal Year (FY) 2005 and $1,000 in FY 2006 to prepare a Preliminary Restoration Plan (PRP).

II. STUDY PURPOSE

The purpose of this document is to provide the results of a study to determine if there is Federal interest in ecosystem restoration in the Storm Lake Watershed, Iowa.

The study has found that there is a Federal interest in continuing the planning process into a more detailed feasibility phase. Specifically, it concludes that the project fits Corps of Engineers Section 206 Authority guidance. This document presents the basis for this finding and establishes the scope of the feasibility phase. A preliminary appraisal of Federal interest, estimated costs, potential benefits, and possible environmental impacts of various alternatives is also presented.

III. STUDY AREA, NON-FEDERAL SPONSOR, AND CONGRESSIONAL DISTRICT

A. Study Area. The study area is the 17,917-acre Storm Lake watershed including a 3,147-acre natural glacial lake located near the City of Storm Lake, in Buena Vista County (County) in western Iowa. The main focus of this study will be the 190 acre Little Storm Lake located on the northwest corner of Storm Lake (figure 1).

B. Non-Federal Sponsor. The non-Federal sponsor for the project is the Iowa Department of Natural Resources (IADNR).

C. Congressional District. The study area lies within the 5th Iowa Congressional District, which is represented by Congressman Steve King.

IV. DISCUSSION OF PRIOR STUDIES, REPORTS, AND EXISTING WATER PROJECTS

The following studies, reports, and projects were reviewed as part of this analysis:

A. The *Storm Lake Restoration Diagnostic/Feasibility Study* was funded by the IADNR in June 1994. This report by Iowa State University (ISU) staff (Hoyman, Lohnes, and Sours) and IADNR personnel (Bonneau) documents an intensive study of Storm Lake and the surrounding watershed, identifying water-quality related problems and their likely causes, and suggesting a potential list of restoration measures. Information in this resource contributed to the study team's knowledge base.

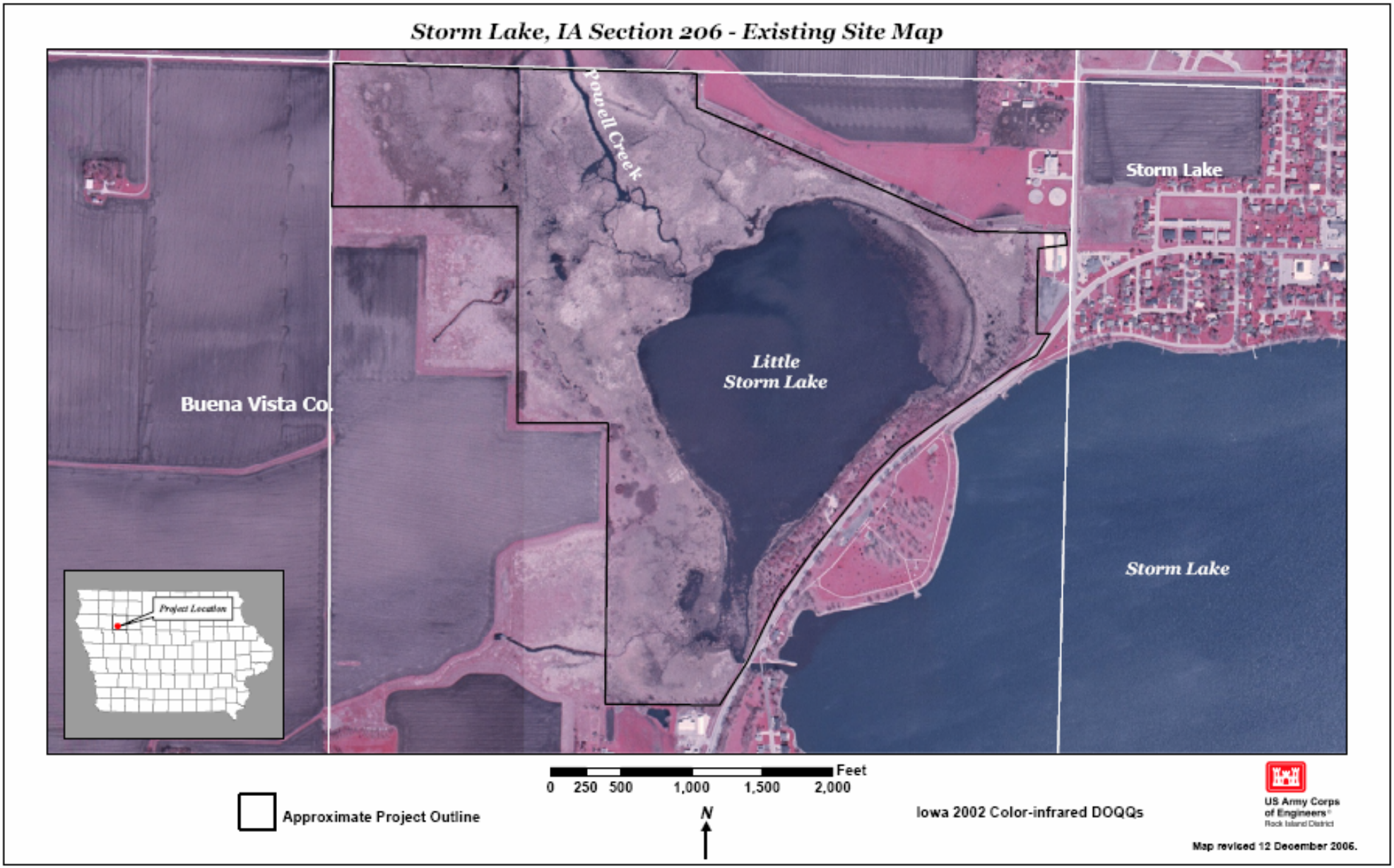
Storm Lake, IA Section 206 - Existing Site Map
Powell Creek
Storm Lake
Little
Storm Lake
Buena Vista Co.
Storm Lake
Project Location
Feet
0 250 500 1,000 1,500 2,000
Approximate Project Outline
N
Iowa 2002 Color-infrared DOQQs
US Army Corps
of Engineers
Rock Island District
Map revised 12 December 2006.

FIGURE 1

B. The ***Comprehensive Plan for Storm Lake Water Quality Project*** was completed in May 2002 by Jeff Kestel of the Iowa Lakes Resource Conservation and Development and community members. The plan presents goals and recommendations for the preservation of the natural character of the lake while allowing for watershed activities such as growth, recreation, and agriculture. Information in this resource contributed to the study team's knowledge base.

C. ***Total Maximum Daily Load (TMDL) for Turbidity Storm Lake Buena Vista County, IA*** was completed in 2005 by IADNR TMDL and Water Quality Assessment Section**.** As required by the Federal Clean Water Act, the IADNR developed a total maximum daily load for Storm Lake. The purpose of the TMDL is to calculate allowable sediment load for the lake that will meet water quality standards. The report outlines specific and quantifiable targets for Secchi depth and total suspended solids in the lake and recommended an implementation and monitoring plan. The plan calls for an evaluation of Little Storm Lake—and its existing and future capacity to trap sediment—to be conducted. The plan also recommends that best management practices such as livestock exclusion, incentive programs, and fertilizer application modifications.

D. The ***ISU Iowa Lakes Survey*** is an ongoing study, conducted by ISU, monitoring water quality in 132 of Iowa's principle recreational lakes. Data through 2004 is published at this time.

E. Storm Lake Dredging Project. A dredging project overseen by the Lake Improvement Commission has been removing sediment from Storm Lake since 2002. The goal of the dredging project is a mean depth of 14 feet within the lake or approximately 700,000 per year. Approximately 2.07 million cubic yards were dredged in the 2002-2004 seasons. The dredging done in the 2002 season was completed by the State of Iowa using a contractor. The County owns its own dredge, and city employees have accomplished the dredging 2003 through the present.

F. Storm Lake Watershed Protection Program was initially funded in 1990 through 2000 and again beginning in 2004. The total investment in the project was over $200,000. Funding was provided by the USEPA Section 319 and Water Quality Infrastructure Program (WQIP) grant, State Water Protection Funding (WPF), and local support. Private landowners participated in the program, implementing best practices to reduce erosion.

V. PLAN FORMULATION

A. Existing Conditions

1. **General.** Storm Lake and the adjoining 190 acre marsh called Little Storm Lake is the fourth largest natural lake in Iowa. It is one of the shallowest of Iowa's 34 glacial lakes. Storm Lake is approximately 3.5 miles long and 2 miles wide. The area is approximately 3,150 acres (Historical Analysis, Andersen). Storm Lake discharges into Outlet Creek which drains into the Raccoon River and ultimately the Des Moines River. The marsh is fed mostly by Powell Creek, which drains the largest portion of the watershed.

2. Watershed. The 14,770 acre (IADNR 2005) watershed (excluding the lake) is predominantly level to moderately sloping land. The watershed to lake ratio is 4.4:1. Soils vary from well-drained to poorly-drained. The soils are considered moderately erodible. The predominate land use in the watershed is cropland. Table 1 shows the types of land use by number of acres and percent of watershed, as estimated in 2002 - 2003.

Table 1. 2002 - 2003 Land Use in Storm Lake Watershed
(*Iowa Department of Agriculture and Land Stewardship, Division of Soil Conservation in conjunction with Buena Vista County Soil and Water Conservation District*

Land Use	Area (acres)	Percent of Total Area
Cropland	10,990	75
Urban	1,530	10
CRP/Hay	760	5
Timber/Marsh/Park	370	3
Farmsteads	350	2
Pasture	100	1
Other	600	4
Total	**14,700**	**100**

3. Water Quality

a. General. Powell Creek enters the marsh in the northwest corner. The creek's base flow is dominated by agricultural drainage tiles which results in a higher nutrient content than groundwater base flow.

i. Nutrients. The Storm Lake system has been classified as hyper-eutrophic (artificially aged). Hyper-eutrophic lakes exhibit high nutrient levels, excessive and sometimes toxic algae blooms, summer and winter fish kills. In addition, these lakes produce foul odors.

The major nutrients entering the marsh are phosphorus and nitrogen. The normal agricultural uses in the watershed import these nutrients through naturally entering water sources. Algae species in the system have sufficient nitrogen levels and are marginally limited in their growth by phosphorus. Therefore, reducing turbidity levels in the lake without concomitant reductions in nutrients could result in potentially explosive and toxic algal blooms.

ii. Sediment. It is believed that under normal hydrologic conditions, Little Storm Lake functions as a sediment trap for Storm Lake, but it can be overwhelmed during high runoff events. Little Storm Lake is assumed to be at or near its sediment trapping capacity which results in higher sediment transport into Storm Lake. Wind resuspension and other in-lake dynamics further exacerbate the total turbidity of the lake. The Lake Improvement Commission has been actively dredging sediment from Storm Lake. Prior to the dredging project, the lake had a mean depth of 8 feet and maximum depth of 14 feet (IADNR 2005)

Though a large percentage of the watershed is in intensive crop production, the Storm Lake Watershed project actively supports the use of best management practices such as conservation tillage systems, including no-till and marginal pasture wetland buffers to keep cattle from wallowing in the streams. A local water quality coordinator works with landowners to develop these practices. During 2005, over 78 acres were enrolled in the no-till program, and 100 acres of pasture were enrolled in the wetland buffer program. These practices are not limited to agricultural lands. In 2005, a local country club created 2.5 acres of buffer along Powell Creek.

iii. Dissolved Oxygen. Because organisms remove oxygen from the water both to breathe and to decompose organic material, dissolved oxygen levels in the Storm Lake complex may fall to levels that stress fish and other aquatic organisms. The shallow warm waters of Little Storm Lake are almost uninhabitable to fish species other than carp and bullheads which are more tolerant of lower oxygen and warmer water temperatures. In shallow, well-mixed lakes like Storm Lake, poor oxygen conditions more commonly affect bottom-dwelling organisms as small volumes of stagnant water overlying the sediment experience lower dissolve oxygen. Dissolved oxygen sampling indicates that Storm Lake remains oxic and relatively well-mixed throughout the growing season (IADNR 2005).

4. Aquatic Resources

a. Vegetation. Macrophytes are aquatic plants that grow above the water line (emergent), on the water surface (floating) or entirely under the surface (submergent). Macrophytes are beneficial in aquatic systems because they stabilize banks, oxygenate water, and provide shelter for small fish and spawning habitat for adult fish. In addition, they serve as a food source for waterfowl and wildlife and as food and substrate for aquatic invertebrates.

As the water clarity of the lake has decreased, macrophyte diversity and extent has decreased. The moist soil habitat has become dominated by a dense monoculture of the invasive species purple loosestrife; emergent vegetation zones have become dominated by cattail.

Purple loosestrife was introduced to North America without its natural enemies, allowing the species to rapidly crowd out native vegetation. Moist soil areas require diverse plant communities, which act as forage for migrating waterfowl. High diversity emergent zones provide fish spawning and nursery areas.

Two additional factors that have probably contributed to the decline of the macrophyte community are the lack of natural water level variation and physical disturbance of existing beds. In many species of aquatic plants, a period of low water is necessary for the successful germination of new growth. Natural drought cycles do occur once every 10 to 20 years within the region surrounding Storm Lake, and water levels within the lake are lowered during that time because no maintenance pumping is done to maintain water levels on the lake. The water level of Little Storm Lake varies with the level of Storm Lake. The existing uncontrolled outflow structure limits seasonal and yearly water level variations, however, which may limit macrophyte germination. Wave wash, benthic fish, and ice action also disturb existing beds.

b. Fish. The fishery of any lake is an important indicator of ecosystem integrity. Storm Lake is not and has not historically been a Centrarchid dominated fishery. The fish community in the Storm Lake complex was surveyed in 1981 and 1989. Both times, black crappie and white bass were the most abundant species (Lannie Miller, personal communication). However, sampling in 1993 revealed that 40 percent of the catch was black bullhead and carp (IA DNR 1994). Both carp and bullhead are associated with lake bottoms and are notorious for uprooting vegetation which increases turbidity during foraging activities. The sediment in Little Storm Lake could be resuspended by this activity. This could contribute to the reduced capacity of Little Storm Lake to effectively

trap sediment. The contribution of fish-induced resuspension of sediment relative to wind resuspension is small, but foraging activities of these species is a responsible agent for lack of macrophytic growth within the Storm Lake complex. These fish surveys provide evidence that white bass and walleye numbers are relatively steady constant whereas bullhead and carp have steadily increased (Miller, 1989; Miller and Herrig, 1991; IA DNR 1994). The Sponsor feels that rough fish activity is not a significant problem in Little Storm Lake.

5. Wetland Resources. Marshes typically provide habitat to a diverse array of fish and wildlife. Additionally, marshes also provide a buffer between agricultural watersheds and aquatic ecosystems. Little Storm Lake is ideally suited to serve as a buffer between the agricultural watershed and Storm Lake because the main water source, Powell Creek, passes through the marsh. Little Storm Lake may have historically acted as a sediment trap for Storm Lake, although during high precipitation events, the capacity of Little Storm Lake to trap sediment is overwhelmed. Little Storm Lake continues to act as a nitrogen trap (IA DNR 1994).

Furthermore, the hydrological connection between the marsh and lake would allow fish to use the marsh as a spawning area and a nursery if suitable submergent vegetation existed, with young fish being able to return to the lake to complete maturation. Historically, waterfowl have actively used Little Storm Lake for breeding, nesting, and staging.

Wind greatly increases turbidity levels in the marsh, which further reduce light levels that sustain macrophytes in the lake. The loss of macrophytes has reduced the suitability of the marsh for wildlife and sport/recreational fish habitat.

B. Expected Future Without Project Conditions. Without action, the ecological effects of nutrients inflow and sediment resuspension in Storm Lake are likely to remain or increase past the current levels. The aquatic habitat in the project area will continue to degrade commensurate with water quality. The creeks entering Little Storm Lake will continue the cutting into the upstream agriculture fields. Sediment-laden water will continue to enter Storm Lake during high precipitation events, eventually causing further degradation of Storm Lake. Impaired water quality, excessive turbidity, and shallow water depth are physical factors that can affect, both directly and indirectly, food supply, forage availability, and amount of suitable habitat, consequently affecting fish populations. It is possible that this could result in a decline in recreational use hours because people prefer to recreate around clear water containing large to quality-size fish. The continued deposition of sediment in Storm Lake from the watershed would decrease the lifespan of the dredged areas within the lake.

C. Problems and Opportunities

1. Problems. The notable ecosystem once supported within the Storm Lake Watershed has experienced significant degradation over the last 100 years. Storm Lake is on Iowa's Impaired Waters List. Sediment and nutrients carried into the lake from its watershed reduced water clarity, lake depth, and the level of dissolved oxygen in the water column. Excessive turbidity and degraded water quality have caused macrophyte bed diversity to be nearly eliminated. Little Storm Lake originally had the ability to remove much of the sediment from incoming waters, and its healthy and diverse native plant population would use and remove much of the nutrients from the water and sediments. Unfortunately the ability to accomplish these tasks has dwindled due to reduced vegetative diversity. This situation has resulted in unacceptable water quality conditions in Storm Lake. The loss of native plant communities, nutrient and

sediment loading, and resuspension—the major stressors on the Storm Lake ecosystem—may be affecting biota in the lake, either directly or indirectly. Rehabilitating the ecosystem will require addressing these main stressors.

a. Loss of Native Plant Communities. The degraded environmental conditions resulting from poor water quality have decreased the native macrophyte density. The invasive species purple loosestrife has filled the gap left by the native vegetation such that the area is now dominated by a dense monoculture. The lack of diversity has negatively impacted other wildlife by reducing suitable habitat. Improvement of water quality is necessary to restore the Little Storm Lake ecosystem to a healthier state. However, it is unlikely that improving these conditions alone would result in a return of the native population.

b. Sediment and Nutrients Loading from the Watershed. Sediment is a key contributor to the degradation of water quality. The high sediment levels have reduced the ability of plants to reestablish. The large influx of the nutrients phosphorus and nitrogen is also a major cause in the degradation of water quality in Little Storm Lake. These nutrients fuel the growth of algae which leads to reduced water clarity and lower dissolved oxygen levels. Along with sediment, nutrients are transported from the watershed sources via streams, surface runoff and/or groundwater inflow to the lake.

c. Resuspension of Sediment. The amount of resuspension has increased over time as reduced water clarity eliminated macrophyte beds that once stabilized the lake bottom and as reduced depth increased the likelihood of resuspension. Most resuspension in the lake is caused by wind action.

2. Opportunities. Significant opportunities exist to address these problems. The lake has been studied extensively, with long-term records of water clarity, fisheries, bathymetry and photographic evidence of change. The IADNR and ISU have extensively investigated many of the factors affecting the lake. From the existing work, adequate information exists regarding the problems that have degraded and are degrading the Storm Lake ecosystem, allowing for the identification of opportunities for improvement. Federal, State and local groups have expressed interest in participating in the restoration of Storm Lake. These interests include the IADNR and grass-root community action groups, which have been formed to address the water quality of Storm Lake. The Storm Lake restoration efforts underway will not be complete without the restoration of function to the Little Storm Lake marsh. Since any restoration of the marsh area would impact existing wetland areas, Federal involvement is essential. The items below reflect areas where Federal support can improve this ecosystem restoration.

a. Reduce Invasive Species. The primary invasive species is purple loosestrife. Purple loosestrife forms dense monocultures and is a low quality food that crowd out native vegetation that offers higher quality forage to waterfowl and furbearers. The marsh would also benefit from invasive fish species reduction.

b. Improve Water Quality. Opportunities exist to improve water quality in Storm Lake through dredging a Little Storm Lake sediment trap, dredging to improve depth distributions of the marsh, creating wind breaks such as rock jetties or small islands to reduce suspension, and treating with chemicals to immobilize phosphorus and sediment.

c. Reestablish Native Vegetation. Little Storm Lake provides a significant opportunity for enhancement because it is publicly owned and it intercepts a large portion of the inflows from the watershed. The marsh is releasing more phosphorus and sediment into Storm Lake than it is receiving from surrounding runoff. By reestablishing the function of this

wetland, this trend should slowly reverse. The marsh can be rehabilitated to improve its capability to retain sediment and nutrients. An opportunity exists to restore a native macrophyte community. In order to germinate, emergent vegetation needs water levels to remain low for a longer period of time.

d. Provide Water Control. Several methods can be implemented to augment the ability to control the water level and discharges entering and leaving Little Storm Lake. A controllable water level allows for advantageous management of the shallow sections to boost plant germination. Enhanced plant and macrophytes growth in and around the lake will reduce the amount of sedimentation and nutrients that can enter Little Storm Lake and then Storm Lake. An added benefit of drawdown will be the consolidation of unconsolidated sediment in the marsh and a longer sediment storage life. This could be addressed through the construction of a pump station and a water control structure**.**

D. Significance. As shown in table 2, Storm Lake is a significant ecosystem both in terms of its ecological and geological uniqueness and in its role as a focal point in the community and region. Storm Lake plays a major social role in the region because of the lack of other public lakes in proximity; multiple public entities have made significant financial investments in restoration and in maintaining the parks and facilities around the lake.

1. Institutional Recognition. Tangible support of the rehabilitation of the lake ecosystem has been demonstrated at the Federal, State, regional, and local levels. The project has been funded through specific Congressional language which has provided $2,063,000 over 4 years. Congressman King and Senators Tom Harkin and Charles Grassley have shown strong support for the project. The dredging project has also been funded by State and local funding and private donations. The U.S. Environmental Protection Agency recently awarded $225,000 through the Section 319 program to address sources of non-point pollution. The IADNR funded the feasibility study of the lake, as conducted by ISU.

2. Public Recognition. A lake valuation study performed as part of the ISU Lake Study indicates that visitation would likely increase by 55 percent if water quality improvements were undertaken at Storm Lake. This equates to $12.6 million in tourism spending. In 2002, there were approximately 260,000 visitors to Storm Lake, making Storm Lake the 10th most visited lake in the state. Based on this study, the Storm Lake community recently received an $8 million Vision Iowa grant for substantial economic development. With these funds, community leaders are pursuing an aggressive project known as *Project AWAYSIS*. Plans include new recreational facilities, lodging, an interpretive center and a county-wide bike trail all centered on the lake. Local businesses and the City recognize the value of the lake and are actively reducing runoff to the lake. The City has developed a wellhead protection and storm sewer discharge monitoring plans. A major meat packing plant constructed a storm water diversion structure to divert the facility's storm water to the waste water treatment plant. Other business have followed suit and implemented the same types of structures.

3. Technical Recognition. The Storm Lake ecosystem supports a diverse ecological community. The ecosystem is capable of and has supported a diverse fish community, extensive aquatic vegetative beds, and diverse wetland areas. Similar to other Midwest lakes, the native aquatic species are affected by water quality degradation due to excessive nutrients and sediments. As the fourth largest of only 34 natural (glacial) lakes in Iowa it represents an uncommon public resource. The biodiversity potential of the lake can be measured in the number of plant and fish species that once were present in the lake. The potential of recognizing restoration of the ecosystem is great.

Table 2. Significance of the Storm Lake Ecosystem

		Source of Significance		
Habitat Type	**Location**	**Institutional Recognition**	**Public Recognition**	**Technical Recognition**
Natural Lake Ecosystem	Entire Storm Lake Watershed	IADNR authorized and funded diagnostic study to develop restoration plan; Clean Water Act Sections 319 and 303(d)	Vision Iowa Grant and Project AWAYSIS; City of Storm Lake wellhead protection plan and storm sewer monitoring plan; local participation in storm water diversion; Storm Lake Preservation Association	4th largest of only 34 natural lakes in Iowa; ecosystem experiencing water quality degradation
Wetlands/Marsh	Various locations throughout the Storm Lake watershed	NRCS Wetland Reserve Program; Conservation Reserve Program; National Wetland Inventory; Executive Order 11990; Clean Water Act Section 401 and 404	Private and public land acquisition; duck hunting popular	95% of Iowa's natural wetlands have been lost; approx. 26,400 acres of natural and artificial marsh exist.[1] Migratory waterfowl utilize the lake and marsh
Aquatic Vegetation (macrophyte) Beds	Various locations through the Storm Lake ecosystem, most prominent in the marsh			Plant communities of native submerged aquatic vegetation species create cover and breeding areas for fish and amphibians and provide food for waterfowl.
Centrarchid Fishery	Found in Storm Lake but not dominant		Native species popular with fishermen	Of the 30 species in this family, 13 are found in Iowa waters [2]

[1] Bishop (1981)
[2] IADNR website

E. Goals and Objectives. Based on the identified problems, the primary goals of the Storm Lake project would be to restore ecosystem balance to the Storm Lake Watershed and to restore function to Little Storm Lake. Objectives for achieving these goals are listed in table 3.

Table 3. Goals and Objectives of the Little Storm Lake Section 206 Project

Goal	Objectives	Potential Features
Improve aquatic species habitat in the Storm Lake Watershed Restore wetland function to Little Storm Lake	Improve quality of water entering Storm Lake by reducing sediment and nutrients Increase plant species diversity in Little Storm Lake Reduce invasive species in Little Storm Lake Increase habitat suitability and coverage for aquatic species and migratory waterfowl	Rough fish exclusion Chemical treatments Powell Creek restoration Sediment traps Wind breaks Aerators Water control structures Invasive species predator introduction Native plantings Shoreline protection

F. Potential Project Features. In order to accomplish the proposed objectives, potential features were proposed that would be considered in the feasibility phase.

1. Rough Fish Exclusion. Rough fish, such as carp, resuspend fine sediments and destroy aquatic vegetation through foraging activities. In addition to the direct impact to native macrophytes, this increases phosphorus levels. The loss of habitat and increased turbidity is detrimental to the native fishery communities within the marsh and lake. Installation of a fish exclusion barrier at the inlet to Storm Lake would keep rough fish from entering Little Storm Lake. Measures might include a structural barrier or an electric barrier. The sponsor and stakeholders are concerned about the amount of structural maintenance a barrier would need. Additionally, an electric barrier presents liability and effectiveness issues. These issues would need to be evaluated during the feasibility study.

2. Chemical Treatments. Chemical binders, such as alum, can trap dissolved phosphorus in the water column and cause suspended sediments to settle to the bottom of the lake. However, most of the gains of alum applications are found once the chemical settles to the lakebed. Once at the bottom, alum binds the phosphorus being released from the settled sediments. An alum treatment is a long-term benefit, lessening the internal phosphorus loading in the system. Alum treatments have a finite effectiveness (approximately 5 years in most cases). Though more complex to maintain, 10 alum treatments may be less expensive than dredging. The frequency of application and the duration of effectiveness should be investigated. No major biotic

changes, such as a fish kills, have been documented with the use of alum. This feature would include a one-time application during implementation followed by further maintenance treatments. Chemical treatments also exist that can help reduce the algae in the lake system. However, these treatments will need to be repeated and may require a more intensely managed Little Storm Lake and perhaps Storm Lake. The sponsor does not support this feature.

3. Powell Creek Restoration. There are several potential measures for restoring Powell Creek, including placement of rock riffles and construction of meanders. Riffles offer benefits especially during low to medium flow conditions. Placement of riffles will force the water to slow down, which can help reduce the sediment load created by livestock activity in the stream Another benefit that can occur is providing a location where the dissolved oxygen in the water is increased. Creating meanders in Powell Creek will provide a more sinuous water path through the upland marsh area which will allow more sediment to be deposited due to a decreased water velocity. These measures would be confined to state-owned property. It is not anticipated that privately-owned land would be used.

4. Sediment Traps. This feature would involve construction of sediment traps in the watershed and Little Storm Lake. Measures could include upstream off-channel and in-stream sediment traps, and a trap in Little Storm Lake. Off-channel sediment traps could be constructed upstream of the Little Storm Lake. These traps would help reduce the total quantity of sediment entering the lake system. Because of the uniqueness of an off-channel trap, the trap could capture the finer sediment particles that typically cause the majority of turbidity in standing waters. Using areas that are conducive to sediment traps (road crossing, natural low areas, etc), an in-stream sediment storage solution or a dry dam will help reduce the total sediments entering Little Storm Lake. Dredging additional depth areas into Little Storm Lake may act as a method of trapping phosphorus by containing large quantities of phosphorus-laden sediment. Once in the trap, the sediment would not resuspend, limiting the effect of the contained phosphorus on the system. This measure, like all sediment traps, has a finite timeframe of effectiveness, as the trap would ultimately be filled to capacity. The feasibility study would compare the length and degree of efficacy versus the cost of implementation to determine feature desirability.

5. Wind Breaks. Because this area experiences high winds, reducing wave fetch in Little Storm Lake could reduce sediment resuspension. Possible measures include island creation in Little Storm Lake and breakwater structures.

6. Aerator. Aeration and oxygenation techniques help alleviate dissolved oxygen depletions in lakes and improves conditions to aquatic habitat. The application of aeration increases dissolved oxygen concentrations when they have become unacceptably low and alleviates fishery problems associated with anoxic or near anoxic conditions at night, in bottom waters, or under ice and snow. Further, the addition of an aerator will force the system to reduce anoxic and noxious algae buildups that might occur during the low flows during the summer months. Aeration affects the biological, chemical, and physical characteristics of a lake or stream and thus has many management implications. The use of aerators is not a sponsor preferred feature.

7. Water Level Control. Water level control can be used by resource managers to effectively enhance the ecosystem. Lowering water levels allows for sediment compaction, which can help limit sediment resuspension. In addition, plant growth can be enhanced in the newly dewatered areas. In the winter, low water can be used to induce fish kills, which is an effective method of rough fish control. A slightly high water elevation in a marsh system can help increase plant diversity by reducing invasive plant species. The flooded stems can providing fish spawning

habitat. In natural systems, water levels fluctuate with the season and on a year-to-year basis. By altering the water level control structures for the marsh, more effective water level management can be accomplished, although water levels in Storm Lake will greatly affect the ability to control water levels in the marsh. Possible measures might include a pump station, controllable outflow weir, and grade controllable weir. There are concerns regarding impacts to landowners and facilities upstream if the water levels were raised above the normal high water level. This will be considered a project constraint during feasibility. It's likely that water control plans will not include water levels above normal levels. As the sponsor, the IADNR is concerned about operation and maintenance costs of a pump station. A full flow structure is preferred by the sponsor.

8. Invasive Species Control. Through the introduction of a simple, yet diverse, collection of natural insect enemies, it may be possible to achieve long-term control, rather than complete eradication, of purple loosestrife in Little Storm Lake. The objective would be to restore the self-regulatory potential of this plant-insect interaction by using biological weed control. Traditional plant control methods such as hand pulling, cutting, and selective herbicide use are both labor intensive and not cost effective for large infestations. Ubiquitous loosestrife seedlings also require many expensive follow-up treatments. Broadcast spraying can kill non-target plants, after which loosestrife seedlings completely take over.

Several states (Wisconsin, Minnesota, Nebraska, Nevada, New Jersey, Massachusetts) and Federal agencies (the United States Fish and Wildlife Service and the United States Department of Agriculture) have begun using biocontrol agents to control large, dense stands of purple loosestrife. Ideally, natural enemies, as well as competition with other plants, prevent many plants from expanding their distributions. In time the abundance of the plant (acting as a host) influences the abundance of its natural enemies. Four host-specific insect species approved by USDA's Animal and Plant Health Inspection Service (APHIS) have been released in the US. These species are *Hylobius transversovittatus*, a root-mining weevil, *Galerucella calmariensis* and *Galerucella pusilla*, two leaf-eating beetles, and *Nanophyes marmoratus* a flower-feeding weevil. *Nanophyes brevis*, a seed feeding weevil, has been approved for introduction; however, European specimens are infested with a nematode, and this infection has prevented its introduction. Additionally, a group of researchers from the University of Nebraska at Kearney have found that the native White-Lined Sphinx Moth will feed on purple loosestrife.

Previous studies suggest these species should be released and significant reductions in purple loosestrife are expected within 3 to 6 years, with long-term control levels reached with 10 years. This technique is a viable and environmentally friendly alternative to conventional control measures.

9. Native Macrophytes Plantings. This feature would involve the planting of native macrophyte species along the fringes of Little Storm Lake. An adequate seed base to regenerate the area is likely available if purple loosestrife coverage is reduced. Planting native species would increase the success of invasive species control but will likely not be necessary.

10. Shoreline Protection. There is relatively little shoreline erosion taking place behind the dense stands of cattails in Little Storm Lake. If the shoreline was disturbed, the appropriate shoreline protection measures should be implemented. Placing erosion protection on the shoreline would decrease erosion. Potential measures include articulated mats, conventional riprap, and bio-engineering solutions.

Each feature proposed would achieve at least one of the objectives. Some measures meet more that one objective. Table 4 illustrates which objectives would be met through implementation of each feature. It is assumed that all proposed features would work towards achieving the objective of increasing habitat suitability.

Table 4. Proposed Features and Objectives Comparison

Feature	Improve Water	Increase Plant Species Diversity	Control Invasive Species
Rough fish exclusion	x	x	x
Chemical treatments	x	x	
Powell Creek restoration	x	x	
Sediment traps	x	x	
Wind breaks	x		
Aerators	x		
Water control	x	x	x
Invasive species predator introduction		x	x
Plantings		x	x
Shoreline protection	x		

G. Preliminary Evaluation of Alternatives. Alternatives will be developed from various combinations of the potential project features described above. The project features to address the previously identified problems and opportunities will be comparatively evaluated according to their ability to meet project objectives, taking into account cost effectiveness and sustainability. However, the project features to restore aquatic habitat are justified based on cost effectiveness in providing ecosystem restoration benefits.

1. General. Implementation of a combination of measures (an alternative) will be required to fully realize potential benefits. During the feasibility phase, a comprehensive analysis of alternatives will provide detailed cost estimates and environmental and economic benefits associated with each plan of improvement. It is anticipated that no net significant adverse impacts associated with the project alternatives will be realized.

The predominant emphasis of the project is the restoration of the aquatic ecosystem. There is a clear need to improve the present state of the environment; the proposed features identified in this analysis would improve the existing conditions and provide benefits in meeting the project objectives.

2. Recommended Plan. Project costs and outputs will be performed during the feasibility phase for each alternative plan for project optimization. For the purposes of analysis, a preliminary screening of the potential project features based on costs, benefits, and implementation feasibility was conducted to determine Federal interest.

The proposed recommended plan is construction of a rough fish barrier at the Little Storm Lake outlet, construction of a pump station and stop-log structure, introduction of invasive species predators, and sediment traps in the lake and watershed. These features are shown in figure 2. A dredged material placement area is not shown in figure 2. The actual location of this area will depend on willing landowner participation and the Sponsor's ability to acquire the property.

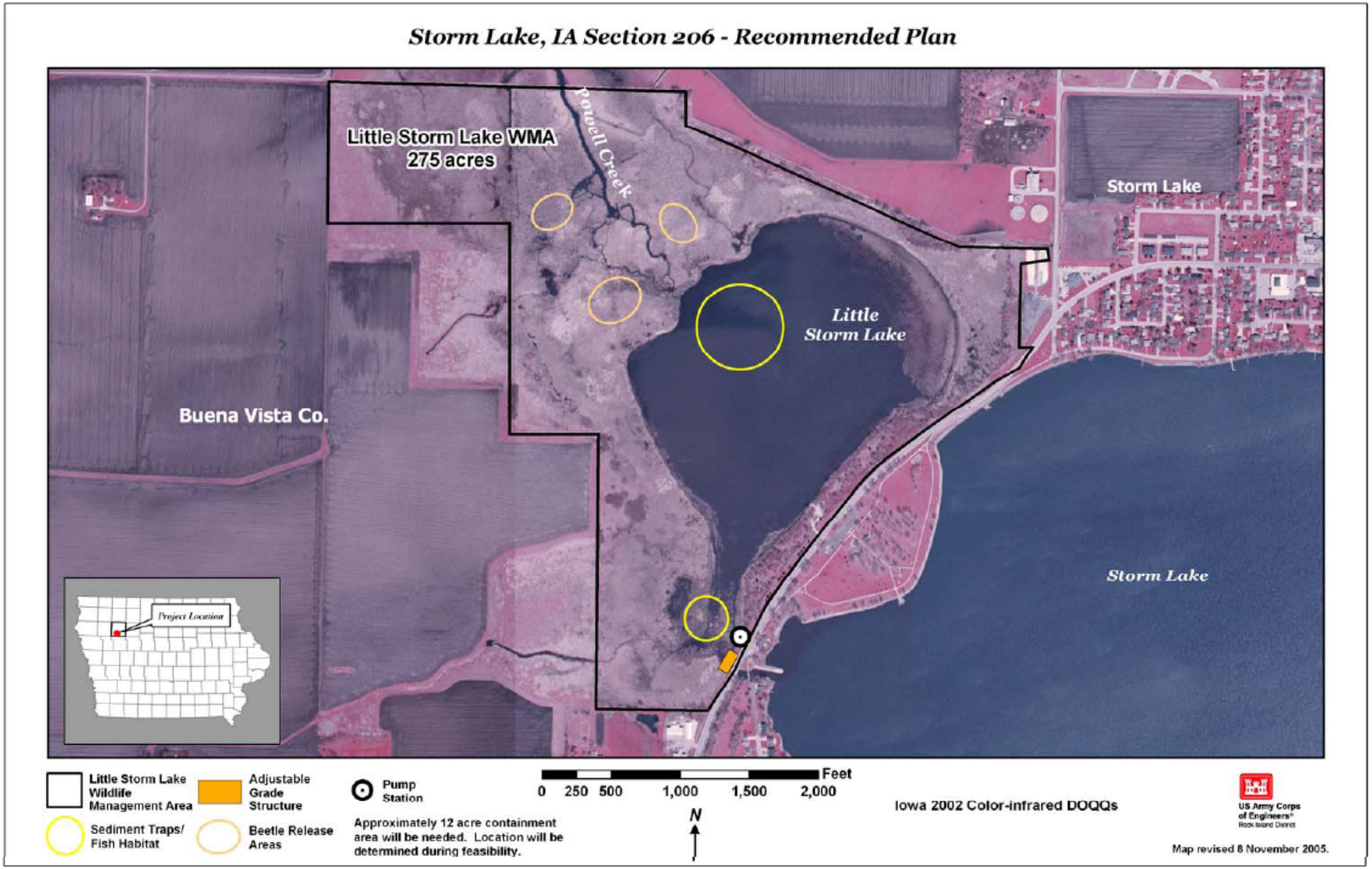
Storm Lake, IA Section 206 - Recommended Plan
Little Storm Lake WMA
275 acres
Powell Creek
Storm Lake
Little
Storm Lake
Buena Vista Co.
Storm Lake
Project Location
Little Storm Lake Wildlife Management Area
Adjustable Grade Structure
Pump Station
Sediment Traps/ Fish Habitat
Beetle Release Areas
Approximately 12 acre containment area will be needed. Location will be determined during feasibility.
0 250 500 1,000 1,500 2,000 Feet
N
Iowa 2002 Color-infrared DOQQs
US Army Corps of Engineers
Rock Island District
Map revised 8 November 2005.

Figure 2

3. Preliminary Cost Estimates. Preliminary cost estimates shown in table 5 were prepared based on the conceptual scope of work. The quantities and costs were calculated using information obtained from other similar projects, professional experience, and standard construction methods. The preliminary cost estimates are for construction only. These estimates are intended to provide a relative cost for each potential project feature and include a 35 percent contingency. Construction costs are given using a January 2005 price level. It is anticipated that the actual construction cost will be higher due to inflation that will occur between January 2005 and the period of the time that construction occurs. More detailed cost estimates will be completed during the feasibility phase.

Table 5. Preliminary Cost Estimate by Project Feature

Potential Project Feature	Preliminary Cost
Mob and Demob	$44,000
Sediment Trap 1	$80,000
Sediment Trap 2	$468,000
Pump Station	$742,000
Stop Log Structure	$153,000
Containment Site	$128,000
Beetles	$1,000
Construction Management	$162,000
Total Construction Estimate	**$1,778,000**
Planning	$320,000
Engineering and Design	$213,000
LERRDs	$1,174,000
Total Project Cost	**$3,485,000**

4. Benefits. Phosphorus reduction benefits for this project can be classified into two types: reduced loads to the lake and reduced concentration in the lake. Clearly, reduced loads to the lake will to some degree reduce concentrations in the lake, so these benefits are connected and eventually project benefits should be expressed in terms of the effects on in-lake phosphorus level because of its ecological relevance. However, the connection between load reduction and in-lake concentration requires a comprehensive understanding of the hydrologic and nutrient cycling processes affecting the lake. Because this understanding will be developed in the feasibility stage and is not yet complete, at this point load reduction cannot be tied directly to in-lake concentration with great confidence. During feasibility, a functional assessment model or the traditional Wildlife Habitat and Appraisal Guide (WHAG) will be used to evaluate the benefits of the proposed alternatives. Using professional judgment, experience from past projects and scientific research done by others, benefits of the recommended plan were estimated and are presented in table 6.

5. Real Estate. Based on the recommended plan presented in Section 2, the project would require approximately 287 acres of fee title lands. The total cost of the real estate requirements would be $1,174,000. This cost includes the value of lands, easements, rights of way (LER) costs and severance damages. This estimate is not an appraisal and should be utilized for general discussion only. No improvements were considered as part of the LER. Contingencies include allowances for increases in land value prior to acquisition, changes in estates, and changes in project limits. There are no known relocations under Public Law (PL) 91-646. No minerals of value are known to be in the area and no active mining is known. Detailed real estate requirements and issues will be addressed in the Real Estate Plan during the feasibility phase.

Table 6. Benefit Quantification by Project Feature

Project Feature	Benefit	Quantification of Benefit
Rough Fish Exclusion	Reduce turbidity through reduced fish rooting behavior; reduce standing stock of rough fish; reduce total phosphorus (TP) levels	Standing stock of rough fish maintained at less than 40% of total catch
Pump station	Regulate water levels for macrophyte germination	Pump station will work in conjunction with stop log structure for water control.
Stop log structure	Controlled drawdown for macrophyte growth	1 ft drawdown = 10 - 15 acres[1] 2 ft drawdown = 20 - 30 acres[1]
Sediment trap within state owned land	Improve water clarity by reduced wind suspension; improve nutrient levels	52-64% reduction in TP levels [2]
Invasive species predator introduction	Reduce invasive, low habitat quality species	81% average reduction in exotic species biomass within 10 years [3]

[1] based on GIS preliminary estimate of drawdown; represents total acres exposed for potential germination
[2] size, retention time and placement of trap will affect result; quantification based on average retention concentrations from Edwards et al. 1999. Transaction of American Society of Agricultural Engineers 42:403-309 and Downing et al. 2000 for a similar lake system
[3] Katovich et al. 1999. Weed Science 47:360-365

VI. FEDERAL INTEREST

The purpose of the Civil Works ecosystem restoration activities is to restore significant ecosystem function, structure, and dynamic processes that have been degraded. The intent of the proposed project is to reestablish the attributes of a natural, functioning, and self-regulating ecosystem. In summary, the proposed project would cost an estimated $3,485,000 ($1,174,000 in LER) and would result in an increase in habitat quality and quantity for the fish species such as walleye, native plant species, and migratory waterfowl. The proposed project would also prevent the loss of a highly-valued and unique local resource. Additionally, based willingness-to-pay surveys conducted by ISU, it is estimated that restoration of the lake may benefit the local economy by generating an additional $12.6 million per year in revenue. These results are consistent with Corps policy of environmental restoration because:

- the proposed project will restore a significant environmental resource within the context of improving regional water resources management programs and objectives;
- the proposed measures fall within established Corps expertise; and
- the proposed project involves cost-effective solutions to improve water quality as the key component in restoring ecosystem structure and function.

Based on the preliminary screening of alternatives, there appears to be potential project alternatives that would be consistent with Corps policies in regards to costs, benefits, and environmental impacts**.**

VII. PROJECT SCHEDULE

Table 7 presents the schedule based on the assumption that the project's naming status would allow feasibility to proceed in FY 2006.

Table 7. Proposed Project Schedule

Milestone	Completion Date	FY
Submit PRP to regional headquarters	Apr 2006	2006
Regional headquarters approves PRP	Jul 2006	2006
Initiate feasibility study (not to exceed $100,000 until FCSA is executed)	Jul 2006	2006
Execute FCSA	Oct 2006	2007
Public review of feasibility report with integrated environmental compliance	Jan 2008	2008
Completion of feasibility study; Submit report to regional headquarters	Aug 2008	2008
Regional headquarters approves project	Nov 2008	2009
Initiate plans and specs phase	Jan 2009	2009
Complete plans and specs	Jul 2009	2009
Execute Project Cooperation Agreement (PCA)	Sep 2009	2009
Acquire LERRDS	Mar 2010	2010
Award contract	May 2010	2010

VIII. PRELIMINARY FINANCIAL ANALYSIS

A. In a letter of request dated October 8, 2003, the Lake Improvement Commission on behalf of IADNR indicated willingness to serve as the local sponsor for the project. The IADNR is legally empowered and financially capable of participating in the project.

B. The sponsor is aware of the responsibility for:

1. 50 percent of all feasibility study costs above the initial $100,000.

2. 35 percent of the design and implementation costs, including the cost of lands needed for the project;

3. Acquiring all lands, easements, and rights-of-way and providing necessary relocations and disposal areas (LERRD) for the project;

4. Operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) of the project at 100 percent non-Federal expense upon completion of construction; and

Attachment 1, *Supplement to the Little Storm Lake Preliminary Restoration Plan Implementation Responsibilities – July 2006*, details all items of local cooperation.

C. The Section 206 Program guidance was revised during the development of this document. The new guidance requires the costs of feasibility studies to be cost shared with the non-Federal sponsor at a rate of 50/50. Land credits do not satisfy feasibility cost sharing requirements. Table 8 outlines the funding requirements for the project based on the new feasibility cost sharing guidance. Actual allocations by year will be subject to funding availability in the Section 206 program.

Table 8. Project Costs by Phase, Funding Source, and Year

	Total	Non-Federal	Federal [1]	2006	2007	2008	2009	2010
Feasibility Costs [2]	320	110	210	100	50	50	10	
Design and Implementation Costs [3]	3,165	1,174	1,991				213	1,778
Design	213	0	213				213	
LERRD	1,174	1,174	0					
Construction	1,778	0	1,778					1,778
TOTALS	**3,485**	**1,284**	**2,201**	**100**	**50**	**50**	**223**	**1,778**

[1] The first $100,000 of the feasibility phase would be 100% Federal.
[2] The feasibility phase is cost shared 50/50 after the first $100,000 which is 100% Federal.
[3] The total project costs are cost shared 65% Federal/35% Non-Federal. However, for a Section 206 project in which the LERRD costs exceed the non-Federal share, the non-Federal sponsor must voluntarily waive reimbursement for all excess LERRD costs.

D. Non-Federal Financial Requirements (estimates):

Land Credit	$ 1,174,000
Cash or Work in Kind	$ 0
TOTAL	$ 1,174,000
Annual OMRR&R	$ 23,000

IX. SUMMARY OF FEASIBILITY STUDY ASSUMPTIONS

The following assumptions will provide the basis for development of the feasibility level report:

- The without project condition of the Storm Lake Watershed will include continued degradation of the ecosystem through reduced water quality resulting in continued loss of native plant and animals species.

- A series of alternative plans will be further developed.

- Benefits and costs will be described in detail and a Cost Effectiveness/Incremental Cost Analysis will be conducted to identify and select a National Ecosystem Restoration (NER) plan in cooperation with the project sponsor.

- All National Environmental Policy Act (NEPA), Fish and Wildlife Coordination Act, and National Historic Preservation Act Criteria will be met. Further, it is anticipated that an Environmental Assessment (EA) will meet NEPA requirements. Finally, the project is not anticipated to have any potential negative impacts to Federal- or State-threatened or endangered species.

- The study team will follow the U.S. Army Corps of Engineers standard planning and feasibility study process in accordance with the Principles and Guidelines and Corps of Engineers' regulations.

- The study team will likely use a functional assessment or standard WHAG to quantify the habitat benefits of the proposed alternatives.

X. VIEWS OF OTHER RESOURCE AGENCIES

Because of the funding and time constraints of this phase, only limited and informal coordination has been conducted with other resource agencies. In initial coordination, the United States Fish and Wildlife Service stated that this project appears to offer a good opportunity to do habitat restoration. They would like to participate in the planning effort as it develops. The Iowa Department of Natural Resources, as the non-Federal project sponsor, has been and will be intensively involved in the planning effort. Personnel from the agency's administration and wildlife, fisheries, field services, and water quality bureaus have participated in the planning to date. The U.S. Environmental Protection Agency has awarded a Section 319 Grant to address water quality issues at the lake. The Natural Resources Conservation Service, the Iowa Lake Resource Conservation and Development Council, Buena Vista County Environmental Health Office, the City of Storm Lake, the Storm Lake Preservation Association, and the Storm Lake Water Quality Coordinator have contributed to the planning for this project.

STORM LAKE SECTION 206
PRELIMINARY RESTORATION PLAN (PRP)

RECOMMENDATIONS

Based on the results of this Preliminary Restoration Plan, a viable and implementable plan can be developed that will meet the necessary Federal interest criteria and will be fully supported by the local sponsor. Therefore, I recommend this analysis be approved to proceed to the feasibility phase of the project.

4/25/06
(Date)

Duane P. Gapinski
Colonel, U.S. Army
District Engineer