Lake Restoration
2007 Report and 2008 Plan

Submitted To

Joint Appropriations Subcommittee on Transportation, Infrastructure, and Capitals
and
Legislative Services Agency

Prepared By

Iowa Department of Natural Resources

December 28, 2007

Executive Summary

The Department of Natural Resources (IDNR) Lake Restoration Program focuses on restoring impaired lakes to improve the quality of life for Iowans. Communities are rallying around their water resources as they seek population growth and economic success. Communities of the Iowa Great Lakes Region, Storm Lake, Crystal Lake, Creston and Clear Lake are obvious examples, but other communities including Lake View and Brighton are identifying the importance of lakes for their futures as well. The distribution and nature of Vision Iowa grants, Community Attraction and Tourism grants, and now, Great Places, all further emphasize the importance of water to community, quality of life and economic growth.

Iowans value water quality and desire safe healthy lakes that provide a full complement of aesthetic, ecological and recreational benefits. In 2006, the legislature created the Lake Restoration Program in HF 2782, and appropriated $8.6 million for the first year. In 2007, the IDNR was able to continue work on improving Iowa's lakes because of the status quo funding from HF 911 through the Restore Iowa Infrastructure Fund (FIIF), which appropriated $8.4 million toward lake restoration. Included in Section (26) of The Endowment for Iowa's Health Account is a process and criteria for completing successful lake restoration projects. It also directs the IDNR to report annually its plans and recommendations for lake restoration funding, as well as progress and results from projects funded by this legislation. A draft FY09 Budget, to highlight proposed project activities, is provided as part of our obligation to report planned activities. This report has been prepared in accordance with these requirements. In addition, it describes some of the important work done by local, state and federal partners. These partnerships, along with sound scientific information, are the foundation of current and future successful lake restoration projects.

Lake Restoration Prioritization Process and Program

- Modeled after the Federal Clean Lakes Program established in the 1970's.
- Ranked 127 public lakes for lake restoration potential.
- Ranking based on a 5-year Iowa State University (ISU)/IDNR assessment of water quality, technical feasibility of restoration, potential economic benefits, use by Iowans, and local support.
- IDNR initially provided the 2006 legislature with list of 35 lake candidates.
- Projects require a lake and watershed (land draining to the lake) restoration assessment and plan.
- Lake and watershed protection requires local resources in combination with state and federal funds.
- Local groups can petition to have their lake added to the priority list.
- IDNR provides an annual progress report to the legislature that includes a work plan and budget.

Water Quality Goals *[Stipulated in 2006 State Legislation (HF2782)]*

- Phosphorous and sediment coming from the watershed must be controlled before lake restoration begins.
- Shallow lakes management will be considered among options for restoration.
- 4 ½ foot secchi disc transparency (water clarity) 50% of the time, April – September.
- Water quality impairments must be eliminated.

- A diverse and sustainable aquatic community will be maintained.
- Water quality and public use benefits must be sustained at least 50 years.

Communication and Public Outreach

Meetings with Local Leaders and Stakeholders

- In accordance with Section 26 of House File 2782: “The Department shall meet with representatives of communities where lakes on the initial list are located to provide an initial lake restoration assessment and to explain the process and criteria for receiving lake restoration funding”.
- Past meetings include; Beeds Lake, Carter Lake, Clear Lake, Crystal Lake, Easter Lake, Green Valley, Lake Darling, Lake Geode, Lake Manawa, Lake of Three Fires, Lizard Lake, Lower Gar, Mariposa Lake, Prairie Rose, Rock Creek Lake, Silver Lake (Delaware), Storm Lake, Union Grove Lake, and Viking Lake.

Inquiries from Stakeholders of Lakes not on the Priority List

- In accordance with HF2782, “Communities with lakes not included on the initial list may petition the Director of the Department for a preliminary lake restoration assessment and explanation of the funding process and criteria”.
- During the first half of FY08, local stakeholders of Lake Rathbun (Appanoose Co.), Lost Island Lake (Palo Alto Co.) and Summit Lake (Union Co.) contacted the IDNR to consider their respective lakes for a restoration project.
- IDNR has reviewed information for Lake Rathbun and Lost Island Lake and indicated that these lakes should be included in the lake restoration program.

Communication Tools and Strategies

- Lakes Restoration Program developed a one-page handout that summarizes important aspects of the process (Appendix I.).
- IDNR, in cooperation with Iowa Department of Agriculture Land Stewardship (IDALS), has worked to develop a holistic approach to locally led watershed projects.
- The Watershed Improvement Review Board has adopted this approach as the basic planning requirement for successful proposals.
- The 9-step planning protocol can be found at: http://www.iowaIDNR.gov/water/watershed/files/protocolguide.pdf

Project Summaries

Carter Lake (Pottawattamie County)

- IDNR is collaborating with Nebraska Department of Environmental Quality (DEQ), using Nebraska 319 funds ($30,000) and Iowa Lake Improvement Funds ($20,000), on a Diagnostic-Feasibility study.
- Nebraska will match $2 million of State of Iowa Funds required to design and construct a pumping station. This project will ensure that Carter Lake has access to high quality water and is able to maintain the necessary level for water quality improvements.

Clear Lake (Cerro Gordo County)

- IDNR obtained a final purchase agreement for the dredge spoil site and completed the land acquisition.

- Purchase of the 208 acre site used approximately $660,000 of lake restoration funds and an additional $660,000 local match.
- Contractors are near completion of the $886,000 containment site. The scheduled construction end-date is spring of 2008.

- Final permitting with COE is also near completion and commencement of dredging is expected in late spring of 2008, with likely completion by fall of 2009. The estimated cost is $8 million ($3.50/cu. yd.) with $6 million from the lake restoration fund and $2 million from local sources.
- In addition to dredging, plans are being developed for a Section 206 U.S. Army Corps of Engineers Aquatic Ecosystem Restoration Project in Ventura Marsh, which flows into the west end of Clear Lake. In its present degraded state, the marsh serves as a major source of nutrients contributing to water quality problems in the lake and is a major reproduction area for common carp.
- Restoration efforts and improvements in water quality have the potential to more than double the annual economic return (currently estimated at $43 million) that Clear Lake generates to the local economy.

The Mayor of Clear Lake, Nelson Crabb, had the following comments regarding the partnership between the IDNR and the local community. - “The City of Clear Lake has enjoyed their partnership with the Iowa DNR in lake restoration efforts. The lake provides nearly $43 million annually to the local economy and we recognize the importance of maintaining and improving this valuable resource. The city has invested $2 million in the dredging project and over $1 million in urban conservation practices over the past several years. We feel the water quality has already started to improve and will continue to progress as additional conservation and restoration measures are implemented. Investing in our greatest asset (the lake) has been very rewarding for all Clear Lakers.”

Crystal Lake (Hancock County)

- As projected, the contractor completed the dredging in the fall of 2007.
- They removed 1.1 million cu./yds. of sediment at a cost of $3.1 million.

- Renovation of the fish community of Crystal Lake, to remove common carp, and modification of the spillway structure to prevent carp from re-entering the system will occur in the fall of 2008.
- IDNR estimates the cost of fish renovation at $250,000.
- The combination of the watershed and lake improvement work will remove Crystal Lake from the Impaired Waters List and add to the estimated $2.5 million spent annually by lake visitors.

Easter Lake (Polk County)

- ISU will conduct a diagnostic feasibility study with a targeted completion date of fall 2009.
- This study will require up to a 25% financial commitment from the Polk CCB to match 75% State Lake Improvement Funds.
- To monitor the studies progress a technical workgroup meets on a regular basis.

Five Island Lake (Palo Alto County)

- In 1989, a group of concerned citizens formed the Five Island Lake Board.
- The Lake Board has stabilized almost 10.5 miles of lake shoreline, dredged over 5 million cubic yards of silt, and worked in the watershed to reduce nutrients and sediment from entering the lake.
- Funding for this project has been a combination of state and local matching grants.
- Local monetary contributions to date exceed $1.2 million.
- State funding as of July 2007 is $980,000.
- The city of Emmetsburg is requesting $175,000 of lake restoration funds for both FY08 and FY09 to match with local funds for their on-going lake restoration projects.

Green Valley Lake (Union County)

- A Diagnostic Feasibility study through Iowa State University is underway with a final report due by the spring of 2008.
- A four-year watershed improvement plan, with $70,000 available annually, is being utilized, to complete approved soil and water quality improvement projects.
- The local NRCS District Conservationist has indicted that they have an extensive list of willing watershed landowners that plan to participate in this initiative.
- In-lake restoration work may center on spillway modification, fish restoration and dredging of coves.
- IDNR has begun negotiations with several landowners for acquisition of a dredge spoil containment site.

Lake Darling (Washington County)

- Sedimentation has reduced the lakes original 305 surface acres to 267 acres.
- During the last five years, extensive soil conservation work has reduced sediment delivery to the lake by 40%.
- 137 construction projects completed in the past 6 years involved 57 different landowners.
- Project total cost was $1,371,301 including $984,924 cost share funding.
- Runoff from 73% of private land in the watershed flows into tile outlet terraces/basins or erosion control ponds constructed as part of the lake restoration process.
- Dramatic improvement in the lake water clarity during the 6-years of project implementation.
- Construction work in 2007-08 will center on an additional 36 watershed structures on or adjacent to state property.

Lake Darling Project Coordinator, Stan Simmons, highlights the cooperative efforts of those involved with projects funded in part by the Lake Restoration Program. – “The successful application of conservation practices in the Lake Darling Watershed is the result of the combined efforts of many, but most important was the cooperative attitudes of the landowners and operators. There were 146 projects completed in the past seven years and 64 involved two or more landowners, for example, cooperative efforts to extend thru line fences.”

- Acting on the recommendations of the completed engineering report, the IDNR will repair the dam and address spillway leakage.
- IDNR has begun negotiations with several landowners for acquisition of a dredge spoil containment site.
- IDNR and ISU have scheduled a meeting for February 2008 to present the feasibility study to the public and discuss suggested alternatives for restoration.
- Obtain additional information about Lake Darling watershed improvements in a brochure available at http://www.iowaIDNR.com/water/nonpoint/files/darling.pdf.

Lake Manawa (Pottawattamie County)

- The Iowa DOT and IDNR met during March of 2007 to determine opportunities to obtain highway building materials from Lake Manawa sediments.
- The IDNR has obtained some additional information from USGS and is putting together a proposal to hire an engineering/environmental restoration firm to review the option of dredging as a lake restoration activity.
- The IDNR meets with groups such as the “Friends of Lake Manawa” to solicit support and to assist in moving the lake/watershed restoration project along.

Lake of Three Fires (Taylor County)

- The final recommended component of the restoration project is a wetland on the IDNR Simmons Wildlife Area immediately above the lake.
- IDNR utilized lake restoration funding to acquire 80 acres of land at a cost of $185,000 and following the land purchase constructed a wetland at a cost of $95,000.

- The wetland project utilized 75% Federal 319 funds and 25% State Lake Restoration funds. With the completion of the wetland, the IDNR will consider the restoration phase of this project completed and group Lake of Three Fires with lakes that require monitoring and occasional maintenance to maintain their high quality ranking.
- Lake of Three Fires maintained excellent water quality despite excessive rainfall events, 30% above normal in 2007.
- The fishery and water quality improvements following lake restoration have far exceeded expectations.
- Fish growth and abundance is high, water clarity exceeds any previous level and park use continues to exceed previous levels.
- These water improvements, along with continued efforts, will make Lake of Three Fires State Park a quality area many can enjoy for many years to come.

Lizard Lake (Pocahontas County)

- A local lake group has promoted lake restoration and they continue to meet with IDNR staff to discuss their concerns.
- IDALS and the local Soil and Water Conservation District awarded a Development Grant in June 2006 to evaluate the watershed of Lizard Lake.
- Iowa State University Limnology Laboratory will develop a Diagnostic Feasibility study for Lizard Lake. As part of potential restoration alternatives, ISU will present "shallow lakes management" as an option for improving the lake's water quality, fish population structure and wildlife potential.

Lower Gar Lake (Dickinson County)

- Local concerned citizens and business owners that live on or recreate on the Iowa Great Lakes system, specifically Lower Gar, Minnewashta and Upper Gar, formed The Three Lakes Improvement Association.
- IDNR Lakes Restoration staff met with this group several times in 2005 and 2006 to discuss lake water quality and water depth issues.
- Iowa State University has prepared and initiated a diagnostic/feasibility proposal to examine lake issues.
- This study, funded locally for 25% of the cost, will examine historic soft sediment deposition, potential removal of a portion of these sediments and the resulting impact on lake water quality.

Prairie Rose Lake (Shelby County)

- IDNR Fisheries and Parks staff have been meeting with NRCS, IDALS, and others about remaining watershed work and initial lake restoration plans.
- A diagnostic/feasibility study is underway and scheduled for completion by May of 2008.
- A watershed assessment was conducted followed by a grant to accomplish targeted soil conservation work in the watershed.
- IDNR has begun negotiations with several landowners for acquisition of a dredge spoil containment site.

Rock Creek Lake (Jasper County)

- Over the last 50 years Rock Creek has lost almost 40% of its lake water volume and 102 lake surface acres.
- Local efforts have accomplished significant work in the watershed; however, local and state partners need a renewed effort to move this project forward.
- Work designing the structures and securing necessary permits and easements should move forward during 2007-2008.
- This watershed will require significant reductions in sediments and nutrients from reaching Rock Creek Lake before we move forward with identified lake restoration measures.

Silver Lake (Delaware County)

- In 2001 an engineering firm evaluated dam integrity and leakage issues.
- The construction firm hired to repair the dam and eliminate dam safety issues completed the work fall of 2007 at a cost of $314,950.
- A small technical workgroup that includes local Delhi city officials, district soil conservation personnel and IDNR field staff will meet in January, prior to an upcoming public meeting, to identify and determine possible solutions to excessive watershed nutrients that are entering the lake.

Storm Lake (Buena Vista County)

- Prior to the current dredging effort, IDNR last dredged Storm Lake in 1962. Lake depth maps developed in 1992 indicate that the 1962 dredging sites lost 77% and 46% of their volume.
- Storm Lake constructed a dredge spoil site in 2001 and began dredging activities in 2001/2002. IDNR lake dredging removed 1.32 million cu./yds. of sediment at a total project cost of $3.3 million.
- Funding limitations restricted this initial dredging activity to 180-acres of the lake.
- The Lake Preservation Association (LPA) expressed a strong interest to continue dredging to achieve better water quality The LPA locally raised and received federal grants totaling over $1 million to continue dredging at Storm Lake.
- They purchased a dredge, and through an agreement with the IDNR, each group has provided $900,000 from 2003 through 2005 to continue dredging operations.
- To reach project goals will require another 9 years of dredging at a projected cost of $11 million ($5.5 million state - $ 5.5 million local).
- State lake restoration funds have contributed $1.5 million to the City of Storm Lake in FY07 and FY08 for dredging. An additional $1 million is requested for FY09.
- The locally led project goal is to dredge 600,000 to 900,000 cu./yds. of sediment annually.
- The City of Storm Lake leased the IDNR containment site for an additional 2-years and has since constructed a new containment site east of Storm Lake.

Little Storm Lake COE Section 206 Aquatic Ecosystem Restoration

- Little Storm Lake is a 190-acre state-owned marsh that is an extension of Storm Lake (marsh and lake elevation is the same).
- This joint project between the local Storm Lake Improvement Group, the US Army COE and the IDNR has as a goal to improve the aquatic species habitat in the Storm Lake watershed and to restore the wetland function of Little Storm Lake.
- This project was initially slated for a fall 2008 construction start, however delays in federal funding have push the construction start date to no earlier than 2009.

Anticipated Benefits

- The City is improving stormwater delivered to the lake.
- This aggressive dredging goal, coupled with watershed improvements and restoration of Little Storm Lake and Wetland will mean significant improvements in water quality.
- In addition, lake restoration efforts so far have encouraged a $35 million economic development named “Project AWAYSIS” that has the potential to create 690 new jobs and over $28 million in new spending in Storm Lake and Buena Vista County.

Mayor of Storm Lake, Jon Kruse, believes that lake restoration has been a catalyst for economic development in the region – “Lake restoration work for Storm Lake and its watershed has been the inspiration for the community to come together and chart its destiny into the future. This community has traditionally had most of its economic base centered on agriculture. Because of lake restoration work, our people determined that we could diversify our economic base by increasing recreational opportunities at Storm Lake.”

Union Grove Lake (Tama County)

- Spillway water seepage has been an on-going problem at Union Grove Lake. Past attempts to repair the problem have met with limited success.
- IDNR hired a geo-tech firm in 2005 to evaluate the problem and contracted a firm in 2006 to repair the structure.
- They completed the project in July of 2007 and successfully addressed the water seepage issue. Total project cost for the spillway repair was $178,572, with the lake restoration program as the funding source.
- The construction firm also made several recommendations for additional future spillway modifications that will preserve the integrity of the system. They will accomplish this work during the summer of 2008 at an estimated cost of $40,000.
- The IDNR is working with local sponsors to develop a plan to improve the lake and water quality conditions.
- IDNR Park’s staff accomplished another small project of interest this past year. They purchased a small beach cleaning system for $4,800 that allows staff to clean beaches, sidewalks, fishing jetties and other park areas of Canada goose fecal material. This material contributes adversely to lake water quality and is not aesthetically pleasing to park patrons.

Viking Lake (Montgomery County)

- A watershed coordinator through the 319 program has been identifying corrective measures within the watershed.
- IDNR staff identified twenty-two (22) areas near the lake, on or including portions of state property, as needing grade stabilization structures to control soil erosion and improve water quality. Construction of twenty sediment structures is complete.
- IDNR did drain the lake after Labor Day (2006) and renovated the fishery to eliminate the problem yellow bass population.
- In addition, after lowering the lake, they repaired the dam gate, protected the shoreline, constructed jetties, deepened shoreline, and improved angler access and fish habitat.

Budget Summaries

Fiscal Year 2008 Budget

The lake restoration budget for FY08, including cost-share and FY07 lake restoration carry forward funds, totals $17,783,386. Through November 30, 2007, the IDNR has spent or obligated $10,682,871 (75%) of Lake Restoration funds and $2,396,542 (70%) of cost-share.

The remaining $3,703,057 of Lake Restoration funds and $1,000,916 of cost-share is allocated among projects at various stages of development.

FY08 Lake Restoration Budget

IDNR Source		**Amount**	**Cost-share**	**Amount**
FY07 Carry Forward Funds		$5,985,928		
FY08 Infrastructure Funds		$8,400,000		
			FY08 Cost-share	$3,397,458
Total	**IDNR**	**$14,385,928**	**Cost-share**	**$3,397,458**

Total Budget $17,783,386

FY08 Expenses (07/01/2007 – 01/05/08)

IDNR Source		**Amount**	**Cost-share**	**Amount**
FY08 IDNR Expenses		$3,157,703		
FY08 IDNR Obligated Funds		$7,525,168		
			FY08 Cost-share Expenses	$328,325
			FY08 Cost-share Obligated Funds	$2,068,217
Total	**IDNR**	**$10,682,871**	**Cost-share**	**$2,396,542**

Total Expenses/Obligated $13,079,413

Fiscal Year 2009 Proposed Budget

Project	Project Description	Special Appropriations	Fed	Other	Total
Clear Lake	Dredging, Marsh Restoration	$3,000,000	$2,000,000	$2,000,000	$7,000,000
Storm Lake	Dredging	$1,000,000	$500,000	$200,000	$1,700,000
Carter Lake	Lake Restoration	$200,000		$200,000	$400,000
Easter Lake	Watershed Improvement, Stormwater	$25,000		$100,000	$125,000
Five Island	Dredging, Water Quality Improvements	$175,000		$175,000	$350,000
Green Valley	Spillway Repair., Land for Containment Site	$800,000			$800,000
Lake Darling	Watershed Improvement, Dam Repair	$1,000,000	$300,000		$1,300,000
Lake Manawa	Dredging	$1,000,000		$1,000,000	$2,000,000
Prairie Rose Lake	Watershed Improvement, Land for Containment Site	$500,000	$200,000		$700,000
Priority Lakes	Diagnostic / Feasibility Studies	$200,000		$50,000	$250,000
Rock Creek Lake	Watershed Improvement	$100,000	$300,000		$400,000
Union Grove Lake	Watershed Improvement, Silt Dike	$300,000	$200,000	$50,000	$550,000
Dam Safety	Dam Safety/Portage Signage	$200,000			$200,000
Shallow Lakes	Water Quality Improvement	$100,000		$100,000	$200,000
	Total	**$8,600,000**	**$3,500,000**	**$3,875,000**	**$15,975,000**

2007 Annual Report

Lake Restoration Program Components

Lake Restoration Prioritization Process

The Lake Restoration Program initially ranked 127 public lakes for lake restoration priorities in 2006. A group of thirty-five lakes, considered highest priority for restoration, was established and serves as a starting point for identifying potential lake restoration projects.

Ranking indices used lake water quality data and watershed characteristics to create groups of good, fair, or poor lakes and watersheds. The department used these descriptions to categorize lakes into management action groups. Twelve lakes primarily require protection of the lake and watershed, and 115 require restoration of the lake and/or the watershed. The ranking process incorporated results from a preliminary economic benefit:cost analysis done by Iowa State University Economists and Dr. John Downing, Director of the Iowa State University Limnology Laboratory. They established economic priorities (high, medium and low) for all lakes by considering lake use, perceived value and population within 50 miles. In-lake restoration cost is an estimation of dredging costs ($5.50/cubic yd) associated with deepening lakes to an average depth of 10 ft. This cost includes an estimated 30% for other in-lake restoration work. Lakes having a $0 value already have a mean depth greater than 10ft. This does not preclude the possibility that other in-lake work is needed to achieve water quality goals. ISU estimated watershed protection for all watersheds at costs of $150/ac (good), $250/acre (fair), and $350/ac (poor) and assessed urban watersheds at $1000/ac. In addition, they adjusted costs for certain lakes because of recently completed restoration work or special needs.

IDNR will review the list of thirty-five lakes annually and determine which lakes should proceed with lake restoration. Until watershed best management practices protect the lake, restoration work cannot move forward, therefore lakes with well-documented watershed protections are the best candidates for restoration. The other necessary ingredient to begin lake restoration is local commitment.

In order to better document how lake restoration will benefit Iowa we will use cost benefit analysis, as well as identifying non-economic benefits to people and our natural resources. Computing and documenting the economic benefits, recreation benefits, health benefits, and natural resource/environmental benefits of lake improvements will be a great asset to the lake restoration process. This information will also go a long way in communicating the need of lake restoration projects to local communities and the legislature.

Fundamentally, the initial list identified technically feasible projects that benefit Iowans and local communities supported. We know that the local support is essential to accomplish restorations. Crystal Lake is a good example of a local community that stepped up to improve their lake's water quality and got themselves and their lake on the priority list. Although their lake was not identified originally as a socio-economic priority statewide, the enthusiasm and local dedication of the community, combined with reasonable costs, local match, and technical feasibility, makes it a great investment and a high priority lake to restore. We hope that more communities will step up to invest in their lake's future.

Estimated Restoration Costs for the Thirty-Five Priority Lakes/Watersheds.

The cost estimates in this table represent a first attempt to approximate financial resources needed for restoring 35 priority lakes. In-lake restoration cost is an estimation of dredging costs ($5.50/cubic yd) associated with deepening lakes to an average depth of 10 ft. This cost includes either an estimated 30% cost above dredging for other in-lake restoration work. Lakes with no proposed dredging include an estimate of other in-lake work and costs that might be required to achieve water quality goals. Permanent watershed protection was estimated for all watersheds at costs of $150/ac (good), $250/acre (fair), and $350/ac (poor). Urban watershed acres were assessed at $1000/ac. Some lakes were adjusted for costs because of recently completed restoration work or special needs.

Lake name	County	Lake Area (acres)	Watershed Area (acres)	Est. Lake Restoration Cost	Est. Watershed Restoration Cost	Estimated Total Cost	Cost / Lake Acre
Arbor Lake	Poweshiek	13	1,046	$187,334	$674,254	$861,588	$66,276
Big Creek Lake	Polk	864	46,822	$3,900,000	$11,705,436	$15,605,436	$18,062
Black Hawk Lake	Sac	919	13,179	$33,670,911	$1,976,796	$35,647,707	$38,790
Blue Lake	Monona	264	5,027	$10,568,625	$754,011	$11,322,636	$42,889
Brushy Creek Lake	Webster	710	56,318	$275,000	$14,079,438	$14,354,438	$20,218
Carter Lake	Pottawattamie	314	2,398	$3,247,972	$1,366,983	$4,614,955	$14,697
Central Park Lake	Jones	25	370	$344,951	$92,606	$437,557	$17,502
Clear Lake	Cerro Gordo	3,669	9,538	$13,289,756	$2,218,904	$15,508,660	$4,227
Crystal Lake	Hancock	264	1,984	$10,332,036	$297,658	$10,629,694	$40,264
Diamond Lake	Poweshiek	96	2,673	$809,364	$668,190	$1,477,554	$15,391
Easter Lake	Polk	185	6,368	$6,000,000	$3,750,638	$9,750,638	$52,706
Five Island Lake	Palo Alto	964	7,726	$950,000	$1,267,289	$2,217,289	$2,300
George Wyth Lake	Black Hawk	44	440	$236,556	$65,947	$302,503	$6,875
Green Valley Lake	Union	420	4,756	$3,011,262	$1,188,891	$4,200,153	$10,000
Hannen Lake	Benton	37	566	$225,305	$141,581	$366,886	$9,916
Hickory Grove Lake	Story	82	3,955	$650,000	$988,653	$1,638,653	$19,984
Kent Park Lake	Johnson	26	669	$463,322	$100,281	$563,603	$21,677
Lake Ahquabi	Warren	116	1,729	$1,000,000	$259,315	$1,259,315	$10,856
Lake Anita	Cass	178	2,317	$50,000	$347,568	$397,568	$2,234
Lake Darling	Washington	268	12,451	$4,500,000	$3,112,751	$7,612,751	$28,406
Lake Geode	Henry	190	10,136	$975,000	$2,534,098	$3,509,098	$18,469
Lake Keomah	Mahaska	77	1,875	$300,000	$468,677	$768,677	$9,983
Lake Macbride	Johnson	870	16,163	$350,000	$4,462,871	$4,812,871	$5,532
Lake Manawa	Pottawatt.	733	2,425	$30,128,179	$1,199,843	$31,328,022	$42,739
Lake of the Hills	Scott	54	1,650	$16,441	$412,532	$428,973	$7,944
Little Wall Lake	Hamilton	246	187	$5,000,000	$28,083	$5,028,083	$20,439
Lower Gar Lake	Dickinson	264	10,506	$14,125,036	$2,747,713	$16,872,749	$63,912
Pleasant Creek Lake	Linn	418	2,060	$750,000	$308,934	$1,058,934	$2,533
Prairie Rose Lake	Shelby	190	4,450	$3,203,083	$1,557,394	$4,760,477	$25,055
Red Haw Lake	Lucas	73	947	$60,000	$236,728	$296,728	$4,065
Rock Creek Lake	Jasper	595	26,071	$8,500,000	$9,124,914	$17,624,914	$29,622
Silver Lake	Delaware	37	201	$983,304	$30,224	$1,013,528	$27,393
Storm Lake	Buena Vista	3,142	14,701	$28,000,000	$3,169,039	$31,169,039	$9,920
Union Grove Lake	Tama	115	6,834	$3,257,200	$2,392,041	$5,649,241	$49,124
Viking Lake	Montgomery	144	2,023	$65,000	$505,856	$570,856	$3,964
	Totals	**16,606**	**280,561**	**$189,425,637**	**$74,236,137**	**$263,661,774**	**$15,878**

Communication and Public Outreach

Meetings with Local Leaders and Stakeholders

In accordance with Section 26 of House File 2782: “The Department shall meet with representatives of communities where lakes on the initial list are located to provide an initial lake restoration assessment and to explain the process and criteria for receiving lake restoration funding”.

The IDNR has established local stakeholder groups and communicated with the public. We have had these discussions with a number of active or planned lake/watershed improvement projects. Including; Beeds Lake, Carter Lake, Clear Lake, Crystal Lake, Easter Lake, Green Valley, Lake Darling, Lake Geode, Lake Manawa, Lake of Three Fires, Lizard Lake, Lower Gar, Mariposa Lake, Prairie Rose, Rock Creek Lake, Silver Lake (Delaware), Storm Lake, Union Grove Lake, and Viking Lake.

Technical field staff held meetings for the following lakes: Black Hawk Lake (Sac County), Big Creek Lake (Polk County), Brushy Creek Lake (Webster Co.), and Hickory Grove Lake (Story Co.).

The lakes listed below do not have active lake improvement projects underway. IDNR staff, during the second half of FY08, plans to compile a list of local community leaders and stakeholders associated with these projects then schedule informational meetings with interested stakeholders representing these lakes.

<u>Potential Future Projects that need Meetings with Local Leaders and Stakeholders:</u>
Arbor Lake (Poweshiek Co.), Black Hawk Lake (Sac Co.), Blue Lake (Monona Co.), Brushy Creek Lake (Webster Co.), Central Park Lake (Jones Co.), Diamond Lake (Poweshiek Co.), George Wyth Lake (Black Hawk Co.), Hannen Lake (Benton Co.), Hickory Grove Lake (Story Co.), Kent Park Lake (Johnson Co.), Lake of the Hills (Scott Co.), Lake Keomah (Mahaska Co.), and Pleasant Creek Lake (Linn Co.).

Inquiries from Stakeholders of Lakes not on the Priority List

Also in accordance with HF2782, “Communities with lakes not included on the initial list may petition the Director of the Department for a preliminary lake restoration assessment and explanation of the funding process and criteria”.

During the first half of FY08, local stakeholders of Lake Rathbun (Appanoose Co.), Lost Island Lake (Palo Alto Co.) and Summit Lake (Union Co.) contacted the IDNR to consider their respective lakes for a restoration project.

Rathbun Reservoir (Appanoose Co.) is a 11,000 acre lake in south-central Iowa that is one our most significant state recreational destinations and a provider of water to the states largest rural water system (Rathbun Rural Water). It is distinct from several of our other large reservoirs, Saylorville, Coralville and Red Rock in that its watershed to lake ratio is only 37:1 and has great potential to maintain and improve lake water quality with a combination of watershed and lake restoration alternatives.

Lost Island Lake (Palo Alto Co.) is a 1,000 ac. natural lake in northwest Iowa that is not meeting its water quality and recreational potential. The Iowa IDNR currently owns 23 percent of the watershed and proposes a watershed assessment of the entire system.

The IDNR has reviewed the available lake and watershed information and has indicated that these lakes should be included in the lake restoration program. We will schedule meetings with local stakeholders from both these lakes in early 2008 to discuss an overview of the funding process and the required next steps.

The other lake system, Summit Lake (Union Co.), has just started initial inquiries to be included in the lake restoration process. Representatives from this lake have not sent a formal petition to the IDNR Director.

Communication Tools and Strategies

The IDNR, in cooperation with Iowa Department of Agriculture Land Stewardship (IDALS), has worked to develop a holistic approach to locally led watershed projects. The Watershed Improvement Review Board has adopted it as the basic planning requirement for successful proposals.

The IDNR website includes the current 9-step planning protocol:

http://www.iowaIDNR.gov/water/watershed/files/protocolguide.pdf

The group plans to develop a brochure (small enough to fit in your shirt pocket) that outlines how the protocol works and identifies where the public fits into the process. People will find these brochures useful as handouts at meetings.

In addition to brochure type handouts, a number of communication and outreach tools for the public and lake stakeholders will be considered as deemed appropriate, including: display/kiosk, lake restoration tool kit and workshop, newsletters, opinion surveys, web site.

For example, the Lakes Program developed a one-page handout that summarizes the Lake Restoration Process. This has proved to be a useful tool in communicate the important aspects of the program to the public.

Program Challenges

Unforeseen Delays in Construction

One of the greatest challenges with construction projects is making sure complex projects move forward without unnecessary delays. The Lakes Water Quality Improvement projects are no exception. The majority of lake restoration projects involve constructing or installing watershed or in-lake improvements. A typical construction project might include the following stages: project scoping, engineering design, work bid letting, contract development, construction, and inspection. All processes must adhere to the standards and requirements of doing business as a public agency.

Certain projects may require easements or land acquisition before construction can begin, followed by required approvals and permits such as archeological/cultural (SHPO), environmental (T&E species), floodplain/404 permit, and sovereign lands permit. Obtaining these approvals or permits may result in delays to the process. In addition, adverse weather, equipment breakdowns, and other unforeseen occurrences can cause delays.

IDNR is committed to streamlining project development and implementation. Resources have been committed to develop an improved project management tracking system for lake restoration projects and budgets. During FY08, we will work to expedite project development steps and use funds for their intended purpose without unnecessary delays.

Multiple-year Projects

Timelines for larger construction projects at a minimum fall within a two-year period. Large dredging projects may take even longer. Dredging contractors face substantial costs to mobilize and set up lake dredging operations and this critical work needs multiple year commitments to secure contactors. As such, the most practical and efficient way to complete a dredging plan is as one continuous project. Clear Lake, Crystal Lake, and Storm Lake are all examples of dredging projects that require a multiple-year funding commitment from the State in order to achieve lake restoration goals.

Local partners may also need a multiple year funding commitment from the lake restoration program in order to pursue funding sources to match State funds. State Infrastructure Appropriations for lake restoration accepts requests on a yearly basis; therefore, it is difficult to guarantee ongoing funding support. The process should incorporate a funding approach and structure that addresses the multi-year commitments needed to secure dredging contractors and local funding sources.

Explaining Lake Restoration Suitability

The lake restoration priority ranking process identified thirty-five lakes based upon a number of socio-economic, lake water quality and watershed indicators. The lake restoration program recognizes that individuals or constituent groups interested in improving a lake and not on the

priority list may ask for inclusion to the program. In addition, there may be external pressures for IDNR to embark in lake restorations that are not wise investments of limited public funds.

The first step will be to review available information about the lake and watershed to determine the appropriate rank of the lake with respect to restoration priority. Some requests will have merit and others will not. As these requests arise, IDNR will need to be prepared to explain that not all lakes are equal with respect to restoration suitability. Challenges for IDNR lake restoration managers include explaining the project selection criteria and responding in a constructive way to helping local lake initiatives involving non-priority lakes.

Project Summaries

Lake-Specific Projects

Carter Lake (Pottawattamie County)

Carter Lake (Pottawattamie County) is a natural lake that is uniquely located in both Iowa and Nebraska. Carter Lake is an old oxbow of the Missouri River that was isolated from the river main channel in 1877. The lake is approximately 300 surface acres at conservation surface pool elevation 970.0 feet, with a watershed area of 2,675 acres (watershed area to lake area ratio of 7.6/1). The lake is approximately 75% in Nebraska and 25% in Iowa. Park areas in Nebraska and the City of Carter Lake in Iowa dominate land use adjacent to the lake.

Problems at the lake have centered on poor water quality, chronic low water levels and nuisance algae bloom. Impairments include nutrients/algae, indicator bacteria, and fish contaminants (PCBs).

Restoration of Carter Lake involves the cooperation of Iowa, Nebraska and the cities of Omaha and Carter Lake. A local Iowa group, the Carter Lake Preservation Society (CLPS), has been very active in moving this project forward. In addition, a Watershed Technical Advisory committee meets monthly to discuss concerns, assist planning, and complete restoration activities.

The CLPS has been instrumental in securing funding for the lake. This includes grants from Watershed Protection Grant ($10,000), IDALS, the Pottawattamie Co. Board of Supervisors ($163,000), IDNR ($27,000) for shoreline and water quality improvements, and IDNR, REAP & Project AWARE for a 2007 lake clean up project ($1,000). The CLPS applied, but was unsuccessful in securing a $49,470 WIRB grant for storm water improvements around the Iowa portion of the lake.

Progress and Planned Activities

IDNR is collaborating with Nebraska Department of Environmental Quality (DEQ), using Nebraska 319 funds ($30,000) and Iowa Lake Improvement Funds ($20,000), to begin a Diagnostic-Feasibility study. This study will build upon the recently completed TMDL for Carter Lake. The contracted company, Olsson Associates, has collected information and begun providing information on potential restoration alternatives. Interested parties plan to hold a public meeting by May 2008.

Low water levels have been a concern at Carter Lake dating back to the 1920s. The cities of Carter Lake and Omaha recently funded an additional project for $27,000 to further study and provide recommendations on water quantity problems at Carter Lake. The study suggested that obtaining water from wells located near the Missouri River was the best option. Nebraska will match $2 million of State of Iowa Funds required to design and construct the pumping station. This project will ensure that Carter Lake has access to high quality water and is able to maintain the necessary level for water quality improvements.

Clear Lake (Cerro Gordo County)

Clear Lake (Cerro Gordo County) is a 3,625 acre natural lake in Northwest Iowa. It has a watershed to lake area ratio of 2.3/1. In 2001, ISU completed a lake/watershed diagnostic/feasibility study. They presented a number of lake restoration options including dredging. The Clear Lake dredging plan included acquiring land for a dredge spoil site, building the containment basin and hydraulically dredging approximately 2.3 million cubic yards of sediment. The initial projected cost was $13 million with the state pledging $9 million and local partners and other leveraged funds making up the rest.

The IDNR supported the following three-year plan in 2006:
FY07: $4,000,000: containment site acquisition and construction; dredging
FY08: $2,500,000: dredging
FY09: $2,500,000: dredging

Progress and Planned Activities

IDNR obtained a final purchase agreement for the dredge spoil site and completed the land acquisition. Purchase of the 208 acre site used approximately $660,000 of lake restoration funds and an additional $660,000 local match. A required archeological/cultural study of the proposed dredging-impacted area was completed and design and construction of the containment site is almost finished. Contractors are near completion of the $886,000 containment site. The scheduled construction end-date is spring of 2008. Final permitting with COE is also near completion and commencement of dredging is expected in late spring of 2008, with likely completion by fall of 2009. The estimated cost is $8 million ($3.50/cu. yd.) with $6 million from the state lake restoration fund and $2 million from local sources. IDNR will advertise bid letting for potential contractors in December of 2007 with a January 2008 bid opening; and, a goal of having a signed contract by the end of February 2008.

As seen in the past, the project may need cost adjustments. For example, we increased the cost of containment site construction originally estimated at $673,000 to $886,000 after the bulking factor of the dredge spoil site increased from 25% to 40%. This increase insured

improved return water quality to the lake and lowered overall dredging costs. Even considering potential cost increases, it is still likely the total project will be lower than the originally estimated cost of $13 million. The current estimate for the dredging project is $8 million ($6 million from the IDNR and $2 million from local partners and other leveraged funds).

In addition to dredging, plans are being developed for a Section 206 U.S. Army Corps of Engineers Aquatic Ecosystem Restoration Project in Ventura Marsh, which flows into the west end of Clear Lake. In its present degraded state, the marsh serves as a major source of nutrients contributing to water quality problems in the lake and is a major reproduction area for common carp.

Carp abundance in Clear Lake contribute to algae and turbidity (water cloudiness) problems in the lake. Carp are aggressive bottom feeders that uproot aquatic vegetation and stir up lake sediments. Their impact to water quality and aquatic habitat can be severe. With funding from the lake restoration program and local interest groups, Iowa State University fisheries scientists are monitoring the movements of carp in the lake in order to investigate potential strategies for removal through netting or chemical treatment.

The recently presented Federal omnibus appropriations bill has $2.6 million earmarked to the Corps for a Ventura Marsh restoration project. If signed into law, this bill will provide the Corps with funding under the 206 Construction Program and be available for the federal cost-share portion of Ventura Marsh restoration. This could result in the project moving forward by spring 2009. Once executed Ventura Marsh land credits will fund the majority of IDNR's portion of the marsh restoration project.

Anticipated Benefits

Restoration efforts and improvements in water quality have the potential to more than double the annual economic return (currently estimated at $43 million) that Clear Lake generates to the local economy. The Center for Agriculture and Rural Development at ISU has projected a significant benefit to cost ratio from lake and watershed restoration at Clear Lake. In addition, future planned restoration of Ventura Marsh will improve the water quality of Clear Lake and help keep the Carp population under control.

Clear Lake Bio-Manipulation (common carp removal)

"Since its arrival in North America in the late 1800s, the highly competitive common carp (*Cyprinus carpio)* has become one of the continent's most widely distributed fish species. Carp in search of food often physically uproot aquatic vegetation and suspend large amounts of sediment in the water column. In Clear Lake and other systems with high carp biomass, the collective activity of these fish can reduce habitat quality for the native biota and accentuate water quality decline, making reduction of carp numbers a key objective in improving lake health. Data collection on the seasonal locations, habitat use, movements, and aggregation areas of adult and juvenile carp in Clear Lake, by radio telemetry, helped formulate an efficient and effective control strategy. Monitoring of these fish has allowed managers to quantify and characterize seasonal distribution and habitat use by common carp and give insight into the preferred times and locations for removal through targeted netting or poisoning" (from C. Penne and C. Pierce, Iowa State University – Annual Progress Report, December 2006).

According to Jim Wahl, IDNR Fisheries Biologist, the study's preliminary findings show the occurrence of a large concentration of carp during the spring in the west end of the lake where there is potential to mechanically remove high densities of carp. The study also illustrated the need for extensive population estimates of carp and bullhead standing stock in Clear Lake so there will be baseline data to work with for mechanical removal in future years.

Anticipated Benefits of Bio-Manipulation (common carp removal)

Historically phosphorus exports to Clear Lake from the marsh have been greater than the phosphorus amount coming into the marsh. The major contributing factor that results in the marsh acting as a nutrient source rather than sink for nutrients is the recruitment and activity of carp. As mentioned above, the contribution of nutrients from the marsh is a contributing factor to water quality problems in the lake.

The photograph at right shows the contrast in water clarity between Clear Lake (***left***) and Ventura Marsh (***right***) following carp removal in 2000 from Ventura Marsh by chemical (rotenone) treatment. Renovation removed approximately 99% of the carp from the fish population in Ventura Marsh, and water quality improved immediately. Submergent vegetation became well-established, water clarity improved and exporting of phosphorus to Clear Lake decreased. Unfortunately, since carp became re-established quickly in the marsh, benefits only lasted a few years. Nonetheless, this experience demonstrated the potential usefulness of common carp management as a water quality improvement technique.

Managers attribute the success of the 2007 commercial harvest on having information on the seasonal locations and aggregation areas of adult and juvenile carp in Clear Lake. This information helped establish a more effective control strategy than past efforts. The 181,441 pounds of carp removed in 2007 was the most successful harvest recorded in the last ten years. Moreover, recent sampling shows the current carp standing stock (at 78 lbs./acre) is less than 25% of the average standing stock observed from 1999 to 2004. Angler walleye harvest in 2007 (11,000 fish), was more than double the harvest of 2006. This may indicate that this species benefited from the decrease of carp in the system.

It is important to implement an on-going fish removal effort to keep carp numbers low. Control and restoration of Venture marsh is an important component to the success of these efforts.

Crystal Lake (Hancock County)

Crystal Lake (Hancock County) is a small 269-acre natural lake in Northwest Iowa with a watershed to lake area ratio of 8.8/1. ISU completed a lake/watershed diagnostic/feasibility study in 2001. In addition, IDNR completed construction of the dredge spoil site in July 2006 at a cost of $838,000. This project involved the IDNR acquiring approximately 100 acres of land to mitigate the use of the wildlife area as a containment site. IDNR awarded a contract to dredge and work commenced in October 2006. As projected, the contractor completed the dredging in the fall 2007. They removed 1.1 million cu./yds. of sediment at a cost of $3.1 million.

Progress and Planned Activities

Now that dredging is complete, renovation of the fish community of Crystal Lake to remove the common carp population will occur in the fall of 2008. IDNR estimates the cost of this portion of the project at $250,000. During the flood year of 1993, carp invaded the lake from the outlet creek while stream flow was extremely high. We also have a contract for $29,000 to modify the small lake outlet structure and prevent future introductions of undesirable fish species after renovation.

Anticipated Benefits

This small community and the surrounding rural area is an excellent example of a locally driven project that will benefit from lake improvement. Following restoration improved fishing opportunities alone could add nearly $400,000 annually to the local economy. In addition improved water quality will benefit other water-based recreation. The combination of the watershed and lake improvement work will remove Crystal Lake from the Impaired Waters List and add to the estimated $2.5 million spent annually by lake visitors.

According to Jim Wahl IDNR Fisheries Biologist, the 10-acre sediment/multi-purpose pond constructed in 2007 above the lake in the Northeast corner of the watershed created additional recreational benefits. The pond reduces sediment delivery to the lake by an estimated 18% and phosphorus by 16%. The pond is now deep enough to support a sport fishery and IDNR has stocked it with largemouth bass, bluegill and channel catfish, which now provide substantial angling opportunities.

Easter Lake (Polk County)

Easter Lake is a 178-acre constructed lake with a watershed to lake ratio of 36/1. Constructed in 1967 Easter Lake began as a lake in an agriculture/suburban watershed that over the years has shifted to a highly developed urban area. Home and business construction activities have contributed greatly to more than a 20% reduction in lake volume. Combine this with storm water issues such as Yeader Creek and the lake's problems become obvious. The Polk CCB owns and manages this area and they are very interested in developing a partnership to accomplish lake and watershed improvements. As an initial step ISU will conduct a diagnostic feasibility study with a targeted completion date of 10/31/09. Polk CCB conducted an initial meeting in March 2006 to discuss the merits of the project. This study will require up to a 25% financial commitment from the Polk CCB to match 75% State Lake Improvement Funds. To monitor the studies progress a technical workgroup meets on a regular basis.

Five Island Lake (Palo Alto County)

Five Island Lake is a 950-acre natural lake located on the north side of the town of Emmetsburg, Iowa in Palo Alto County. In 1989, following five years of diminished recreational opportunities and poor water quality conditions due to low lake levels, a group of concerned citizens formed the Five Island Lake Board. They established two major goals for the project: Increase the lake water depth; and, improve the lake water quality. The Lake Board accomplished their goals by stabilizing with riprap almost 10.5 miles of lake shoreline, hydraulic dredging of over 5 million cubic yards of silt, and working in the watershed to reduce nutrients and sediment from entering the lake. Lake dredging work is nearing complete with work continuing in the watershed to address stormwater runoff. Funding for this project has been a combination of state and local matching grants. Local monetary contributions to date exceed $1.2 million with state funding approaching $980,000 by July 2007. The city of Emmetsburg is in the process of requesting $175,000 of state lake restoration funds for FY08 and FY09 to match with local funds for their on-going lake restoration project. In addition to the dredging portion of their project, they are evaluating the need for additional work in the watershed and in-lake management strategies to achieve the desired water quality goals.

Green Valley Lake (Union County)

Green Valley Lake is a 390-acre lake constructed in 1950. It has a watershed to lake ratio of 11.3/1. A limited lake restoration project through the State and U.S. EPA's Clean Lakes Program was undertaken in the mid 1980s, however additional watershed and in-lake work is needed. A Diagnostic Feasibility study through Iowa State University is underway with a final report due by the spring of 2008. The local district soil group and NRCS have completed a watershed assessment and have developed a four-year plan to make needed watershed improvements. Cost share funding is now available for local landowners to accomplish soil and water quality improvement projects on their property.

A four-year watershed improvement plan, with $70,000 available annually, is being utilized to complete approved projects. The local NRCS District Conservationist has indicted that they have an extensive list of willing watershed landowners that plan to participate in this initiative. In-lake restoration work may center on spillway modification, fish restoration and dredging of coves. Major fish restoration and spillway modification work could begin as early as fall 2008. A technical workgroup that includes IDNR staff, the city of Creston, Southern Iowa Rural Water, Green Valley Chemical and CIPCO meet to coordinate activities. In addition the IDNR met with several landowners to discuss acquiring a future dredge spoil containment site. Recently a local group contacted the IDNR and asked us to consider Summit Lake for watershed/lake restoration. Note: Summit Lake is in the same watershed immediately below Green Valley Lake.

IDNR and ISU have scheduled a meeting for February 2008 to present the feasibility study to the public and discuss suggested alternatives for restoration.

Lake Darling (Washington County)

Lake Darling is a 267-acre man-make lake, constructed within a 1,400 acre state park, with a watershed to lake ratio of 46.5/1. Initially impounded in 1950, it has historically been a fair fishery plagued by severe in-lake siltation and poor water quality. Sedimentation has reduced

the lakes original 305 surface acres to 267 acres. During the last five years, extensive watershed soil conservation work has reduced sediment delivery to the lake by 40%. Additional soil conservation work took place on state/private land in 2006 and 2007.

Construction work in 2007-08 will center on an additional 36 watershed structures on or adjacent to state property. The cost estimate for nine of these structures, currently under construction, is $73,744. Acting on the recommendations of the completed engineering report, the IDNR will repair the dam and address spillway leakage. In addition they will continue to search for a dredge spoil containment site.

IDNR and ISU have scheduled a meeting for February 2008 to present the feasibility study to the public and discuss suggested alternatives for restoration.

According to Don Kline, IDNR Fisheries Biologist, some key highlights from recent watershed improvement projects include:

- 137 construction projects completed in the past 6 years involved 57 different landowners.
- Project total cost was $1,371,301 including $984,924 cost share funding.
- Runoff from 73% of private land in the watershed flows into tile outlet terraces/basins or erosion control ponds constructed as part of the lake restoration process.
- Dramatic improvement in the lake water clarity during the 6-years of project implementation.

Obtain additional information about Lake Darling watershed improvements in a brochure available at http://www.iowaIDNR.com/water/nonpoint/files/darling.pdf.

Lake Manawa (Pottawattamie County)

Lake Manawa is a 715-acre natural lake with a watershed to lake ratio of 3.5/1. Mosquito Creek supplies additional water to the lake. Past lake dredging work in the 1960s deepened significant portions of the lake. However, maximum lake depth does not exceed 13 feet with large expanses of 6 to 7 feet deep water. The Iowa Department of Transportation approached the IDNR to explore the possibility of dredging the lake for sand to use for highway construction. However, there is concern about whether they can remove sand materials from Lake Manawa while still maintaining the hydraulic seal between the lake and the fluctuating Missouri River.

The Iowa DOT and IDNR met during March of 2007 to determine opportunities to obtain highway building materials from Lake Manawa sediments. It was determined at the meeting that, while DOT is still interested in obtaining highway building materials, it will be up to the IDNR to determine how to safely supply the product. The IDNR has obtained some additional information from USGS and is putting together a proposal to hire an engineering/environmental restoration firm to review the option of dredging as a lake restoration activity. The IDNR meets with groups such as the “Friends of Lake Manawa” to solicit support and to assist in moving the lake/watershed restoration project along. Feasibility updates and restoration possibilities should be available for review by summer 2008.

Lake of Three Fires (Taylor County)

Lake of Three Fires Lake is a 96-acre constructed lake with a watershed to lake ratio of 38/1. ISU completed a diagnostic/feasibility study in 2000 and identified a number of restoration alternatives. Watershed work and lake dredging was completed in 2005. The final recommended component of the restoration project is a wetland on the IDNR Simmons Wildlife Area immediately above the lake. This wetland will provide water quality protection and diversify the wildlife area. The wetland project is a cooperative venture in which NRCS will design the project, and IDNR will acquire the additional land necessary for the project, manage project construction and inspection. IDNR utilized lake restoration funding to acquire 80 acres of land at a cost of $185,000 and following the land purchase constructed a wetland at a cost of $95,000. The wetland project utilized 75% Federal 319 funds and 25% State Lake Restoration funds.

Lake of Three Fires maintained excellent water quality despite excessive rainfall events, 30% above normal in 2007. With the completion of the wetland, the IDNR will consider the restoration phase of this project completed and group Lake of Three Fires with lakes that require monitoring and occasional maintenance to maintain their high quality ranking.

Following is a chronological description of lake conditions and restoration work provided by Gary Sobotka, IDNR Fisheries Biologist:

Lake of Three Fires (Taylor County) benefits from extensive past water quality improvement practices. The 75-year-old lake suffered from the combined affects of sediment-nutrient deposition and a prolific common carp population. Water clarity measurements were commonly between 1 and 2 feet with measurements less than 6 inches common after heavy rains. Historically fish growth was slow and seldom provided quality fish. The rehabilitation project involved attacking the poor water quality problem from several angles. Sediment removal, common carp removal and soil conservation in the watershed helped greatly improve the water quality.

IDNR renovated the fishery in the early 1980s but common carp returned within a few years. The spillway of the lake was the likely entry point. Reshaping it would eliminate that possible entry point and help ensure long lasting benefits to the fish population. Its original design was a long gently sloping ramp. During the fall of 2003 modification flattened the profile and added a 10-foot sheer drop.

Hydraulic dredging removed sediment from the lake. Lake bottom soundings identified that sediment covered much of the lake to a depth of 3 to 6 feet with some areas exceeding 15 feet. An appropriately sized spoil sight was then designed according to sediment estimates. The dredging contractor constructed a sediment retention lagoon on existing state property and dredged an estimated 500,000 cubic yards of sediment during the late spring of 2004. IDNR drained the lake in the fall of 2004 and renovated the remaining fishery. They also sampled watershed ponds for the presence of common carp but found none.

Construction of several fish attracting structures occurred during the winter of 2004-5. These consisted of earthen mounds with riprap sides and gravel tops. They also placed numerous cedar trees near existing shoreline access areas. Construction of a replacement boat ramp allows for boat launching into deeper water. Project activities also repaired fishing jetties and placed riprap along 1100 feet of unprotected shoreline. Following completion of the shoreline

and habitat improvements, managers closed the water control gate, restocked fish and allowed the lake to refill.

Water clarity during the filling stages far exceeded that of most measurements taken prior. . Fish growth has been astounding. Fall 2007 electro-fishing showed an abundant largemouth bass population with many individuals near 18 inches and extremely high numbers of individuals from 4 to 12 inches. The bluegill population has also exhibited fast growth with many individuals near or exceeding 8 inches. Crappies have returned from ponds in the watershed. Abundance is moderate with a good population of 8.5 to 11 inches crappie available to anglers. Many of the channel catfish have reached over 3 pounds and a few individuals exceed 4 pounds. The future of the fishery looks brighter than at any point during the past 30 years.

Lake restoration funds built silt retention structures on nearly twenty of the lake's small sub-watersheds and developed a wetland on a pubic area above the lake's main arm. Some of these retain permanent water and some provide temporary water retention. Most are on existing public property and the land use above is almost entirely timber. Several deeply cut ravines were stabilized with this practice.

The fishery and water quality improvements following lake restoration have far exceeded expectations. Fish growth and abundance is high, water clarity exceeds any previous level and park use continues to exceed previous levels. These water improvements, along with continued efforts, will make Lake of Three Fires State Park a quality area many can enjoy for many years to come."

Lizard Lake (Pocahontas County)

Lizard Lake (Pocahontas County) is a 285-acre shallow natural lake. Rough fish (buffalo, bullhead and carp) dominate the lake population. The lake contains very little area of aquatic vegetation and exhibits poor water quality. A local lake group has promoted lake restoration and they continue to meet with IDNR staff to discuss their concerns. In June 2006, IDALS and the local Soil and Water Conservation District awarded a Development Grant to evaluate the watershed of Lizard Lake.

Iowa State University Limnology Laboratory will develop a Diagnostic Feasibility study for Lizard Lake. As part of potential restoration alternatives, ISU will present "shallow lakes management" as an option for improving the lake's water quality, fish population structure and wildlife potential. Management may include renovation of the fisheries population, aquatic vegetation management and/or watershed treatment. Local sources have committed 25% for the diagnostic/feasibility study cost. Interested parties have scheduled a public meeting for spring 2008 to discuss and evaluate the report results and review restoration alternatives.

Lower Gar Lake (Dickinson County)

Recently local concerned citizens and business owners that live on or recreate on the Iowa Great Lakes system, specifically Lower Gar, Minnewashta and Upper Gar, formed The Three Lakes Improvement Association. IDNR Lakes Restoration staff met with this group several times in 2005 and 2006 to discuss lake water quality and water depth issues. Iowa State University has prepared and initiated a diagnostic/feasibility proposal to examine lake issues.

This study, funded locally for 25% of the cost, will examine historic soft sediment deposition, potential removal of a portion of these sediments and the resulting impact on lake water quality. Due to the complex nature of the system, such as nutrient movement from and to West Lake Okoboji and East Lake Okoboji, this study may take up to 24 months to complete.

Prairie Rose Lake (Shelby County)

Prairie Rose Lake is a 215-acre constructed lake with a watershed to lake ratio of 23.5/1. Problems at the lake center on low fish populations, historic lake siltation and poor water quality. Lake improvements in recent years include; jetties and fish structure (1998), sediment basin and shoreline riprap (2001) and sediment basins (2004). Local efforts have accomplished significant work in the watershed and identified additional work for completion.

IDNR Fisheries and Parks staff have been meeting with NRCS, IDALS, and others about remaining watershed work and initial lake restoration plans. They held a first public meeting in February of 2007 to discuss the watershed/lake restoration project. Landowners in the watershed, interested stakeholders, soil commissioners and NRCS field staff joined IDNR staff and ISU D/F staff at this meeting. A diagnostic/feasibility study is underway and scheduled for completion by May of 2008 and watershed assessment was conducted followed by a grant to accomplish targeted soil conservation work in the watershed. In addition, the IDNR has begun negotiations with local landowners about acquiring land for a dredge spoil containment site.

Rock Creek Lake (Jasper County)

Rock Creek Lake is a 491-acre lake constructed in 1952. The lake has a watershed to lake ratio of 54/1. Over the last 50 years it has lost almost 40% of its lake water volume and 102 lake surface acres. ISU completed a D/F study in 2000. Local efforts have accomplished significant work in the watershed; however, local and state partners need a renewed effort to move this project forward.

The watershed coordinator identified several soil conservation structures on State property. Work designing the structures and securing necessary permits and easements should move forward during 2007-2008.

Continued watershed improvement projects have been a difficult “sell” to area landowners. A meeting earlier this fall by the technical work group resulted in outlining a different approach to meet the necessary reductions in sediment and nutrient delivery to Rock Creek Lake. It will revolve around dividing the total watershed into larger subwatershed segments, and then designing larger watershed structures that will require a higher government percentage contribution to put these water quality improvement practices in place. Several landowners have expressed interest in this concept. This challenging watershed will require this and other innovative concepts to significantly reduce sediments and nutrients from reaching Rock Creek Lake and to eventually allow us to move forward with the D/F studies lake restoration measures.

Silver Lake (Delaware County)

Silver Lake is a small, natural lake enlarged by the construction of a dam. It has a 34-acre surface area lake and a lake ratio of 6.4/1. UNI completed a diagnostic feasibility study in 2001 and the IDNR completed a TMDL analysis in 2001. Lake depth maps and sediment borings indicated excessive lake sedimentation depths ranging from 0.5 to 4 feet. A lake watershed assessment conducted in 2001, documented areas of high phosphorus input in the watershed. The assessment also identified excessive manure application levels as a problem. NRCS continues to work with landowners in the watershed to reduce nutrient and sediment lake inputs.

In 2001 an engineering firm evaluated dam integrity and leakage issues. Initial repair estimates were $200,000. The construction firm hired to repair the dam and eliminate dam safety issues completed the work fall of 2007 at a cost of $314,950 (see attached project pictures). A small technical workgroup that includes local Delhi city officials, district soil conservation personnel and IDNR field staff will meet in January, prior to an upcoming public meeting, to identify and determine possible solutions to excessive watershed nutrients that are entering the lake. The Lake Restoration Program requires control of watershed inputs before starting identified in-lake restoration work. Preliminary estimates still identify future watershed corrective measures at $100,000 and in-lake restoration costs at $1,500,000...

The next step before in-lake restoration can begin is to address nutrient inputs from the watershed. IDNR will host a meeting in January 2008 to discuss restoration objectives and necessary watershed work needed prior to any in-lake efforts.

Storm Lake (Buena Vista County)

Storm Lake (Buena Vista County) is a shallow natural lake (4th largest natural lake in Iowa) with a surface acreage of 3,150 acres and a watershed to lake ratio of 4.5/1. Prior to the current dredging effort, IDNR last dredged Storm Lake in 1962. Lake depth maps developed in 1992 indicate that the 1962 dredging sites lost 77% and 46% of their volume. Studies indicate that sediment filled these areas from the watershed not from in-lake dynamics.

Progress and Planned Activities

Storm Lake constructed a dredge spoil site in 2001 and began dredging activities in 2001/2002. IDNR lake dredging removed 1.32 million cu./yds. of sediment at a total project cost of $3.275 million. Funding limitations restricted this initial dredging activity to 180-acres of the lake. The Lake Preservation Association (LPA) expressed a strong interest to continue dredging to achieve better water quality The LPA locally raised and received federal grants totaling over $1 million to continue dredging at Storm Lake. They purchased a dredge, and through an agreement with the IDNR, each group has provided $900,000 from 2003 through 2005 to continue dredging operations.

To reach project goals will require another 9-years of dredging at a projected cost of $11 million ($5.5 million state - $ 5.5 million local). State lake restoration funds have contributed $1.5 million to the City of Storm Lake in FY07 and FY08 for dredging. An additional $1 million is requested for FY09. The locally led project goal is to dredge 600,000 to 900,000 cu./yds. of sediment annually. The City of Storm Lake leased the IDNR containment site for an additional 2-years and has since constructed a new containment site east of Storm Lake.

Recommended Budget and Work Plan for Storm Lake
FY07: $500,000: Dredging
FY08: $1,000,000: Dredging
FY09: $1,000,000: Dredge Containment Site Development; Dredging

Dredging is progressing as planned. The Lake restoration program expended $1,000,000 in funds through December 2007.

Little Storm Lake COE Section 206 Aquatic Ecosystem Restoration

Little Storm Lake is a 190-acre state-owned marsh that is an extension of Storm Lake (marsh and lake elevation is the same). This joint project between the local Storm Lake Improvement Group, the US Army COE and the IDNR has as a goal to improve the aquatic species habitat in the Storm Lake watershed and to restore the wetland function of Little Storm Lake. Reaching those goals will require the following objectives; water quality improvements achieved by reducing sediment and nutrients entering Storm Lake, increasing plant species diversity, reducing the coverage of the invasive purple loosestrife plant species, and increasing the habitat suitability and coverage for aquatic species and migratory waterfowl. IDNR land credits will serve as the majority of the local match for the federal funds required to initiate and complete this project. This project was initially slated for a fall 2008 construction start, however delays in federal funding have push the construction start date to no earlier than 2009. The technical workgroup determined that removal of 200,000 cu/yds of sediment should meet Little Storm Lake water quality goals. Increased construction cost estimates by the COE and an unrealistic construction timeline may dictate that the state and local partners explore other Little Storm Lake restoration alternatives.

Anticipated Benefits

In 1998, the impaired waters list added Storm Lake for turbidity. Following the guidelines of the diagnostic/feasibility study, the LPA set a goal of dredging an additional 1,500 acres of Storm Lake to an average depth of 13 feet. The City is improving stormwater delivered to the lake, and recent improvements to IBP are improving the storm water delivered to the lake. This aggressive dredging goal, coupled with watershed improvements and restoration of Little Storm Lake and Wetland will mean significant improvements in water quality. Past, current and future watershed, wetland and lake improvement projects will ultimately result in the removal of Storm Lake from the Impaired Waters List.

In addition, lake restoration efforts so far have encouraged a $35 million economic development named “Project AWAYSIS” that has the potential to create 690 new jobs and over $28 million in new spending in Storm Lake and Buena Vista County. With local support, the Iowa IDNR is designing a $ 3 million renovation of the Storm Lake Marina that will improve lake access and compliment the AWAYSIS project. Preliminary analysis by the Center for Agriculture and Rural Development at ISU has projected a minimum of 2:1 benefit to cost ratio for lake and watershed improvement efforts at Storm Lake that would result in good water quality.

According to Lannie Miller, IDNR Fisheries Biologist, the dredging of Storm Lake continues to provide deeper water and reduce the amount of silt in this shallow natural lake. The restoration of Little Strom Lake utilizing the Section 206 aquatic ecosystem restoration project or another program will reduce silt levels in Little Storm Lake and provide improved water quality for the main lake basin. During the last several years, we are already observing yearly small

improvements in water quality. A combination of restoration activities will continue to improve the water quality of Storm Lake and aquatic ecosystem health.

Union Grove Lake (Tama County)

Union Grove Lake, last dredged in 1990, is a shallow constructed lake, with a surface area of 105 acre and watershed to lake area ratio of 63/1. Statewide mapping efforts will develop current bathymetry for the lake and determine current lake volume. A current lake watershed assessment will provide information on the status of the watershed. Additionally a TMDL report is nearing completion that will identify and quantify issues that are adversely influencing the lake's water quality.

Spillway water seepage has been an on-going problem at Union Grove Lake. Past attempts to repair the problem have met with limited success. IDNR hired a geo-tech firm in 2005 to evaluate the problem and contracted a firm in 2006 to repair the structure. They completed the project in July of 2007 and successfully addressed the water seepage issue. Total project cost for the spillway repair was $178,572, with the lake restoration program as the funding source. The construction firm also made several recommendations for additional future spillway modifications that will preserve the integrity of the system. They will accomplish this work during the summer of 2008 at an estimated cost of $40,000.

The IDNR is working with local sponsors to develop a plan to improve the lake and water quality conditions, projects that are being considered and evaluated are renovation of the fish population, removal of sediments from the upper lake sediment trap, additional watershed protection and dredging work in the upper reaches of the lake. Plans are to develop a workplan for these projects by July of 2008. We estimate the total costs for these projects at $1,200,000. IDNR Park's staff accomplished another small project of interest this past year. They purchased a small beach cleaning system for $4,800 that allows staff to clean beaches, sidewalks, fishing jetties and other park areas of Canada goose fecal material. This material contributes adversely to lake water quality and is not aesthetically pleasing to park patrons.

Viking Lake (Montgomery County)

Viking Lake is a 137-acre man-make lake, located within a 1,000-acre state park. Initially impounded in 1957 it has historically been an above-average fishery, however with the introduction of yellow bass approximately 10 years ago, the fishery has dramatically declined. Water quality at the lake has always been average, however following periods of heavy rainfall turbid water conditions could persist for up to two weeks, persistent algal have also been an issue at the lake. A watershed coordinator through the 319 program has been identifying corrective measures within the watershed. A WIRB (Watershed Improvement Review Board) grant will address water quality issues at Viking Village (a small home development adjacent to state property within the lake's watershed).

Staff identified twenty-two (22) areas near the lake, on or including portions of state property, as needing grade stabilization structures to control soil erosion and improve water quality. Construction of twenty sediment structures is complete. Construction of the two remaining structures is on hold due to stalled negotiations with the Burlington Northern Railroad for securing construction easements. IDNR did drain the lake after Labor Day (2006) and renovated

the fishery to eliminate the problem yellow bass population. In addition, after lowering the lake, they repaired the dam gate, protected the shoreline, constructed jetties, deepened shoreline, and improved angler access and fish habitat.

Agencies & stakeholders that are working together include IIDNR (fisheries, parks, & engineering), NRCS, IDALS, and private landowners.

Related Project Summaries

Other Priority Lakes

FY08 funds were budgeted for lake and watershed improvements in six (6) other priority lakes. State and federal funding sources; including IDNR Section 319 Nonpoint Source Pollution Control, IDALS/DSC Water Protection Fund, Watershed Protection Fund and WIRB Grant support watershed work for a number of lake restoration projects . Work ranged from completing diagnostic-feasibility studies to designing and constructing watershed structures to stabilizing lake shorelines and installing fish habitat.

Shallow Lakes Management Initiative

Ducks Unlimited and the Iowa IDNR's Wildlife and Fisheries Bureaus established a prioritized list of at least 50 shallow lakes for renovation over the next ten years. The first lake listed for renovation is Diamond Lake in Dickinson County, with work beginning during the summer of 2006. In 2007, IDNR started renovations at Dan Green Slough in Clay Co. and Four-Mile Lake in Emmet Co. They also purchased a twelve inch portable pump and trailer to assist in lowering water levels at these and future shallow lake restoration projects. Ducks Unlimited has successfully utilized these pumping systems in the Dakotas and Minnesota where additional drainage options are required. They provided specifications for the equipment to the IDNR and based on those recommendations the IDNR purchased a system for $76,003.

The following excerpt from the 2006 Annual Report for Natural Lakes, provided by Joe Larscheid, IDNR Fisheries Biologist, describes the basis and objectives for the IDNR's Shallow Lakes Management Initiative.

"Shallow lake management has always been a challenge in Iowa and around the world. Shallow lakes are scattered throughout Northwest Iowa and, in most of these lakes water quality lakes is less than desired. In fact, most of these lakes are turbid, algae-dominated systems with little to no vegetation, and poor sport fisheries comprised mostly of common carp (Cyprinus carpio), and black bullheads (*Ameiurus melas*). Lake restorations have historically focused on reducing nutrient inputs by repairing the watershed, or removing phosphorus -laden sediments from the lake. While these methods have worked well in deeper lakes, generally this approach has not been successful in shallow lakes.

Shallow lakes differ substantially from deeper lakes in many respects (Scheffer 1998). Shallow lakes usually exist in either of two alternative stable trophic states with or without any change in the nutrient budget of the lake (Scheffer et al., 1993, Moss et al., 1996). These lakes can exist as a very turbid, algae-dominated system with little to no vegetation, or as clear water,

macrophyte dominated system. In shallow lakes, the benthivorous and planktivorous fishes along with wind and wave action and in some cases heavy boating traffic can perpetuate the algae dominated system.

By controlling or removing the factors perpetuating the algae dominated turbid system it is possible to "flip" the system into a clear water macrophyte dominated system (Scheffer, 1993). The positive impacts of emergent and submergent vegetation on water quality are due to several factors. Rooted vegetation prevents resuspension of sediments into the water column by solidifying bottom sediments and suppressing wind and wave action. Rooted plants provide habitat for periphyton and zooplankton and fish species commonly found in clear water lakes. Rooted vegetation also ties up nutrients making them unavailable for algae. Some plants also release allelopathic substances into the water suppressing algae growth. Many of these mechanisms are difficult to assess and vary among water bodies. However, their combined effect stabilizes the clear water trophic state (Scheffer et al., 1993). Both the clear water macrophyte state and the algae dominated state are stable, and it takes a major perturbation to move from one state to another (Scheffer et al., 1993). Three methods that show great promise to cause the shift from the turbid to the clear water state are benthivorous fish control, heavy piscivore stockings (to control both benthivorous and planktivorous fishes), and water level draw downs (Scheffer et al., 1993).

The goal of this project is to develop tools that managers can use to shift and maintain shallow lakes in a clear water state.

Project Objectives:

- ***Shallow lake renovation based on alternative stable trophic states.*** By the year 2007, develop management guidelines to cause shallow lakes to shift from the turbid, algae -dominated systems to the clear, macrophyte-dominated systems.
- ***Physical characteristics of shallow lakes before and after restoration*** Describe, by the year 2007, the watershed, bathymetry, sediment profile, and water chemistry of several shallow lakes.
- ***Biological characteristics of shallow lakes before and after restoration*** Describe, by the year 2007, the plankton, macrophyte, fish community and waterfowl use of several shallow lakes assessed and relate changes to biomanipulation of benthivorous fishes."

Related Monitoring and Assessment

Ambient Monitoring

The Iowa Lakes Survey project (2000-2005) conducted by the Iowa State University (ISU) Limnology Laboratory has provided invaluable water quality data and other information from among 132 Significant Publicly-Owned Lakes (SPOL) in Iowa. Sampling data and other summarized information about survey lakes are available on the internet at http://limnology.eeob.iastate.edu/lakereport/. Beginning in 2006, ISU Limnology Laboratory and the University Hygienic Laboratory (UHL) continued ambient lake monitoring of the 132 survey as part of their respective annual monitoring agreements with IDNR. Funding support for ambient lake monitoring comes from the IDNR Water Monitoring Program through annual appropriations of the State's Infrastructure Environment First Fund. In addition starting in 2006,

IDNR expanded the list of lakes sampled to include 34 lakes that fall outside of the classification of SPOL, but are still a valuable resource for the state.

Ambient lake monitoring data provide the basis for evaluating status and trends in lake water quality and assessing compliance with water quality standards protecting designated beneficial uses. For example, development of a lake classification system used the 2000-2005 lake survey as the basis to prioritize lakes for restoration. Looking ahead, the data will be invaluable as an historical record of water quality to measure progress in water quality improvement.

Field crews monitor the lakes for basic water chemistry, nutrients, chlorophyll, phytoplankton and zooplankton at least three times during the spring and summer. Additionally, researchers construct a temperature profile for each lake to determine the thermocline and the oxygen content along the temperature profile. Past lake monitoring also includes testing for common herbicides, insecticides and metals in both the water and lake sediments. Sampling of lake water quality was coordinated with and augmented by the collection of fish data.

Beach Monitoring and Safe Lakes Initiative

The Iowa Department of Natural Resources (IDNR) has conducted bacterial monitoring at Iowa's state owned beaches since the IDNR's Ambient Water Monitoring Program's inception in 2000. Over the first seven years of monitoring, the IDNR has noticed different patterns emerge in the bacterial occurrences at beaches.

Bacterial monitoring at swimming beaches of 37 Iowa lakes during the summer recreational period in calendar years 2002 through 2007 found the majority of Iowa's state owned lakes have a low incidence of violations of either the one-time maximum or the geometric mean bacterial standards at their beach. 27 of these lakes violate the geometric mean standard less than two years out of five. The remaining 10 lakes meet the requirements for the Iowa's ***"Vulnerable Beach"*** list. In order to meet these requirements, a beach must have exceeded the state geometric mean bacterial standard for *E. coli* in more than two years out of a running five years.

The lakes with vulnerable beaches currently eligible for special monitoring consideration include (members of the lake restoration priority list are underlined)

Backbone (Delaware), Beeds Lake (Franklin), Clear Lake (Cerro Gordo), West Okoboji - Emerson Bay (Dickinson), George Wyth (Black Hawk), Lake Darling (Washington), Lake of Three Fires (Taylor), Lower Pine Lake (Hardin), Nine Eagles (Decatur), and Rock Creek (Jasper).

Although the IDNR has monitored and identified bacteria for all of these lakes, these efforts have only been partially successful in determining the bacterial sources responsible for the standards violations. Sources known or suspected of playing a role in these violations include; wildlife, septic system discharges, runoff from livestock pastures, manure application fields, livestock with direct access to streams and gullies, wastewater discharges from IDNR park facilities, wastewater discharges from residential developments on or near the lakes, and humans and pets using the lakes for recreational purposes. The goal is to directly address the bacterial problems of each lake and significantly reduce the frequency of bacterial violations.

The ***Safe Lakes Initiative*** coordinated by the IDNR Watershed Monitoring and Assessment Section through funding from EPA 319 and the State Revolving Fund is an organized attempt to address these problems. The activities of this project are divided into three major categories: 1) identification of bacterial sources, 2) development of pollutant reduction strategies for each bacterial source, and 3) implementation of the developed pollutant reduction strategies for each lake.

Bacterial Source Identification

For each lake, an intensive effort to identify the contributing bacterial sources has been ongoing since 2006. As part of this effort, a comprehensive watershed assessment was completed to identify and evaluate potential contributions from such sources as open feedlots, manure application fields, septic system or other wastewater discharges from rural residences or residential developments, livestock pastures (including livestock with direct access to streams), and wildlife. Based on the results of this assessment, the IDNR will conduct additional monitoring or other studies, as necessary, to define the magnitude of the bacterial contribution from identified watershed sources.

Development of Pollutant Reduction Strategies

For each identified potential bacterial source and each lake, a pollutant reduction strategy is being developed. In developing this strategy, we will consider both current approaches and new strategies that may be more effective in dealing with the problem.

Plan Implementation

In 2008, IDNR will attempt to implement the developed bacterial reduction plan for each lake. Specific activities may vary between lakes, and therefore the implementation efforts may differ. For some lakes, it may be possible for IDNR to carry out the bulk of the efforts internally. Some projects will require participation by outside parties, including; individual landowners, county supervisors or boards of health, the Division of Soil Conservation/IDALS, USDA's Natural Resources Conservation Service or Farm Services Agency, and lake preservation associations.

IDNR Fisheries / IOWATER Lakes Monitoring

This project provides flexibility to tailor sampling to individual lake needs and is able to supplement existing lake data by adding water quality information for sites or times of the year not sampled by the ambient program. Sample analyses are a combination of field tests used in the IOWATER volunteer monitoring program and laboratory analysis of chemical parameters done by the University Hygienic Laboratory.

IDNR staff selected and sampled for 13 water quality parameters in 35 lakes in 2006. They sampled a number of lakes that are restoration priorities or included in the shallow lake management project; including, Brushy Creek Lake; Clear Lake/Ventura Marsh (shallow); Diamond Lake (shallow); Lake Darling; and Lake Geode.

They may also sample above lakes for Microcystin if they demonstrate that cyanotoxins were a concern during previous screening projects. Microcystin is a natural toxin produced by a type of blue-green algae (cyanobacteria). At elevated levels, Mycrocystin and other cyanotoxins may

represent a health threat to animals and humans. For this reason, IDNR plans to continue investigation of Cyanotoxin occurrence and factors leading to levels of concern in Iowa and elsewhere.

Shallow Lakes Monitoring

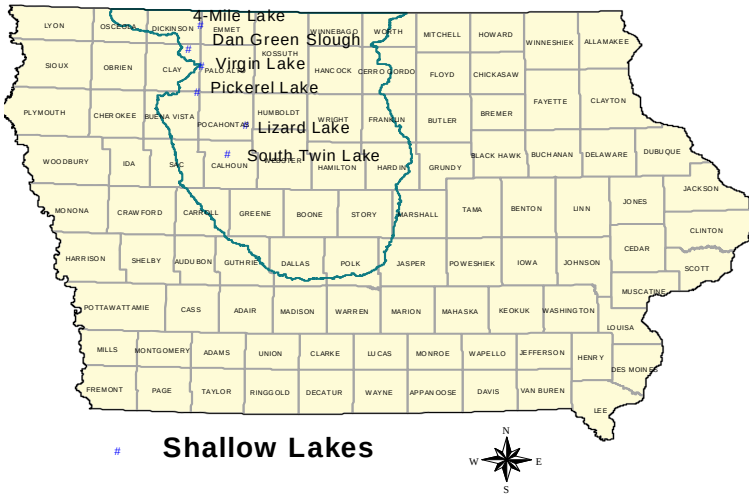
FY07-08 Lake Restoration Funds supports monitoring in seven shallow lakes in north central Iowa. The sampling will document the biological, physical habitat and water quality characteristics of these lakes before, during and after renovation work. To date, pre-renovation data exists for 2006 and 2007 sampling seasons. This data is available to assist resource managers as needed. However, this monitoring data is most useful in comparison with post-restoration data.

Below is an excerpt from the monitoring work plan (Evelsizer and Fisher, IDNR Watershed Monitoring and Assessment Section, May 2006).

PROJECT OVERVIEW

In the spring of 2006, the Iowa IDNR's Wildlife and Fisheries Bureaus and Ducks Unlimited formed an agreement as part of a Shallow Lakes Initiative Project to renovate several ecologically degraded shallow lakes across northwest Iowa. The overall goal of this agreement is to use tools developed by managers to shift and maintain shallow lakes from an ecologically degraded system to a clear water state that supports desirable fish populations, abundant aquatic plants, invertebrates, and thus increased use by waterfowl. This agreement also represents a unique opportunity to improve an already existing resource for multiple benefits, which includes water quality, conservation of wildlife and fish and higher quality recreational uses for the public.

Locations of Six Shallow Lakes to be Monitored in 2006



The Iowa IDNR's Watershed Monitoring and Assessment Section performed wetland assessments on permanent and semi-permanent wetlands throughout north-central Iowa in the summer 2007. Methods used to monitor the ecological condition of these wetlands were easily adapted for use on these shallow lake/permanent wetland environments. To assess the condition of these shallow lakes it will be important to collect information from all aspects of each of these systems. All partners of this agreement believe that the proposed methods for shallow lake monitoring should include basic physical/chemical analysis, analysis of nutrients and suspended solids and biological (fish, macrophyte and invertebrate communities) sampling.

Additional information about the sampling protocol:

Water Sampling
Sampling conducted at the deepest location of each lake's open water zone using a canoe or johnboat. For water sample collection, crews will gather water from the lake in a bucket following our standard collection protocol (UHL 1997a). The water from this sample will then be poured into appropriate bottles and labeled accordingly. Staff will place each bottle into a cooler with ice to avoid direct sunlight and cooled until delivery to UHL for analysis within their designated holding time.

Chemical Sampling
Chemical contaminant sampling will consist of using the water grab samples from the middle of the open water zone of each shallow lake as mentioned above. Staff will send collected water samples from these shallow lakes to UHL for nutrient, suspended solids, and chlorophyll analysis. Sampling for parameters takes place bi-monthly, from May through September.

Physical Component
Crews will collect standard physical data bi-monthly from the canoe/boat with a multi-parameter probe which measures dissolved oxygen concentrations, water temperature, conductivity and pH. In addition, crews will record turbidity and secchi depth. The surrounding land use composition of each lake's watershed will be analyzed as well using available GIS coverages. Additional GIS coverages that display public drainage tile lines, drainage ditches, bathymetric features and other important factors will also be used. These procedures will allow managers to pinpoint potential sources of nutrient and sediment.

Biological Component
Sampling biological communities is an important aspect of shallow lake manipulations. In order to quantify such changes careful biological sampling must occur.

Aquatic Plants - An aquatic plant survey once at each lake in late-July – early August. Sampling should coincide with the peak growth period to ensure the maximum overlap of species. Sampling methods were adapted from the USFWS Upper Mississippi Refuge Vegetation Survey, using a modification of the point transect method for site selection.

Birds – Avian surveys twice per site annually. The first survey will occur in the spring. Guy Zenner (state waterfowl biologist) has agreed to include these shallow lake sites in their annual spring waterfowl migration surveys. Methods for this survey will require crews to identify and tally all water-bird species found on or near the site. IDNR wildlife personnel and/or birding volunteers as organized by the wildlife managers at Spirit Lake will conduct similar migratory counts on a weekly basis throughout the fall (mid-Sept. – mid-Nov.) by. During the summer months, IDNR personnel in the WMAS section will record water-bird species while monitoring each of these sites from mid summer through September.

Fish - Fish will be sampled using regular fyke nets (for large fish) and “mini-fyke nets” (for small minnow sized fish). Fish sampling will take place once per lake and match the standard operating methods used by the fisheries bureau

Invertebrates – Beginning in 2007, invertebrate populations were collected within each lake once during the summer. In future years, invertebrate sampling will occur twice per year (late April/early May and again in late July/early August). The first invertebrate survey should coincide with the annual spring migration of waterfowl specifically that of diving ducks such as Lesser Scaup.

Plankton – Both zooplankton and phytoplankton samples will be collected once per month. Both of these communities are an important component of the lower end of the trophic structure of each shallow lake. Because plankton biomass tends to fluctuate throughout the open water season, we feel it is necessary to sample once per month to capture any temporal changes that may occur.

Related Activities and Studies

Aquatic Vegetation BMPs

We are halfway through the IDNR’s three-year cooperative study with Iowa State University to develop both short- and long-term strategies needed to address the impact of aquatic plants on fish, fishing and other lake uses. The goal of this study is to develop lake-by-lake management plans that strike a balance between clear water, plant growth and lake use. Although aquatic plants are an essential component of lake ecosystems, the combination of clear and nutrient-rich water can result in excessive growths of vegetation, especially in shallow water near shore. These same, near shore areas are also the portions of our lakes most used by the public. Information gained in this study will result in a detailed knowledge of the relationships between water quality, lake basin characteristics, fish and plants. This information will greatly benefit assessment of aquatic plant communities and methods used to control nuisance growths. The result will be implementation of those practices most suited to management of plants in Iowa’s valuable and heavily used lakes.

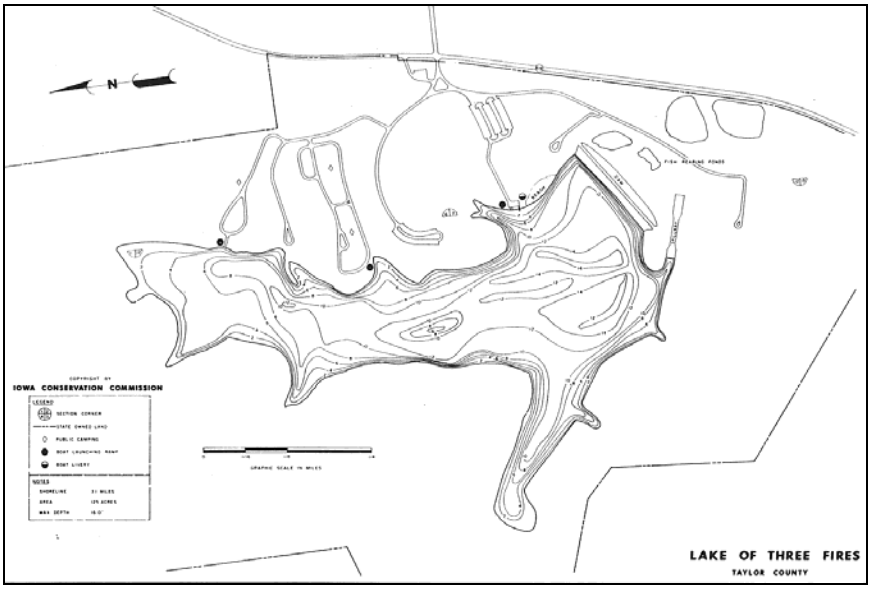
Previous studies have shown restoration that includes limited growths of aquatic plants can result in a healthier aquatic community and greater public use. Lake of Three Fires, a recent lake restoration project nearing completion, is a case in point. Lotus choked the shallow areas prior to dredging. Lotus colonies can expand rapidly, produce a canopy above the water and reduce use in large areas. In fall 2006, IDNR started a project to replace lotus with water lilies. Anglers and other lake users can travel in areas around lilies and their pink or white flowers are aesthetically pleasing. Introduction of aquatic plants to lakes is dependent on propagation

techniques and the nursery stock the IDNR is developing with the assistance of the Missouri Department of Conservation.

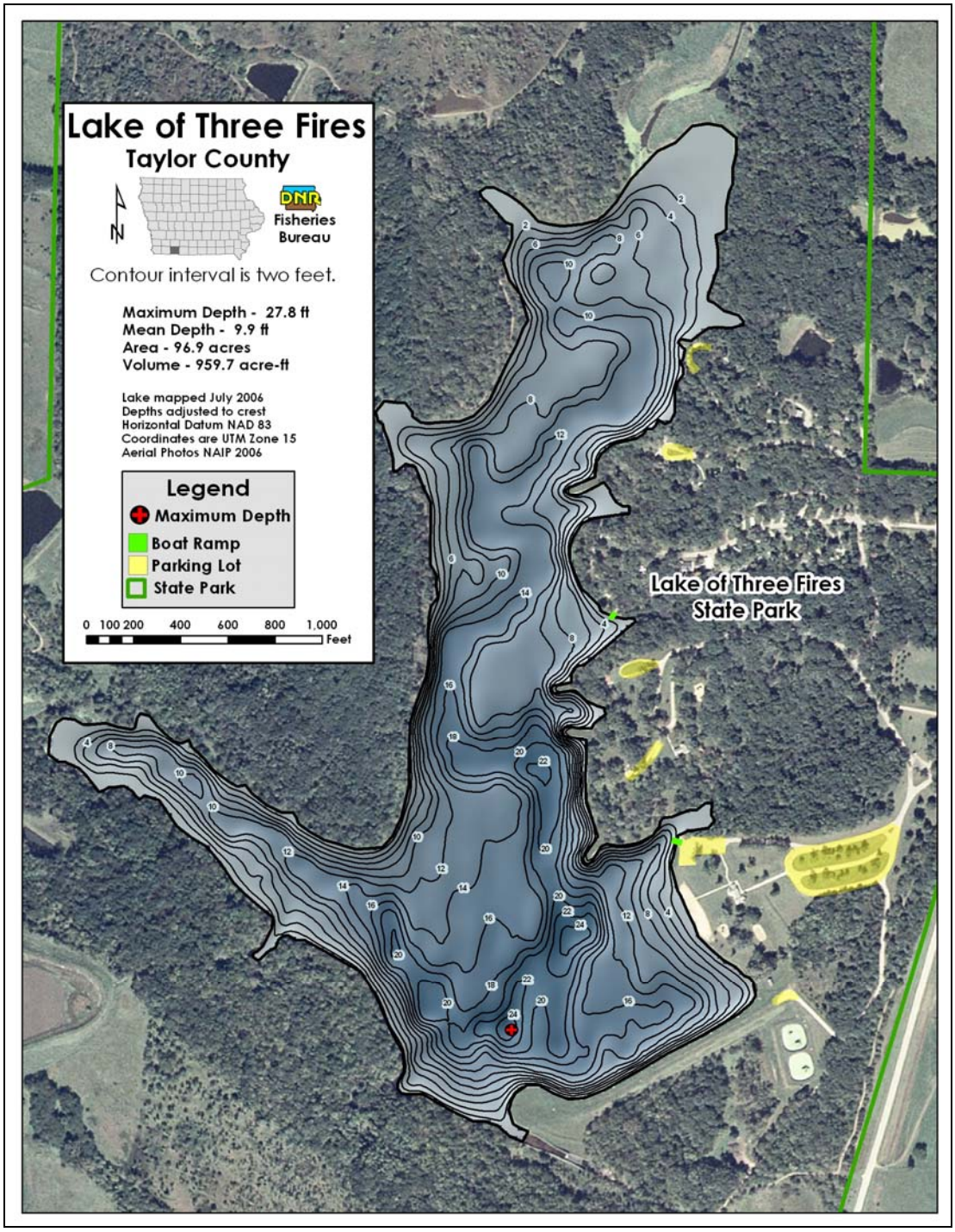
Best management practices will include techniques that will prevent nuisance growths of vegetation in high-use areas. Assessed techniques include managing water-level fluctuations and deepening shallow water in high use areas such as boat docks, beaches and fishing access. These management practices, combined with prudent use of approve herbicides show great promise in management of lakes for optimum biological diversity and public use. Biological control is another alternative, though past experiences has shown it often produces undesirable "all-or-nothing control" and limited focus to problem areas. Obviously, the goal will be a clear lake that supports a diverse community of desirable native plants. With likely project success through lake-by-lake management plans that focus on a combination of control of nuisance plant species, introduction of desirable plants and education of the public relative the importance of plant in a healthy lake. In summary, this information is critical to the IDNR's efforts to restore lake water quality and maintain, even increase, the public's use of lakes.

Statewide Bathymetric Lake Mapping

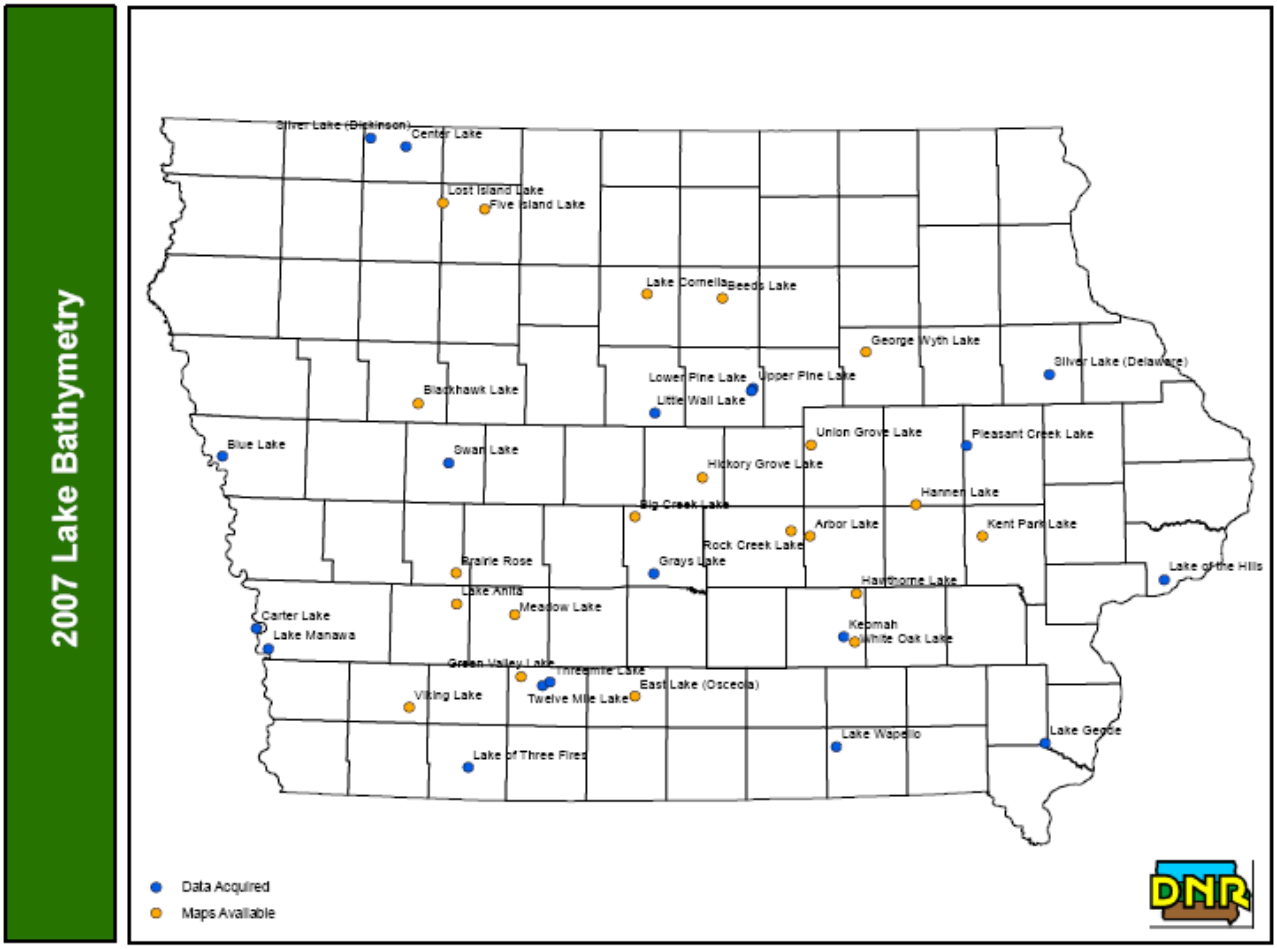
The last major effort to map Iowa's lakes began in the early 1970's. Managers relied upon these early contour (bathymetric) maps to guide restoration efforts, calculate water volumes and basin characteristics, and assist recreational users. Lakes go through many changes during their lifespan, and over the past 30 years silt deposition has profoundly changed many lakes in Iowa. Older maps, in many cases, have simply become obsolete. Additionally, many of Iowa's new lakes are not mapped.



Since the 1970's, there have been significant technological advances leading to improvements in map accuracy and utility. Our current mapping efforts are utilizing state-of-the-art electronics and map generating software. This effort, including maps and underlying data, provides a fundamental data layer needed by communities and resource professionals to make important lake management decisions.



The Iowa Statewide Lake Mapping Project designs maps around a standard set of methods developed over the past two years. Data acquisition began in 2006, with 31 lakes being mapped. IDNR acquired data for 12 lakes in 2007, and plan for a full schedule for 2008. Maps are currently in final review for 31 lakes and they are scheduled for release to the public this winter.



Combining shading models, aerial photography, the DTM, and contour lines creates one final product, the contour map. Public amenities, such as boat ramps, parking areas, and park and public land boundaries are added and labeled. Mappers add a legend before sending the map to lake managers for edits and comments. Finally, the lake map is ready for public use and distribution to field offices and websites. The combination of new data with aerial photography provides the public with an improved product.

In addition to a better visual product, the data will have additional uses in research and will benefit the Lake Restoration Program. The new lake data and maps will also become a very accurate and useful historical record for future lake management. In many cases, comparison of as-built contours to present day bathymetry can provide information of historical sedimentation rates and identify the regions most affected by sedimentation. In addition, they will allow for a current baseline to any proposed dredging activities.

Biological Integrity

Beginning in 2006, Iowa State University Limnology expanded biological monitoring to collect bottom-dwelling invertebrates that represent an important link in the food web of lake ecosystems. They will use this data to develop a lake biological quality index based on species diversity and abundances. The index will complement existing water quality indicators of lake health and provide another tool to measure progress toward lake restoration goals.

In addition, ISU will incorporate this information into the recently, fall of 2007, NRC approved five-year project entitled "Benchmarks of biological integrity for lake restoration success: fish, invertebrate, and plankton communities in Iowa lakes". The purpose of this project is to provide the IDNR with an evaluation of protocols for assessing the biological integrity of fish and macroinvetebrates in Iowa lakes, to develop standard sampling protocols for these organisms, to execute this sampling design on lakes identified as priorities for restoration and protection, and to assemble and calibrate biological condition metrics and indices to use in developing benchmarks for restoration success.

Fisheries and Lake Water Quality Relationships

Fisheries researchers at Iowa State University are conducting a study titled; "Assessment of the Interrelationships between the Fisheries Community and Limnological Characteristics of Iowa Lakes" is linking lake water quality and fisheries quality. The research will contribute to knowledge and tools that are useful to lake restoration efforts.

Zachary Jackson's (MS thesis) recently completed the study and submitted a final report. The purpose of the study was to describe fish population and assemblage structure among lakes, and determine relationships between fish, limnological conditions, lake basin morphology, and watershed characteristics in Iowa lakes. This information is necessary to understand relations between fish assemblage characteristics and water quality, a relationship important to the protection and improvement of Iowa's lake resources. Researchers used fisheries data collected from 129 Iowa lakes during 2001-2006. Lakes included in the study correspond to those sampled as part of the Iowa Lakes Survey administered by Dr. John Downing at Iowa State University.

A variety of summary statistics (e.g., mean, variance, quartiles) were calculated for each species to provide an overall description of fish populations and assemblages in lakes. Specifically, summary statistics focused on relative abundance estimates [i.e., catch-per-unit-effort (CPUE)]; size structure [e.g., proportional stock density (PSD), relative stock densities (RSDs)], and condition [i.e., relative weight (*Wr*)] of each species. Multiple regression analysis was then conducted to evaluate how fish population dynamics were related to limnological and watershed characteristics.

Results of the study suggested that high water transparency resulted in high relative abundance, good condition, and fast growth of sport fishes in Iowa lakes. Catch rates of bluegill *Lepomis macrochirus*, black crappie *Pomoxis nigromaculatus*, and largemouth bass *Micropterus salmoides* were generally low when omnivores (e.g., black bullhead *Ameiurus melas*, common carp *Cyprinus carpio*) were present. Body condition of the study species was highest in highly productive lakes (i.e., high nutrient or chlorophyll *a* concentrations) with clear water. We also found evidence that reductions of the abundance of black bullhead and common carp may

benefit sport fishes in many systems and that activities resulting in increased densities of bluegill, largemouth bass, and black crappie will negatively influence condition and growth of these species. Fish population dynamics were more closely related to biotic and limnological conditions compared to measures of lake basin morphology and watershed characteristics, but many of the observed patterns are likely mediated by land use activities. Although several patterns were observed in the data, additional research is need to provide a better understanding of how fish are related to water quality in Iowa lakes.

Iowa Lakes Valuation Project

[The information presented below was provided as part of working agreements between the IIDNR and the Iowa State University, Department of Economics, Center for Agricultural and Rural Development.]

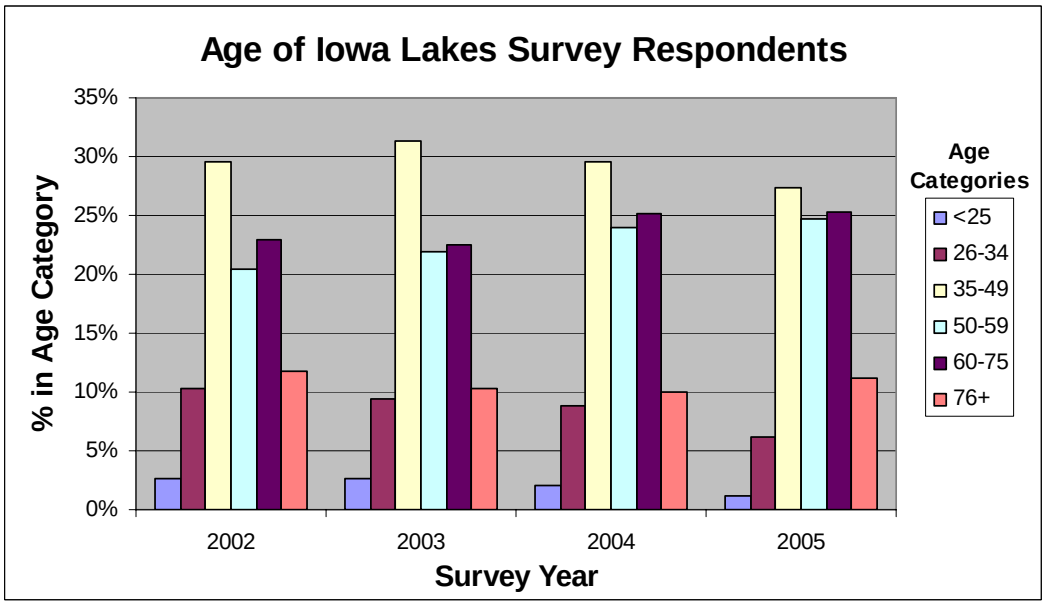
Iowa's natural resource base supports a highly productive agricultural system as well as an increasingly important outdoor recreation industry. A number of trends are likely to affect how Iowa's natural resource base will continue to meet those two interests. An increasingly urban population base in Iowa expects the state to maintain the quality and quantity of outdoor environment and recreational resources. National competition for quality jobs and the workers to fill those positions means that Iowa also needs to have competitive recreation opportunities and natural resource amenities. Iowa's efforts to participate in new economic development growth will require maintaining existing quality and making new recreation opportunities available.

The rapid growth of the corn-based ethanol industry and growing interest in other bio-fuels production is challenging Iowa's agricultural producing capacity and creating strong incentives to bring more acres into production. As Iowa's production agriculture responds to the new bio-based opportunities, it is important that producers operate in a way that does not displace or degrade the quality of recreational opportunities.

How are Iowans visiting their lakes?

The lakes of Iowa are a popular destination for single and multiple day recreation trips among Iowans. In 2002, approximately 62% of Iowans visited a lake in Iowa at least once, with an average of about eight unique visits a year per resident. Yet, while the frequency of visiting lakes by Iowans is significant, usage does vary across different groups. For example, by age, the CARD collected the following information:

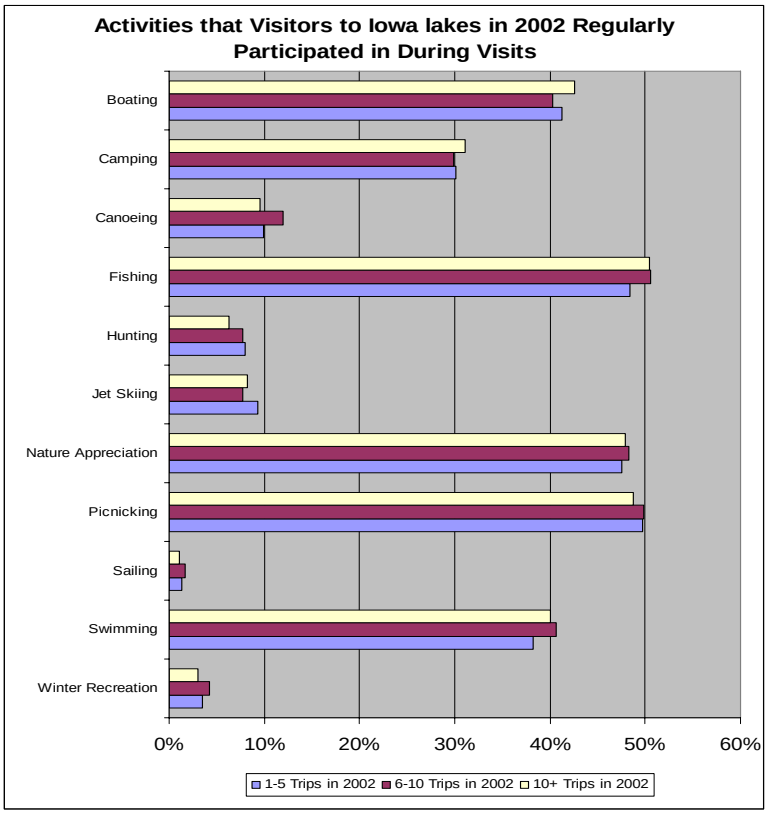
- The most common age group of respondents to the Iowa lakes survey was individuals of ages between 35 and 49.
- Individuals under the age of 25 have the highest percentage of visits 10 or more visits to Iowa lakes. The percentage of individuals who visited lakes 10 or more times is decreasing in age.
- Individuals over the age of 76 have the highest percentage of 0 visits to Iowa lakes. The percentage of individuals who visited lakes 0 times is increasing in age.
- Overall, a large percentage of individuals in each age group visited lakes in Iowa at least once during the year, but individuals under the age of 60 more frequently visit Iowa lakes.



What activities do visitors to Iowa lakes enjoy?

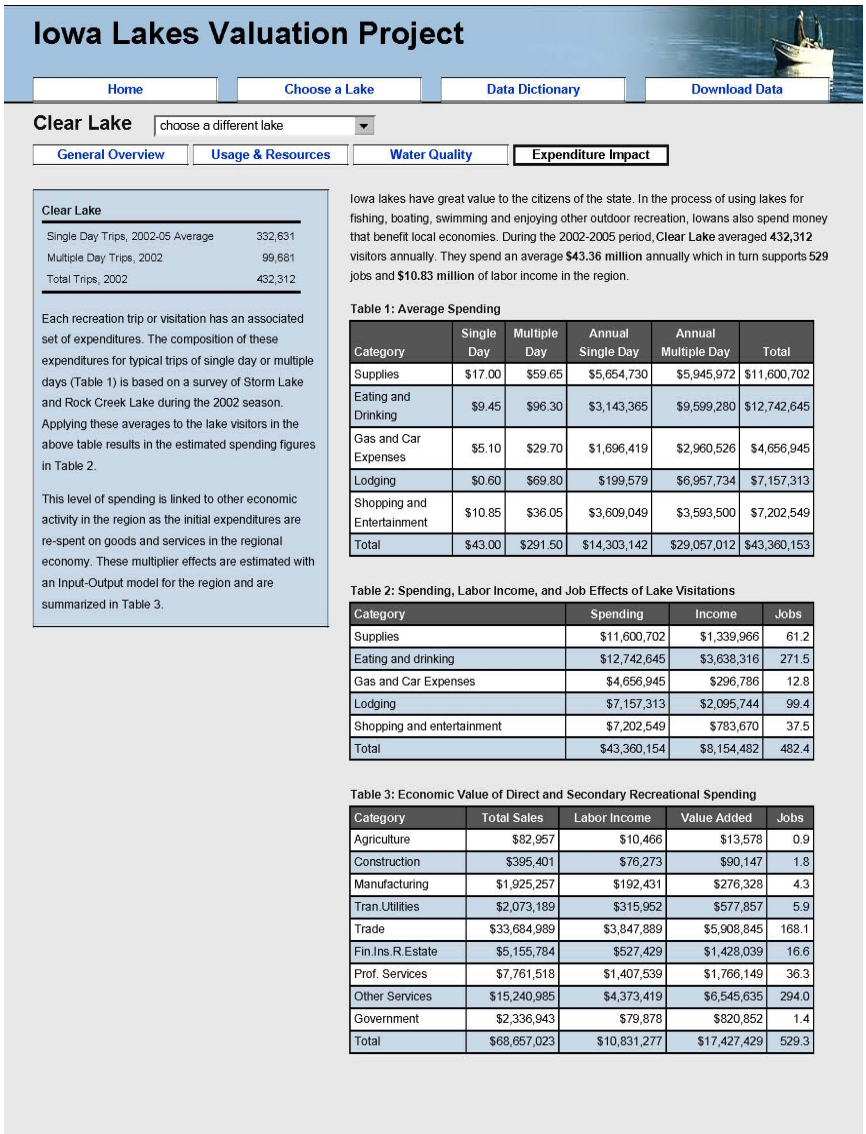
Iowans engage in a number of different activities at lakes in Iowa. The following chart summarizes what activities visitors to Iowa lakes in 2002 regularly engaged in during their visits. For each recreational activity, the table presents percentages broken down by the total number of visits during the year.

The data collected through the Iowa lakes survey shows that the most popular activities at Iowa lakes are fishing, picnicking, nature appreciation, boating, and swimming. The least common activities are sailing and winter recreation (e.g. snowmobiling). As well, the data shows that individuals who visit lakes many times during the year (10 or more visits) typically participate in the same activities as individuals who do not visit Iowa lakes as often (1-5 visits).



Economic Impact

Iowa lakes have great value to the citizens of the state. In the process of using lakes for fishing, boating, swimming and enjoying other outdoor recreation, Iowans also spend money that benefit local economies. Each recreation trip or visitation has an associated set of expenditures. A survey of Storm Lake and Rock Creek Lake, during the 2002 season, is the basis for average of expenditures for typical trips. Researchers applied these averages to the number of lake visits at each priority lake to estimated spending and job creation. For example, during the 2002-2005 period Clear Lake averaged 432,312 visitors annually. They spent an average of $43.36 million annually, which in turn supported 529 jobs and $10.83 million of labor income in the region. It is important to note that these economic impacts are based solely on spending by Iowans. Out of state visitors provide an additional revenue source. They estimated that the 35 priority lakes generate $277 million annually to the economy and that statewide visitation to the 132 Significant Publicly-Owned Lakes generates $977 million in spending.



Iowa Lakes Valuation Project

Home | Choose a Lake | Data Dictionary | Download Data

Clear Lake choose a different lake

General Overview | Usage & Resources | Water Quality | Expenditure Impact

Clear Lake	
Single Day Trips, 2002-05 Average	332,631
Multiple Day Trips, 2002	99,681
Total Trips, 2002	432,312

Each recreation trip or visitation has an associated set of expenditures. The composition of these expenditures for typical trips of single day or multiple days (Table 1) is based on a survey of Storm Lake and Rock Creek Lake during the 2002 season. Applying these averages to the lake visitors in the above table results in the estimated spending figures in Table 2.

This level of spending is linked to other economic activity in the region as the initial expenditures are re-spent on goods and services in the regional economy. These multiplier effects are estimated with an Input-Output model for the region and are summarized in Table 3.

Iowa lakes have great value to the citizens of the state. In the process of using lakes for fishing, boating, swimming and enjoying other outdoor recreation, Iowans also spend money that benefit local economies. During the 2002-2005 period, **Clear Lake** averaged **432,312** visitors annually. They spend an average **$43.36 million** annually which in turn supports **529** jobs and **$10.83 million** of labor income in the region.

Table 1: Average Spending

Category	Single Day	Multiple Day	Annual Single Day	Annual Multiple Day	Total
Supplies	$17.00	$59.65	$5,654,730	$5,945,972	$11,600,702
Eating and Drinking	$9.45	$96.30	$3,143,365	$9,599,280	$12,742,645
Gas and Car Expenses	$5.10	$29.70	$1,696,419	$2,960,526	$4,656,945
Lodging	$0.60	$69.80	$199,579	$6,957,734	$7,157,313
Shopping and Entertainment	$10.85	$36.05	$3,609,049	$3,593,500	$7,202,549
Total	$43.00	$291.50	$14,303,142	$29,057,012	$43,360,153

Table 2: Spending, Labor Income, and Job Effects of Lake Visitations

Category	Spending	Income	Jobs
Supplies	$11,600,702	$1,339,966	61.2
Eating and drinking	$12,742,645	$3,638,316	271.5
Gas and Car Expenses	$4,656,945	$296,786	12.8
Lodging	$7,157,313	$2,095,744	99.4
Shopping and entertainment	$7,202,549	$783,670	37.5
Total	$43,360,154	$8,154,482	482.4

Table 3: Economic Value of Direct and Secondary Recreational Spending

Category	Total Sales	Labor Income	Value Added	Jobs
Agriculture	$82,957	$10,466	$13,578	0.9
Construction	$395,401	$76,273	$90,147	1.8
Manufacturing	$1,925,257	$192,431	$276,328	4.3
Tran.Utilities	$2,073,189	$315,952	$577,857	5.9
Trade	$33,684,989	$3,847,889	$5,908,845	168.1
Fin.Ins.R.Estate	$5,155,784	$527,429	$1,428,039	16.6
Prof. Services	$7,761,518	$1,407,539	$1,766,149	36.3
Other Services	$15,240,985	$4,373,419	$6,545,635	294.0
Government	$2,336,943	$79,878	$820,852	1.4
Total	$68,657,023	$10,831,277	$17,427,429	529.3

Source: http://www.card.iastate.edu/lakes_demo/lake_economic.aspx?id=21

Average annually spending, number of job supported, and resulting labor income from 2002 to 2005. These values were estimated from the number of annual visitors at each lake.

Lake	Annual Trips	Annual Spending	Jobs	Labor Income
Arbor Lake	30,264	$3,446,395	247	$3,326,078
Beeds Lake	80,234	$4,843,162	62	$949,794
Big Creek Lake	352,681	$19,086,870	233	$4,767,861
Black Hawk Lake	146,043	$19,045,791	1,367	$18,380,882
Blue Lake	50,999	$3,622,578	47	$710,425
Brushy Creek Lake	144,908	$8,057,768	578	$7,776,462
Carter Lake	47,754	$2,507,166	31	$626,285
Central Park Lake	58,145	$5,757,582	413	$5,556,578
Clear Lake	432,312	$43,360,153	529	$10,831,277
DeSoto Bend Lake	53,558	$2,711,288	195	$2,616,634
Diamond Lake	44,397	$3,724,612	267	$3,594,582
Don Williams Lake	85,896	$8,255,225	592	$7,967,026
Easter Lake	116,448	$5,687,923	69	$1,420,831
Green Valley Lake	69,852	$6,105,927	438	$5,892,763
Hannen Lake	75,583	$10,411,608	747	$10,048,127
Hickory Grove Lake	71,123	$6,462,499	79	$1,614,319
Kent Park Lake	90,655	$6,008,667	73	$1,500,953
Lake Ahquabi	120,022	$8,633,254	619	$8,331,857
Lake Anita	58,602	$5,143,309	369	$4,963,751
Lake Darling	72,136	$4,653,988	334	$4,491,512
Lake Geode	99,702	$7,350,925	527	$7,094,297
Lake Keomah	49,526	$3,286,900	236	$3,172,150
Lake MacBride	248,051	$17,841,870	218	$4,456,863
Lake Manawa	135,829	$7,814,997	95	$1,952,170
Lake of the Hills	85,781	$8,739,106	107	$2,183,011
Little Wall Lake	56,921	$4,081,499	293	$3,939,010
Prairie Rose Lake	47,681	$3,373,066	242	$3,255,308
Red Haw Lake	38,817	$2,349,755	30	$460,811
Rock Creek Lake	80,301	$6,881,498	494	$6,641,257
Springbrook Lake	60,765	$5,960,936	428	$5,752,833
Storm Lake (incl Little Storm Lake)	167,965	$10,139,902	728	$9,785,907
Three Mile Lake	116,531	$13,000,845	933	$12,546,971
Union Grove Lake	37,122	$1,596,263	115	$1,540,536
Upper Pine Lake	64,530	$4,363,185	313	$4,210,861
Viking Lake	44,882	$2,678,639	192	$2,585,125
Total 35 Priority Lakes	3,536,018	**$276,985,148**	12,241	$174,945,107
Total all 132 SPO Lakes		**$977,000,000**		

Value of Restoration Cost/Benefit Analysis

Economic impact analysis provides information on the direct and indirect economic activity that visitors to the lakes bring to the nearby towns and regions and predicts that improved water quality associated with lake restoration projects will increase visitation to a lake. Visitors bring with them purchasing power and spend money on goods and services at locations near the lake. Future economic impact analysis will quantify the magnitude of these effects by linking estimates of increased visitation from water quality improvements with spending patterns of visitors and the multiplier effects of that spending throughout the region. A web-accessible database provides the fundamental building blocks for future monitoring and assessment of water quality and socioeconomic responses.

http://www.card.iastate.edu/lakes_demo/

These analyses and data resources will provide interested parties (local citizen groups, chambers of commerce, economic development interests, and state legislators) valuable information on the likely increase in economic activity that would occur in and around the target lakes if water quality projects were undertaken at the lake that resulted in increased visitor days.

New investments, to improve the environment and add recreation opportunities in the state, generate economic impacts and benefits. Improving water quality can translate into enhanced recreation opportunities. The Iowa Lakes Valuation project identified that recreation benefits and water quality in the lake and watershed are significantly related. In addition, benefits can be substantially greater than costs of restoration. Expanded parks and facilities also demonstrate sizeable social benefits relative to costs.

Iowa State University is still conducting this inter-disciplinary study of the costs and benefits of improving water quality. The Lakes restoration and valuation project will use this information to address issues of what type and values of benefits would result from efforts to restore and improve water quality in Iowa's lakes.

LIDAR

LiDAR stands for "Light Detection and Ranging". It is a process of scanning the earth with lasers from an aircraft to obtain accurate elevations. LiDAR is similar to sonar (depth finder) in that it uses a time of travel method of measuring distance.

LiDAR is capable of providing accurate elevation data. The statewide project will generate elevation data that is within 8 inches of actual elevations (currently available statewide data has an accuracy of ± 5 feet).

LiDAR acquisition started in the fall of 2006. Collections also took place in the spring and fall of 2007. Equipment failures, spring flooding, and poor fall weather have hampered the rate of collection to date. Currently, the IDNR has acquired data on approximately 40% of the state and is processing QA/QC information with the USGS office in Rolla, MO. The IDNR anticipates the majority of the state will be collected by the end of the fall 2008 season. The state will use LiDAR data to develop elevation maps for all Iowa counties, and make these maps and aerial photography available for public use over the Internet.

The IDNR strongly believes LiDAR will provide tremendous environmental benefits to the state in terms of improved water quality modeling; conservation practice placement, design, and implementation; and flood plain delineations. Examples related to lake restoration include:

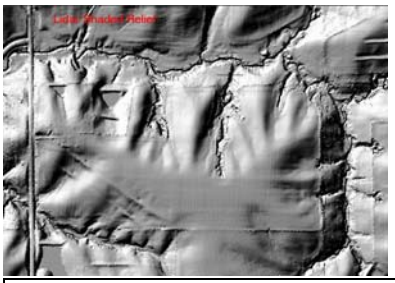
- Soil conservation structure (terraces, sediment ponds, etc.) planning and estimating
- Erosion potential measurements and modeling
- Watershed modeling
- Runoff modeling
- Conservation practice performance
- Watershed delineation

Currently, partnerships among IDOT, IIDNR, NRCS, and IDALS have committed the funds needed to acquire the LiDAR data ($4.3 million). They still need $2.8 million to complete the project.

The Lake Darling Watershed was part of a pilot project of LiDAR technology in Iowa. Below are several images that demonstrate the utility of LiDAR data.

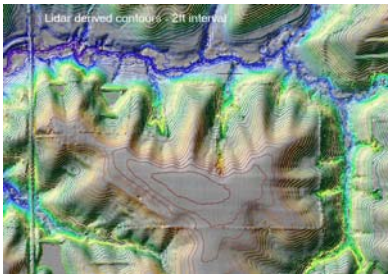
Four data samples for one area of the Lake Darling watershed.

Color infrared photography 2002



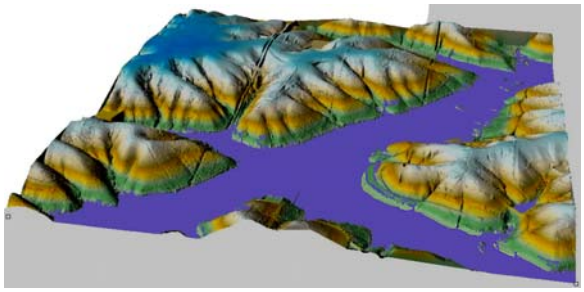
Shaded relief view with LiDAR *based elevation data*

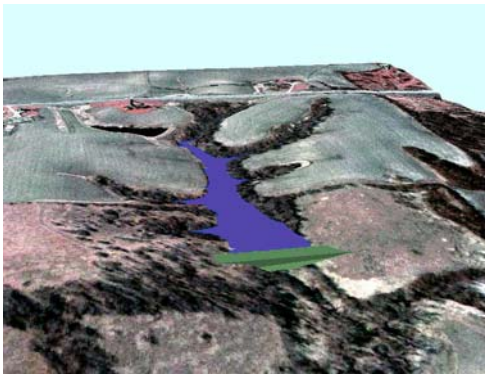
Shaded relief view with currently available elevation data

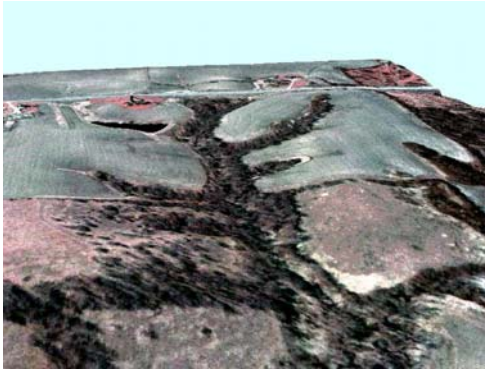


Contours (2-foot intervals) derived from LiDAR

Color-enhanced LiDAR view over Lake Darling, Washington County (above left). Elevation is exaggerated. Digital aerial photographs (below left) are draped over LiDAR elevation coverage of a gully in the Lake Darling watershed. A proposed dam, designed to stop sediment from moving to the lake, was incorporated into the third photo (right).







Watershed Assessment Improvements

A cooperative project involving the IDNR Section 319 Nonpoint Source Control Program, IDALS Division of Soil Conservation (DSC) and the Natural Resources Conservation Service (NRCS) initiated activities to improve watershed assessments for water quality projects. This interagency initiative is identifying ways to provide better technical assistance to project planners and coordinators. Varying types and levels of technical assistance may be provided through this initiative, including: access to watershed assessment experts, GIS mapping and analysis resources, use of tablet computers or PDA's for recording waterbody and watershed data, and technical consultation.

Two recent Geographic Information System (GIS) map coverages show promise of improving watershed assessment capabilities leading to better targeting of watershed practices and structures designed for lake water quality improvement and protection.

1. The National Wetland Inventory (NWI) mapping update for Iowa is providing an accurate location for all the wetlands, farm ponds and other water traps that can be used in sediment delivery calculations for lake watersheds. Most of the Upper Mississippi River Basin in Iowa is done and plans are to complete the Missouri River Basin area of western Iowa next year.

2. The Historic Aerial Photo Project is another useful coverage for planning and assessing watershed improvements. The data from this project is useful to see past farm practices (or lack of) and identify changes (wetlands drained, waterways built, sediment basins that have been built, etc.). This data coverage could help evaluate whether lake volume loss has been at a constant rate over the last 50+ years. Additionally, this provides an accurate base map to reference old lake bathymetry and other maps that can aid in improving accuracy of lake volume estimates.

Local, State and Federal Partnerships

In order to achieve lake restoration goals it is critical that the IDNR form effective watershed partnerships. This includes partnerships at the local level, but also at administrative levels of government. Local, state and federal programs offer a multitude of programs for financial assistance to landowners for soil conservation and other water quality protection practices.

The strategy pursued in the lake restoration program will be to seek out key individuals with expertise at the local level and the program administration level. This expertise will maximize access to financial incentives for landowner participation in watershed improvement and lake restoration projects. Listed below are several examples of potential partners in watershed improvement and lake restoration.

<u>Local:</u>

- Chamber of Commerce
- City/Town Mayors and Councils
- Conservation and Recreation Clubs and Organizations
- County Board of Supervisors
- County Conservation Board
- IDNR Field Offices (Environmental Services, Fisheries, Forestry, Parks, Wildlife)

- IDALS/ Division of Soil Conservation – Project Coordinators
- IOWATER Volunteers / Educators / Interested Citizens
- Lake Associations / Groups
- NRCS Soil and Water Conservation Districts (SWCD)
- Private Landowners
- USDA Resource Conservation and Development (RC&D)
- Watershed Organizations

State:
- Agribusiness and Community Organizations
- IDALS/ Division of Soil Conservation
- Iowa Department of Transportation
- Iowa Environmental Council
- Iowa Farm Bureau
- Iowa Natural Heritage Foundation

Federal:
- U. S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- Natural Resources Conservation Service
- U.S. Army Corps of Engineers
- U.S. Geological Survey

Additional Information

Several brochures are available on-line that offer more information about lake restoration and watershed improvement.

- Lake Ahquabi
  http://www.iowaIDNR.com/water/nonpoint/files/ahquabi.pdf

- Brushy Creek Lake
  http://www.iowaIDNR.com/water/nonpoint/files/brushycreek.pdf

- Lake Darling
  http://www.iowaIDNR.com/water/nonpoint/files/darling.pdf

- Nine Eagles Lake and Slip Bluff Lake
  http://www.iowaIDNR.com/water/nonpoint/files/nineeagles.pdf

Appendix I.

Handout:

Lake Restoration Prioritization Process and Program

Key Concepts and Facts:

- Lakes are important to Iowans: Six of ten Iowans visit lakes each year; they will visit these lakes an average of eight times during the year.
- Iowans prefer lakes with better water quality.
- Lakes provide significant economic benefits – ex. Clear Lake's $43M annual economic benefit to the region is expected to double after restoration.
- A lake is a reflection of both watershed and lake management.
- Lake restoration starts in the watershed, it relies on strong local involvement and voluntary participation of landowners.

Current Prioritization and Program

- Modeled after the Federal Clean Lakes Program established in the 1970's.
- IDNR provided the 2006 legislature with a priority list of 35 lake candidates.
- Priorities based on a 5-year ISU/IDNR assessment of water quality, technical feasibility of restoration, potential economic benefits, use by Iowans, and local interest/involvement.
- Projects require a lake **and** watershed (land draining to the lake)restoration assessment and plan
- Lake and watershed protection requires local resources in combination with state and federal funds
- Local groups can petition to have their lake added to the priority list.
- Project status: 7 to be completed in 2007, 15 underway, 15 in review
- IDNR provides an annual progress report to the legislature that includes a work plan and budget

Water Quality Goals

Stipulated in 2006 State Legislation (HF2782):

- Phosphorous and sediment coming from the watershed must be controlled before lake restoration begins.
- Shallow lakes management will be considered among options for restoration
- Water quality targets:
  - 4 ½ foot secchi disc transparency (water clarity) 50% of the time, April – September;
  - Water quality impairments must be eliminated;
  - A diverse and sustainable aquatic community will be maintained; and
  - Water quality and public use benefits must be sustained at least 50 years.

Budget

- 2007 funding $8.6 Million
- 2008 funding $8.4 Million

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Web Page: http://www.iowaIDNR.gov/water/lakerestoration/

Fiscal Year 2008 Budget

Project	Project Description	DNR Budget FY08	Non-State Budget FY08	DNR FY08 Expenses	Non-State FY08 Expenses	DNR Obligated Funds	Non-State Obligated Funds	DNR Remaining Budget	Non-State Remaining Budget
Clear Lake	Carp Telemetry & Aging	$47,328		$11,853				$35,475	$0
Clear Lake	Containment Site, Dredging	$5,439,275	$2,000,000		$238,896	$6,453,315	$2,000,000	-$1,014,040	-$238,896
Crystal Lake	Spillway Repair, Watershed Improvement, Fish Renovation, Containment Site, Dredging	$1,810,673		$1,301,319		$340,704		$168,650	$0
Storm Lake	Dredging	$1,000,000		$1,000,000				$0	$0
Brushy Cr. Lake	Shoreline Protection	$60,051				$69,452		-$9,401	$0
Carter Lake	Stormwater, DF Study, Shoreline Stabilization	$125,000						$125,000	$0
Easter Lake	Watershed Improvement, Stormwater	$100,000						$100,000	$0
Five Island	Dredging	$94,788				$175,000		-$80,212	$0
Green Valley	Watershed Improvement, Spillway Repair	$600,000		$1,600				$598,400	$0
Lake Ahquabi / Hooper	Shoreline Protection	$85,000						$85,000	$0
Lake Darling	Watershed Improvement, D/F Study, Dam Repair	$1,017,110	$300,000	$23,859		$148,559	$18,436	$844,692	$281,564
Lake Manawa	D/F Study	$70,000						$70,000	$0
Lake of Three Fires	Wetland/Watershed	$23,719	$71,158	$22,130	$66,389	$1,165	$3,493	$424	$1,276
Lost Grove	Sediment Ponds	$951	$2,855	$952	$2,855			-$1	$0
Prairie Rose Lake	Watershed Improvement, Containment Site	$750,000	$200,000	$1,300				$748,700	$200,000
Red Haw Lake	Shoreline Protection	$25,000						$25,000	$0
Rock Creek Lake	Watershed Improvement	$100,000	$300,000					$100,000	$300,000
Silver Lake	Spillway Repair	$314,949		$271,272		$43,677		$0	$0
Union Grove Lake	Spillway Repair, Watershed Improvement, Silt Dike, Dredge Sediment Pond	$718,572		$178,572				$540,000	$0
Viking Lake	Watershed Improvement	$10,000	$30,000					$10,000	$30,000
Dam Safety	Dam Safety/Portage Signage	$200,000						$200,000	$0
Engineering Services	Design	$690,000		$155,198				$534,802	$0
ISU Research	Biological Integrity					$80,876		-$80,876	$0
Minor Projects	Minor Projects	$63,987		$15,111				$48,876	$0
Priority Lakes	Diagnostic / Feasibility Studies	$343,530	$93,445	$42,168	$20,185	$212,420	$46,288	$88,942	$26,972
Priority Watersheds	Watershed Protection for Lakes	$200,000	$400,000					$200,000	$400,000
Shallow Lakes	Pumping System, Water Quality Improvement	$175,000						$175,000	$0
UAA		$320,995		$132,369				$188,626	$0
	Sub Totals	**$14,385,928**	**$3,397,458**	**$3,157,703**	**$328,325**	**$7,525,168**	**$2,068,217**	**$3,703,057**	**$1,000,916**

Fiscal Year 2009 Proposed Budget

Project	Project Description	Special Appropriations	Fed	Other	Total
Clear Lake	Dredging, Marsh Restoration	$3,000,000	$2,000,000	$2,000,000	$7,000,000
Storm Lake	Dredging	$1,000,000	$500,000	$200,000	$1,700,000
Carter Lake	Lake Restoration	$200,000		$200,000	$400,000
Easter Lake	Watershed Improvement, Stormwater	$25,000		$100,000	$125,000
Five Island	Dredging, Water Quality Improvements	$175,000		$175,000	$350,000
Green Valley	Spillway Repair., Land for Containment Site	$800,000			$800,000
Lake Darling	Watershed Improvement, Dam Repair	$1,000,000	$300,000		$1,300,000
Lake Manawa	Dredging	$1,000,000		$1,000,000	$2,000,000
Prairie Rose Lake	Watershed Improvement, Land for Containment Site	$500,000	$200,000		$700,000
Priority Lakes	Diagnostic / Feasibility Studies	$200,000		$50,000	$250,000
Rock Creek Lake	Watershed Improvement	$100,000	$300,000		$400,000
Union Grove Lake	Watershed Improvement, Silt Dike	$300,000	$200,000	$50,000	$550,000
Dam Safety	Dam Safety/Portage Signage	$200,000			$200,000
Shallow Lakes	Water Quality Improvement	$100,000		$100,000	$200,000
	Total	**$8,600,000**	**$3,500,000**	**$3,875,000**	**$15,975,000**