IMPROVING THE WATER QUALITY OF PARK LAKE:

RECOMMENDATIONS AND OPTIONS FOR THE FUTURE

2002

WATER RESOURCES MANAGEMENT WORKSHOP 2001
GAYLORD NELSON INSTITUTE FOR ENVIRONMENTAL STUDIES
UNIVERSITY OF WISCONSIN–MADISON

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The Water Resources Management Workshop is a regular part of the curriculum of the Water Resources Management graduate program at the University of Wisconsin–Madison. The workshop involves an interdisciplinary team of faculty and graduate students in the analysis of a contemporary water-resources problem.

For more information, contact:

Gaylord Nelson Institute for Environmental Studies

Public Information Office

15 Science Hall

550 North Park Street

Madison, Wisconsin 53706

telephone 608/263-3185

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PREFACE

In fulfillment of the requirements of the Water Resources Management Master's degree program within the Gaylord Nelson Institute of Environmental Studies at the University of Wisconsin–Madison, graduate students participate in a summer practicum addressing a real-world water resources problem. The 2001 Water Resources Management Workshop addressed the water resources issues of Park Lake in Pardeeville, Wisconsin. This document is the summary of their findings and recommendations to the Park Lake Management District (PLMD).

Practicum participants:

Faculty Advisor:
Frederick W. Madison

Graduate Students:
Kristin Anderson
Bob Boucher
Douglas Dawson
Melissa Hornung
Tara Roffler
Kurt Schoen
Benjamin Sheesley
Cristen Taylor
Joanne Vokoun

ACKNOWLEDGMENTS

Kristen Anderson, Geospatial Coordinator/Deputy Director, Columbia County Land Information Department

Don Baloun, Natural Resources Conservation Service

Roger Bannerman, Wisconsin Department of Natural Resources

Carolyn Rumery Betz, Bureau of Watershed Management, Wisconsin Department of Natural Resources

Virginia M. Mayo Black, Communication Specialist, Wisconsin Department of Natural Resources

Barbara Borns, Gaylord Nelson Institute for Environmental Studies Student Services Program Manager, University of Wisconsin–Madison

John H. Broihahn, Assistant State Archaeologist, Historic Preservation Division, Wisconsin Historical Society

Stefanie Brouwer, Land Acquisition and Recreation Grants Specialist, Wisconsin Department of Natural Resources

Gary Bubenzer, Professor of Biological Systems Engineering, University of Wisconsin-Madison

Jason Buck, GIS Specialist, Columbia County Land Information Department

Susan Butler, Farm Service Agency

Kurt Calkins, Land and Water Conservation Director, Columbia County Land and Water Conservation Department

James Congdon, Upper Rock Basin Water Team Leader, Wisconsin Department of Natural Resources

Paul Cunningham, Bureau of Fisheries and Habitat Protection, Wisconsin Department of Natural Resources

Michael L. Czechanski, Senior Cartographer, Wisconsin Geological and Natural History Survey

Charles P. Dykman, Wisconsin Association of Lakes

Jim Elliot, Park Lake Management District

Meg Galloway, State Dam Safety Engineer, Wisconsin Department of Natural Resources

Ken Genskow, Evaluation Unit Coordinator, Environmental Resources Center

Susan Graham, Lake Coordinator, Wisconsin Department of Natural Resources

Ronald Grasshoff, Environmental Analysis and Review Specialist, Wisconsin Department of Natural Resources, South-Central Region

Glenn Green, J.F. Brennan Co., Inc., Total Marine Service

Michelle Greenwood, Publications Unit Chief, U.S. Geological Survey, Wisconsin District Office

James Hebbe, County Conservationist, Green Lake County

Dan Hunt, Water Regulation and Zoning Specialist, Wisconsin Department of Natural Resources

Timothy Johnson, Wisconsin Department of Natural Resources

John Laedlein, GIS Database Specialist, Wisconsin Department of Natural Resources

Tim Larson, Fisheries Biologist, Wisconsin Department of Natural Resources, Poynette Office

Calvin Lawrence, GIS Specialist for Wetlands Inventory, Wisconsin Department of Natural Resources

Jan Libby, Financial Assistance Specialist/Bureau of Community Financial Assistance, Wisconsin Department of Natural Resources

Frederick W. Madison, Water Resource Management Advisor, Professor of Soil Science, University of Wisconsin–Madison

James Miller, Program Assistant, Gaylord Nelson Institute for Environmental Studies, University of Wisconsin–Madison

David Nolan, Financial Specialist, Environmental Resources Center, University of Wisconsin–Madison

Len Olson, Conservation Planner, Wisconsin Department of Agriculture, Trade and Consumer Protection

Cailin Orr, Graduate Student, University of Wisconsin–Madison, Center for Limnology

Kenneth Potter, Professor of Civil and Environmental Engineering, University of Wisconsin–Madison

Todd Rietmann, Land and Water Conservation Technician, Columbia County Land & Water Conservation Department

David Roberts, Park Lake Management District President

William Rose, Hydrologist, U.S. Geological Survey, Wisconsin District Office

Jim Ruwaldt, Fish and Wildlife Service, Private Lands Office, Madison

Carroll Schaal, Bureau of Fisheries and Habitat Protection, Wisconsin Department of Natural Resources

Becky Scott, Financial Assistance Specialist/ Environmental Loans Section, Wisconsin Department of Natural Resources

Cheryl Sandeen, Program Assistant, Gaylord Nelson Institute for Environmental Studies, University of Wisconsin-Madison

Sean Sallmann, Fish and Wildlife Service, Leopold Wetland Management District, Portage

Jeff Schure, Water Management Specialist, Wisconsin Department of Natural Resources, South-Central Region

Patrick Sheahan, Government Outreach Team Leader, Wisconsin Department of Natural Resources

Robin Shepard, Water Resources Education Program Coordinator, Environmental Resources Center

Mike Stapleton, Columbia County Zoning District

Jana Stewart, Geographer, U.S. Geological Survey, Wisconsin District Office

William Sturtevant, Assistant State Dam Safety Engineer, Wisconsin Department of Natural Resources

Susan Tesarik, Wisconsin Association of Lakes

Jeffrey Thornton, Southeast Wisconsin Regional Planning Commission

Sherm Van Drisse, Park Lake Management District Secretary

Mary Wagner, TRM and Urban NPS and Stormwater Grants, Wisconsin Department of Natural Resources

Terry Wakefield, Bog Golf Course Owner

Ernest Wolf, Public Administrator, Village of Pardeeville

Leslie Yetka, Water Resources Specialist, City of Burnsville (Minnesota) Natural Resources Department

David Zaber, Assistant Professor of Limnology, University of Wisconsin–Madison

Joy Zedler, Professor of Botany and Aldo Leopold Chair, University of Wisconsin–Madison

EXECUTIVE SUMMARY

In the fall of 2000, the Park Lake Management District (PLMD) approached the 2001 Water Resources Management (WRM) Workshop about developing alternative management scenarios for Park Lake in Pardeeville, Wisconsin. Since the lake's creation with the construction of two dams in 1856, sediment has been accumulating in the lake. Agricultural and urban land use in the lake's watershed has contributed to sedimentation as well as nutrient loading in Park Lake; algal blooms, nuisance fish and vegetation, and a lack of water clarity also afflict the lake. Such problems are characteristic of dammed lakes, especially those with agricultural and urban impacts.

The 2001 WRM Workshop set out to critically assess the resources of Park Lake and its watershed and to develop several options for the management of these resources. Over the course of the workshop, we examined previously collected lake data and took new measurements of water quality and sedimentation. We examined the natural resources of the watershed in the field and from aerial photographs and topographic maps. We researched means to address the problems Park Lake is experiencing. The in-lake management alternatives that we explored as possibilities for Park Lake include dredging, biomanipulation, and dam removal. We also investigated governmental and institutional issues, especially related to stormwater management in urban and residential areas that surround the lake. Additionally, we examined the watershed contributing to Park Lake and explored ways to increase water quality through various upstream management techniques. We tried to provide a thorough analysis of the benefits and drawbacks of the various management alternatives for Park Lake.

Ultimately, we developed several options for lake management that range from techniques that can be used within the lake to management options for the urban areas surrounding the lake and the entire watershed feeding into the lake.

In-lake management options

Dredging

Dredging, the physical removal of lake-bottom sediment with the use of machinery, is widely used in rivers to maintain navigability. Dredging can result in increased depth for boating and swimming, improved water quality and fishing habitats, and reduced aquatic vegetation populations. This management alternative is very costly and requires additional management measures to ensure a lasting improvement. Unless sediment deposition is controlled on the larger watershed scale, dredging would merely serve as a short-term solution.

Prior to reaching any decision to dredge Park Lake, an extensive feasibility study would be required. The feasibility study would take into consideration the following: sediment sources and delivery, sediment characterization, sediment removal areas and depth, environmental problems associated with sediment removal, sediment removal methods, selection of feasible access and sediment disposal area, water inflow and outflow, long-term impacts on lake level, and costs.

Selective dredging of certain parts of the lake is one option to minimize the cost of dredging while improving valuable parts of the lake. One alternative we developed entails the dredging of a deeper part of the lake to the southwest and the creation of a wildlife preserve and/or a golf course in what is currently the eastern part of the lake. A rendering included with this report illustrates this possibility.

Biomanipulation

Biomanipulation involves the use of water-level management in conjunction with various physical and chemical controls to manipulate aquatic plant and animal communities. Water-level drawdown alone can be used to allow lake sediments to compact and thus decrease turbidity. Drawdowns can be used either to eliminate undesired plant species or stimulate growth of desired plant species. Herbicides can be used along with a drawdown to make the elimination of nuisance species more successful; seeding can be done to stimulate desired vegetation growth.

Rough fish populations, such as carp and gizzard shad, are a problem in Park Lake. They exacerbate the already poor water quality of the lake by means of their feeding and spawning habits. Methods to control rough fish populations include a lake-level drawdown in conjunction with either netting the fish or killing them using rotenone, a fish poison. Restocking of sport fish can be done after this process.

The involvement of the public and the Wisconsin Department of Natural Resources (WDNR) is critical to the implementation of any biomanipulation methods. The success of biomanipulation varies widely and is highly dependent on the characteristics of the lake. Experts are needed to evaluate the potential for success. Moreover, communication and cooperation with the community is essential. Because biomanipulation involves a lake-level drawdown, the recreational uses of the lake would be diminished for several months.

Dam removal

If the community surrounding Park Lake were to decide that it wanted to restore the Fox River to its natural free-flowing state, then dam removal would be an option to consider. This process would involve a one-time removal cost and would eliminate the need for future dam repairs and maintenance. The increased flow rates and cooler temperatures would likely prevent nuisance algal blooms, and fisheries would benefit from the lengthening of the coldwater region, allowing game species to thrive and decreasing the available warm-water habitat preferred by carp and other rough fish. On the basis of surveys done prior to dam construction, it is likely that the area would still have a small lake in the deeper part of the now-existing lake.

Were the two dams to be removed, many options exist for the use of the reclaimed land. The former lakebed could be an area for public use and enjoyment. We created a rendering that shows a possible alternative for land use in the reclaimed land.

Although dam removal is not a currently recommended alternative because of the value the community places on the lake, future circumstances, such as dam deterioration, may make dam removal a more appealing option. Taking this into consideration as a possibility for the future may help to make more informed decisions about how to manage Park Lake in the present.

Governmental/ Institutional options

The PLMD planning process as it relates to Smart Growth

Several steps can be taken within the residential areas of Pardeeville and Wyocena to improve the water quality of Park Lake. The stormwater system is not well mapped, precluding the village from making informed decisions regarding the management of stormwater and wastewater, which have an impact upon the water of Park Lake. Additionally, the village applies a large amount of salt to roads, which eventually ends up in the lake, degrading its quality.

These issues should be addressed; however, the PLMD does not have the administrative authority to take many of the steps necessary in protecting the quality of the lake. Adopting Sanitary District powers would give the PLMD a greater capacity to finance improvements, create a stormwater ordinance, and manage growth. If the PLMD were to choose to expand its jurisdiction to be coterminous with the watershed, it could achieve a type of "Watershed Governance." It would be ideal to have control standards over the entire (54 square mile) watershed to protect water quality. Wisconsin Smart Growth legislation requires municipalities to go through a planning process. With expanded administrative responsibilities, the PLMD could help to shape the future of Park Lake through this process.

Whether or not the PLMD were to take on additional administrative duties, improvements in management practices within the urban areas would benefit the water quality of the lake. If the PLMD or the people of Pardeeville were to choose not to expand the PLMD's jurisdiction, then mapping the stormwater system, decreasing the amount of salt applied to roads, and distributing outreach materials about urban conservation practices would enhance (or slow the degradation of) the water quality of Park Lake.

Park Lake watershed management practices

Nonpoint source pollution management

Nonpoint source pollution to the Fox River and Park Lake derives from residential and farm land-management practices within the watershed and residential areas. Sediments, nutrients, and chemicals enter the aquatic system and contribute to habitat destruction, reduction in drinking-water quality, harbor and stream siltation, and a decline in recreational use of the lake. Several management solutions are available to help curb these detrimental effects. The guidelines set forth by the new Nonpoint Source Pollution Management Program of the WDNR will be useful to the PLMD. These guidelines contain standards for applying fertilizer, controlling soil erosion from cropland, and managing manure and stormwater.

Wetlands serve as a valuable means for curbing nonpoint source pollution. Phosphorous and nitrogen can be chemically held in the wetland through the large amount of biomass contained there. The thick plant life of the wetlands also allows eroded sediments from upstream to settle out. Wetlands are also important ecosystems that support a great diversity of plants and animals. Existing Wetland Reserve Program (WRP) lands in sections 3, 9, 10, and 15 of T13N, R11E are especially good at improving water quality because of their proximity to the Fox River. However, the discontinuities in this wetland area make water-level manipulation difficult. We recommend that the PLMD purchase property located in the NE1/4 NE1/4 NW1/4 sec. 15, T13N, R11E to fill one of these discontinuities. This could set a precedent for the incorporation of similar property into the WRP, thus creating a single continuous wetland block in this area.

Buffer strips are also important in the prevention of nonpoint pollution. The PLMD can improve buffer strips in the watershed beyond the basic standards set in Wisconsin Administrative Code NR 115. For instance, it may put pressure on Columbia County to enforce its Shoreline Zoning Ordinance. Furthermore, we recommend that the PLMD distribute to shoreland owners pamphlets and other instructions for improving the riparian buffers (buffers along the lake banks).

Funding sources for in-lake and watershed management

Many funding sources at the federal, state, and local levels can be utilized for various management alternatives. At the federal level, funds are available from the Fish and Wildlife Service and the U.S. Department of Agriculture. The WDNR provides a variety of funds for improvement and restoration of water resources. State financial assistance is also given to county Land Conservation Departments, through which funds can be distributed. On the local level, nongovernmental organizations may also provide money.

Funds are most often used for land acquisition, resource management plans, educational and informational projects, wetland restoration, wildlife habitat creation or restoration, nutrient management, agricultural and residential nonpoint pollution reduction, dam removal, lake biomanipulation, stormwater control, and agricultural conservation practices. It is uncommon for dredging to be eligible for funding.

Outreach

Educational outreach can be effective in promoting better management practices within the watershed. The PLMD should consider adding an outreach educational component to their lake management district programming. It could contract with the Columbia County University of Wisconsin–Extension office and inform shoreline landowners of the advantages of maintaining a naturally vegetated buffer strip on their shoreline to minimize detrimental effects of lawn care products such as herbicide, pesticides, and fertilizer.

Copies of relevant issues of the Yard Care and Environment series of water-quality fact sheets for residential areas could be obtained from the University of Wisconsin–Extension and distributed to all shoreline owners. A public meeting to inform the public on the implementation of these practices and their benefits could follow this handout distribution. Further shoreline protection procedures are covered extensively in the section on Watershed Management (Chapter 4) and should be considered as an integral part of the lake protection activities of the PLMD.

General recommendations for management

After evaluating the problems that Park Lake is experiencing and exploring the various options for management, we make the following general recommendations for the management of the lake:

- Restore wetland areas in the watershed, especially those that may assist in removing the sediment and nutrient flux to Park Lake.
- Develop a comprehensive plan for the future of the village, which would address municipal, shoreline, and agricultural practices that have an impact on the quality of Park Lake.
- Remove carp from Park Lake and the upper reaches of the Fox River.
- Increase outreach to people in the urban areas surrounding Park Lake and in the upper watershed about the issues of water quality in the lake and watershed.
- Consider innovative land uses that may reduce the area of the lake while maintaining the economic base of the town as well as enjoyment of the area by residents.

CHAPTER 1: INTRODUCTION

Purpose

In December 2000, the Water Resources Management (WRM) practicum group was asked by the Park Lake Management District (PLMD) to investigate different management alternatives for the lake. Park Lake is an impounded lake, created by the construction of two dams (fig. 1.1).

As is almost inevitably the case with impounded lakes, Park Lake has experienced a great deal of sedimentation and nutrient influx into the lake. Much of this is due to agricultural practices in the watershed. In this system that is naturally a river system, the slowing of water flow in the created lake has allowed the sediments and associated nutrients to accumulate in the lake instead of being flushed downstream. Additionally, the sandy soils around Park Lake have allowed seepage from the septic tanks of houses around the lake to seep into the lake itself, also providing unwanted nutrients. Furthermore, salts applied to roads make their way into the lake either via surface runoff or groundwater seepage after the salts have percolated into the ground; these salts accumulate over the years because they do not attenuate naturally. All these factors have degraded the water quality of Park Lake considerably. This has an impact upon the health of ecosystems in the lake and in the Fox River as well as the recreational use of the lake and river.

We investigated many management alternatives, conducted a survey to aid in the process of making management decisions; evaluated management options within the lake itself, in the urban area surrounding the lake, and in the watershed contributing to Park Lake; and gathered information about potential sources of federal, state, and local funding to improve Park Lake and its watershed. We provide this information as a resource for the community of Park Lake to draw from in making decisions about management of their natural resources.

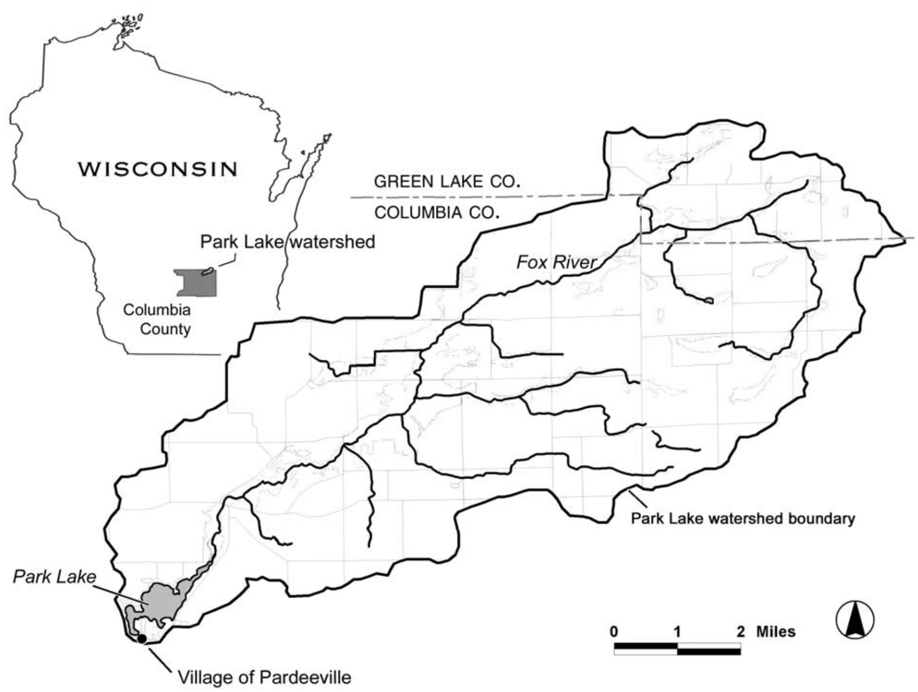

Figure 1.1. *Map showing the location of Park Lake within Columbia County, Wisconsin.*

Institutional Framework for the Watershed

First, it is necessary to understand the framework within which management decisions will be made. The governmental bodies within the Park Lake watershed include the PLMD, which is a special unit of government, the village of Pardeeville, and the towns of Green Lake County and the towns of Columbia County.

Village of Pardeeville

Pardeeville has roughly 2,000 residents, covers an area of slightly more than 1 square mile, and is located completely within the town of Wyocena. Census figures indicate that Pardeeville's population has increased by 20 percent from

Figure 1.2. *Photograph of Park Lake swimming beach.*

1990 to 2000. The area surrounding Park Lake outside the village limits has increased at a higher rate.

The village's operating budget for fiscal year 2000 was $876,000. The village has a public utility that owns and operates the water and sanitary system within the limits of the city. The utility has a current assessed infrastructure value of $2,146,767 in water service and $2,489,839 in sewer service systems. Pardeeville water utility provides public water supply from three community wells that range from 300 to 480 feet deep. The wells currently withdraw 180,000 gallons per day (gpd). The groundwater appears to recharge adequately; levels have remained stable, according to the water utility maintenance department. The drinking water is stored in two water towers to supply pressure. The storage volume of the most recently built water tower (1990) is 300,000 gallons and the older tower is 50,000 gallons. During water main breaks and other threats to drinking water safety, the village chlorinates its drinking water supply. The sewage treatment plant and the municipal water system are run by electricity. Both systems have complete emergency electrical generator systems.

Pardeeville owns and is responsible for the repairs and operation of the two dams that created the impoundment, Park Lake. One is an earthen dike that dams the discharge into the Fox River. The other is an earthen and concrete dam supplying a hydroelectric plant that produces approximately 42 kilowatts (kW) per day, which the village utilizes to power municipal resources. (Ten kW/day is required for an average home.) The hydroelectric dam is on the site of the original milldam. It uses 14 feet of head (drop) funneled through a 42-inch flume pipe to power the electric turbine generator. The hydroelectric power plant has recently been a maintenance burden and fiscally operates at a break-even status. In 2001 the village spent $45,000 on power plant maintenance. The power plant usually operates during the summer because of Wisconsin Department of Natural Resources (WDNR) requirements stipulating a minimum water surface level within the lake.

Pardeeville reopened its swimming beach on Park Lake in 2001 (fig. 1.2). It had been closed since 1996 due to a shortage of lifeguards. The village has provided for a public beach for most of the century. No other official public swimming facility exists in the village. Two public boat launches are on Park Lake; neither is in the village of Pardeeville. The village enacted a no-wake zone in the bay closest to downtown Pardeeville a few years ago.

Pardeeville Sewage Treatment Plant

The treatment plant was completed in 1985. It has a treatment capacity of 330,000 gallons per day (gpd), although peak capacity is higher. The current treatment load is about 260,000 gpd, although roughly 60,000 gpd of this is groundwater leaking into the system. The treatment plant will need to renew its license with the WDNR in 2004. The plant was originally designed to serve the community until 2007.

The treatment process includes primary and secondary treatment and a polishing pond. The treatment plant does not release effluent to the river; all treated effluent is infiltrated into the ground via an infiltration pond. There are three infiltration ponds and their usage is rotated monthly. This allows two months of rest for each pond. Permits to build this type of treatment plant are no longer issued.

The sewerage system currently does not cover the north and east side of Park Lake and future developments in the area will utilize septic systems for wastewater management. Increased numbers of septic systems built for development near the lake, combined with the permeable sandy soils in the area, could have severe negative impacts on the lake's water quality due to increased nitrogen and phosphorus loading and possible fecal coliform contamination.

Stormwater management

The village owns a street sweeper and performs street sweeping weekly during the summer to reduce nonpoint source pollution. Storm sewer outfalls drain into Park Lake from the village, although their whereabouts and water-quality impacts are unknown. The designers of new developments are required to manage stormwater with the project design to avoid creating a public nuisance.

In the winter of 2000–01, Pardeeville used roughly 90 tons of salt on municipal roads. This was more than normal; an average winter requires 65 tons. State trunk highways 22 and 44, and county trunk highway P run through the village in proximity to the lake and are salted by the county. We estimate that a total of 100 tons of salt is annually applied to roads within the PLMD. Because the outfalls of the Pardeeville stormwater system discharge directly into Park Lake, it would appear that most of the salt discharges into the lake as well. The long-term effects to Park Lake are unknown.

Park Lake Management District

The PLMD is a special unit of government (chartered under jurisdiction of Wisconsin State law); its mission is to manage the lake and some associated upland areas for water quality purposes. It currently assesses $20 annually for riparian lots and $10 for non-riparian lots. The district has the right to tax and tariff, but its administrative power is secondary to that of towns and villages. Lake districts have limited legal authority on water-quality issues. The town of Wyocena administers the land to the east, north, and south of Park Lake.

Park Lake site characterization

Park Lake is a 312-acre (0.49 sq. mi.) impoundment located along the Fox River, extending northeast from the village of Pardeeville in Columbia County (fig. 1.1). It measures 1.2 miles in length and 0.6 mile in width, and has 6.5 miles of irregular shoreline, including an island to the north (Park Lake Development Committee, 1990). Park Lake lies within a 53.8-square-mile watershed, the Park Lake watershed. Approximately 3 percent (1.6 sq. mi.) of this area drains directly into the lake and 97 percent (52.2 sq. mi.) drains into the Fox River. Approximately 60 percent of the shoreline of Park Lake is within the village of Pardeeville. The volume of Park Lake is 2,187 acre-feet (Kammerer, 1996). Area residents and tourists mainly use the lake for swimming, boating, and fishing. Park Lake is physically divided into a large, shallow east basin and a smaller, but deeper west basin (fig. 1.3). It has a maximum depth of 27 feet and an average depth of 7 feet in the eastern basin and 12 feet in the western basin (Kammerer, 1996; Park Lake Committee, 1990). Only 0.2 percent of the lake, near the main dam, is deeper than 20 feet (Kammerer, 1996; Park Lake Development Committee, 1990).

Park Lake was formed by the construction of two small dams that were completed in 1856 and flooded a deep-water marsh of the Fox River (Board of Commissioners of Public Lands, 1851). The northernmost structure (main dam), through which the bulk of the discharge flows, drains to the Fox River. A small part of the water

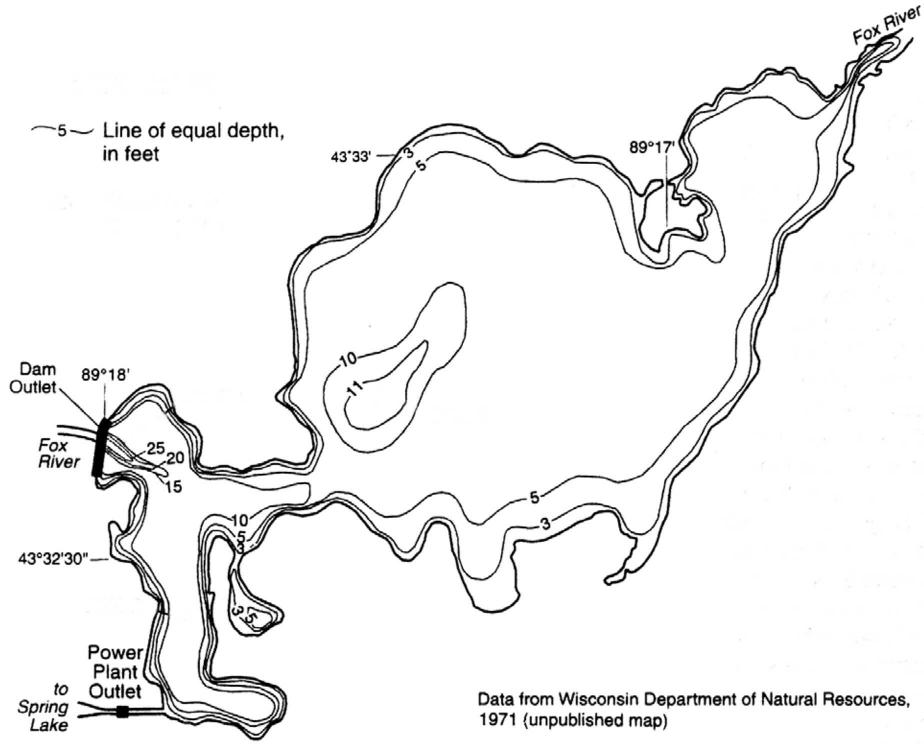

Figure 1.3. *Bathymetric map of Park Lake. The Fox River enters Park Lake in the larger, shallower lobe to the east; the deepest section in this part of the lake is just over 11 feet. The river exists from the smaller, deeper arm of the lake through two dams. Near the northern dam, the depth approaches 27 feet (modified from Kammerer 1996; data from Wisconsin Department of Natural Resources, 1971).*

flows through the southernmost dam, which is at a hydroelectric power plant, and discharges water to Spring Lake, located immediately downstream. The southernmost dam is operated by a stop-log gate system. This somewhat outdated system can make the discharge of the dam difficult to control (R. Grasshoff, Wisconsin Department of Natural Resources, written communication, 2001). The dams are currently controlled by the village of Pardeeville and are regulated by the Wisconsin Department of Natural Resources (WDNR).

Natural Resources

Fish

Historically, Park Lake has had an excellent fishery. A WDNR survey from 1988 reported that a good bluegill, bass, and crappie fishery was present in the lake at that time. Stocking of musky, walleye, and northern pike has occurred in Park Lake. However, in recent years the population of rough fish, such as carp and gizzard shad, has increased dramatically. A survey of randomly chosen residents in the PLMD, conducted by the WRM Workshop in the summer of 2001, showed that carp and other rough fish have seriously harmed the fishery and are among the major contributors threatening water quality. Additionally, 40 percent of the respondents rated the water quality in Park Lake as poor or seriously degraded. Degraded water quality is significant not only because of the negative impacts on natural resources, but on the recreational uses of Park Lake as well. Because 66 percent of the survey respondents replied that they had fished in Park Lake within the past 12 months, and more than half (55%) of the respondents stated that the quality of Park Lake has decreased or greatly decreased since their first exposure to the lake, improving the water quality of Park Lake is a priority for the PLMD. (For additional survey results, please refer to Park Lake Management District Survey Results in appendix A).

Vegetation

In recent years some lake residents have observed a decrease in the aquatic vegetation communities of Park Lake. Lake vegetation surveys performed by the WDNR in 1989 showed that the species richness was low, although the amount of plant material was very high. Specifically, milfoil was abundant in shallow zones and coontail was also very common. The Aquatic Plant Management Plan for Park Lake (Leverance and Molter, 1999) inventoried the results from an aquatic vegetation survey conducted in August 1998. Although the eastern areas of the lake support dense aquatic plant growth, especially near the inlet of the Fox River, this growth is not heavy in the western part of the lake. Another aquatic vegetation survey, conducted in August 2001, reported that plant growth appeared to be restricted to lake areas less than 3 feet deep and that less diversity than in the 1999 study was observed (C. Molter, WDNR, verbal communication, 2001). In addition, wetland areas adjacent to Park Lake are showing signs of invasion by purple loosestrife, an exotic plant species.

The loss of submerged aquatic plants in shallow lakes and the subsequent change from a plant- to an algal-dominated community has been directly linked to increased amounts of phosphorus entering the aquatic system (Phillips et al., 1999). The increased nutrient loading in Park Lake, in combination with the disturbance of lake sediments by bottom-feeding fish, may be negatively affecting the existence of healthy plant communities. A study conducted at Lake Belle View, Wisconsin, which experienced problems similar to those seen in Park Lake, identified turbidity due to rough fish as one of the main factors that limited diverse aquatic plant growth and prevented the attainment of clear water (WRM, 1995).

Hydrology

Climate

The climate in the area is typically continental with cold winters and warm summers. The mean annual temperature in southern Wisconsin is about 45 degrees Fahrenheit, and the mean annual precipitation is approximately 34.5 inches (National Climatic Data Center, 2002). Graphs of average monthly temperature and precipitation for Portage, Wisconsin, located approximately 10 miles west of Pardeeville are shown in figures 1.4 and 1.5.

Park Lake watershed and stream flow

No extensive hydrologic studies of Park Lake watershed have been conducted, although the U.S. Geological Survey (USGS) (Kammerer, 1996) did monitor the watershed for water year 1993 (October 1992–September 1993). Unfortunately, the hydrological statistics from that year are not believed to be typical because it was a flood year. During this period, the three weather stations nearest Pardeeville recorded an average of 48.08 inches of precipitation, which was approximately 50 percent above normal. Surface water from the Fox River accounted for 94 percent of the inflow to the lake. Precipitation falling directly on the lake accounted for 2.5 percent and groundwater inflow accounted for the remaining 3.5 percent.

Geology and hydrogeology

Geology

The bedrock underlying the entire Park Lake watershed is composed of Precambrian, Cambrian, and Ordovician layered sandstones, dolomites, siltstones, and shales. Much younger Quaternary age unconsolidated deposits of glacial origin are at the surface.

Hydrogeology

The principal aquifers in Columbia County are the sandstone aquifer and the sand and gravel aquifer. The high-yielding sandstone aquifer is composed of Cambrian and Ordovician rock units and extends down to the Precambrian igneous and metamorphic rocks; this aquifer is absent northwest of Pardeeville where the Precam-

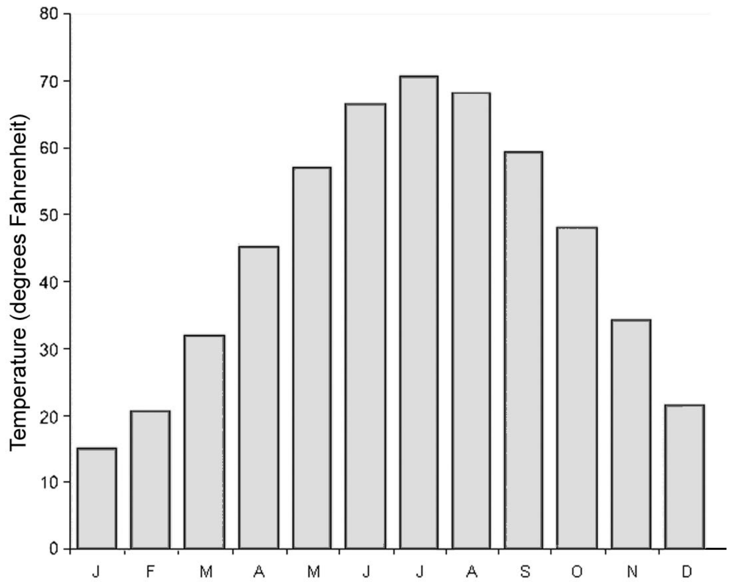

Figure 1.4. *Average monthly temperatures, Portage, Wisconsin, 1971–2000. Maximum average high temperatures range from almost 71 degrees in July to 15 degrees in January (National Climatic Data Center, 2002).*

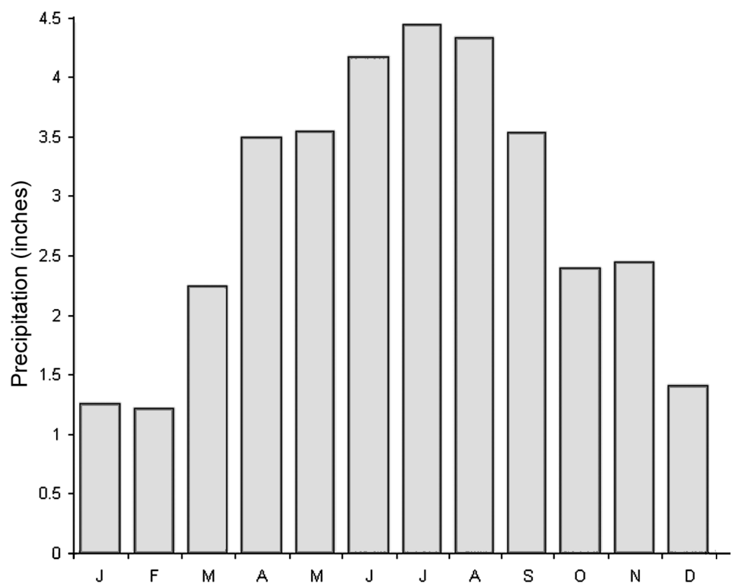

Figure 1.5. *Average monthly precipitation, Portage, Wisconsin, 1971–2000. Precipitation reaches a maximum of more than 4 inches in the months of June, July, and August. The average annual precipitation over this period is 34.5 inches (National Climatic Data Center, 2002).*

brian crops out, but can be up to 700 feet thick elsewhere. The sand and gravel aquifer consists of unconsolidated glacial materials, mostly in the area surrounding the Fox River. Yields from this aquifer are sufficient to meet domestic needs.

The quality of groundwater in Columbia County is generally good, with the exception of some high nitrates. The water can be hard as a result of passing through rock with large amounts of calcium and magnesium (Harr et al., 1978).

Sedimentation

Watershed soil loss

In 1999 the Wisconsin Department of Agriculture, Trade and Consumer Protection (WDATCP) began collecting annual field data on soil loss at the watershed level for most of the state. They sample each watershed randomly by using roadside transects every 0.5 miles. The data shown in table 1.1 are based on 102 sample points collected in 1999 and 103 sample points collected in 2000 (2001 data were not yet available for the entire watershed at the time this report was written). The results for the two-year period indicated that an average of 85.5 percent or 19,133 acres of the Swan Lake watershed (which encompasses the Park Lake watershed) fell below the tolerable soil loss amount in tons/acre/year (WDATCP 1999 and 2000) (fig. 1.6). Using the Universal Soil Loss Equation (USLE), WDATCP estimated an average of 2.75 tons/acre/year of topsoil had eroded in this watershed.

Seventy-five percent of the cornfields had 0 to 30 percent residue cover. This means that most farmers in the watershed use chisel plows and disk tillers to prepare the soil for crops.

Sources of sediment and related factors

To understand how sediments are being delivered into a lake body, it is fundamental to know the dynamics of the watershed. Land use in the Park Lake watershed is primarily agricultural, with approximately 78 percent of the land in cropland and pasture, 18 percent in woodland, 1.3 percent in lakes, 1.3 percent in wetlands, and 1.2 percent in developed areas (Kammerer, 1996).

It has been noted by Park Lake users that sediments are carried into the lake via the Fox River. Sediment sources include farm runoff,

Table 1.1. *Watershed soil loss: The percentage of watershed fields and the number of watershed acres with indicated relative soil loss for 1999 and 2000, Swan Lake watershed[1]. T = the tolerable soil loss amount in ton/acre/year; N = number of samples.*

	1999 (N=102)		2000 (N=103)	
Soil loss	**Percent**	**Acreage**	**Percent**	**Acreage**
<1 x T	84	18,988	87	19,277
1–2 x T	11	2,392	7	1,557
2-3 x T	3	791	3	647
>3 x T	1	264	2	527
Unknown	1	264	1	238

[1] The accuracy for data collected in the Swan Lake watershed is unknown, but is comparable to countywide data for Columbia County, which has 460 sample points and a confidence interval of 90 percent, ±5 percent error. With two years of data to increase accuracy and little variation between the years, this watershed data may have a confidence interval in the 80 percent range (L. Olson, WDATCP, verbal communication, 2001).

Table 1.2. *Watershed crop cover: The percentage of watershed fields and the number of watershed acres with indicated crop present for 1999 and 2000. N = number of samples.*

	1999 (N=102)		2000 (N=103)	
Crop	**Percent**	**Acreage**	**Percent**	**Acreage**
Corn	56	12,722	57	12,718
Soybeans	4	937	9	1,965
Small grains	5	1,191	3	766
Hay	30	6,902	23	5,198
Fallow	0	0	2	383
Vegetables	4	810	4	859
CRP	1	136	1	119
Unknown	0	0	1	238

bank erosion, natural runoff from fields, woods, and wetlands (Park Lake Development Committee, 1990). Most of the soils in the Park Lake watershed have sandy or loamy topsoil, which is good for growing rotational crops, but are highly or moderately erodible (USDA-NRCS, 1977, 1978). The major soil associations in the Park Lake watershed and their characteristics are listed in table 1.3.

Once deposited within the lake, sediments have many detrimental impacts to water quality and habitat. Depending on the sediment sources, toxic materials may be infused within the sediment, exacerbating poor water quality. Sediments also contribute to high water turbidity, thereby decreasing sunlight penetration and reducing photosynthesis. Submersed plant populations can be reduced, resulting in a loss of habitat for fish and invertebrate species. Over time, more sensitive aquatic insects, such as mayflies and caddis flies, are being replaced by pollution-tolerant lake flies and sludge worms. Sediments also cover critical habitat, such as fish-spawning areas. Rough fish, like carp, eventually replace game fish (Park Lake Development Committee, 1990). By reducing lake-water depth, sediments may also lead to a decline in recreation, such as boating and swimming.

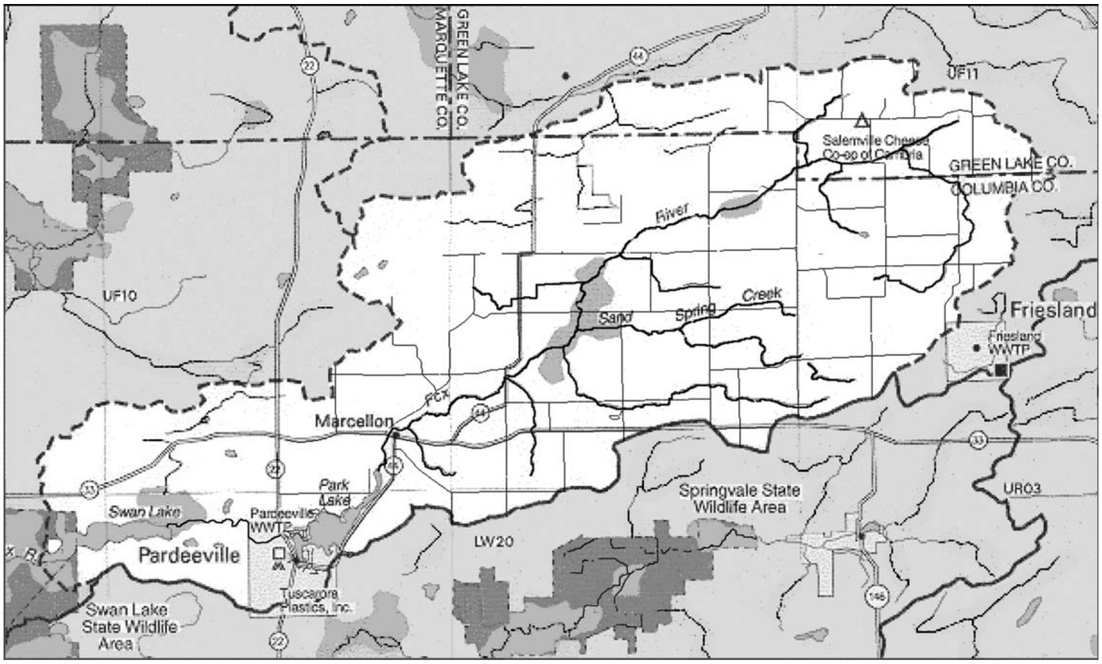

Figure 1.6. *Swan Lake watershed map. The majority of this watershed nearly parallels the Park Lake watershed, yet it extends farther west of the lake (from Wisconsin Department of Natural Resources, <www.dnr.state.wi.us/org/gmu/upfox/surfacewaterfiles/watersheds/uf15.html>).*

Historically, agricultural runoff has been the primary mechanism of sediment delivery into Park Lake. Agricultural sediments are particularly problematic because they contain high levels of nutrients such as nitrogen and phosphorus. As a result, Park Lake is classified as highly eutrophic. Moreover, the loss of wetlands in the watershed had decreased the sediment retention capabilities of the watershed. Additionally, alterations to wetlands on the southern end of Park Lake have also increased the sediment loading into Park Lake. Wetlands improve water quality by trapping and filtering out sediments carried in runoff, decrease localized flooding by serving as storage areas, recharge groundwater, and provide critical habitat to fish and wildlife. When wetlands are ditched and/or drained, these ecological functions are reduced or lost entirely.

At present, the re-conversion of some agricultural areas to wetlands has decreased the amount of sediment entering the lake. Furthermore, improved soil management on those lands being actively farmed throughout the watershed appears to have reduced the impact of agriculture on water quality.

Although agriculture makes up the largest component of land use in the watershed, there are other significant sources of runoff into Park Lake, including yards, village streets, developed and undeveloped areas, and construction sites in the adjacent uplands. Various activities on the 6.5 miles of irregular shoreline contribute sediment directly into Park Lake. Approximately 140 houses are directly adjacent to the Park Lake shoreline.

Sediment delivery into the Fox River

The U.S. Geological Survey conducted a study in 1997 on sediment, suspended solids, and total phosphorus from small watersheds in Wisconsin. Although the Park Lake watershed was not included in the study, data from a similar watershed, the Silver Lake watershed, may give a general estimate of sediment delivery into the Fox River from the Park Lake watershed (W. Rose, U.S. Geological Survey, verbal communication, 2001). The Silver Creek watershed is similar to the Park Lake watershed in ecoregion, area, and dominant land use. On the basis of nine years of data, total suspended solids or sediment in the

Table 1.3. *Description of the soil associations found in the Park Lake Watershed, grouped by county (Park Lake Development Committee 1990; USDA-NRCS 1978)*

Columbia County

Soil association	Topsoil	Fertility	Drainage
Lapeer–Wyocena	sandy or loamy	moderate	moderate or high
Grelton–Gilford–Friesland	loamy	high or moderate	low or moderate
Boyer–Oshtemo–Dresden	sandy or loamy	mostly low	mostly high
Houghton–Adrian–Palms	organic matter	low	low
Plano–Griswold–Saybrook	silty	high	low

Green Lake County

Soil association	Topsoil	Fertility	Drainage
Kidder–Rotamer–Grellton	sandy loam	moderate to high	high
Plano–Mendota–St. Charles	silt loam	high	moderate to high

Silver Creek watershed ranged from 11 to 48 tons per square mile, with a median of 19 tons per square mile (Corsi et al., 1997). It is important to note, however, that sediment data can be highly variable.

Sediment deposition in Park Lake

Park Lake has an average depth of 7 feet and a volume of 2,187 acre-feet (Kammerer, 1996). On the basis of the greater depths near the dam, the lake's original average depth was approximately 15 feet, with a volume of 4,680 acre-feet. The estimated sediment accumulation, also known as total sediment volume, in Park Lake is 1,451 acre-feet, which was determined from sediment measurements taken in various locations in Park Lake. This value is the equivalent of filling a standard football field, including the end zones, to the height of a 110-story building.

We took sediment measurements at 18 different sites in Park Lake on July 31, 2001. We measured water depth with sonar; initial accuracy of the sonar unit was verified with a weighted rope. Soft sediment depth was measured with a calibrated metal probe. To determine sediment thickness, water depth was subtracted from the bottom sediment depth. We plotted sediment thickness for each of 18 sites on a map of Park Lake and divided the lake into four regions on the basis of similar sediment thickness. The average sediment depth was calculated in each of the four regions. The areas of each region were then multiplied by the sediment thickness. These values were added together to give a total sediment volume of the lake (fig. 1.7).

Water quality

Park Lake has been an impoundment for approximately 150 years. In that time, it has acted as a settlement pond for all of the sediments, nutrients, and other materials that have come from the agricultural practices and urban population within its watershed. The resultant accelerated eutrophication has created nutrient-rich water that supports algae and macrophyte growth. The introduction of rough fish, such as carp and gizzard shad, has resulted in resuspended sediment and increased turbidity.

Eutrophication

Lakes need a certain amount of nutrients to function properly; when the balance of the nutrients becomes disrupted, the production of the lake can increase to a dangerous level, resulting in eutrophication: possible algal blooms, low dissolved oxygen, and a decrease in other aquatic organisms. Eutrophication has a negative impact on the biological, chemical, and physical characteristics of the lake as well as on its recreational uses.

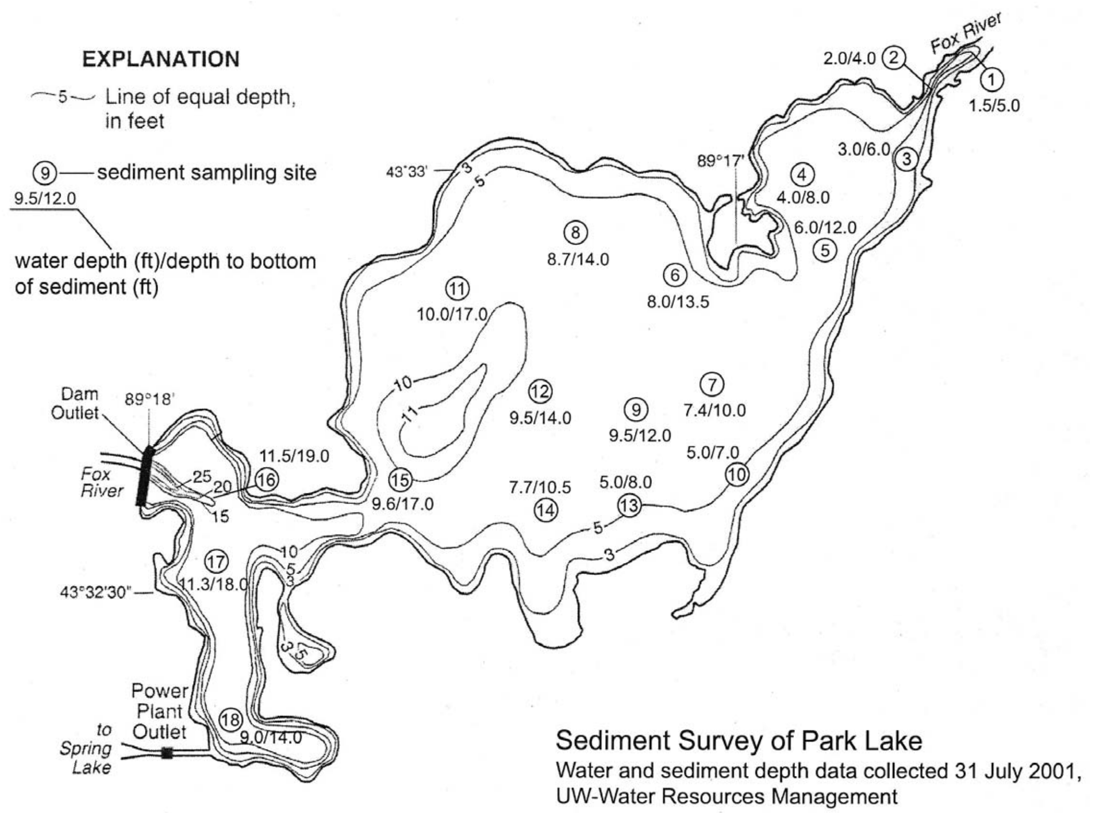

Figure 1.7. *Sediment survey of Park Lake showing 18 sampling sites. The data collected were used to determine a total sediment volume of 1,451 acre-feet for Park Lake. Water depths at each site match reasonably well with the bathymetric data collected by the Wisconsin Department of Natural Resources in 1971 (modified from Kammerer, 1996).*

We tested several water quality parameters of Park Lake in the summer of 2001. Phosphorus, chlorophyll a, and Secchi disk depths indicated that the lake is eutrophic. Measurements of dissolved oxygen compared to those taken in previous years seemed to show that dissolved oxygen levels have gone down over the years. In general, the quality of the water in Park Lake is low. A full suite of water-quality data taken in the summer of 2001 can be found in appendix B.

Total phosphorous. If the total phosphorus of a lake or an impoundment is higher than 0.025 mg/L, it is considered highly eutrophic (Lillie et al., 1993). Park Lake has been documented to have excess phosphorus. Data taken in the spring and summer of 1986 showed that Park Lake's total phosphorus concentration was between 0.04 and 0.09 mg/L (Field, 1987). In 1994, the USGS studied the water quality of the lake and its watershed again. The total phosphorus for the Fox River above the lake and Park Lake was above the desired level, reaching extremely high concentrations during the spring months of 1993 (18,300 lb or 50 lb/day; Kammerer, 1996). It should be noted that 1993 was an extremely wet year; precipitation was 50 percent above normal, and runoff was 150 to 200 percent above normal. This suggests loading far in excess of what would be expected in a normal year.

Phosphorus can be brought into a system by natural and human actions, but it is mostly the human activities that result in large concentrations of it. Such activities include the use of fertilizers and animal waste in agriculture, results of land-use practices such as bank erosion from livestock trampling, urban water runoff (possibly sediment loss from construction sites), and sediment re-suspension due to rough fish. Horne and Goldman (1994) stated that only five to ten percent of the phosphorus actually is delivered in a soluble form; the rest is bound to the moving sediments. Due to its fairly steady runoff flow regime, many wetlands in the Park Lake watershed may be acting as sinks for and sources of dissolved phosphorus; this may explain why phosphorus loading into Park Lake continues to be a significant problem despite improvements in agricultural practices (W. Rose, USGS, verbal communication, 2001).

As the fish, plants, and other organisms die, their decomposition releases the phosphorus they contained. When the layer above the lake bottom becomes devoid of oxygen, the release of phosphorus increases greatly (WRM, 1995). This does not appear to be a significant factor in Park Lake (Kammerer, 1996).

Temperature and dissolved oxygen. Park Lake experiences the normal thermal stratification of a northern temperate lake. The water temperature for Park Lake in 1987 ranged between 0.3°C in February to a high of 27.3°C in July (USGS, 1987). These temperatures are typical for lakes in this area.

There is a layering of the dissolved oxygen as well as thermal stratification. The deepest sections of the lake experience anoxic (oxygen-depleted) conditions in the fall and winter. Excessive phosphorus causes increased algal blooms that saturate the upper water layer with oxygen during the day; at night, the respiration consumes a large amount, effectively decreasing the surface dissolved oxygen concentration to near-fatal levels for fish (USGS, 1987).

Secchi depth. In 1987, the USGS measured the depth of water transparency with a Secchi disk; the greater the depth measured with the disk, the greater the water clarity. Secchi depths of 3.3 feet in April 1987 and 1.1 feet in August 1987 suggest that increased algae blooms resulting from the excessive phosphorus are causing this decrease. This low water clarity is an indicator of poor water quality, affecting the fish and plant life communities by decreasing the light that they need. In the summer of 2001, Secchi depths ranged from 1.2 and 2 feet.

pH and conductivity. The pH of the lake is one of the few attributes that is in the acceptable range. The April 1987 measurement was 9.1, decreasing in the summer to 7.4 in July 1987 (USGS, 1987). In Park Lake, the pH also declines with depth just as the temperature and dissolved oxygen do. Conductivity, which is a proxy of the amount of dissolved ions in the water (a high amount of dissolved ions is indicative of low quality water), and pH are both within the normal range for a lake of the area.

Chlorophyll a. During the summer months of 1987 on Park Lake, chlorophyll a concentrations were indicative of a large algal bloom (USGS, 1987). Chlorophyll a concentrations were 120 mg/L in August, which is acceptable, but still very high (USGS, 1987). In the previous April, the levels were 26 mg/L. Excessive phosphorus conditions, typical of impounded rivers, become conducive for high algal production. Park Lake's high summer chlorophyll a is indicative of the harm caused by the lake's many years of being a sediment trap for the watershed.

CHAPTER 2: IN-LAKE MANAGEMENT OPTIONS

In this chapter we examine three viable in-lake management options for the residents of the PLMD: dredging, biomanipulation, and dam removal. These options have been successfully used in many other lakes. The intent of this chapter is to highlight the science and technology behind the options as well as their benefits and limitations. Our approach is to present these options in a manner in which the PLMD can make an informed decision about whether these techniques are applicable to their objectives and goals. It is important to note that all these options will require additional detailed site analysis by professional staff of Park Lake and may incur considerable financial investment for successful results.

Dredging

All impounded reservoirs formed on natural rivers are subject to some degree of sediment inflow, which, over time, can fill in the impoundment. The actual deposition process within a reservoir is complex and depends on a number of factors, namely hydrological fluctuations in water, sediment inflow, sediment particle-size variation, mechanical reservoir operation, and reservoir size and shape (Strand and Pemberton, 1982). Historically, the most influential factor in Park Lake has been sediment inflow from the surrounding watershed. Sedimentation and filling of a reservoir will continue until storage capacity is lost, which occurs when the sedimentation rate nearly equals sediment loss through outflow or until adequate watershed-management alternatives are implemented to reduce the amount of sediment entering the reservoir.

Dredging, which involves the physical removal of lake-bottom sediment and rooted plants, can be used to increase the total lake volume. To reach optimum effectiveness, however, dredging can be combined with in-lake barriers. In-lake barriers are specifically designed to help minimize sediment re-suspension and accumulation. Although dredging and in-lake barriers have been effective management strategies for some lakes and rivers, they are not universal solutions.

Benefits of sediment removal

Increased volume

Through a combination of natural and anthropogenic processes, lakes and impoundments fill in with sediment over time. Because flowing water is more effective in transporting debris and eroded soil than still water, sedimentation occurs when water is slowed down by impoundment structures. With negligible flow, lakes and impoundments serve as excellent sinks for sediment and nutrients. Impoundments, however, typically have shorter life spans than natural lakes. According to Marshall (1988), "Impoundments… usually persist less than 100 years, depending upon the mill pond's size, watershed size, land use within the watershed, and condition of the dam structure." The Park Lake impoundment was built between 1848 and 1849, and it has exceeded the 100-year mark by more than 50 years. However, dredging can help restore an impoundment to its original volume by removing bottom sediment.

Removal of toxic sediments

Although dredging can be effective in removing toxic sediments from a lake, problems can arise over the selection of an appropriate disposal site. Some of the main factors to consider when selecting a disposal site include cost, transport risks, and proximity to sensitive areas (i.e., groundwater recharge areas, wetlands, floodplains, etc.). Arsenic is an example of an element that requires a safe disposal site because it poses a potential health hazard (Dunst, 1982). Other sediment contaminants that require careful disposal include polychlorinated biphenyls (PCBs), dioxins, and other heavy metals, such as mercury (Priore and Cichon, 1996). Due to the agricultural nature of the Park Lake watershed, there may be moderate levels of copper and arsenic in the sediment because they are typically used in herbicides (D. Hunt, WDNR, verbal communication, 2001). At present, the sediments in Park Lake contain nutrients such as phosphorus and nitrogen. Other dissolved minerals, including calcium, magnesium, and bicarbonate, derived from the dolomitic bedrock and calcareous deposits, underlie the watershed (Kammerer, 1996). However, none of these minerals have been identified at toxic levels in Park Lake.

Macrophyte removal

Reduced current in a lake can create suitable habitat for rooted vegetation. As plant structures impede the re-suspension of sediments, further sedimentation occurs. Although aquatic plants are a desirable and necessary component of a lake ecosystem, excessive populations of rooted plants may infringe upon recreational activities, such as fishing, boating, and swimming. By increasing the lake depth and decreasing the light penetration, dredging may hinder the re-establishment of rooted macrophytes. Because Park Lake has not experienced a macrophyte problem since 1999, this will not be a major factor in the decision to dredge Park Lake (Roberts, 2001).

Phosphorus removal

Phosphorus can fuel massive algal blooms and can encourage overabundant populations of macrophytes. Moreover, the amount of phosphorus necessary to cause a nuisance for lake users and riparians is relatively small. According to Klein (1998), just 1 gram of phosphorus can produce 100 grams of algal biomass. In 1993, total phosphorus input to Park Lake from the watershed was 18,300 lb, or 50 lb/day (Kammerer, 1996). However, loading data from that extremely wet year may represent values far in excess of those from an average year.

Phosphorus is typically the focus of lake management programs because it is commonly the nutrient that controls the rate of algae growth (Klein, 1998). Information about the phosphorus content of sediment in various locations along the lakebed can be helpful in identifying potential hot spots that contribute the largest amounts of nutrients to the lake. Sediment cores can be taken throughout the lake to better characterize the depth and distribution of nutrient-rich bottom sediments.

Internal loading is the process by which phosphorus is released from the bottom sediment as a result of high pH levels, physical disturbance, and/or anoxic (oxygen-depleted) conditions. Internal loading can be an important phosphorus input in some lakes, although this process does not appear to be important in Park Lake (Kammerer, 1996): The main source of phosphorus to Park Lake is not internal loading, but rather the Fox River (Kammerer, 1996).

Lake bottom alteration for navigational and recreational purposes

Dredging lake and river sediments has traditionally been used to make harbors more conducive to navigational purposes (Klein, 1998). Dredging has the potential to make Park Lake safer for boating by increasing water depth. It also can help improve water quality, which will make the lake more conducive for other recreational activities such as swimming, water skiing, tubing, and fishing.

Enhanced fish production

Accrual of sediment in lakes results in the potential for winter kills due to lack of oxygen. This is particularly true for shallow eutrophic lakes, such as Park Lake. The accumulation of bottom sediments also results in the loss of habitat for aquatic fauna. The populations of important game fish, such as Northern Pike, are also reduced and replaced by rough fish (Roberts, 2001). Historically, Park Lake has had an excellent bass and panfish fishery. Since 1998, however, Park Lake has experienced a significant decline in its fisheries, with carp and gizzard shad being the dominant fish species (Roberts, 2001).

Sediment-removal methods

Of the different types of dredges used in sediment removal projects, the hydraulic dredge and mechanical dredge are the most commonly used. A less frequently used dredge is the pneumatic dredge. Because hydraulic, mechanical, and pneumatic dredges are designed for specific purposes, each type has its unique advantages and disadvantages. The best method to use for dredging is determined by certain project parameters, such as the volume and type of sediment, distance to the disposal or holding site, and the proximity to sensitive areas.

Mechanical dredges

Grab bucket dredges are cranes that have large clamshell buckets. The crane can be operated from either the shore or on top of a barge. The clamshell bucket removes the bottom sediment and transports the materials into a receptacle for transport to a disposal site. Grab bucket dredges are used primarily for shoreline alterations (Cooke et al., 1986). Two major advantages of the grab bucket dredge are that they work well in confined areas and they can be transported efficiently (Cooke et al., 1986). Some of the disadvantages include a limited reach of 90 to 120 feet, uneven bottom contours, resuspension of materials, and time-intensive, operational procedures (Cooke et al., 1986).

Hydraulic dredges

There are several types of hydraulic dredges, but most commonly used hydraulic dredge for lake-dredging projects is the cutterhead section dredge. The main components of this hydraulic dredge include the hull, cutterhead, pump, power unit, and pipeline. The hull serves as the support structure for the power unit and pump. The cutter loosens up the bottom sediment, and the dredge pump suctions the sediment slurry. Slurry is transported through a pipeline to the disposal site. Some of the advantages of the cutterhead section dredge over the grab bucket dredge are more efficient operational procedures and fewer reach limitations (Cooke et al., 1986). There is also a downside to hydraulic dredges: The percentage of solids in slurries is only around 10 to 20 percent; the remainder of the volume is water. This may result in an unexpected lowering of the lake-water level (Cooke et al., 1986). It also means that the disposal site will have to have enough storage for the excess water.

Pneumatic dredges

Unlike hydraulic dredges, which use pumps to suck slurry into the section head, the pneumatic dredge uses hydrostatic pressure. The main components of the pneumatic dredge include a pick-up head, compressor, several pump bodies, which are kept at atmospheric pressure, and air lines, which are connected to the pump bodies. Sediment and water, under hydrostatic pressure, are forced into the pump body. Pneumatic dredges have several advantages over hydraulic dredges and grab bucket dredges: The slurry contains a greater proportion of solids and there is less sediment re-suspension (Cooke et al., 1986). A major disadvantage of the pneumatic dredge is that it cannot operate effectively in lakes less than about 30 feet deep (Cooke et al., 1986).

Drawdown

The water level in a lake can be manipulated by regulating the outlet control structure. Depending on the lake management objectives, the water level can be raised or lowered. During a lake-water drawdown, the sediment is exposed to air and allowed to consolidate. The hardened sediment can be removed by dryland excavation techniques, such as bulldozing. The main objectives of a lake-water drawdown project are to maintain and/or restore shoreline, consolidate lake sediments, increase lake depth, reduce nutrient release, and limit aquatic plant growth (Park Lake Development Committee, 1990).

In general, the longer the sediment is exposed to the air, the greater the benefits (Thornton, 2000). Lake-water drawdown as a sediment removal tool has certain advantages over conventional dredging procedures. Overall, a drawdown is far less expensive than dredging (Cooke et al., 1986). In addition, there is less risk of runoff from the containment site because the water content is lower in the consolidated sediment than the dredged sediment (Cooke et al., 1986).

Despite the ecological and economical benefits of lake-water drawdowns, there are also consequences: winterkill; loss of desirable aquatic plants; fewer plants in inshore areas, which may effect habitat; the requirement of an "environmental assessment" Chapter 30 (Wisconsin Statutes) permit; extension of cattail bed; odors as plants decompose; the release of a nutrient pulse from reflooding, which could stimulate a spring algal bloom; recreational losses of the lake during drawdown; and changes in aesthetics (Park Lake Development Committee, 1990). In addition, a drawdown can be more disruptive to the benthic (bottom dwelling) community than conventional dredging (Cooke et al., 1993). Before a lake-water drawdown is initiated, it is imperative to conduct a thorough assessment of endangered and/or threatened species to ensure that the project will not have an adverse impact on these species.

Considerations when removing bed materials from lakes

It is beyond the scope of this report to recite all of the sediment removal procedures in the Wisconsin Administrative Codes and State Statutes. However, the following regulations highlight the legal obligations of the Park Lake Management District in regards to lake-dredging projects:

- Chapter 30, Wisconsin State Statute, "Navigable Waters, Harbors and Navigation"
- Chapter 31, Wisconsin State Statute, "Regulation of Dams and Bridges Affecting Navigable Waters"
- Chapter NR 103, Wisconsin Administrative Code, "Water Quality Standards for Wetlands"
- Chapter NR 347, Wisconsin Administrative Code, "Sediment Sampling and Analysis, Monitoring Protocol and Disposal Criteria for Dredging Projects"
- NR 500, Wisconsin Administrative Code, "General Solid Waste Management Requirements"

Chapters 30 and 31 of the Wisconsin Statutes require written permits for certain activities on or near a waterway, such as dredging bed materials from a lake or stream. Some examples of bed materials include muck, sand, gravel, silt, loam, stumps, logs, etc. A lake-dredging permit application packet can be obtained from the WDNR Water Management Specialist in Columbia County. The permit application packet contains the WDNR *Application for Lake Dredging, State/Federal Application for Water Regulatory Permits and Approvals, and a Fee for Decisions on Applications to Alter Lakes, Streams or Wetlands.*

Prior to submitting the required applications for a lake-dredging project, it is necessary to contact the county, city, or village zoning department to find out whether the project is in either a mapped wetland or floodplain and whether local zoning restrictions could affect the project (WDNR, 2001e). Because the Columbia County Zoning Department does not have jurisdiction over dredging, it does not require a permit. However, the Columbia County Zoning Department does have jurisdiction over the disposal of spoils in agriculturally zoned areas. The Columbia County Zoning Department would require the PLMD to obtain a conditional use permit for the disposal of lake spoils on agricultural land in the county (M. Stapleton, Columbia County Zoning Department, verbal communication, 2001).

Depending on the type of waterbody, additional permits for a dredging project may be required from the U.S. Army Corps of Engineers. The Corps has two main regulatory programs: 1) Section 10 of the Rivers and Harbors Act of

1899, and 2) Section 404 of the Clean Water Act. Section 10 requires that a U.S. Army Corps of Engineers permit be obtained to conduct work "in, over, or under a Navigable Water of the U.S." (U.S. Army Corps of Engineers, 2001). A United States navigable water is classified by its historical, present, or future transportation capabilities for interstate commerce. These waters typically include many of the larger rivers and lakes, such as the Mississippi River and Lake Superior. Under Section 404, a U.S. Army Corps of Engineers permit is required for the discharge of dredged material into United States waters. A Corps permit would most likely not be needed for a dredging project in Park Lake because neither Park Lake nor the Fox River, near Pardeeville, is classified as Section 10 waterway. Moreover, the disposal of dredged material from Park Lake would probably take place on land, not in another waterbody.

Before a permit is granted for a lake-dredging project by the WDNR, it needs to be reviewed by the Columbia County Water Regulation and Zoning Specialist (D. Hunt, WDNR, verbal communication, 2001). It is important to note that if the proposed dredge area is a wetland, floodplain, or other sensitive habitat, a permit will most likely be denied (WDNR, 2001m). If the proposed dredging project is less than 3,000 cubic meters (about 9,900 cubic feet), it does not require a public notice. However, if the amount of bed material to be dredged is greater than 3,000 cubic meters, the proposed dredging project will require public notice. Furthermore, an Environmental Assessment Supplement must be submitted to the WDNR (WDNR, 2001m).

Compared to other in-lake management activities, dredging can be expensive. Total costs depend on an array of project parameters: consulting fees, access to sediment, dredging equipment, personnel, sediment characterization, distance to the disposal site, disposal site fees, etc. According to Peterson (1981), costs can range from \$0.18 cubic yard to \$10.71 cubic yard. (These figures are based on the 1975 dollar.) Costs can also be calculated per acre. According to the Park Lake Development Committee (1990), cost estimates for dredging projects in Wisconsin range from \$15,000 to \$25,000 per acre. If these values were to be multiplied by the total surface area in Park Lake (312 acres), the cost would range from \$4,680,000 to \$7,800,000.

Dredging recommendations for Park Lake

Dredging may not be the most feasible in-lake management technique for Park Lake. First of all, as indicated earlier, internal loading is not a main contributor of phosphorus to the lake. Instead, the main contributor of phosphorus in Park Lake is surface runoff from the surrounding watershed (Kammerer, 1996). The removal of a large quantity of lake sediment, therefore, would most likely have a negligible impact on the level of phosphorus and other nutrients in the lake. One of the ways to help determine the longevity of a dredging project is to compare the ratio between the watershed area and the lake surface area. Typically, the smaller the ratio of the watershed is to the lake surface area, the longer the benefits (Peterson, 1982). The ratio of the Park Lake watershed area (2,187 acres) to the Park Lake surface area (312 acres) is moderately high (110:1). Unless runoff from the surrounding watershed is mitigated, dredging will only serve as a temporary solution in Park Lake. Other reasons against dredging the entire lake are the unpredictable results and the exorbitant costs. Therefore, we highly recommend that if the PLMD selects dredging as an in-lake management solution, it opts for selective dredging.

Selective dredging entails removing sediment from specific locations in the lake on the basis of certain management objectives. For example, one objective may be to remove sediment from the beach to enhance swimming and tubing. Another objective may be to deepen sections of the lake for recreation. One of the main benefits of selective dredging is that it is more economically viable for the PLMD. Other benefits include less interference with recreational uses of the lake that larger dredging projects can impose. Finally, selective dredging creates less disturbance and sediment re-suspension.

Selective dredging for in-lake barriers

The function of an in-lake barrier is to help minimize the continual process of sediment accumulation in Park Lake. The barrier, similar to a dike or berm, would deflect inflow from the Fox River so that the inflow would follow a course down a channel along the south shore of the lake to the upper dam. This channel, transporting water at a greater rate, would allow sediment to remain entrained and be carried over the dam without deposition in the main lake area.

Examples of existing in-lake barriers that serve a similar purpose in impounded waters are rare. However, a proposed project on Lake Belle View, in the village of Belleville, Wisconsin, offers some insight about the potential effects such a barrier might have. The proposed Lake Belle View barrier would effectively close off the lake from the river channel with the exception of an access gate that allows passage between the two water bodies. For more information about this project, see the 1995 Water Resources Management report (WRM, 1995).

Potential advantages of in-lake barriers include the following:

- manipulation of water level in the main basin via access gates,
- wetlands restoration,
- improved water quality,
- increased recreational opportunities,
- improved control of rough fish population,
- creation of new habitat for game fish, and
- increased property values on the lakeshore.

However, the potential advantages of an in-lake barrier must be balanced by considering the potential disadvantages of such a project. Overall, the costs associated with in-lake barriers are very high, and considerable financial planning for Pardeeville would be required, especially with attached dredging costs. In-lake barriers are highly manipulative of natural systems by altering the flow of water and the hydrology of lakes. Flow into the main basin area can be reduced, allowing algal blooms to occur; natural habitat is disrupted during berm construction and can be permanently impacted; berms can fail on compressible foundation sediments; and shoreline erosion can take place in the created channel. Furthermore, a significant amount of research is required to determine the necessary channel gradient, barrier height, and ideal dredge locations.

Knowledge of two main regulatory processes is essential before construction of an in-lake barrier. Each requires a permitting process by law. On the state level, an "Application for Miscellaneous Structures" is required by the WDNR to receive a permit for an in-lake barrier (WDNR, 2001m). Also of primary importance is Chapter 30.12, Wis. Stats., which addresses structures and deposits in navigable waters and contains specific language regarding legal information and permitting (WDNR, 2001f). Federal law also requires a permit application for the use of dredge and fill material within a lake; this falls under Section 404 of the Clean Water Act regulated by the U.S .Army Corps of Engineers (U.S. Environmental Protection Agency, 2001).

Dredging for the Rushes Golf Course and marsh restoration

The rendering shown in figure 2.1 ("The Rushes") is a golf course landscape concept created for the eastern end of the lake. Bob Boucher (WRM) developed the concept and Matt Porges, a landscape architect, drew the rendering. The west end of the lake in this rendering is deeper than it is now and has been sewered. The lake would have to be drawn down and the west end dredged to remove accumulated sediment; the dredged sediment would then be used to build the golf course. The lake would be refilled to approximately 88 acres. The 18-hole golf course design is 170 acres and modeled after "The Bog," a championship course near Cedarburg, Wisconsin. The Bog, designed by Arnold Palmer, is highly successful. It is unique in the way it utilizes its marsh setting.

Constructing a championship golf course could attract additional investment into the area. Property values around golf courses and lakes traditionally are high. However, the loss of the lake for residents of the eastern side would probably be traumatic. Water rights for those citizens could be maintained by providing lake access for all residents who "lost" frontage through a marina for their boats. A swimming area could also be created in this new, improved Park Lake.

The Park Lake community has the option of creating a "green" golf course that reduces the use of commercial fertilizers and pesticides, thereby decreasing nutrient loading into the lake and Fox River. Furthermore, the groundskeepers could incorporate native plants into the landscaping, which could enhance the natural integrity of the golf course.

Biomanipulation

Biomanipulation is another option for managing some of Park Lake's problems. The term is used to describe a variety of management practices, all of which are used to manage aquatic communities through the control of natural populations of organisms (Gophen, 1990). Biomanipulation includes water-level management, chemical methods, and mechanical methods for management of turbidity, vegetation, and fish populations.

Biomanipulation is done to improve water quality of aquatic systems and in many cases follows large-scale sediment removal in a lake and nutrient management in a watershed. The most essential goal of biomanipulation is the creation of a desirable and sustainable ecosystem (Sagehashi et al., 2000).

The total phosphorus load to Park Lake, as documented during a 1993 field study, might be too high to use biomanipulation strategies successfully (Kammerer, 1996). However, the rainfall and runoff during this period was anomalously high and not likely representative of current loadings. Contrary to our own expectations, we found the upper watershed to have low erosion vulnerability.

The results of biomanipulation vary widely, depending on the characteristics of the lake in question. A great deal of fieldwork done by experts in biomanipulation is necessary to properly assess the potential results of this management alternative. It would be misleading to estimate the response of Park Lake to biomanipulation without the evaluation of these experts. It is imperative to work closely with the WDNR in this process of field evaluation and management planning. However, this should not prevent the people of the PLMD from pursuing the possibility of using this alternative because it could be an effective and economical way to treat the problems of Park Lake.

Methods of turbidity control

Water-level management is useful in decreasing the amount of suspended sediment and thus turbidity in lakes. When a lake is drawn down and bottom sediment is exposed to the sun, the sediment consolidates. Muck-type sediments, as are found in Park Lake, have been found to consolidate from 40 to 50 percent with exposure to sun and rain. Consolidated sediments have been found to remain firm after lake levels are brought up again, although groundwater seepage can interfere with this. A possible negative effect of exposing the sediments is a release of nutrients into the water upon reflooding due to the oxidation of exposed organic matter. However, experimental evidence for this is variable (Cooke et al., 1993).

Methods of vegetation control

Like many impoundments, Park Lake has a his-

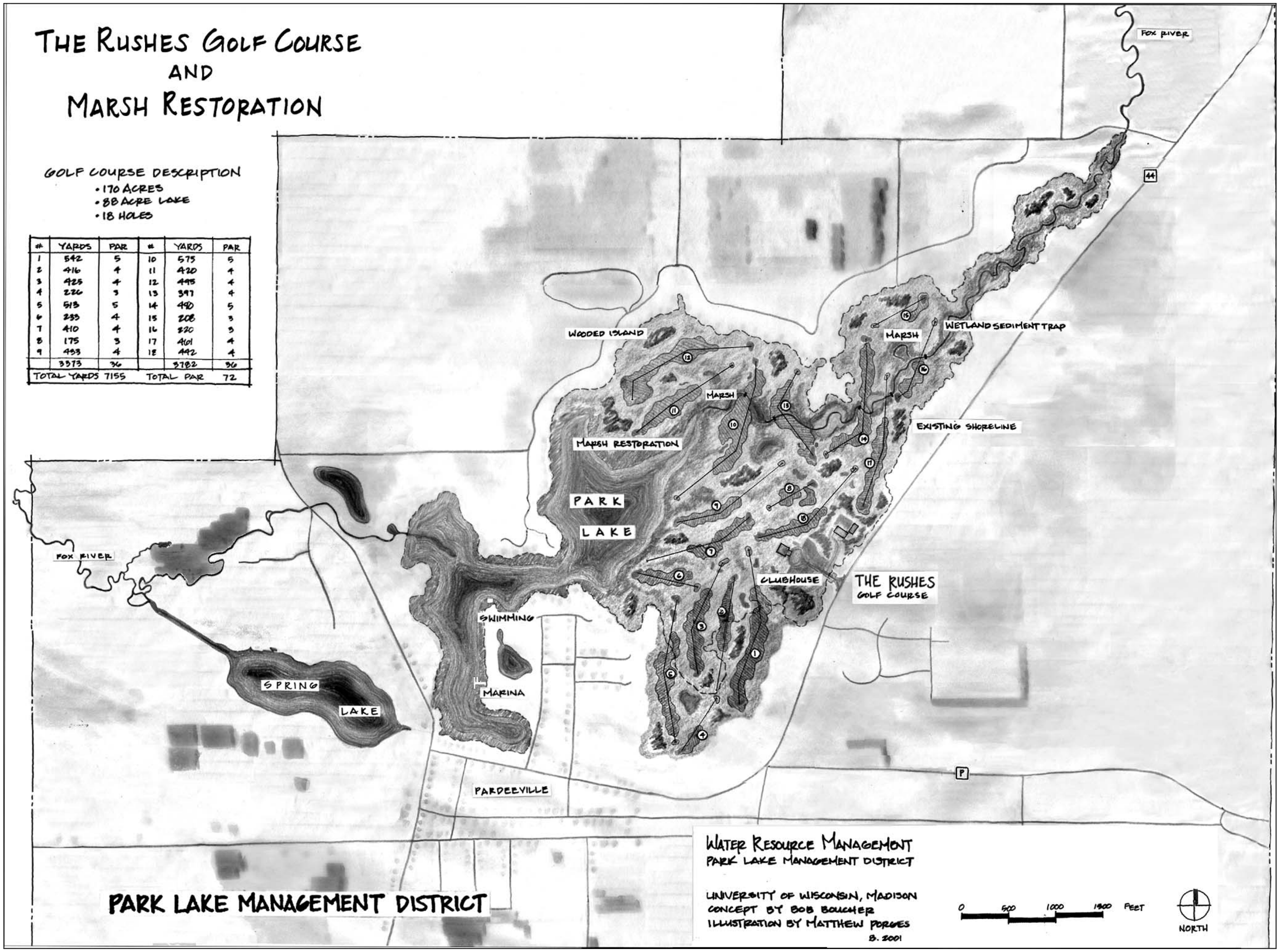

Figure 2.1. *Rendering of The Rushes Golf Course. The rendering shows a landscape architect's view of a marsh-land golf course created in part from selective dredging of Park Lake and the manipulation of its sediment. The rendering is in no way intended to be a finalized guide for construction, but rather a starting point upon which to base further thoughts about this lake management option.*

tory of excessive aquatic vegetation and algae growth. Although the intensity of these occurrences has fluctuated in recent years, several management options may be considered for implementation.

Aquatic plants are an important component of a lake ecosystem. They provide nesting sites, shelter, and food for many organisms as well as increased oxygen concentrations in the water body and sediments. Aquatic plant communities can also absorb nutrients and help stabilize sediments and reduce shoreline erosion.

In certain circumstances, aquatic vegetation may become a nuisance to lake users or may include invasive plant species. In these cases where excessive plant growth is impacting recreational or aesthetic enjoyment and wildlife habitat, harvesting of vegetation may be recommended.

Lake drawdowns

Water-level management alone can be used to manipulate lake vegetation. Drawdowns can be done for the purposes of killing nuisance vegetation or stimulating desired aquatic plant growth.

Drawdowns to kill nuisance vegetation. Drawdowns intended to rid the lake of nuisance vegetation should expose the plants, especially their root systems, to dry, hot, or dry and freezing conditions for a period long enough to kill the plants (Cooke et al., 1993). Lake drawdowns for killing plants can be carried out in winter or summer. Wintertime drawdowns that are done before ice develops on the lake will expose plant roots, which then freeze. Later, during the spring thaw, the bottom sediments may be scoured by ice moving through the lake (WRM, 1995). Summer drawdowns can expose plant roots to hot, dry conditions that kill nuisance plants. For the purpose of killing plants, winter drawdowns appear to be more successful than those in the summer. In the winter, there is no threat of invasion of exposed lake soil to semiterrestrial plants or proliferation of aquatic emergent plants. There is also much less impact on recreational activities on the lake in the winter (Cooke et al., 1993).

Drawdowns to stimulate desired aquatic species growth. Summer drawdowns can also stimulate the growth of desired vegetation in a lake. Studies have shown that the existence of aquatic macrophytes can improve water clarity, reduce phytoplankton (algae), reduce nutrients, and reduce resuspension of sediments (Scheffer, 1999). Vegetation that has not been able to grow in Park Lake because of the very turbid conditions may be able to grow in places where the water depth is decreased to allow more sunlight to reach the bottom. Portielje and Van der Molen (1999) found that improvement of water transparency is critical to the recolonization of submersed macrophytes to recover eutrophic aquatic systems. In some cases, full exposure of the bottom sediments is necessary. Exposure of the littoral zone, or shoreline, results in the germination of aquatic vegetation seeds. Once plants start to grow, the water levels can be returned to normal. In areas where total exposure does not occur, increased light penetration may still stimulate macrophyte growth (Scheffer et al., 1993).

According to Hosper and Jagtman (1990), 25 percent or more of a lake should contain diverse vegetation to maintain water clarity. Drawing down the lake level will not only fully expose some sediment, but will also allow light penetration to the lake bottom in areas that that otherwise do not receive light. The amount of vegetation that will be established with any prescribed drawdown cannot be determined exactly, but upper and lower limits of drawdown for a desired vegetation scenario can be estimated.

However, it has been noted that the recovery of macrophytes following biomanipulation has often been slow and erratic. The impact of grazing birds and the stability of the sediments have been identified as constraints to submerged macrophyte recovery in soft-sediment lakes (Madgwick, 1999; Strand, 1999).

If the drawdown is successful and desired aquatic growth takes root, water quality will continue to improve. As stated earlier, water clarity improves lake vegetation, but vegetation improves lake clarity. Thus, both a turbid lake state and a vegetated lake state are self-reinforcing (Scheffer et al., 1994). The recovery of macrophyte communities following lake biomanipulation is recognized as being the key to stabilizing water-quality conditions (Madgwick, 1999). Whether a lake retains its water clarity after biomanipulation seems to a large extent to depend on the development of submerged vegetation following restoration (Strand, 1999). The aquatic plants appear to provide important habitat for zooplankton and may also offer a refuge from fish predation (Jeppesen et al., 1999; Phillips et al., 1999; Strand, 1999; Zalewski, 1999). In addition, algal growth can be diminished by the uptake of phosphorus from the water and sediment by the aquatic vegetation.

Plant response to drawdowns. Different plant species can be expected to respond to lake drawdowns in different ways. Data from Nichols and Vennie (1991) about Wisconsin lake plants and their characteristics can be used to determine how certain species may respond. Additionally, they provided data about nuisance potentials, sediment stabilization, and food and habitat provided to wildlife. Some plants may not thrive due to ice, waves, or fluctuating water levels (Nichols, 1992). Eurasian milfoil, which is a problematic invasive plant in Park Lake (Roberts, 2001), can be controlled by winter drawdowns as long as the soil is exposed for several weeks. Because of its reproductive capabilities, it can also recolonize quickly in places where native plants are not dominant (Cooke et al., 1993).

Mechanical and chemical aquatic vegetation control

Aquatic plant harvesting is used to keep a body of body open for recreation and navigation and to discourage the spread of exotic species. Vegetation harvesting methods can include mechanical, manual, chemical, and biological processes.

The aquatic vegetation in Park Lake has been mechanically harvested in the past, and the PLMD has even considered the possibility of purchasing a plant harvester. At present, this decision is on hold because the aquatic vegetation growth in recent years has not been excessive. If aquatic plant growth becomes a nuisance again in the future and activities such as fishing, swimming, and boating are restricted, harvesting may be necessary to maintain open channels for navigation purposes and to reduce growth in pier and dock areas.

Manual removal of vegetation, including pulling or cutting by hand or rake, does not require a permit, provided that the plant fragments are collected and removed and rare or endangered species are undisturbed (WDNR, 2001n). Mechanical harvesting with conventional equipment also does not require a WDNR permit. Harvesting should not be attempted in depths of less than 3 feet to avoid resuspending bottom sediments (WDNR, 2001n). At this time, because the majority of aquatic vegetation in Park Lake occurs at this depth, mechanical harvesting is not recommended. The use of bottom barriers to inhibit aquatic vegetation along docks and in swimming areas requires a WDNR permit (WDNR, 2001n).

Chemical treatment of aquatic vegetation requires an approved permit from the WDNR (WDNR, 2001n). Only six chemicals are approved for this use in Wisconsin (S. Graham, WDNR, verbal communication, 2001). Lake shoreline property owners must contract with a licensed applicator to apply liquid chemicals to water. Chemical treatment is usually specific to plant type and requires certain lake-use restrictions (WDNR, 2001n).

Vegetation removal methods can vary widely in cost, effectiveness, and environmental impact. An aquatic management plan should balance these concerns in an attempt to meet the needs of the lake community and at the same time preserve the health of the ecosystem (Gibbons et al., 1994). In addition, the management of aquatic plants should be done in a manner that preserves and protects a healthy and diverse population of native plant species (S. Graham, WDNR, verbal communication, 2001).

The local WDNR Aquatic Plant Manager may be contacted for additional information regarding aquatic vegetation removal, permit requirements for chemical treatments, or general vegetation management. The WDNR protects native aquatic vegetation and regulates their removal in certain cases.

Algae control with barley straw. The use of barley straw as a management option to control algae was brought to our attention by members of the PLMD as an alternative they were interested in learning more about. Decomposing barley straw has been associated with phytoplankton (algae) control in many shallow surface waters, such as small lakes, drainage ditches, reservoirs, and ponds. Although the precise chemical mode of algal suppression is still being determined, it is thought that the straw generates inhibitors during aerobic decomposition in water (Ridge et al., 1999).

As the straw decomposes in the water, different chemicals in its cells break down at different rates. The lignin in the cell walls is slowly released into the water. Under oxygenated conditions, the lignin is oxidized to humic acids. When sunlight shines into oxygenated waters that contain humic substances, hydrogen peroxide is formed. Low levels of peroxide are known to inhibit algal growth. Although peroxides will only last in the water for a short time, they will be continuously formed when humic acids are present with sufficient sunlight (ACR, 2001). It is thought that because barley straw decomposes slowly and gradually releases lignin over a long period, prolonged anti-algal activity is seen (Ridge and Pillinger, 1996).

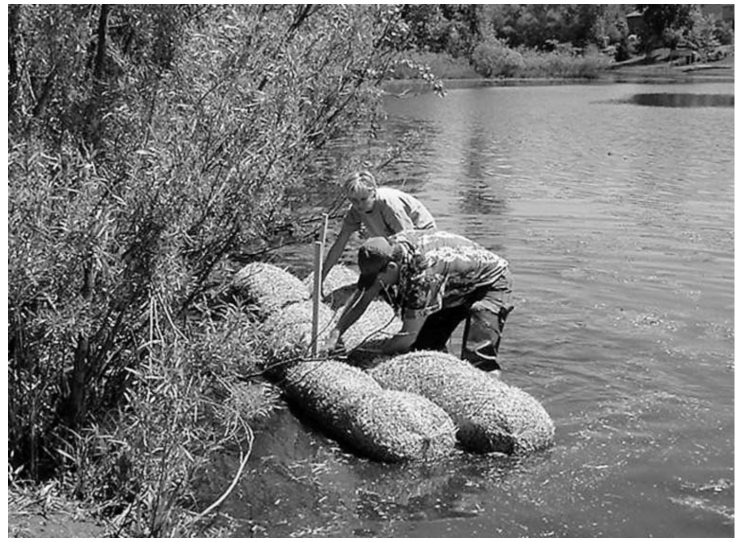

Figure 2.2. *Barley straw being installed at South Twin Lake in Burnsville, Minnesota (courtesy of Leslie Yetka, City of Burnsville Natural Resources Department).*

Straw bales are placed in nets or cages and applied near the surface of the water (fig. 2.2). Inhibition of algae growth is most effective if the bales are applied early in the season before algae growth occurs and if the straw is located in areas where there is water movement near the surface, in well oxygenated conditions.

The use of barley straw may facilitate a switch from algal to macrophyte domination in shallow water bodies (Ridge et al., 1999) because the suppression of algal blooms may allow recolonization by vascular aquatic vegetation. The new plant growth could subsequently compete with and further reduce algal growth (Barrett et al., 1996).

To determine whether the application of barley bales would be appropriate for Park Lake, several points should be considered. Suitable locations must be identified for the placement of barley straw. The requirement of well oxygenated water may limit their possible placement, and the bales could create conflicts with other lake users. Homeowners are required to obtain a permit before placing anything in public water (S. Graham, WDNR, written communication, 2001). Also, the use of barley straw requires a substantial management effort for general maintenance and upkeep as well as a monetary commitment to supply new straw for continued effectiveness.

Although the use of barley straw to control algae has been considered safe, certain potential disadvantages should be considered. Barley straw use is still considered experimental and is not a commonly used management technique in Wisconsin water bodies. Controlled experiments to date have failed to demonstrate broad spectrum effectiveness (S. Graham, WDNR, written communication, 2001). In addition, although the range of algal species whose growth is inhibited by barley straw is wide, different sensitivity by certain species could influence the relative abundance and seasonal presence of nuisance algae (Ridge et al., 1999). Also, because the straw ceases to be anti-algal after a period of approximately six months, considerable effort is required to gather and dispose of the straw, and straw residue could accumulate on the lakebed.

The application of barley straw may be most appropriate and effective only as a short-term strategy during the formation and implementation of a comprehensive nutrient management plan (Ridge et al., 1999). To obtain continued reductions in algal growth, we recommend that the long-term management of eutrophic water bodies include a concentrated effort to reduce nutrient inputs.

Methods of fish control

Park Lake's current status as a hypereutrophic system is due in part to its carp population. Carp are benthivores, fish that feed on the small organisms that inhabit the bottom silt of lakes and streams (Becker, 1983). They were introduced into many waters of the United States in the late 1880s as a possible food fish, but they were shown to be unfavorable and destructive to many native species of fish and macrophyte populations (Boschung et al., 1983; Becker, 1983). The feeding habits of carp are to blame: They search through the silt to find food, and in the process, suspend sediments and detach the roots of plants (Winkelman, 1995; Meijer et al., 1990). Carp prefer shallows waters, such as Park Lake; they increase their population by overwhelming other species and become damaging to the lake itself (Boschung et al., 1983; Becker, 1983). Carp are also very tolerant of warm waters and low dissolved oxygen levels, giving them an advantage over other, more valuable sport fishes (Mitsch and Gosselink, 1993). Although they are not the direct cause of Park Lake's highly eutrophic state, the carp exacerbate the situation with their actions.

A decrease in algal biomass can be achieved by reducing the number of benthivorous and planktivorous (zooplankton-eating) fish. A reduction in the planktivorous fish population will most likely result in an increase in the number of large-bodied zooplankton. These zooplankton will help to control the algal biomass through increased grazing pressure. In addition, by removing the benthivorous fish the turbidity of the system will decrease because the bottom sediments are no longer disturbed or suspended by bottom foraging.

A series of manipulations can be performed to promote certain interactions between aquatic organisms and achieve specific water-quality results (Shapiro, 1990). In most cases where fish populations are managed, the primary result is a reduction in algal or phytoplankton biomass. The removal of fish creates a top-down effect on the trophic cascade (food web) and has been used in many lakes to improve water quality (Jeppesen et al., 1999; Phillips et al., 1999). The removal of fish using biomanipulation can involve the simultaneous performance of lake drawdown and mechanical and chemical methods.

Management alternatives incorporating lake drawdown

A lake drawdown in Park Lake is the most plausible way to control the carp population and restore more suitable fish species as well as aquatic vegetation habitats. By placing an obstruction at

Table 2.1. *Advantages and disadvantages of using rotenone on the Park Lake system for the removal of carp and shad (modified from Finlayson et al., 2000).*

Advantages	Disadvantages
1. Control method for total elimination of carp and other unwanted fish species.	1. Short-term loss of drinking and recreational water use.
2. Can be used in a flowing system.	2. Short-term impacts on habitats for other aquatic life forms.
3. Results are soon observed.	3. Effects can be considered foul by humans.

the inflow of the Fox River before the drawdown, a large percentage of the carp and shad would be trapped in the lake water, and the drawdown would then begin. By opening the gates of the two dams, the water level would be lowered, confining the fish to the deepest sections of the lake.

Mechanical removal. One option is to ensnare the carp live with the use of nets. To do this, the drawdown would have to be low enough so that the fish would be in accessible pools to be caught. Certain companies, such as Aquatic Engineering, can study the lake and determine whether carp removal is a possibility (Britton, 2001). After the survey of the situation is completed, they are then able to trap and remove the carp from infested waters (Britton, 2001).

Chemical methods. Another option is to use the poison rotenone. This option does have various side effects that the lake managers and community members will need to evaluate before deciding upon its use. Rotenone is a substance lethal to only those organisms with gills, causing them to become unable to uptake oxygen into the organisms' bodies. Other animals should not be allowed to drink the affected water, due in part to possible undesirable effects. Rotenone does not affect fish eggs, which is why the drawdown should be done before the spawning season of carp and shad begins in April (WRM, 1995; Boschung et al., 1983). The rotenone must be employed in a particular concentration related to the water's temperature, turbidity, volume, and pH, and the application must be approved by the WDNR (WRM, 1995; Finlayson et al., 2000). Once it has been applied, the rotenone must be allowed to spread throughout the remaining water to affect all organisms with gills. After the fish in the lake have succumbed to the rotenone, their bodies must be removed and disposed of according to the WDNR standards (WRM, 1995). In table 2.1, the advantages and disadvantages of using this chemical are shown.

The EPA has named rotenone a restricted-use chemical because of its potential effects on humans through inhalation and/or oral contact. This is why only certain individuals (employed by government resource agencies or those private citizens who are granted permits by such agencies) are allowed to apply the chemical in the environment. Two other main considerations for rotenone use are the suitable disposal of the rotenone containers and the release of water for drinking and irrigation. Because Park Lake is in the headwaters of the Fox River, rotenone use can have serious implications for downstream residents. Other sources of water would need to be found during the time the rotenone is detectable in the water. This is why all proper authorities should be contacted before rotenone is applied. Some of the Park Lake restoration would use state funding, so an environmental impact statement would also need to be completed (Finlayson et al., 2000). Once the rotenone is dispersed in the system and has had a proper time to dissolve, the fish can be removed with assistance from the WDNR and disposed of properly.

Restocking with desirable fish. Once the carp and other affected fish have been removed, the draw-

Table 2.2. *Regulations regarding biomanipulation*

Type of biomanipulation	Wisconsin Statutory Code	Permit and Environmental Assessment (EA) Requirements	Administrative rules
Carp removal	Chapter 29—Removal of Injurious Rough Fish	Permit and EA required	
Lake level management	Chapter 31—Regulation of Dams and Flowages	Permit and EA required	NR 102-104 Water QualityStandards for Wetlands and Wisconsin Surface Waters
Rotenone application	Chapter 144—Public Health/Pollution	Permit and EA required	NR 102-104 Water Quality Standards for Wetlands and Wisconsin Surface Waters

down can end. Because the sediment was allowed to settle and to be exposed to the sun, new macrophytes can be introduced. As soon as the aquatic vegetation management has been completed, the lake can be returned to its normal level. Desirable species of fish can then be stocked in Park Lake, and water will be clear. However, to ensure this, nutrient loading from upstream sources must be properly managed.

Management alternatives without lake drawdown

Mechanical removal. Two options for catching fish exist without drawing down the lake. The first is to have commercial anglers travel to Pardeeville to trap the fish. This takes time and money and may inhibit sport fishing on the lake. The chances that the anglers would be able to capture all the carp and shad are low. A second option is to encourage local anglers in the area to catch the fish to promote lake health. This does not guarantee a 100 percent catch either, and it could take up much time and resources.

Chemical methods. Rotenone can be used for carp removal without a drawdown. Prentiss Incorporated has developed a system of delivering rotenone directly to the nuisance fish (Prentiss, 2002). Carp are trained easily, so it does not take long to get the carp ready for removal (Boschung, 1983; Prentiss, 2002). Using non-lethal bait in a specially built retention ring, carp can be brought to the surface to feed, and after only a short time the lethal bait can be used (Prentiss, 2002). This particular bait is inundated with rotenone and is only released upon entering the stomach of the carp. It then flows into the bloodstream and disrupts the fish's oxygen uptake (Prentiss, 2002).

This is more advantageous than using rotenone throughout the lake because a drawdown is not needed and sport fish are unaffected. However, there is always a possibility that not all of the carp and shad will eat the lethal bait. Multiple treatments may be necessary to remove more of the nuisance fish. In addition, this method does not work well in the flowing waters of a river, so the carp that have moved into the upstream waters of the Fox River may need to be removed in a different way.

Public involvement

For integrated and sustainable lake management, increased ecological awareness must be combined with participation of the local population (Kairesalo et al., 1999). It is important to inform the public of management plans and gain support for restoration efforts. Lake drawdowns can be very controversial, and a public hearing is recommended. It can take many meetings to ensure that the viewpoints of all stakeholders are considered (P. Cunningham, WDNR, verbal communication, 2001). In addition, effective zoning of watercraft traffic may be suggested or justified to reduce the effects of boat-induced turbidity and to increase macrophyte regeneration.

Table 2.3. *Advantages and disadvantages of various methods of biomanipulation*

Management technique	Advantages	Disadvantages
Fish management	Detrimental fish can be removed and desirable fish can be restocked	May require a lake drawdown; removal and disposal of fish costly
Water-level management	Establishment of macrophytes creates habitat for fish and zooplankton	Requires a lake drawdown; does not address issue of rough fish
Barley bales	Creates habitat for zooplankton; may improve water clarity; relatively inexpensive	Experimental; temporary solutionto algae blooms; does not address issue of rough fish

Recommendations for pursuing biomanipulation

The best way to use biomanipulation effectively is to have a comprehensive plan to control turbidity, vegetation, and fish. Table 2.2 shows the regulations that need to be followed for various methods of biomanipulation, and Table 2.3 presents a summary of the various advantages and disadvantages for each method of biomanipulation. Because turbidity, fish, and vegetation are interconnected in a lake system, all three must be controlled together, or the management effort has little chance of having lasting results. Our recommendations for this type of integrated management scheme are to reduce nutrient loads from the entire Park Lake watershed contact the WDNR to arrange for extensive field evaluation.

Paul Cunningham of Fisheries Management in the WDNR can be contacted for advice in water-level management and other biomanipulation implementation at Park Lake (address: WDNR, 101 S. Webster, Madison, Wisconsin 53703; telephone: 608/266-2621).

Dam removal

The problems presented by Park Lake are hardly unique. Many of the mill ponds of Wisconsin are having severe problems with eutrophication and sedimentation. Some communities have chosen dam removal to solve their problems. This information about the dam removal process is provided so that informed decision-making can take place should future circumstances make this a viable alternative for the Pardeeville community.

Background

A dam structure changes the water above it from a lotic (moving) to a lentic (stagnant) environment. In the pool behind the dam, nutrients, debris, and sediment build up, phytoplankton productivity increases, and fish migration is blocked (Baxter, 1977). Temperature is also affected (Baxter, 1977). During the summer, warmer water becomes trapped in the upper surface layer of the lake and is not released to the river. In the winter, heat enters the river from the lake's outflow. As a result, the water below the dam is cooler in the summer and warmer in the winter, and these abnormal temperature changes affect the type of organisms that thrive there (Baxter, 1977).

Nearly all of Wisconsin's river ecosystems have been significantly altered by dams. At one time, the state had about 3,700 dams (Gebken et al., 1995) on almost 33,243 miles of flowing water (Becker, 1983). Even though the majority of dams in Wisconsin were classified as small ones, with a height under 33 feet, their cumulative impacts are measurable (Kanehl et al., 1997). In the 1800s, these dams were mainly built for hydropower (Mecozzi et al., 1991). Most of them now provide communities with flood control, recreational sources, and scenery (Gebken et al., 1995). Several of Wisconsin's dams are old and in need of repair, but maintenance may be more expensive than their actual value (Kanehl et al., 1997). Furthermore, they may no longer be as beneficial to humans. In many cases, the reservoirs have filled with sediment from decades of erosion, creating an undesirable waterbody for recreational activities (Kanehl et al., 1997). They are also responsible for reducing the state's game and non-game fish populations (Becker, 1983) and threatening the survival of other aquatic species (Gebken et al., 1995). Research has shown that dam removal can improve a river's habitat, fishery value, and biotic integrity (Kanehl et al., 1997). In addition, flood control can in many cases be accomplished more effectively and for less money by restoring wetlands, maintaining riparian buffers, or helping homes and business relocate out of the floodplain (River Alliance of Wisconsin, 2001). For all the reasons mentioned above, the state of Wisconsin supports dam removal projects as a means to restore its river ecosystems (Pajak, 1992).

The only answer that will fully solve the problems presented by Park Lake is removal of the dams that form it. This option may not be the most desirable to the residents of Pardeeville for historical and aesthetic reasons. Nonetheless, it must be presented because it is the best sustainable ecological alternative. The restored flow rates and cooler water temperatures would eliminate the problems of algal blooms and sedimentation. Native fish populations would benefit; the carp population may diminish for lack of warm-water habitat.

In the long run, dam removal is also the most economical alternative for the PLMD. Continued repair and maintenance costs of the dam and reservoir would be eliminated. Although it would not solve several watershed problems such as phosphorus loading and high turbidity, the problems would no longer be in Pardeeville—they would simply flow through on their way to the river's next point of retention.

The water quality of Park Lake is very poor by almost all known standards. Much of the origin of the poor water quality is from the contributing watershed. Eroded sediments and nutrients generated by upstream agriculture are washed into the river. The lake formed by the dam is not what it once was; the ecological system has changed dramatically.

The retention of water in Park Lake has created an area into which sediment and nutrients drop out of the river water before it continues on its path. The combination of warm water and nutrient deposition is the primary cause of the unsightly algal blooms. As time has progressed, sedimentation has increased, depth has decreased, and the environment has only become warmer. This warm water habitat is not only more conducive to algal blooms, but provides ideal breeding grounds for carp populations while deterring inhabitation by native fishes.

If citizens could be persuaded as to the ecological integrity of dam removal, the process could take place in stages to ease the transition. Opening the dams prior to their removal would reestablish the natural streambanks and vegetational patterns and allow for human adjustment to a "running river" setting before complete dam removal. A number of scenarios could result in preservation and enhancement of property values and recreational opportunities.

Community perspective: Common sources of opposition to dam removal

Communities usually have strong ties to the reservoir behind the dam. Even though the Park Lake dams are not serving their original purpose and will eventually degrade, local residents may oppose removing them because of their potential loss in historical, present-use and property values as well as concerns about contaminated sediment being discharged downstream.

Historical value

The village of Pardeeville was established after the Fox River was dammed for a mill operation. Although the Park Lake dams no longer serve that function, they are a visual reminder to residents and visitors of their historical significant to Pardeeville. Some residents, particularly older ones who were around during the mill days, may be concerned that Pardeeville will lose its heritage if the dams are removed. The PLMD may be able to alleviate their concerns by creating a museum display that includes a background piece on the mill operation, photos of the dams, and stories from residents.

Present-use value

A community's desire to maintain the present values associated with the reservoir is a typical argument for keeping a dam. People generally enjoy the view of open water and the opportunities it provides for recreation as well as observing nature. Surrounding residents may not want to lose a main feature of their community's landscape, even if it is degraded. The survey results reflect that the recreational value of the lake is high for many local residents. Park Lake hosts the village's only major park, which includes a swimming beach. Residents and visitors also enjoy using the reservoir for boating, canoeing, jet skiing, and fishing. If the dams are removed, the community's recreational opportunities will change from those associated with lakes to those associated with streams and wetlands. People who primarily use Park Lake for swimming, boating, and jet skiing may oppose dam removal because they will lose their source of recreation in Pardeeville. The PLMD may need to promote stream and wetland recreation by sponsoring a community workshop on activities such as canoeing and bird watching.

Shoreline property value

Park Lake residents may be concerned about the loss of property values after dam removal. However, no concrete evidence is available to suggest that dam removal greatly affects property values, especially in combination with proper land-use management.

An 1834 land survey indicates that the area that is now Park Lake was a marshland (Board of Commissioners of Public Lands, 1851; fig. 2.3) that may have been characterized by deep water (R. Grasshoff, WDNR, 2001). According to the Wetland Classification by the U.S. Fish and Wildlife Service, a deep freshwater marsh has soil covered with 15 centimeters to 1 meter of water (Mitsch and Gosselink, 1993). Dam removal may not necessarily decrease property values, especially if an alternative natural and/or recreational space is created. Other land-management options are discussed in the *Land-use considerations* section in this chapter.

Environmental concerns

The sediment trapped behind the main Park Lake dam may contain toxins, such as pesticides and herbicides washed into the reservoir from farmland upstream. If so, the toxic sediment must be dredged before breaching the dam because releasing it would be harmful to the downstream community and ecosystem (Lindloff, 2000). However, dredging is very costly and community members could argue that removing the dams would be more expensive than maintaining them. The actual costs of dam repair vs. dam removal are very site specific, and an accurate estimate of the costs associated with removing this dam would require professional assistance. The PLMD should research funding opportunities for dam removal, which is discussed in the *Dam removal cost* section.

Dam removal regulatory considerations

After a decision has been made to offer the community a permanent solution to the problem presented by the current state of Park Lake, questions of authority must be examined. All relevant governmental entities, identified in this paper in the introduction (chapter 1), must be informed and involved. Fortunately, the dams that create Park Lake are owned by the municipality, which will have already conceded to the community's desire to find a solution that is best for them.

Just as in the decision to construct a dam, several statutes must be consulted and perhaps regulatory permits must be received before the beginning phases of dam removal can be initiat-

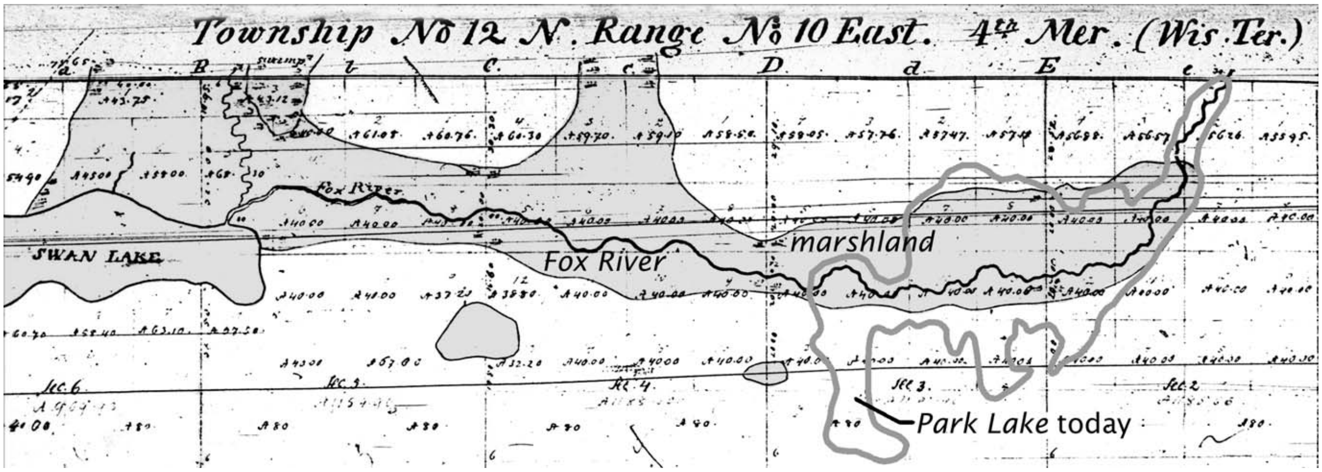

Figure 2.3. *Historical map of the Fox River in T12N, R10E, based on an 1834 land survey. Before the Fox River was dammed to form Park Lake, its riparian area was wholly marshland. It is possible that a significant part of the present location of Park Lake (delineated at right) was once a freshwater marsh and may have contained areas of deep water (modified from Board of Commissioners of Public Lands, 1851).*

ed. It should be clear that at a minimum, dam removal will result in the discharge of sediment into the downstream river. In such a situation, authority to govern such activity is in the hands of the government. The following list of rules and regulations (adapted from WRM, 2000) may come into play in the dam removal decision-making process. Please note that not all of these rules/regulations will apply to every dam decision-making situation. In addition, please be aware that this may not be a comprehensive list.

Wisconsin State Statutes

- Chapter 30, Navigable Waters, Harbors and Navigation
- Chapter 31, Regulation of Dams and Bridges Affecting Navigable Waters
- Chapter 33, Public Inland Waters
- Chapter 60, Town Sanitary Districts
- Chapter 227, Administrative Procedures and Review

Wisconsin Administrative Code

- Chapter NR 103, Water Quality Standards for Wetlands
- Chapter NR 115, Wisconsin's Shoreland Management Program
- Chapter NR 116, Wisconsin's Floodplain Management Program
- Chapter NR 117, Wisconsin's City and Village Shoreland—Wetland Protection Program
- Chapter NR 330, Warning Signs and Portages for Dams
- Chapter NR 333, Dam Design and Construction
- Chapter NR 335, Dam Maintenance, Repair, Modification, Abandonment and Removal Aid Program

Land-use considerations

When a decision is made to remove the dams, plans for land-use activities must be formulated. A large quantity of previously flooded land will now be a focal point of the community and, particularly, of landowners. Community meetings regarding the development of land-use plans for previously flooded areas must be held. The most significant question involving newly exposed surfaces will be determining the ownership of such parcels. It is possible that the dam owner purchased the land to be flooded at the time of construction, that the land is owned by current adjacent landowners, or that the land is owned by someone who sold the adjacent land and never sold the flooded land and is now dead. Research must be conducted to determine ownership.

Impacts on property values caused by dam removal and the condition of the dam and impoundment are common concerns that should be addressed within the community.

This land can be a valuable community asset. The 312 exposed acres from Park Lake could be used as a wildlife preserve (fig. 2.4; for more information about this rendering, see *Fox River restoration and wildlife preserve rendering* section at the end of this chapter). The community will be presented with a unique opportunity to develop a public resource around the free-flowing Fox River. The recreational prospects are many. The river would likely transform to an area of excellent game fish habitat, riparian habitat, and a canoer's dream. The importance of community involvement in the conception of this resource is monumental. Land-use considerations are important in every phase of small dam removal.

Dam removal cost

Economic incentives may favor dam removal. An initial consulting estimate of the costs of dam removal may present figures that are unappealing at first. However, in comparison with long-term figures of recurrent dam repair and maintenance of the structure itself and the impoundment it forms, an analysis of the best economic choice may be surprising. On average, dam removal costs three to five times less than dam repair (Lindloff, 2000). For example, a dam removal on the Baraboo River in Sauk County accumulated costs of $213,770, a small fee compared with the repair estimate of $694,600 to $1,091,500 (American Rivers, 2001). In Pardeeville, a 1992 repair estimate submitted by Mid-State Associates, Inc. for the main Park Lake dam totaled $95,000 (W. Sturtevant, WDNR, 2001). In 2001, an expenditure for needed repairs to the hydroelectric power plant and dam was $45,000 (E. Wolf, Village of Pardeeville, 2001).

Property values will be a continual concern throughout the process of dam removal. However, at some point, property values, which are artificially elevated due to the proximity of Park Lake, may decline as the community becomes more aware of the reservoir's degenerate condition. As time progresses, it is likely the reservoir depth may decrease to the point where it fails to support current recreational activities, such as popular jet skiing and swimming activities. Recreational value is likely to increase with dam removal due in part to the improved fisheries, which have been associated with almost every dam removal to date.

Other management options that provide continued value to Park Lake are more costly than dam removal due to their repetitive nature. In addition to the cost of dam maintenance, the potential cost of impoundment maintenance, such as dredging the reservoir, is not only relatively enormous, but recurring and not eligible for assistance. There are many funding opportunities for dam removal and associated restoration or monitoring projects (Lindloff, 2000).

Funding for dam removal can come from a variety of sources. Many dams have been removed with direct funding from federal, state, tribal, or local governments that either own the dams, have responsibility for abandoned structures, or have funding for river restoration. The private sector, particularly corporations, has also played a critical role in financing dam removal projects. The *Funding sources* section (chapter 5 of this report) provides a brief overview of the role each sector can play in financing dam removal. The information provided in that section and the associated appendices are undoubtedly incomplete. We expect there have been numerous dam removal funding arrangements of which we are unaware. In addition, the roles of the varying sectors in dam removal are evolving rapidly and may change significantly over the next few years.

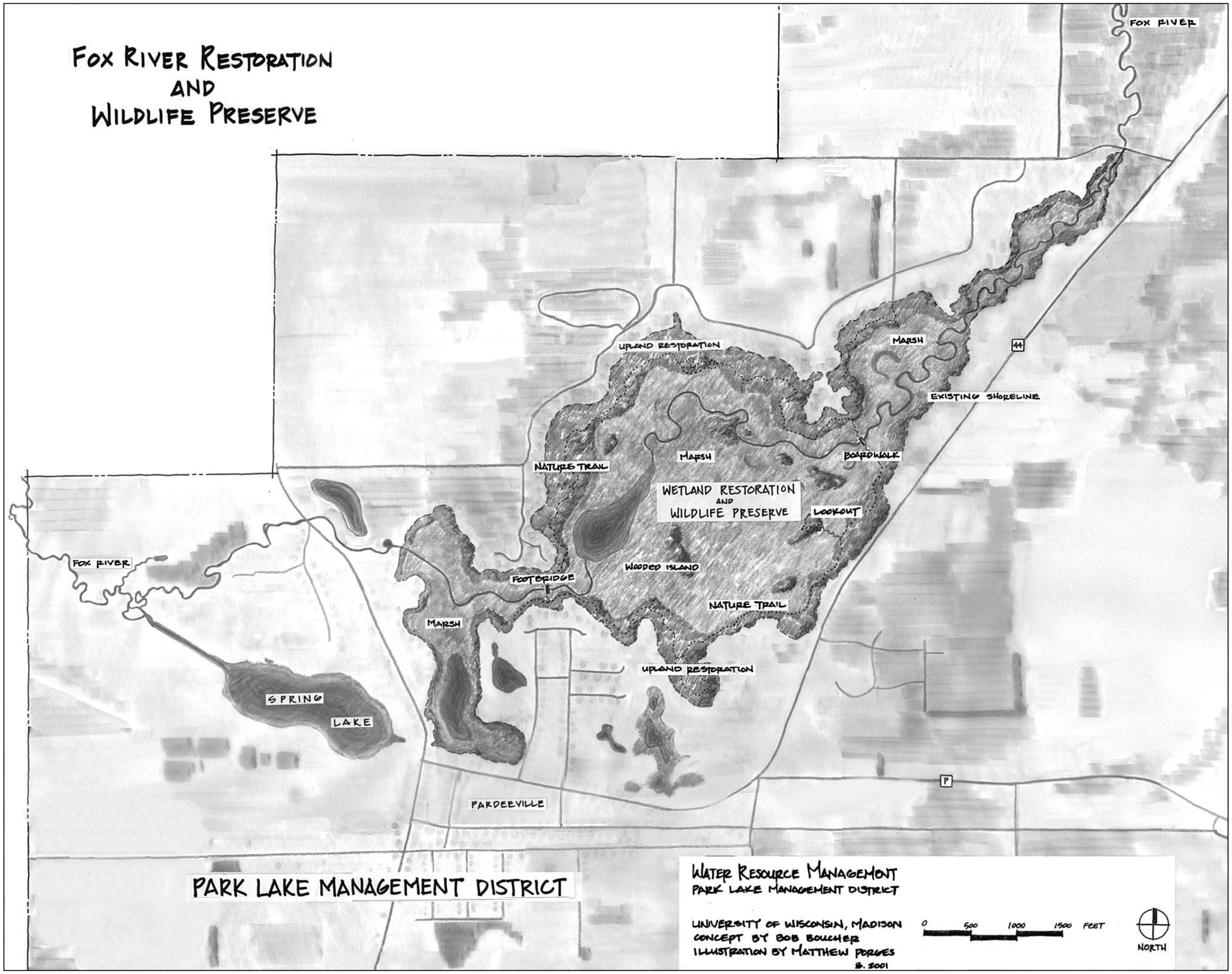

Figure 2.4. *Rendering of the Park Lake area after dam removal and river restoration. This rendering is a hypothetical view based on a landscape architect's vision of a post-Park Lake wildlife preserve. As in figure 2.1, it is simply a starting point upon which to base thoughts and increase communication about this management alternative.*

Dam removal process

There are four general steps in the dam removal process (Lindloff, 2000).

Step 1—Planning of the removal and restoration process

The first step—the decision-making phase—is by far the most important. Public support and engagement of the project are initiated. Legal considerations are explored and professional consultants are brought in to assess such factors as the amount of sediment behind the dam and its possible toxicity. The rate of release and time of drawdown should be resolved. Consultants can also be contracted to aid in the land-planning process.

In deciding whether to remove the Park Lake dams, we recommend using the decision-making guide developed by the 2000 Water Resources Management Workshop, which is currently available online at <www.ies.wisc.edu/research/wrm00/deccat.htm>. It is designed as an introduction to the first steps the community will take before dam removal can be considered as a serious option. This document would help guide the PLMD in identifying leaders and stakeholders, assessing initial disagreements, choosing a decision-making method, informing stakeholders and the public, and reaching a consensus among decision-makers (WRM, 2000).

Step 2—Drawdown or draining of the impoundment

Before the dam can be removed, the pond water should be gradually released from behind the dam by opening or notching it. This will slow the release of sediment.

Step 3—Removal of dam structure

The dam is generally removed when river levels are at their seasonal lows. It is important not to release too large an amount of sediment. In some cases, dredging can reduce the amount of sediment released. However, the expense of this activity can be supplemented with state funds in conjunction with dam removal.

Step 4—Post-removal environmental restoration

As mentioned previously, the former site of an impoundment is a highly disturbed ecological area. As such, it is subject to invasion by aggressive or exotic plant species. Although immediate seeding of the riverbanks is recommended to prevent erosion, this should be a managed activity that occurs as soon as banks are accessible. The river should be given a period of time to restore its natural flow. In some cases, prediction of the new channel can be very difficult. Therefore, the community must await river course and floodplain reestablishment before initiating land-use activities. If the riparian system is not managed, it will likely become overrun by exotic species because sources are prevalent upstream and exotic species fare best in disturbed sites. The village's only major park may need to be structurally modified because its swimming beach and recreational facilities are tied to the current configuration of the reservoir.

What the area will actually look like after the dam removal process is difficult to predict. However, the community can play an active role in participation via the land-management input described above. The best scheme for restoration is to allow the river to reconstruct its own path. This process can be time consuming. At the behest of the community, systems of modeling natural river channel re-establishment could be employed to further community goals for the area. Although much of the exposed land might initially take the form of mud flats, supplementation of ground support via sand enhancement could make this more than just a wetland. Natural vegetation should be established around the river to prevent further augmentation of sediment loads in the river.

Success story: The Rockdale Dam removal case

In 1999, the Rockdale community underwent a

Figure 2.5. *Rockdale Dam Millpond, Koshkonong Creek, Wisconsin. View of the area before removal of the dam (courtesy of T.S. Hooyer and M.L. Czechanski, Wisconsin Geological and Natural History Survey).*

Figure 2.6. *Post-Rockdale Dam Millpond, Koshkonong Creek, Wisconsin. After the Rockdale Dam was removed, vegetation started growing in the sediment; the Koshkonong Creek began to cut a channel in the sediment (courtesy of M.L. Czechanski, Wisconsin Geological and Natural History Survey).*

facilitated decision-making process to determine the fate of the Rockdale dam, which resulted in its removal in 2000. The scale of the dam removal process for the Rockdale Dam is considerably smaller than what would apply in the Park Lake Dam removal scenario. However, many of the controversies and questions encountered in the decision-making process are comparable to the concerns of Pardeeville residents. This example (obtained from WRM, 2000) is provided as an introduction to the dam removal process, not as a standard operating procedure. Each dam removal case is specific to the community.

The Rockdale Dam used to be located on the Koshkonong Creek near the villages of Cambridge and Rockdale, Wisconsin. Over time, the Rockdale Millpond had filled in with sediment to the point where it prevented recreational use (fig 2.5). The dam itself was in poor condition, and the cost of fixing it was very expensive. Thus, the owner's only choice was to remove the dam. Some Rockdale residents wanted the area restored to its natural condition; others, especially shoreline residents, were concerned about losses in property value, community identity, and aesthetic value. With the help of University of Wisconsin–Extension staff, the owner brought the community together to make a decision about the fate of the dam. From a series of presentations by experts in the field, stakeholders learned more about natural resources, millpond dynamics, dam safety, lake district formation, and a plan to add the land to Cam-Rock Park. Once the stakeholders understood the situation, they were able to devise creative solutions that were accepted by all. Their final decision was to remove the dam and have Dane County Parks purchase the exposed land as an addition to the Cam-Rock Park. The WDNR funded the dam removal, river restoration, and streambank stabilization (fig. 2.6). In this case, dam removal was an acceptable option for the community.

Recommendation for Park Lake

If the Pardeeville community decides that it wants a free-flowing system with environmental integrity, dam removal is an option to consider. This process would involve a one-time removal cost and would eliminate the need for future dam repairs and maintenance. The increased flow rates and cooler temperatures would likely prevent nuisance algal blooms, and fisheries would benefit from the lengthening of the coldwater region, allowing game species to thrive, while decreasing the available warm water habitat preferred by carp and other rough fish. On the basis of a presettlement land survey, it is possible that the area would still be characterized by a waterbody, although it would be more natural in form. Associated land management activities could preserve societal values by dedicating the former impoundment area to public use and enjoyment.

Although dam removal is not a currently recommended alternative, future circumstances, like dam deterioration, may change the light by which the community views this option.

Fox River restoration and wildlife preserve rendering

Figure 2.4 is a concept rendering of the Fox River restoration and wildlife preserve, showing the site as it might appear if it were returned to presettlement ecological conditions with the dams removed and the river restored. It was developed by Bob Boucher (WRM) and drawn by Matt Porges, a landscape architect. The 312-acre Park Lake would no longer exist, and the Fox River would begin to rediscover its channel. The area that had once been the reservoir could become a "commons" of upland and wetlands plant communities that would reestablish themselves over time. Planting native vegetation and preventing the growth of undesirable invasive plants could enhance this process. The wildlife habitat could also be enhanced by providing native forage to encourage resettlement of a biodiverse community of species such as birds, mammals, and amphibians.

A nature trail system could provide public access and recreation through a matrix of woodlands and wetlands. The trail would provide the community with a number of benefits such as wildlife viewing as well as an exercise area. Enhancements to the trail include a boardwalk over wetland areas and bridges over the river in two locations to provide a loop for hikers. Interpretive displays could be situated in certain locations, which would provide educational material on native flora and fauna. Other possible components include a lookout tower and ponds for waterfowl.

CHAPTER 3: GOVERNMENTAL AND INSTITUTIONAL OPTIONS

The most important natural feature in the PLMD and Pardeeville is the lake. The tax base is dependent on high lakeshore property values; a degraded lake will lower these values and impede future development. Protecting and maintaining a quality lake will encourage investment in high value housing stock, which is important for a healthy financial future. It is in the best interest of the village tax base to only allow growth that protects the quality of the lake. This will allow an expansion of the tax base.

The futures of the PLMD and the Pardeeville area are interdependent. They will have to work closely together to protect and restore the lake. The communities will need to decide what they want their future to be. A plan needs to be in place so the PLMD can be proactive to proposed development pressures and opportunities as they occur.

The Smart Growth legislation adopted by the Wisconsin Legislature in 2000 requires communities to develop comprehensive plans. Smart Growth contains nine elements for consideration. (See the entire document at the web site <www.doa.state.wi.us/olis/>, which also includes funding sources.) The planning elements are issues and opportunities; housing; transportation; utilities and community facilities; agricultural, natural, and cultural resources; economic development; intergovernmental cooperation; land use; and implementation. The process must also include an element of citizen participation (Grabow, 2001). The PLMD will need to be mindful of the Smart Growth components to formulate a successful comprehensive input to the planning process.

THE PLMD PLANNING PROCESS AS IT RELATES TO SMART GROWTH

Adopting sanitary district powers

The PLMD does not currently have the administrative authority to take many of the steps required to protect Park Lake. As a lake management district, a special purpose unit of government, it has limited powers of action, unlike the general purpose units of government that have far-reaching powers relative to land use and land management. Lake districts have very limited powers on the landward side of lakes to protect and enhance the environmental values (quality) of lakes.

The best solution is for the PLMD to adopt sanitary district powers. Chapter 33, Wis. Stats., provides for the adoption of sanitary district powers by a lake management district, pursuant to section 33.22 (3) and (4).

> Public inland lake protection and rehabilitation districts are also permitted to exercise certain powers of sanitary districts. These powers include the authority to plan, construct and collect charges for the following:
>
> 1. A system of water supply
> 2. Solid waste collection and disposal
> 3. Sewer service
>
> These powers give authority to:
>
> 1. Perform related activities and improvements necessary for the promotion of the public health, comfort, convenience, or welfare of the district.
> 2. Provide chemical or mechanical treatment of waters for the suppression of swimmers' itch, algae and nuisance plants.
> 3. Require the inspection of private sewerage systems for compliance with state plumbing code.
> 4. Provide financial assistance for the replacement of failing private sewerage systems.
> 5. Levy special assessments to finance capital projects.
>
> A lake district may not assume the power to levy town sanitary district taxes. A lake district can assume only the powers of a sanitary district authorized by the annual meeting.
>
> —Wisconsin Lakes Partnership (1996)

Adopting sanitary district powers would increase the lake district's administrative authority, allowing it the capacity to finance sanitary sewer extensions, the work of consulting firms, and staff. The PLMD could also enforce stormwater ordinances outside of Pardeeville to improve water quality around Park Lake while facing impending development pressure. Sanitary district powers would give the PLMD the authority to manage the water-quality consequences of growth and provide long-term benefits for the community and lake.

With sanitary district powers, the PLMD would have the power to control sanitary sewage and develop stormwater standards for proposed developments. Therefore, they would be able to achieve the requirements of Smart Growth and strongly influence the direction of future growth.

Park Lake is the first major impoundment of the Fox River headwaters. Therefore, it is in an advantageous geographic position for its governmental units to adopt water-quality policies to protect its 54-square-mile watershed, providing benefit to the entire downstream Fox River system.

However, the entire watershed land use affects Park lake-water quality. To control standards over water quality and quantity over the entire watershed would be ideal. The administrative process and requirements to accomplish this are included in appendix C [(S.33.33 (2), Stats.); Thornton, 1996)]. This change would also need to include a process of public information, education, and support from the counties. The entire process would have to be approached strategically and could have substantial long-term benefits. If the PLMD chose to do this, it would be the first lake district in Wisconsin to extend control throughout its entire basin. This action of "watershed governance" might attract significant support and attention from water-quality advocates. It might also have critics fearful of imposed taxes and controls. At the very least, the PLMD should examine its current boundary effectiveness and contemplate the potential of expanding its territory. There is precedent for undertaking a review of lake district boundaries and considering the exercise of sanitary district powers by public inland lake protection and rehabilitation districts (Thornton, 1996).

If the PLMD decides to assume sanitary district powers, it should also consider adopting a stormwater ordinance that requires best management practices such as infiltration devices. This would give it the administrative power to achieve the community goal of water resource protection. It should also champion the adoption of an upgraded ordinance in Pardeeville for consistency.

Controlling land use with regulations and ordinances

Most communities use planning and zoning to control land use, but regulations that support the goals of the community master plan are important tools. Those goals are articulated in the Columbia County Land and Water Resource Management Plan (1999).

A stormwater ordinance is one of the tools that can address imperviousness and runoff in a variety of ways. The adopted Smart Growth master plan should clearly state that, wherever feasible, stormwater runoff should be managed on site using stormwater best management practices. This encourages infiltration and protects the existing hydrologic regime (Van Rossum and Carluccio, 2001). A sample stormwater ordinance is given by Van Rossum and Carluccio (2001) and many more on line at the web site <www.stormwatercenter.net>, an EPA funded resource.

Regulations and ordinances can provide water-resource protection in a variety of ways, as stated by Van Rossum and Carluccio (2001):

- Prohibit or limit uses that pose hazards to water quality.
- Adopt zoning that encourages development in areas capable of supporting it and discourage development in areas unsuitable to sustain it.
- Use open space/cluster design approaches to development.
- Limit the amount of lot coverage and define impervious cover to include buildings, roads, sidewalks, parking areas, compacted earth and piping.
- Include stormwater management and infiltration in special permit decision making.
- Implement effective erosion and sediment control regulations with inspection and enforcement funded by developer fees.
- Restrict earth removal and site disturbance and require that topsoil be maintained on site.
- Map and protect aquifer recharge and wellhead-protection zones from the impacts of proposed development.
- Prohibit development within the floodplain.
- Establish a stream corridor and wetland buffer zone of a least 100 feet beyond the 100-year floodplain where development activities are restricted.

—Van Rossum and Carluccio (2001)

On the basis of USGS data (Kammerer, 1996), the watershed contains about 1.2 percent impervious surface, developed as buildings and roads, with higher degrees of impervious cover in localized areas. In the case of Pardeeville, impervious surfaces close to the lake create a stormwater management problem that needs to be addressed as an element of lake-water quality management.

Planning recommendations

Map the storm sewer system

An engineering consulting firm can be hired to document and map the location, integrity, and capacity of the current storm sewer system and to develop a computer model of the current stormwater management system. This model could be used to estimate the amount of urban development that can be built before the system capacity is exceeded. The model could also be used to evaluate the benefits available through retrofitting to increase the amount of precipitation that is routed into infiltration and the benefits of reducing the amount of surface runoff.

Evaluate the storm sewer system's impact on water quantity and quality. The current impacts of the storm sewer system on Park Lake are unknown. The regions north of Lake Street and south of Breezy Point mainly drain into Park Lake. North Main Street drains into Spring Lake or the Fox River below the dam. Other areas drain into marshy areas around the village or stormwater detention ponds in the village.

We recommend hiring a consulting company to evaluate thoroughly the effects of the storm sewer system on the lake. This is an important action because most of the precipitation that falls on Pardeeville is probably conveyed through the storm sewer system into Park Lake. This water contains nutrients, heavy metals, or other contaminants that are detrimental to the lake ecosystem. Also, as the village grows, it could face urban flooding problems if the stormwater system is insufficient.

After a consulting company provides a thorough review of the stormwater system, the PLMD should determine whether steps should be taken to change the stormwater conveyance system. These changes would be intended to reduce the quantity of stormwater flowing into the lake, slow down the time it takes to reach the lake, or reduce the amount of materials contained within the runoff. Many options are available to accomplish these goals.

One of the most effective methods of reducing stormwater runoff problems is to decrease

Figure 3.1. *A rain garden planted on residential property in Maple Grove, Minnesota (courtesy of Leslie Yetka, City of Burnsville, Minnesota).*

the volume and flow rate of runoff leaving a site. This can be done by slowing the flow of the water while it is on the site. It can also be accomplished by increasing the amount of water that infiltrates, or flows into the ground. Infiltration directly reduces the amount of stormflow and also provides other benefits. Infiltrated water recharges groundwater aquifers, maintains base flows in streams, and feeds springs. Some of the water that infiltrates in the Pardeeville area will eventually enter Park Lake, but the water that reaches the lake via an underground flowpath will be colder and cleaner than the surface runoff. It is recommended that PLMD undertake steps to increase the amount of infiltration that occurs within the lake district. Many construction techniques can be implemented to increase infiltration; some of them are relatively complex projects planned prior to construction of a development, and some are inexpensive retrofits that can be accomplished by a homeowner in a few hours. In the case of the Lauderdale Lakes in Walworth County, Wisconsin, the lake management district has purchased lands and installed stormwater detention basins in critical areas of the watershed to limit the impacts of surface runoff on the lake.

The PLMD should also consider, in the storm sewer evaluation process, the use of best management practices to reduce the nonpoint pollution contained in stormwater. Many lake districts in Wisconsin use informational programming to education the public about these practices; we recommend the University of Wisconsin–Extension "Shoreland Stewardship Series" (UW–Extension, 2000a, 2000b).

The PLMD could take the initiative by distributing householder information flyers and packets to encourage residents within the districts to employ effective yard care practices to reduce nonpoint source pollution. Best management practices could include vegetated buffer strips, recharge or rain gardens, bioretention, infiltration trenches and basins, porous paving, rain barrels, and rain gutter retrofits.

Vegetated buffer strips prevent erosion, increase infiltration, and remove particulate matter from stormwater before it reaches the lake. They also reduce the amount of phosphorus and sediment flowing into the lake. They can be planted by current site owners or required in future developments.

Rain gardens reduce the amount of stormwater leaving a specific site. Water from an impervious surface, such as a rooftop, is diverted into a small, specially designed garden (fig. 3.1). The water is used by the garden's plants, which are chosen specifically for the rain garden. Native plants, evolved to survive on the rainfall associated with the Wisconsin climate, can be good choices for a rain garden. Rain gardens increase infiltration and provide some water-quality improvement. We recommend that the PLMD fund the construction of a rain garden on a piece of municipally owned property in Pardeeville as a demonstration of construction techniques and the effectiveness of these gardens; the village hall would be an excellent place to construct one. This would improve the stormwater management at the village hall and expose the PLMD citizens to an aesthetically pleasing and water saving stormwater management option.

Another water-quality practice that utilizes landscaping and soils to treat runoff is bioretention. In bioretention, the water collects in shallow depressions and filters water through a fabricated planting soil medium (fig. 3.2).

Figure 3.2. *A bioretention pond with sand bottom in Earley Lake Estates, Burnsville, Minnesota (courtesy of Tara Roffler, University of Wisconsin–Madison, Water Resources Management).*

Infiltration trenches combine two functions: They provide conveyance, similar to a culvert or a grass swale, but they also provide significant infiltration. The bottom of the trench is designed to allow water to flow downward into the underlying soil. The sandy soils of the Pardeeville region would be an ideal location for this practice. These trenches can be constructed near impervious sites, such as parking lots, as a means of reducing stormflow volumes.

An infiltration basin also serves two functions: It detains water on-site and increases infiltration. Again, this type of facility would work well in Pardeeville due to the high sand content in the area soils. Depending on the sediment load of the incoming water, occasional maintenance may be necessary. This could include scraping the bottom of the infiltration pond to prevent clogging.

Porous pavement is another option for improving the quality of stormwater runoff. A study in France found that porous pavement, when used on highways, reduced heavy metals in runoff from 20 percent to 74 percent. It also provided a 90 percent reduction in hydrocarbons and an 81 percent reduction in total suspended solids (Pagotto et al., 2000).

Rain barrels and rain gutter retrofits are often used together. Commonly, rain gutters discharge roof runoff directly to impervious areas such as sidewalks or driveways. This connects the entire area of the roof directly to the storm sewer system. Diverting some of this water reduces runoff volumes, and the diverted water can be utilized on-site. One method of doing this is to simply extend the downspout several feet onto the lawn. This increases groundwater recharge, provides free water for the homeowner during each precipitation event, reduces runoff volumes, and is exceptionally inexpensive. An extension of this idea is to install rain barrels below the downspouts; this lets the homeowner save precipitation and use it to irrigate the lawn later.

Evaluate the impacts of chemical inputs from the community

The village of Pardeeville applies large amounts of salt to roads during the winter months. Road salt is very soluble in water and can enter the lake. Studies have found high amounts of road salt present in stormwater runoff. In an urban site in Milwaukee, three storms following a salt application had at least 400 percent more chloride (the anion associated with road salt) in the runoff than in the runoff from the storms prior to application (Greb, 2000), with the three post-storm events exceeding 1,500 mg/L (milligrams per liter) of chloride.

Salt-laden runoff can kill vegetation. An Environment Canada (the Canadian equivalent of the U.S. EPA) study found road salt could kill vegetation as far as 160 feet from a road (Environment Canada, 1999) and that some roadside vegetation species, sensitive to chloride, were disappearing. Plant roots prevent erosion, and killing the vegetation in roadside ditches could lead to increased erosion. In Pardeeville, this would cause more sediment to enter Park Lake.

Road salt also threatens aquatic organisms. The U.S. EPA determined that exposure to chloride concentrations of 230 mg/L for four days is toxic to certain forms of aquatic life, and that some plant species are impacted at much lower exposure levels. These plant species are found near the bottom of the food web, so losing them could have significant negative impacts (New Hampshire DES, 1996).

Another Environment Canada study (2000) evaluated the effect of chloride on ponds. The study found that chloride accumulated in the pore water (the water in the spaces between sediment particles in the pond bottom) under the pond in levels toxic to benthic (bottom-dwelling) organisms. The study also found evidence that stormwater with high concentrations of salt can sink to the bottom of the pond. This interferes with the physical mixing process and prevents oxygen from reaching organisms in the bottom of the pond. Thus, road salt can kill benthic organisms in two ways: directly, by poisoning them, or indirectly, by preventing sufficient oxygen from reaching their habitat (Environment Canada, 2000).

In addition to chloride, road salt also contains an iron cyanide compound to reduce clumping. Studies are currently underway to establish the full effects of this compound on aquatic ecosystems.

CHAPTER 4: PARK LAKE WATERSHED MANAGEMENT PRACTICES

Nonpoint Source Pollution Management

Nonpoint source pollution problems

In Park Lake, eutrophication and sedimentation problems as well as the resultant complications historically derived from these conditions have their foundation in the upland watershed of the Fox River. The solutions offered in chapter 2 about in-lake management alternatives, with the possible exception of dam removal, will only be successful when the issue of upstream pollutant inputs is addressed and resolved.

It is likely that nutrient and sediment input is not currently occurring at the same high rate of prior years because of such factors as abandoned or less aggressive agricultural practices, establishment of buffer strips between the river and active agricultural fields, and participation in government programs such as the Conservation or Wetland Reserve Programs. Significant improvement in agricultural practices for reducing soil loss in the Park Lake watershed have been made.

Resolving the remaining problems that originate upstream must start with those who work and live upon the land in the watershed. Community outreach encouraging the establishment of buffer strips on recreational and agricultural lands adjacent to the river, elimination or substantial reduction in the input from fertilizers, native plant landscaping, and wetland restoration will greatly reduce the pollutants that continue to contaminate Park Lake. The PLMD can assume a position of leadership in these efforts by focusing on larger wetland restoration projects upstream.

Nutrient and sediment traps

Wetlands

The destruction of wetlands characterized many management decisions and agricultural practices of the early twentieth century. Wetlands maintain and improve the quality of water resources. They serve as a source of groundwater recharge and discharge, provide flood storage, anchor shorelines and minimize erosion, trap sediment, retain and remove nutrients, support and enhance the food chain, are a habitat for fisheries and wildlife, and are a source for human recreation (Mitsch and Gosslink, 1993). Wetlands can improve water quality by diluting high concentrations of contaminants (Mitsch, 1994; Hammer, 1992 and 1993). The treatment of water occurs through different wetland processes that include filtration, nutrient uptake by vegetation, sedimentation, precipitation and adsorption of chemicals, and microbial activity (Watson et al., 1989).

One of the most important hydrologic functions of wetlands is to provide water retention and prevent flooding. Their sponge-like capacity is a result of porous organic soils that can retain large quantities of water. Studies have shown that increased proportions of wetlands in a watershed reduce flood flows (Johnston et al., 1990), and Mitsch and Gosselink (2000) suggested that a range of 3 to 7 percent of temperate-zone watersheds be in wetlands to provide adequate flood control and water quality. Approximately 1.3 percent of the Park Lake watershed is wetland (Kammerer, 1996).

The location of wetlands in the watershed can also affect floodwater velocity and volume. Mitsch and Gosselink (2000) suggested that several small, low-cost freshwater marshes placed in a watershed's upper reaches are more effective in controlling flooding than one large wetland in the lower reaches. This may or may not be the case in the Park Lake watershed; the overall placement of wetlands within the watershed must be analyzed along with each wetland site (Weller et al., 1996). Numerous studies have shown that wetlands are most effective in enhancing water quality when they come in contact with the surface water. Therefore, theoretically, riverine wetlands should improve water quality to a greater extent than other wetland types because they have the most interactions with sur-

Figure 4.1. *A wetland created through the Federal Wetland Reserve Program in the Park Lake watershed (courtesy of Dave Roberts, Park Lake Management District).*

face runoff in the watershed by being close to the stream (Brinson, 1988).

Research has shown that removing wetlands in agricultural watersheds by drainage systems will result in more phosphorus and nitrogen to be discharged downstream (Woltermade, 2000). Some wetlands have been destroyed in the Park Lake watershed via tiling and the channelization of fields. This has resulted in the bypass of the land's natural filtration system and the direct input of nutrient runoff into the Fox River. Plugging these agricultural drainage channels can create a superficial wetland environment that could buffer the Fox River from some of its present detrimental inputs. For example, in the area of sections 3, 9, 10, and 15, T13N, R11E (U.S. Geological Survey, 1980), property containing large drainage ditches has been incorporated into the Wetland Reserve Program (WRP). On one particular 75-acre piece (SE ¼ sec. 9, T13N, R11E), four main channels that drained to the Fox River were plugged, allowing this area to gradually return to wetland (fig. 4.1). The recent influence of the WRP program in this area of the Park Lake watershed is beneficial to wildlife habitat and water quality.

According to Woltermade (2000) the capability of wetlands to remove water contaminants is most influenced by the relative size of the wetland to the watershed and its retention time for nutrients and sediment—the greater the wetland to watershed area ratio, the longer the retention time and the greater the improvement in water quality. While retaining water, wetlands are able to trap sediment and actively remove nitrogen and a limited amount of phosphorus.

Wetland types and their vegetation

In an environment such as the Park Lake watershed, the value of wetlands is important to keep the Fox River and the lake properly filtered, diverse in wildlife, and high in water quality. We used the digital WDNR Wisconsin Wetland Inventory maps to determine the types of wetlands along the Fox River and Park Lake: deep and shallow marshes, shrub-carrs, floodplain forests, and wet meadows (WDNR 2001a). Each of these has their own unique species of plants that distinguish them from one another.

Deep and shallow marshes. Along the Fox River, deep and shallow marshes are found. They are usually close together, possibly the length of a gradient as the land slopes near the river. A marsh is considered shallow if it is less than 6 inches deep, and more than that is considered deep (Thompson and Luthin, 2000). The water levels are seasonally variable, depending on local rainfall and spring snowmelt, so the actual boundaries of the wetland may also be erratic. Emergent plants are able to survive in shallow marshes. A large number of the marshes near the Fox River contain much cattail, but other emergents, such as spike rush and bur reed could also be found in these types of environments (Mitsch and Gosselink, 1993).

Shrub-carrs. Thompson and Luthin (2000) described shrub-carrs wetlands as a type that contains many shrubs, as its name implies, and that exists due to disturbance. When farmers removed the original wetlands with ditches and drainage, other types of wetlands were able to dominate. The shrub-carrs are able to tolerate drier conditions, but still need a nearly saturated soil to thrive. Red-osier dogwoods and sandbar willows are plants that are most commonly found in these areas (Eggers and Reed, 1997).

Floodplain forests. Only a few floodplain forests exist along the Fox River. They mostly are near bends in the river and only extend for a short reach inland. These floodplains are subjected to seasonal flooding like the marshes, but usually become dry later in the year (Thompson and Luthin, 2000).

Wet meadows. Wet meadows can be difficult to restore to their original wetland type because invasive reed canary grass can become abundant (Thompson and Luthin, 2000). The disturbed wetlands, such as those along the Fox River, are where the reed canary grass can take over and dominate the wetlands (Mitsch and Gosselink, 1993). If not for the reed canary grass, other grasses and forbs would develop, including aster and goldenrod.

When and if the wetlands of the Park Lake watershed are restored, more types of vegetation can become abundant and provide for a healthier water system. The plants will provide food and nesting sites for many types of animals, from lowly invertebrates to sandhill cranes. Also, the wetlands' vegetation helps improve water quality by settling nutrients and solids that would otherwise clog the waterways downstream. Many types of vegetation are found only in wetlands, and by restoring them, Park Lake could become cleaner and healthier, plus many new habitats and environments would be created. The Park Lake watershed needs some type of wetland restoration to ensure the water, environmental, and aesthetic quality of Park Lake and beyond.

Buffer strips

Functions of buffer strips. Buffer strips (also called riparian buffers and vegetated filter strips) are a common means of reducing the negative impacts to aquatic resources from surrounding rural and urban land-use practices (fig. 4.2). Defined strictly as vegetative zones located between natural resources and adjacent areas subject to human alteration (Castelle et al., 1994), they can relieve surface from unwanted sediment, nutrient, and other pollutant runoff. A wetland environment is ideal for a buffer strip. Strategically, government ordinances may advocate or enforce stream buffers on a basin-wide scale because of their ability to trap and diffuse nonpoint source pollution before it enters the aquatic system (Basnyat et al., 2000). Furthermore, researchers have promoted buffers as best management practices (BMPs) for controlling upland agricultural nonpoint source pollution (Snyder et al., 1998).

Figure 4.2. *A stream buffer established along the Upper Fox River. The farmland is to the right and the stream (hidden from view) is to the left (courtesy of Dave Roberts, Park Lake Management District).*

Buffer strips have a large number of functions that may benefit an area ecologically, socially, and economically. A well constructed buffer strip has all of the functional benefits that a wetland has. The best buffer strip programs are those that function in multiple ways rather than attempting to pinpoint and resolve specific water-quality problems, such as sedimentation (Wenger and Fowler, 2000). In states such as Wisconsin that already have implemented a

Shoreland Management Program, improvement of existing buffer strips to encompass a broad variety of functional benefits is recommended.

The key function of buffers in the Park Lake watershed would be to trap sediment, nutrients (nitrate and phosphate), and pesticides. Sediment is the nonpoint source pollutant causing the most serious problems in streams and lakes (Gilliam, 1994; Wenger and Fowler, 2000) in part because nutrients and pesticides are carried with it. Forested buffers have been shown to reduce the amount of sediment leaving agricultural fields by as much as 90 percent—most of this material is deposited in the riparian area close to the field's edge (Gilliam, 1994). Furthermore, buffers have been shown to reduce channel erosion by blocking the flow of sediment and debris, stabilizing stream banks and wetland edges, and promoting infiltration (Castelle et al., 1994; Wenger and Fowler, 2000). Overall, buffers are effective at slowing down runoff water, allowing silt and sand to drop out before it enters a stream and may greatly reduce Park Lake watershed sedimentation problems.

Buffers also serve as a very good control of nitrogen (as nitrate, ammonia, or organic nitrogen) in runoff water through the work of microorganisms that readily transform it into nitrogen gas (Wenger and Fowler, 2000). Furthermore, a large percentage of nitrate in subsurface flows can also be removed so that in some areas a greater than 90 percent reduction in nitrate concentration has been observed as water passes through riparian areas (Gilliam, 1994). Other studies have shown that wetland buffers can remove between 37 to 80 percent of the total nitrate entering them (Kovacic et al., 2000); forested buffers can reduce in-stream nitrate concentrations to levels 48 percent less than that in neighboring agricultural fields (Snyder et al., 1998). Improving or developing buffers in the Park Lake watershed may significantly decrease nitrate entering the Fox River and its tributaries.

Buffer strips are only able to trap a limited amount of phosphorus. Because it can be attached to the sediment that drops out in a buffer, phosphorus can be adequately controlled in the short term. However, in the long term, riparian soils can become saturated with this nutrient, making buffers an uncertain management solution for controlling phosphorus in runoff (Wenger and Fowler, 2000). Furthermore, buffers are relatively ineffective in removing the dissolved phosphorus that enters apart from sediment (Gilliam, 1994). Research conducted by the U.S. Geological Survey has found that in many cases, wetlands act as sinks for phosphorus loading during high runoff flow, but as sources of dissolved phosphorus during low flow (W. Rose, U.S. Geological Survey, Wisconsin District Office, verbal communication, 2001). Overall, studies have shown that buffers provide little control of phosphate and total phosphorous in the long term (Kovacic et al., 2000; Snyder et al., 1998).

Types of buffer vegetation. Natural buffer vegetation typically grows in very wet soils receiving the surface and subsurface water that flows toward these topographically low areas (Gilliam, 1994). Therefore, buffers are in many cases composed of wetlands dominated by grasses or forest. Forested and grassed buffer vegetation types are capable of performing sediment and other contaminant filtration. It has been noted, for example, the positive impact that forested buffers have on reducing the contamination of agricultural fertilizers on surface waters in Virginia (Snyder et al., 1998). Similarly, constructed wetlands planted with common grasses and sedges have improved water quality in Illinois streams (Kovacic et al., 2000). However, effective performance of all buffer functions, including protection of aquatic habitat, requires forested buffers (Wenger and Fowler, 2000). Therefore, it is recommended that existing buffer zones along the Fox River and its main tributaries Sand Spring Creek and Deer Creek be preserved as forest or be restored to a native forested state in rural areas.

Buffer width and extent. Aspects of the riparian zone, including slope, surface roughness, vegetation type, sediment particle size, and runoff characteristics play a role in determining buffer width, as does the intensity of adjacent land use and the intended function of the buffer strip (Castelle et al., 1994). In many cases, site-specific conditions require buffers of variable lengths. As function moves from the physical (water temperature/sediment removal) to chemical (nutrient removal) to biological (species diversity), buffer width increases. In general, buffers that are less than 15 to 30 feet wide provide very little protection of water resources; buffers between 50 and 100 feet are necessary for good control of pollutants (Wenger and Fowler, 2000; Castelle et al., 1994). However, buffers up to 300 to 330 feet wide may be necessary to fully protect the aquatic resources in some locations.

Two basic buffering methods are typically used to protect water resources: fixed length and variable length. Fixed-length buffers protect the same amount of land along an entire stream, lake, or wetland. They do not account for site-specific conditions and may not adequately buffer in some areas, but they are easy to enforce and require little knowledge of ecological principles. Variable-length buffers, although adjustable for differing riparian characteristics and buffering function, require more training to place properly and offer less predictability for land-use planning (Castelle et al., 1994; Wenger and Fowler 2000).

Buffer extent refers to the amount of surface water in a given watershed that needs buffering. Environmental research claims that, at a minimum, all perennial (flow year-round) and intermittent (flow at least 6 months/year) streams should be protected by buffers, and that ephemeral (flow less than 6 months/year) streams be protected when possible (Wenger and Fowler, 2000). It is recommended that buffer strips be enforced in the Park Lake Watershed to an extent that includes all of the Fox River, and its major tributaries, Sand Spring Creek and Deer Creek.

Ecosystem restoration

Wetlands serve many important services to the local ecosystems. Many forms of life use the wetlands for certain stages of life, from plants to insects to fish (Thompson and Luthin, 2000). Restoration of the wetlands in the Park Lake watershed should be the top priority for any management activity that is planned. Each wetland should have its own objective for restoration. Some may be able to be re-established to what they once were, but others may not. Those working on restoration proposals should have set objectives in place so they know what the wetland ought to look like when completely restored. With the wetlands' boundaries and the ultimate goal in place, restoration can begin.

Many modified wetlands have been ditched to drain away the excess water. Ditch plugs and fills are common ways to reverse the draining effect on the wetland. Plugs stop the drain at the lowest point, causing the water to fill into the once-dry wetland (Thompson and Luthin, 2000). Qualified specialists investigating the site should take certain precautions depending on the type of soil and slope of the land before any action is taken. These specialists may be from the WDNR, U.S. Fish and Wildlife Service, or some other agency. Plugs may be at the outset less expensive, but will also need continued maintenance to ensure they are working properly. Ditch filling is more extensive initially; the ditch is completely filled in by placing the old remains (called spoils) back into the channel (Thompson and Luthin, 2000). However, the wetlands in the Park Lake area have probably been drained for many years, and the spoils may have decayed and are less that what is needed to refill the ditches. To overcome this obstacle, other fill from the site or a similar site can be used. To ensure the level of the wetland is maintained, ten percent of extra fill should be added to make available for any settling that occurs (Thompson and Luthin, 2000). Although fills take more time to complete, they need less maintenance; the long-term maintenance is comparable to the effort of maintaining the plugs, depending on the site.

These practices will restore a wetland, but only if other draining practices are stopped. To remove water from potential farmlands without ditching, drain tiles may have been placed into the soil. These are tubes that collect water as the soil becomes saturated. The land is then stable enough to farm. Drain tiles may have been used in many of the Park Lake watershed wetlands because of possible flooding problems, so old tile maps either need to be found or the actual tiles should be located. Tile maps may be found with the people who placed the tiles, the county land conservation department, or even the Natural Resources Conservation Service (NRCS) (Thompson and Luthin, 2000). With this information, the tiles can be removed and dismantled, stopping the constant flow of water away from the wetland. In their restoration handbook, Thompson and Luthin (2000) noted that more than one layer of tiles may exist on a given plot, plus that due to years of being in the wetland, the soil around the tiles may have become channelized and needs to be filled in. If the tiles are removed or dismantled and the ditches are filled, the chances of successfully rehabilitating a wetland are increased.

For all of these restoration practices, experienced assistance is necessary from state and/or federal agencies. Before any ditch reconstruction or tile removal is begun, the proper authorities should be contacted for guidance and possible funding.

Wetland wildlife

Invertebrates. Many types of invertebrates would find the restored wetlands of the Park Lake watershed habitable. For example, insects or insect larvae that depend on varied wetland habitats, including the muddy bottom, the grass/substrate interface, or even the surface of the water would thrive in the wetlands. Weller (1994) and Daly et al. (1998) pointed out that beetles such as whirligigs and giant water beetles can use wetlands for reproduction and feeding, certain flies use the wet surfaces to emerge into adults, and damselflies and dragonflies (and their naiad stages) are commonly seen inhabitants of wetlands. Certain genera of insects, including caddisflies, are indicators of a wetland's health and are good signs for the system (Daly et al., 1998). The still water of a healthy wetland becomes an ideal breeding place for mosquitoes, and this needs to be taken into consideration.

Other types of arthropods could be found in or near the wetlands along the Fox River. Crawfish forage among the grasses and sedges and excavate burrows into the soft soil along the riverbanks and in the wetland (Kozloff, 1990; Weller, 1994). These animals act as scavengers, cleaning up detritus and other waste of the wetlands (Kozloff, 1990). This helps the wetlands filter the water.

Shelled invertebrates, such as snails and clams, could utilize the restored habitats. The grass and sedge leaves would be ideal for snails to crawl around and feed on (Kozloff, 1990); in addition, they could help in the cleaning process of water in the wetland. Clams would most likely feed on the banks of the river where the water would be flowing out of the wetlands (Kozloff, 1990).

Still other invertebrates might be found living in and around the wetlands. Certain worms, such as leeches, are able to survive in this type of habitat. They, like the crawfish, act as decomposers, consuming the waste of the wetland (Kozloff, 1990).

Such a variety of invertebrates would help wetlands continue to function properly and stay healthy.

Fish. Wetlands are important to many fish species. They provide habitats for young fry, which can hide among the different plants. Also, because the wetlands would be close to the river, shade would cool the water, increasing the chance for fish to survive (Thompson and

Luthin, 2000). In a healthy wetland, many insects and larvae are available for the young fish to feed on. During seasonal flooding of the Fox River, these wetlands could also provide a new food source for the larger fish in the higher waters along the banks.

Not only are the wetlands a good habitat and nursery for the fish, but they can also aid other fish downstream by filtering the water and making a cleaner environment (Weller, 1994; Thompson and Luthin, 2000). By removing the heavy amount of chemicals and nutrients from upstream sources along the Fox River, the water quality of Park Lake would have a better chance of improving. These wetlands could be important breeding and feeding sites to many fish species, including sport fish such as walleye, northern pike, muskellunge, and bluegill (Thompson and Luthin, 2000).

Birds. Wetlands serve as important habitats for many waterfowl species and their young. South-central Wisconsin is an active vector for a variety of ducks, geese, and other types of birds to migrate through and breed in. According to the Wisconsin Waterfowl Association (2001), Columbia County is the breeding site for sandhill cranes, herons, mallards, and a variety of other water birds, and in Green Lake County, many more species can be found nesting.

In addition to these waterfowl, other birds find wetlands an ideal place to live. Long-legged wading birds, such as herons, egrets, and sandhill cranes, are also commonly found in local wetlands. The plants of the marshes provide camouflage for the birds and nests, plus the young fish swimming among the grasses area a food source for the birds and their young (Thompson and Luthin, 2000).

The wetlands not only attract birds, but also people. Bird watching is a popular activity, and with healthy wetland habitats, the Park Lake watershed could be a destination for many bird watchers and increase the recreational opportunities of the area.

Other animals. With a healthier watershed, other wildlife will find the area attractive. The wide variety of vegetation could support other animals. Various types of amphibians and reptiles could find refuge in the wetlands. Even mammals, such as muskrats, raccoons, foxes, and deer, would find suitable habitats (Mitsch and Gosselink, 1993; Weller, 1994). Restored wetlands of Park Lake and the Fox River could increase the wildlife quantity and quality as well as the enjoyment of the watershed by the residents of Pardeeville.

Management practices and applicable government regulations

Farmland management in the Park Lake Watershed

According to the Columbia County Land & Water Conservation Department, many farmers in the Park Lake Watershed have implemented farmland conservation practices to minimize soil loss and nutrient runoff from their fields (T. Rietmann, Columbia County Land & Water Conservation Department, 2002). A common practice is chisel plowing, which minimizes soil erosion because it is less disruptive of the soil and leaves residue from the previous crop as cover (USDA-NRCS et al., 1998). Another practice is nutrient management planning, which avoids excessive fertilizing by only applying the amount of nutrients that the crops need, when they need them (USDA-NRCS et al., 1998). The Department has also worked with some farmers to construct manure storage structures, water and sediment control basins, and grass waterways (T. Rietmann, Columbia County Land & Water Conservation Department, 2002). A manure storage structure prevents phosphorus runoff from manure piles, and a water and sediment control basin (fig. 4.3) traps runoff from cropland upslope (USDA-NRCS et al., 1998). A grass waterway safely carries field runoff, prevents gullies from forming, increases stormwater infiltration, and

Figure 4.3. *A water and sediment control basin being constructed in the Park Lake watershed. An earthen berm (background) and underground outlet were just completed, and the berm had also been seeded (courtesy of Todd Rietmann, Columbia County Land and Water Conservation Department).*

may trap some sediment, nutrients, and chemicals (USDA-NRCS et al., 1998). These practices, as well as 25 others (including wetland restoration, buffer strips, and streambank protection) are provided to Wisconsin farmers through a cost-share program at rates of either 50 or 70 percent (refer to Wisconsin Administrative Code ATCP 50.54).

Technical staff at the Columbia Land & Water Conservation Department will work with each interested farmer in the county to find the best conservation practice or a combination of them that fits the farmer's needs. They have been working with more and more farmers every year, but there are still a few farmers in the Park Lake Watershed who are not controlling their nutrient runoff and soil erosion (T. Rietmann, Columbia County Land & Water Conservation Department, 2002). The Amish Community seems to be expanding in the area—3 or 4 farms in the watershed were bought recently. However, working with the Amish farmers could be challenging due to social and cultural differences (T. Rietmann, Columbia County Land & Water Conservation Department, 2002). If all farmers do not implement conservation practices, there could be even more soil loss and nutrient runoff in the watershed, which would further degrade the quality of water in Park Lake. The PLMD should encourage a public education campaign for these farmers to adopt farmland conservation practices.

Redesign of the nonpoint source program

According to the WDNR, urban and rural nonpoint pollution is the primary threat to water quality in Wisconsin, impacting approximately 40 percent of its streams, 90 percent of its inland lakes, and many of its other water resources (WDNR 2001h). Nonpoint source pollution destroys habitat, kills fish, and threatens our use of water resources for drinking and recreation (WDNR 2001h).

As explained in the 2000 *Wisconsin Water Quality Assessment Report to Congress* (WDNR, 2000c), the state of Wisconsin is revising its nonpoint source pollution program to deal with urban and rural nonpoint source pollution. The WDNR and the Wisconsin Department of Agriculture, Trade and Consumer Protection are working together to create standards that address nonpoint source pollution as well as improve current programs that deal with storing manure, managing nutrients, controlling erosion from cropland and construction sites, and managing stormwater. The following are the major proposed changes:

- local governments will have more power in managing their nonpoint source pollution, which will be a requirement in their programs;
- standards will be established for agricultural fertilizer application, cropland erosion control, and manure management; and
- municipalities and developers must control runoff from construction sites and developed urban areas as well as runoff entering storm sewers (WDNR, 2000c).

At the time that this report was written, the WDNR was still reviewing 2001 public hearing testimony. To review the proposed administrative codes and get updated information, visit the WDNR Bureau of Watershed Management web page at <www.dnr.state.wi.us/org/water/wm/nps/admrules.html> or call 608/267-7694 with questions.

Shoreland zoning—state and county government buffering regulations

The state of Wisconsin has developed a shoreland management program for the riparian area of its surface water to buffer and control the intensity of development around it. The program is "a partnership between state and local government that requires the adoption of county shoreland zoning ordinances to regulate development near navigable lakes and streams, in compliance with statewide minimum standards" (WDNR 2001o). Thus, county shoreland zoning ordinances must meet or exceed the minimum standards found in the Wisconsin Administrative Code ch. NR115. Although municipal areas are typically exempt from these codes, they apply in general to the following:

- land within 1,000 feet of the ordinary high water mark (OHWM) of navigable lakes, flowages, or ponds; and
- land that is within 300 feet of a navigable streams and rivers, or to the landward side of the floodplain of rivers and streams, whichever is greater (s. 59.692 (1) Wisconsin Statutes).

Wisconsin state law basically describes a shoreland buffer as a strip of land extending 35 feet inland from the ordinary high water mark where no more than 30 feet in any 100 feet of shoreline may be clear cut to remove trees and shrubbery. The following are the key statewide minimum standards taken from Administrative Code ch. NR 115 (WDNR 2001j) that need to be addressed in Wisconsin county shoreland zoning ordinances:

Lot size

- Sewered lots must have a minimum average width of 65 feet and a minimum area of 10,000 feet.
- Septic tank lots must have a minimum average width of 100 feet and a minimum area of 20,000 feet.

Buffer strip

- Clear-cutting of trees and shrubs is not allowed in the strip of land from the OHWM to 35 feet inland.
- One exception exists for a 30-foot wide path down to the water for every 100 feet of shoreline.

Setbacks

- All buildings and structures must be set back at least 75 feet from the OHWM.
- Exceptions: Piers, boat-hoists, and boathouses are allowed along the shore.
- If an existing pattern of development exists, counties may allow new homes to be built at the average setback of neighboring homes, if it is closer than 75 feet from the OHWM.

Legal nonconformities

- A provision for the grandfathering of homes exists; it allows for their continued use if built before the county shoreland zoning ordinance was enacted and located closer to the water than the existing setbacks allow.
- The county must address nonconformities in their shoreland zoning ordinance by limiting or prohibiting additions, structural alterations and repairs. This is intended to bring these structures into compliance with the shoreland zoning ordinance over some amount of time.

Columbia County's Shoreland Zoning Ordinance is administrated by Michael Stapleton in the city of Portage (WDNR, 2001g). It addresses all the regulations stipulated in ch. NR115 including lot size, buffer strip requirements, setbacks, and legal nonconformities. It includes specific shoreline vegetation protection standards for their "Tree and Shrubbery Protection Area," including:

- A protection area parallel to OHWM and extending 35 feet inland from OHWM.
- Tree and shrubs regulations, such as removal of dead, dying, or diseased trees at discretion of landowner. (DNR shorecover removal improving trout habitat is acceptable.)
- A viewing access corridor (VAC) where no more than 30 feet in any 100 feet along OHWM may be clear-cut to maximum depth of 35 feet.
- Maintenance regulations such as natural shrubbery shall be preserved as far as practicable, and if removed, replaced with equally effective vegetation.

However, enforcement of the vegetation protection area is not addressed. The Shoreland Zoning Ordinance also includes the following:

- A "Shoreland-Wetland District" that limits land use in these areas, but can be rezoned if it will not result in significant adverse impacts on wetland function.
- A zoning permit requirement for filling or grading within 300 feet of OHWM.

Evidence suggests that current shoreland zoning standards mandating a 75-foot setback and 35-foot buffer zone may be insufficient to fully protect against erosion and nutrient loading even when most buffer vegetation is intact. The width of a 75-foot zone in terms of providing wildlife habitat is sufficient primarily for edge-adapted species, while larger buffers provide greater benefit to wildlife (WDNR, 1999). Accordingly, many Wisconsin counties have classified their waters on the basis of size, biological indicators, and sensitivity to development, and have established greater building setbacks and buffer requirements (UW-Extension, 2000b).

Urban buffers in the Park Lake watershed

Although typically exempt from the shoreland ordinance laws in ch. NR115, there are many beneficial reasons to promote the development of urban area buffer strips. Preserving or restoring the natural character of shoreland can increase property values (Wisconsin Environmental Initiative, 2000; Wenger and Fowler, 2000). For example, lake views can be enhanced by colorful trees and vegetation, noise can be absorbed and property shielded from recreation on lakes, shoreline habitat can be formed for a rich variety of wildlife, and land can be protected from sloughing into a lake and causing water-quality problems and/or nuisance weed growth. Furthermore, by providing a source of food and cover, near-shore buffer areas provide a natural habitat that is critical in supporting fish and aquatic life.

The *Waterfront Management Practices Checklist* produced by the Wisconsin Environmental Initiative, Wisconsin Realtors Association, and The Wisconsin Lakes Partnership (Wisconsin Environmental Initiative, 2000) is recommended for people owning residential lakefront property. It contains a list of best management practices for landscaping, lawncare, gardening, building and remodeling structures, and protection of shoreland, wildlife habitat and aquatic plants. The recommended practices must be followed in accordance with countywide shoreland zoning ordinances. Documents such as this and the UW-Extension's *Shoreline Stewardship Series* (UW-Extension 2000a, 2000b) are valuable tools for riparian landowners who care about protecting their water resources and simply need direction for doing so.

The sandy soils that surround Park Lake can provide excellent filtration of contaminants and act as a natural buffer if some of the above practices are followed. These soils should be used to absorb runoff from rooftops, driveways, lawns, and streets, thereby slowing stormwater as it progresses towards the lake. Where ditches run between homes to the lake, as is the case in some

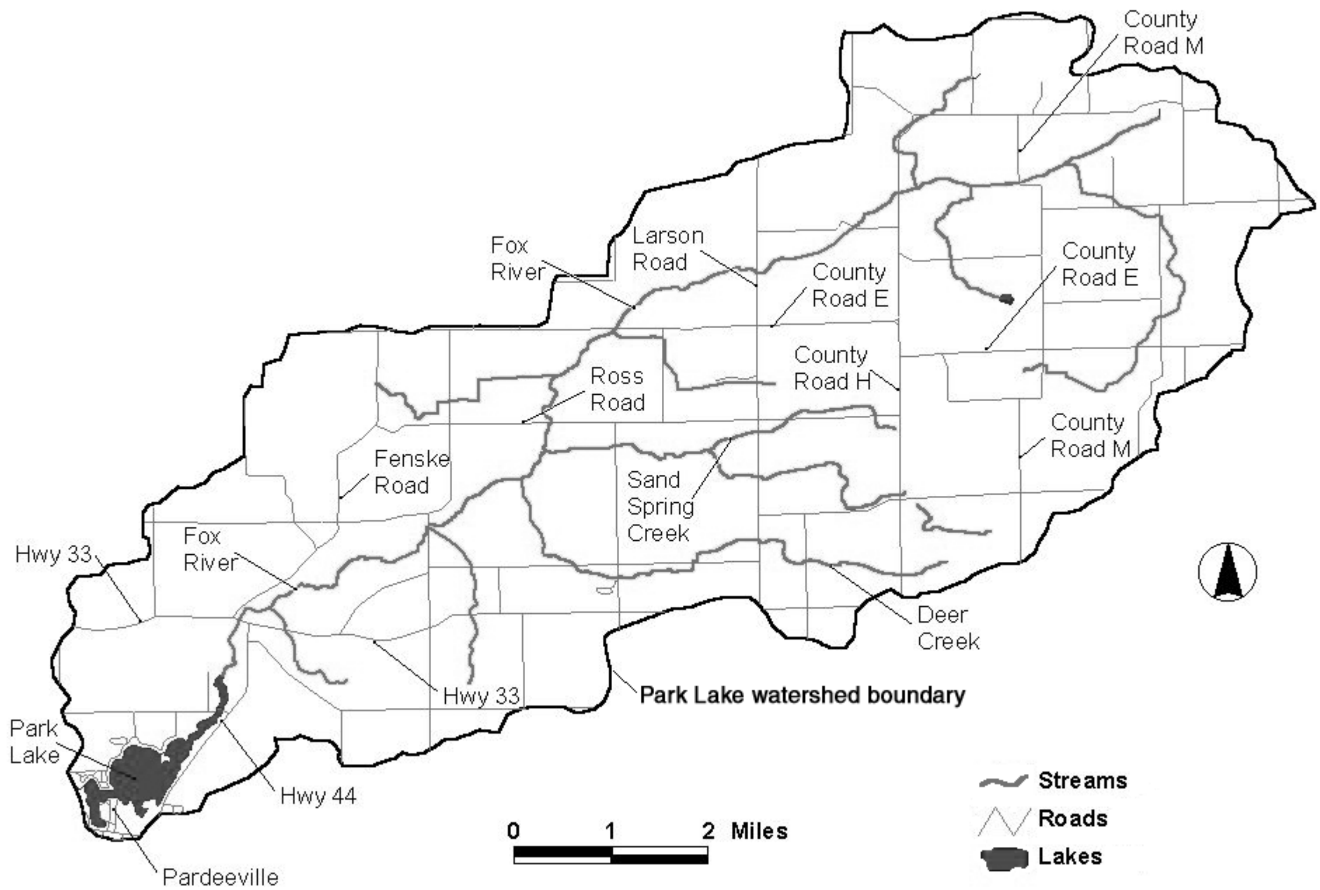

Figure 4.4. *Map of the hydrography in the Park Lake watershed. Major riverways and roads are labeled (digital data courtesy of the Wisconsin Geological and Natural History Survey).*

residential areas on Park Lake's north side, barriers or small berms should be constructed to promote infiltration. (For more information about stormwater in the Pardeeville residential area, see chapter 3.)

Geographic information system analysis of rural buffering areas

Using a geographic information system (GIS), maps were created to show the hydrography, wetlands, and a 35-foot buffer zone in the Park Lake watershed (see figs. 4.4 and 4.5). Digital wetland data were made available by the WDNR based on the Wisconsin Wetlands Inventory of 1978. These maps will help to analyze areas where key lands might be restored or converted to wetland. Land of high priority falls in the Wetland Reserve Program (WRP), a 640-acre area northwest of the junction of county roads E and H. A map of these lands is shown in figure 4.6. The Park Lake watershed divide runs through this area, and some of the WRP lands are located outside of it to the north. Overall, wetlands make up 1.3 percent of the area in the Park Lake watershed, and nearly 50 percent of the buffer zone in the Park Lake watershed is wetland.

It is recommended that the Park Lake Management District purchase for the WRP a property located at NE 1/4, NE 1/4, NW 1/4, sec. 15, T13N, R11E. Ownership of this 15-acre piece of farmland would fill a small gap in the WRP land and allow water levels to be manipulated without any ill effect to a landowner. If converted to wetland, its proximity to the Fox River would help to improve the buffer already created by this WRP area. Furthermore, if successful, this purchase could serve as a precedent

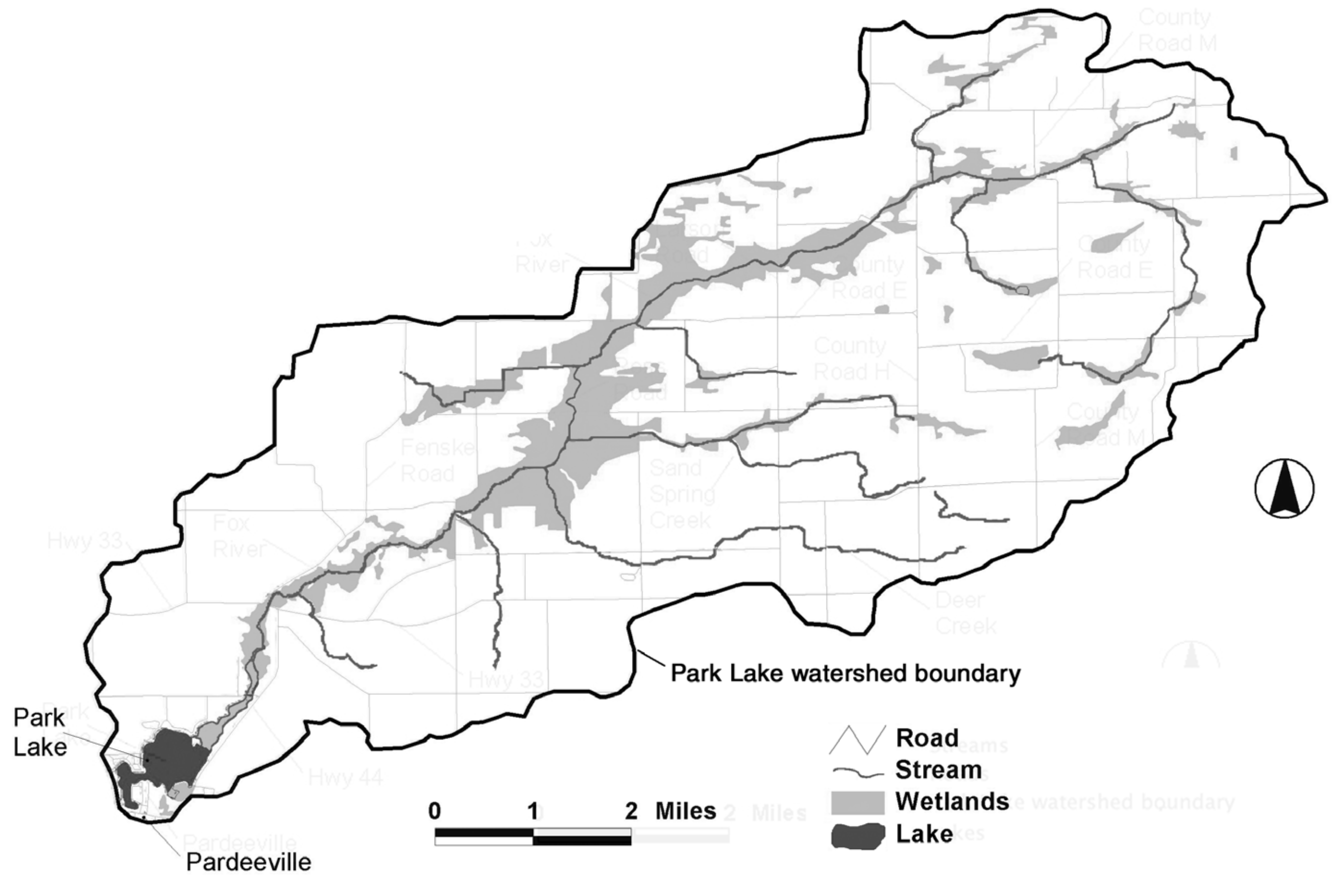

Figure 4.5. *Map of wetland areas in the Park Lake watershed. Wetlands border the length of the Fox River and compose about 1.3 percent of the watershed area. Maintaining a 35-foot buffer zone on all reaches of the Fox River and its tributaries is necessary to improve water quality in the watershed (wetland data from 1978 Wisconsin Wetlands Inventory; digital data courtesy of the Wisconsin Geological and Natural History Survey).*

for filling in more gaps in the existing WRP land in this area. Ownership of such a large, continuous block of wetland near the river has the potential to be beneficial for the water quality of the Fox River and Park Lake. Other similar land purchases will help to fill in gaps in this WRP area thereby improving the quality of water that enters the nearby Fox River.

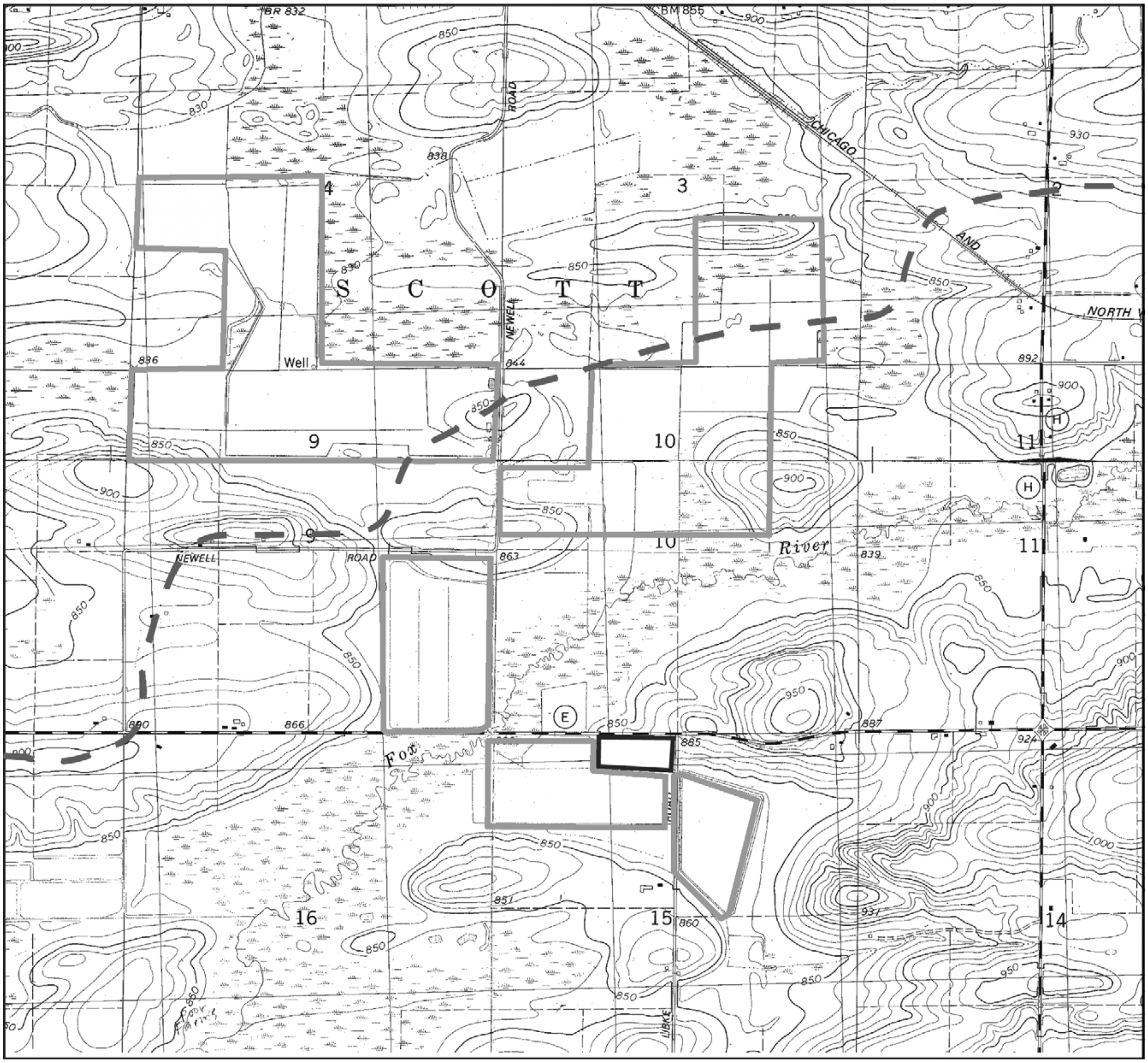

Figure 4.6. *Map outlining the approximate coverage of Wetland Reserve Program land near the Fox River in the Park Lake watershed. Dashed line is Park Lake Watershed boundary; heavy gray lines are existing WRP lands; solid black box indicates area recommended for purchase (NE¼ NE¼ NW¼ section 15, T13N, R11E).The purchase of more land for the WRP will further improve the quality of water in the watershed by extending buffering capacity, especially near the Fox River. Sources: U.S. Geological Survey, Marquette Quadrangle, Wisconsin, and Sand Spring Creek, Wisconsin, Quadrangles, 7.5-minute series (topographic), 1980.*

CHAPTER 5: FUNDING SOURCES FOR IN-LAKE AND WATERSHED MANAGEMENT

A necessary part of reducing nutrient and sediment loads to Park Lake lies in instituting conservation practices in the entire watershed of the lake. Certain changes in agricultural and other land-use management can greatly reduce the rate of lake-water quality diminishment. Many opportunities for financial assistance in various management alternatives exist. Funding for conservation practices such as upper watershed management, biomanipulation, stormwater management, and dam removal can be found at the federal, state, and local level. In many cases, funding sources can be used in conjunction with one another to more fully cover the costs of the desired management alternative.

Although the selection of programs provided here should not be considered a comprehensive inventory of all the current funding opportunities available, it does identify a wide variety of options that would be appropriate for the continued management of Park Lake and its watershed. These programs are subject to change.

Contact information for these programs can be found at the end of this chapter.

Federal funding programs

The U.S. Department of Agriculture (USDA) offers a wide variety of programs to fund conservation farming practices. The Natural Resources Conservation Service (NRCS) and the Farm Service Agency (FSA) are involved in helping farmers implement these programs (see table 5.1). The U.S. Fish and Wildlife Service (US FWS) provides funding for fish and wildlife resources, aquatic ecosystems, and sport fish resources (see table 5.2). The National Fish and Wildlife Foundation provides funds for restoration of fish, wildlife, and native plants (see table 5.3).

U.S. Department of Agriculture Farm Bill Conservation Programs

Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program (EQIP) provides educational, financial, and technical assistance to farmers. Two options for funding under EQIP are available: statewide (35% of the program funds) and priority area funding (65% of the program funds). Statewide EQIP funding focuses primarily on nutrient management, prescribed grazing, and residue management. Approximately \$10 to \$18 per acre is given to farmers to help farmers implement better conservation practices and/or reward them for changing their practices. Funding from the statewide part of the EQIP program is allotted on the basis of a statewide competition among all farmers who enroll (D. Baloun, NRCS, verbal communication, 2001). In the priority area part of the EQIP program, a local workgroup, consisting of the NRCS district conservationist, the Land Conservation Department county conservationist, the FSA county executive director, a WDNR forestry or wildlife person, and the chair of the Land Conservation Committee, works with local farmers and sometimes with planning and zoning staff to identify primary resource concerns. After identifying the potential priority area, the workgroup determines what particular conservation practices would improve environmental conditions and the amount of funding that would be needed (D. Baloun, NRCS, verbal communication, 2001). These priority issues are reviewed by the State Technical Committee (USDA-NRCS, 2000). Columbia County as of yet has no land identified as priority areas under EQIP (D. Baloun, NRCS, verbal communication, 2001).

To enroll in the EQIP program, a landowner can go to his or her NRCS or FSA county office (D. Baloun, NRCS, verbal communication, 2001).

Table 5.1. *Federal Funding Programs: USDA Farm Bill (NRCS and FSA)*

Program	Goals	Eligible parties	Financial incentives	Where to start	Contact person
EQIP	nutrient management, prescribed grazing, residue management	landowner	money given for behavioral change; mostly 75% cost-share	NRCS or FSA county office	Columbia Co.: Steve Prissel, NRCS, or Bev Hepler, FSA Green Lake Co.:Steve Prissel, NRCS or Cindy Mlodzik, FSA
CRP	buffer strips, wind breaks, shelterbelts, shallow water for wildlife habitat, installling waterways, general cropland retirement	landowners	rental rates on enrolled land paid to farmers, 50% cost-share assistance with planting	FSA county office	Columbia Co.: Bev Hepler Green Lake Co.: Cindy Mlodzik
WRP	restoration of wetlands	landowners	75% cost-share for 30yr easements; 100% cost -share for permanent easements	NRCS county office	Columbia Co.: Steve Prissel Green Lake Co.: Steve Prissel
RC&D	inventive ideas for economically feasible conservation practices	multi-county area	up to 75% cost-share; up to $10,000 per contract	NRCS county office	Columbia Co.: Steve Prissel Green Lake Co.: Steve Prissel
WHIP	in stream restoration, fisheries, streambank stabilization, dam removal	landowners		NRCS county office	Columbia Co.: Steve Prissel Green Lake Co.: Steve Prissel
FPP	purchase development rights	landowners and local townships	matching funds to those raised	NRCS county office	Columbia Co.: Steve Prissel Green Lake Co.: Steve Prissel
WF 08, FP 03	predominantly flood prevention, also aquatic ecosystems	small watersheds	$500,000-$10 million; WF08 is 100%, FP03 is 75% cost-share	NRCS county office	Columbia Co.: Steve Prissel Green Lake Co.: Steve Prissel
FIP	tree plantings or improving tree plantings; i.e. removing cattle	landowners	up to $10,000 per contract	NRCS county office	Columbia Co.: Steve Prissel Green Lake Co.: Steve Prissel
CREP	riparian buffers, filter strips, waterway plantings, wetland restoration	landowners	land rental rates, cost-sharing, rental incentive payments, up front payments	FSA or NRCS county office	Columbia Co.: Ken Wolter Green Lake Co.: Susan Blachowiak

Table 5.2. *Federal Funding Programs: Fish and Wildlife Service*

Program	Goals	Eligible Parties	Financial Incentives	Where to Start	Contact Person
PFW	wetland restoration, grassland, savannah, endangered species, dam removal, in-stream habitat	landowners	funding from grants and matching funds from field office appropriations	Leopold Wetland Management District	Columbia Co.: Sean Sallmann or Rhonda Krueger Green Lake Co.: Sean Sallmann or Rhonda Krueger
Fish and Wildlife Resources	nonconsumptive fish and wildlife recreation opportunities	varies, see FWS contact	appropriated funds and donations from FWS	WDNR state office	FWS: Gary Reinitz WDNR: Tim Larson or Paul Cunningham
Sport Fish Resources	boating access, fishery projects, salt/freshwater projects	varies, see FWS contact	funds from excise taxes on fishing equipment, fish finders, motorboat fuels, small engine fuels, and import duties	WDNR state office	FWS: Gary Reinitz WDNR: Tim Larson or Paul Cunningham
Wildlife Resources	restoration of wild birds and mammals	varies, FWS contact	see grant programs	WDNR state office	FWS: The Division of Federal Aid WDNR: Tim Larson or Paul Cunningham
Aquatic	wetlands acquisition, restoration, and management	varies, see FWS contact	competitive grants	WDNR state office	Gary Reinitz
Aquatic Resources and Hunter Education	training in aquatic resource education in aquatic ecology, aquatic resource management, safety, fishing, and conservation ethics	varies, see FWS contact	up to 10% of state's annual Sport Fish Restoration apportionment	WDNR state office	FWS: Gary Reinitz WDNR: Tim Larson or Paul Cunningham

Table 5.3. *Federal Funding Programs: National Fish and Wildlife Foundation*

Program	Goals	Eligible Parties	Financial Incentives	Where to Start	Contact Person
Challenge Grants	Fish and wildlife habitat restoration, dam removal, native plant restoration	Varies; see NFWF contact	Varies; see NFWF contact	NFWF regional office	Sarah Ellgen

Conservation Reserve Program (CRP)

The Conservation Reserve Program (CRP) is the largest of the USDA conservation programs. It is designed to convert highly erodible or environmentally sensitive land to vegetative cover (USDA-NRCS, 2000). There are two options for enrollment in this program: a continuous and a formal signup. In the continuous signup, a farmer can enroll any eligible land in the program and receive cash rent for the land enrolled upon implementing conservation practices (D. Baloun, NRCS, verbal communication, 2001). These practices include installing buffer strips adjacent to streams and other water sources, contour grass buffers within a field, windbreaks, shelterbelts, shallow water areas for wildlife, and grass waterways (S. Butler, FSA, verbal communication, 2001). The formal signup is more appropriate for large acreages. A landowner will earn environmental points using an Environmental Benefits Index to enter a national competition for getting his or her land into the program (D. Baloun, NRCS, verbal communication, 2001). The formal signup is used to take land out of production, improve or create wildlife habitat, restore prairies and wetlands, and plant trees. In Wisconsin, between 50 percent and 85 percent of applications have been accepted into the program in previous years (S. Butler, FSA, verbal communication, 2001).

To pursue enrollment in the CRP program, a landowner can go to his or her FSA county office (S. Butler, FSA, verbal communication, 2001).

Wetland Reserve Program (WRP)

The Wetland Reserve Program (WRP) is an opportunity for landowners to retire marginal agricultural land and receive financial incentives to restore wetlands (USDA-NRCS, 2001b). The three options for enrollment in the program include permanent easements, 30-year easements, and 10-year restoration cost-share agreements (USDA-NRCS, 2000). In all cases, landowners retain private ownership (USDA-NRCS, 2001b) and control access to their land (USDA-NRCS, 2000). The USDA pays 100 percent of restoration costs for permanent easements and 75 percent of restoration costs for 30-year easements and 10-year agreements. Other agencies or private organizations may provide the remainder of costs not covered by the USDA (USDA-NRCS, 2001b). To be eligible, land must be suitable for wildlife benefits and restorable (USDA-NRCS, 2001b). Landowners are still responsible for taxes on the land (USDA-NRCS, 2001c). Wisconsin is given an allotment ($6 million in 2000), and enrollment in the program is competitive statewide (D. Baloun, NRCS, verbal communication, 2001).

To pursue enrollment in the WRP program, a landowner can go to his or her NRCS county office (S. Butler, FSA, verbal communication, 2001).

Wisconsin Resource Conservation and Development (RC&D)

The Wisconsin Resource Conservation and Development program (RC&D) involves the pooling of technical and financial resources within a large area (USDA-NRCS, 2000), usually a multi-county area (D. Baloun, NRCS, verbal communication, 2001). Wisconsin RC&D areas can be established by submitting an application for national competition (D. Baloun, NRCS, verbal communication, 2001). Each area is governed by a council of citizens. The council identifies concerns and develops strategies to solve problems (USDA-NRCS, 2000). The potential solutions can be very inventive, and the possibilities are large (D. Baloun, NRCS, verbal communication, 2001). Currently, Columbia and Green Lake counties are not part of an RC&D area (USDA-NRCS, 2000).

To pursue enrollment in the program, concerned citizens can first contact their NRCS county office.

Wildlife Habitat Incentives Program (WHIP)

The Wildlife Habitat Incentives Program (WHIP) provides cost-sharing for private landowners to develop habitat for wetland wildlife, fisheries, endangered species, and upland wildlife (USDA-NRCS, 2001f). The USDA provides up to 75 percent cost-share in the implementation of habitat development practices (USDA-NRCS, 2001d), and generally the maximum cost-share is $10,000 (USDA-NRCS, 2001e). Agreements between landowners and the USDA are usually a minimum of 10 years (USDA-NRCS, 2001a). Assistance is provided on a statewide competitive basis (D. Baloun, NRCS, verbal communication, 2001). Landowners can sign up on a continuous basis, and applications will be reviewed on the basis of priority conservation areas designated by the state (USDA-NRCS, 2001e). WHIP funds have been used to reintroduce fisheries, stabilize streambanks, restore oak savannah (D. Baloun, NRCS, verbal communication, 2001). In this program, more than 6,500 acres of land were restored for needed habitat in Wisconsin (USDA-NRCS, 2000). This program can also be used to help fund dam removal (American Rivers, 2001).

To pursue enrollment in WHIP, a landowner can start at his or her NRCS county office (S. Butler, FSA, verbal communication, 2001).

Farmland Protection Program (FPP)

The Farmland Protection Program (FPP) is a program to purchase development rights for conservation easements. It applies only to land that farmers want to preserve in agriculture (USDA-NRCS, 2001f). The USDA will provide funding for the purchase of development rights as long as matching funds are provided by state, local, or tribal governments (D. Baloun, NRCS, verbal communication, 2001; USDA-NRCS, 2001a). Funds are provided on a nationally competitive basis (USDA-NRCS, 2001f), and up to 50 percent of fair market easement value is provided by the USDA (USDA-NRCS, 2001a). The land and infrastructure must be able to sustain long-term agriculture (USDA-NRCS, 2001a). The land must have a conservation plan (USDA-NRCS, 2001a); the local township must develop a Purchase of Development Rights program (D. Baloun, NRCS, verbal communication, 2001).

Initially, pursuing enrollment of land requires the cooperation of the local township or other government entity to develop a conservation plan (D. Baloun, NRCS, verbal communication, 2001). Then an application can be made to the NRCS state office by the government entity (USDA-NRCS, 2001a).

Watershed Protection and Flood Prevention Act (WF 08 or FP 03)

The Watershed Protection and Flood Prevention Act is typically tied to flood prevention (D. Baloun, NRCS, verbal communication, 2001). Funding can be used to repair aging dam structures (USDA-NRCS, 2000). However, funding can also go toward watershed protection, erosion control, water quality, fish and wildlife habitat, wetland restoration and creation, and public recreation within a small watershed (USDA-NRCS, 2001a). WF 08 is a 100 percent cost-share program, and FP 03 is a 75 percent cost-share program.

To pursue enrollment in either WF 08 or FP 03, the PLMD could first contact their NRCS county office.

Forestry Incentives Program (FIP)

The Forestry Incentives Program (FIP) supports good management practices on private land including tree planting, site preparation for natural regeneration, timber stand improvement

(USDA-NRCS, 2001a), and removing cattle from timber stands (D. Baloun, NRCS, verbal communication, 2001). Up to $10,000 per contract per landowner may be available.

To pursue enrollment in FIP, a landowner can start at his or her NRCS county office.

Conservation Reserve Enhancement Program (CREP)

The Conservation Reserve Enhancement Program (CREP) is a USDA and state partnership in which a maximum of 100,000 acres in the state are set aside for one or more of the following purposes: riparian buffers, filter strips, waterway plantings, and wetland restoration of 40 acres or less. There is also a small component of wildlife habitat creation. As in CRP continuous signup, rental rates for land that is set aside for the program will be paid to the landowners as well as cost-sharing, additional rental incentive payments, and up-front payments from the state. CREP involves 15-year contracts and permanent easements (S. Butler, FSA, verbal communication, 2001). CREP is only available for targeted high priority areas in the state (USDA-NRCS, 2000). The southern half of Columbia County and the eastern half of Green Lake County are included in these priority areas (S. Butler, FSA, verbal communication, 2001).

To pursue enrollment in CREP, a landowner can start at his or her FSA, NRCS, or LCD office (S. Butler, FSA, verbal communication, 2001).

Fish and Wildlife Service Programs

Partners for Fish and Wildlife (PFW)

The Partners for Fish and Wildlife (PFW) provides financial assistance for upland habitat restoration (Thompson and Luthin, 2000). This includes wetland restoration, grassland and savannah restoration, endangered species protection, and in-stream habitat improvement and dam removal (J. Ruwaldt, FWS, verbal communication, 2001; American Rivers, 2001). Sometimes PFW is used for lake enhancement, but more commonly it is used for watershed management (J. Ruwaldt, FWS, verbal communication, 2001). PFW is an agreement lasting 10 or more years (S. Sallmann, FWS, verbal communication, 2001), and the only eligibility requirement is that the land be considered restorable (Thompson and Luthin, 2000). Grants are made to fund restorations. The FWS works with several large grant programs, such as the North American Wetland Conservation Act grant (NAWCA), to provide these funds. A ten-county area that includes Columbia and Green Lake Counties, receives a lump sum appropriation of federal money each year (S. Sallmann, FWS, verbal communication, 2001). This money can be used to supplement grant money for restoration (J. Ruwaldt, FWS, verbal communication, 2001). Funding from nongovernmental organizations as well as governmental agencies such as the WDNR, NRCS, and Land Conservation Departments has commonly been used in conjunction with PFW to fund restoration projects. The nongovernmental organizations include Pheasants Forever, Wisconsin Waterfowl Association, Ducks Unlimited, the WDNR, Wings Over Wisconsin, and the Aldo Leopold Foundation (S. Sallmann, FWS, verbal communication, 2001).

To pursue PFW, the PLMD can first contact Sean Sallmann of the FWS Leopold Wetland Management District. (See contact information under Fish and Wildlife Service Programs at the end of this chapter.)

Grant programs administered by the state

Several programs for which the U.S. Fish and Wildlife Service provide funds for conservation are administered through the states via the WDNR. The Fish and Wildlife Resources grant program provides funds to benefit fish and wildlife species and provide nonconsumptive fish and wildlife recreation opportunities. The Sport Fish Resources grant program funds fishery projects and fresh water projects. The Wildlife Resources grant program provides funds for the restoration of wild birds and mammals. The Aquatic Ecosystems grant program provides financial assistance for wetlands acquisition, restoration, and management. The Aquatic Resource and Hunter Education grant program funds training for aquatic resource education (U.S. Fish and Wildlife Service, 2001).

National Fish and Wildlife Foundation Programs

The National Fish and Wildlife Foundation provides Challenge Grants to restore fish and wildlife and the habitats on which they depend (National Fish and Wildlife Foundation, 2001). This can include dam removal (American Rivers, 2001). Proposals for Challenge Grants are due on July 15 or December 15. To pursue a Challenge Grant, the PLMD can first contact Sarah Ellgen of the Midwest/Mississippi River Valley Region (National Fish and Wildlife Foundation, 2001). (See contact information for National Fish and Wildlife Foundation Programs at the end of this chapter.)

In many of these programs, there is a large potential for partnering with more than one fund-providing agency to fully cover the cost of conservation practices. The USDA, U.S. Fish and Wildlife Service, and the WDNR are all open to making cooperative efforts and have much previous experience doing this. Communities and local groups such as land trusts and local chapters of various conservation groups such as Ducks Unlimited may provide the matching funds necessary for obtaining grants or covering the rest of the cost not covered by any given funding agency

State Funding Programs

The WDNR administers a number of grant and loan programs to fund various projects. Financial assistance may be available on a competitive basis for land acquisition, conservation, and restoration, nonpoint source pollution and stormwater management, and lake, river, and watershed management (see table 5.4).

Lake Management Planning Grant Program

The Lake Management Planning Grant Program provides financial assistance to local governments or qualified lake associations to collect and analyze data concerning the physical, biological, or chemical health of their lake. In addition, funds provided by the grant may also be used to investigate watershed conditions, plan for any lake management or protection activity, review local ordinances or obtain information regarding perceptions of lake use and water quality through social surveys (S. Graham, WDNR, written communication, 2001).

Local governments are eligible to apply for this grant. In addition, nonprofit conservation organizations and qualified lake associations may also apply.

Grants are awarded for small- and large-scale projects. Small-scale projects may include lake trend monitoring, lake education, organization development, or other assessments. Large-scale projects are more comprehensive and may include a complete lake management plan that addresses local concerns and also analyzes options for lake and watershed management.

The cost-share available to recipients is 75 percent, with a project cap of $3,000 for small-scale projects and $10,000 for large-scale projects. A lake is eligible for more than one planning grant with a lifetime maximum cap of $100,000. Grants are competitive and are awarded through a ranking procedure. The deadlines for applications are February 1 and August 1 of each year (WDNR, 2001c).

Lake Protection and Classification Grant Program

The Lake Protection and Classification Grant Program provides financial assistance to carry out the recommendations of lake or watershed management plans that were established during the Lake Management Planning Grant process.

Table 5.4. *State Funding Programs: Wisconsin Department of Natural Resources*

Program	Goals	Eligible parties	Financial incentives	Contact person
Lake Management Planning Grant Program	Assist with the collection and analysis of lake or watershed data, plan for any lake management or protection activity	Local governments including cities, villages, towns, counties, regional planning commissions, tribal governments, and special purpose districts such as lake, sewerage, and sanitary; nonprofit conservation organizations and qualified lake associations	Grants up to $3,000 (small-scale) or $10,000 (large-scale) with a lifetime maximum cap of $100,000 per lake; 25% local match required	Susan Graham or Pat Sheahan
Lake Protection and Classification Grant Program	Restore critical wetlands, obtain land for acquisition, obtain local ordinances and develop regulations for the protection of water quality, and general lake improvement projects	Local governments including cities, villages, towns, counties, regional planning commissions, tribal governments, and special purpose districts such as lake, sewerage, and sanitary; nonprofit conservation organizations and qualified lake associations	Grants up to $200,000; 25% local match required	Susan Graham or Pat Sheahan
River Planning Grants	Assist river organization development, information and education, assessment of water quality, fish, and aquatic life and nonpoint source evaluations	Local governments including cities, villages, towns, counties, and tribal governments; nonprofit conservation organizations and qualified river management organizations	Grants up to $10,000; 25% local match required	Bob Hansis or Pat Sheahan
River Management Grants	Implement river protection and restoration projects including purchase of land or conservation easement, develop local ordinances, install nonpoint source pollution control practices, and assist with educational activities	Local governments including cities, villages, towns, counties, and tribal governments; nonprofit conservation organizations and qualified river management organizations	Grants up to $50,000, 25% local match required	Bob Hansis or Pat Sheahan
Targeted Runoff Management Grants (TRM)	Address effects of polluted runoff in both urban and rural areas; fund construction-based BMPs	Local governments including cities, villages, towns, counties, regional planning commissions, tribal governments, and special purpose districts such as lake, sewerage, and sanitary; local governments may use the funds to provide financial assistance to private landowners	Grants up to $150,000; 30% local match required	Mary E. Wagner
Urban Nonpoint Source and Storm-water Grants (UNPS&SW)	Control polluted runoff in urban areas	Local governments including cities, villages, towns, counties, regional planning commissions, tribal governments, and special purpose districts such as lake, sewerage, and sanitary; local governments may use the funds to provide financial assistance to private landowners	30% local match required for technical assistance costs; 50% local match required for construction costs	Mary E. Wagner
Clean Water Fund Program	Provide financial assistance for wastewater, stormwater runoff, and urban nonpoint source projects	Local governments including city, town, village, county, town sanitary district, public inland lake protection and rehabilitation district, metropolitan sewerage district or tribal government	Subsidized loans with interest rate between 55% and 100% of the State's market rate.	Becky Scott
Knowles–Nelson Stewardship Local Assistance Program	Acquire land or rights in land, restore natural areas, and develop land for conservation and public nature- based outdoor recreation	Local governments including towns, villages, cities, counties and tribal governments may apply for acquisition, restoration and development projects; qualified nonprofit conservation organizations may apply for land acquisition grants	50% local match required in form of cash or donated land, labor, supplies, or equipment	Stefanie Brouwer
Dam Grant	Provide financial assistance for dam maintenance, repair, modification, abandonment, and removal	Municipalities and public inland lake and rehabilitation districts	Grants up to $200,000; 50% local match required; currently funding status is uncertain	DNR Dam Safety Program

Projects that may be eligible for funding include land acquisition, restoration of critical wetlands, the development local ordinances and regulations that are designed to enhance and protect water quality, and lake classification and improvement projects.

Local governments are eligible to apply for this grant. In addition, nonprofit conservation organizations and qualified lake associations may also apply. The cost-share available to recipients is 75 percent, up to a maximum of $200,000. This grant may not be used to fund projects associated with dam repair, operation, or removal; lake dredging; most aquatic vegetation harvesting; or the design, installation, operation, or maintenance of sanitary sewers. The deadline for the grant application is May 1 of each year (WDNR, 2001c).

River Protection Grant Program

The purpose of the River Protection Grant Program is to aid local organizations or governments in protecting or improving rivers and natural river ecosystems. Financial aid is available for projects that provide information and education about river ecosystems, improve river system assessment and planning, and implement protective or restorative river management activities. Eligible rivers include any natural river or river segment that is recommended for protection in a management plan produced by a federal, state, or local resource agency. The program includes two separate grants: River Planning and River Management Grants.

River Planning Grant

The focus of the River Planning Grant is to provide assistance for river organization development, information and education, assessments of water quality, fish, and aquatic life, and nonpoint source evaluations. Local governments are eligible to apply for this grant. Nonprofit conservation organizations and qualified river management organizations may also apply. The cost-share available to recipients is 75 percent, with a $10,000 maximum per grant. The deadline for the grant application is May 1 of each year (WDNR, 2001d).

River Management Grant

The focus of River Management Grant is to aid in land acquisition by purchase or easements, development of local ordinances, restoration of instream or shoreland habitat, and the installation of nonpoint source pollution control practices. Education, planning, and design activities may also be funded. Local governments are eligible to apply for this grant. Nonprofit conservation organizations and qualified river management organizations may also apply. The cost share available to recipients is 75 percent, with a $50,000 maximum per grant. The deadline for the grant application is May 1 of each year (WDNR, 2001d).

Runoff Management Grants

The Targeted Runoff Management (TRM) and Urban Nonpoint Source and Stormwater (UNPS&SW) Grant Programs were created by the Wisconsin Legislature to address the problem of polluted runoff from urban and rural areas. With financial assistance, governmental units can identify projects to help protect water quality. Projects funded by TRM and UNPS&SW grants are site specific and are generally targeted to high priority resource problems in areas smaller than a sub-watershed. Both grant programs may include projects within a Priority Watershed.

Targeted Runoff Management Grants (TRM)

The focus of TRM grants is to address the effects of polluted runoff in urban and rural areas. Specifically, they can be used to fund the construction of best management practices (BMPs), such as stream bank protection projects, wetland construction, and detention ponds (M. Wagner, WDNR, verbal communication, 2001).

Local governments are eligible to apply for this grant. They may use the funds on lands that they control or they may use the funds to provide financial assistance to private landowners. Currently, the grant period is two years, with the possibility of a one-year extension. The maximum cost-share rate available to recipients is 70 percent of eligible costs, up to a maximum of $150,000 (total state share). A TRM grant may not be used to fund staffing, studies, or design. Projects that will not be considered for funding include those designated as point source pollution control; those that are not water-quality based (drainage or flood control); construction-site erosion control and post-construction structural best management practices for new development; and rural projects in Priority Watershed areas.

The selection process for project funding is competitive. Applications are scored on a number of criteria: fiscal accountability and cost effectiveness, water quality, extent of pollution control as well as the extent of local support and the likelihood of project success. Prior to final project selection, the WDNR will discuss its funding recommendations with the Land and Water Conservation Board. Contact the program coordinator for more information regarding application deadlines (WDNR, 2001k).

Urban Nonpoint Source and Stormwater Grants (UNPS&SW)

The focus of Urban Nonpoint Source and Stormwater Grants (UNPS&SW) grants is to control polluted runoff in urban areas. For a project to be eligible for cost sharing for BMPs, it must be in an urban area that meets one of the following criteria: has a population density of at least 1,000 people per square mile, has a commercial land use, is the non-permitted portion of a privately owned industrial site, or is a municipally owned industrial site. For a stormwater planning project to be eligible for funding, it must currently be in an urban area or in an area that is projected to be urban within 20 years.

Local governments are eligible to apply for this grant. A variety of activities may be eligible for funding through this grant. Technical assistance costs for planning, associated informational and educational activities, ordinance development and enforcement, training, and design are cost-shared at 70 percent. Construction costs, such as stormwater detention ponds, and stream bank or shoreline stabilization are cost-shared at 50 percent. Currently, the grant period is two years, with the possibility of a one-year extension. There is no maximum funding limit for this grant. The selection process for projects is competitive. Applications are scored on a number of criteria: fiscal accountability and cost effectiveness, water quality, extent of pollution control as well as the extent of local support and the likelihood of project success.

Certain restrictions apply to this program. The grant may not be used to fund the following practices: construction site erosion control and post-construction structural BMPs for new development; projects that are not water-quality based (drainage or flood control); and dredging projects. Contact the program coordinator for more information regarding application deadlines (WDNR, 2001l).

Clean Water Fund Program

The Clean Water Fund Program (CWFP) provides financial assistance in the form of low-interest loans for wastewater, stormwater runoff, and urban nonpoint source projects (B. Scott, Wisconsin Department of Natural Resources, verbal communication, 2001). It is one of three subsidized loan programs included in the state of Wisconsin Environmental Improvement Fund. Eligible projects receive a subsidized interest rate between 55 percent and 100 percent of the state's market rate. Costs related to the planning, design, and construction of eligible projects may be covered by the loan. To be eligible a project must be related to water quality. The scope of a proposed project must be approved by the WDNR Bureau of Watershed Management.

The CWFP also includes two subprograms focused on wastewater in addition to regular loans. Financial Hardship Assistance may be available to certain municipalities in the form of a reduced interest rate or a grant. Also, the Small Loan Program is available for projects that have a total cost of less than $750,000. Local governments are eligible to apply and must meet certain requirements specified by the WDNR and the Wisconsin Department of Administration to be considered for a loan (WDNR, 2000a, 2000b).

Knowles–Nelson Stewardship Local Assistance Program

The Knowles–Nelson Stewardship Local Assistance Program is an umbrella for four individual grant programs that each focus on the acquisition of land or rights in land, restoration of natural areas, or the development of land for conservation and public nature-based outdoor recreation in urban and rural areas, especially those lands that are threatened by development. The local assistance grants include the following subprograms: Aids for the Acquisition and Development of Local Parks (ADLP), Urban Green Space Grants (UGS), Urban Rivers Grants (URGP), and Acquisition of Development Rights (ADR) Grants.

Local governments may apply for funds for acquisition, restoration, and development projects. Qualified nonprofit conservation organizations are eligible to apply for land acquisition grants. The funds awarded to grant recipients cover up to 50 percent of eligible costs. The deadline for grant application is May 1 of each year (WDNR, 2001b).

Dam Grants

The purpose of Dam Grants is to provide financial assistance to dam owners. This may include funds for dam maintenance, repair, modification, abandonment, and removal. Municipalities and public inland lake and rehabilitation districts may apply for 50 percent cost-sharing, up to a maximum contribution of $200,000. Funding for this grant program is variable and financial aid is not always available for allocation. A separate fund exists specifically for the removal of abandoned or small dams (WDNR, 2001h).

County funding programs

Each county in Wisconsin has established, or is in the process of establishing, a county Land and Water Resource Management Plan. The purpose of these plans, which are locally developed and implemented, is to reduce soil erosion, protect water quality, identify resource concern areas, and to conserve county-identified natural resources. These plans must meet state performance standards (Wisconsin Land and Water Conservation Association, 2001).

The Department of Agriculture, Trade and Consumer Protection's (WDATCP) Soil and Water Resource Management program (SWRM) provides financial support for the implementation of these land and water resource management plans. Funds are allocated to individual county Land Conservation Committees and Departments. Cost-sharing and technical assistance may be available to landowners to install best management practices and is dependent on the amount allocated and the identification of priority sites within the county (WDATCP, 2001).

Currently, rule changes for this program have been proposed. For more information, contact your county Land and Water Conservation Department.

Nongovernmental organizational funding

Many nongovernmental organizations can provide financial assistance for conservation practices. Funding from these organizations in many cases may be used as matching funds for other programs to supplement funding. Nongovernmental organizations include the Wisconsin Waterfowl Association, Duck Unlimited, Inc., Wings Over Wisconsin, Inc., Waterfowl USA, and Pheasants Forever (Thompson and Luthin, 2000).

Contact information

Farm Bill Programs
Columbia County USDA Offices
2912 Red Fox Run
Portage, WI 53901-3400
608/742-5361
FSA County Executive Director—Ken Wolter
CRP and EQIP program manager—Bev Hepler
NRCS District Conservationist—Steve Prissel

Green Lake County USDA Offices
630 South St.
Green Lake, WI 54941-9496
920/294-6474
FSA County Executive Director—Susan Blachowiak
CRP and EQIP program manager—Cindy Mlodzik
NRCS District Conservationist—Steve Prissel

Fish and Wildlife Service Programs
U.S. Fish and Wildlife Service
Leopold Wetland Management District
W10040 Cascade Mt. Rd.
Portage, WI 53901
608/742-7100
Sean Sallmann or Rhonda Krueger

Wisconsin Private Lands Office
4511 Helgesen Dr.
Madison, WI 53718
608/221-1206
Jim Ruwaldt

Wisconsin DNR
101 S. Webster
Madison, WI 53703
608/266-2621
Paul Cunningham or Tim Larson

National FWS Office:
Gary Reinitz
Gary_Reinitz@fws.gov

National Fish and Wildlife Foundation Programs
Midwest/Mississippi River Valley Region Office
National Fish and Wildlife Foundation
Sarah Ellgen
1 Federal Dr.
Ft. Snelling, MN 55111
612/713-5171

Wisconsin Department of Natural Resources Programs

Lake Grants
Susan Graham
WDNR Lake Coordinator
608/275-3329

Pat Sheahan
WDNR Environmental Grants Specialist
608/275-3315

River Grants
Bob Hansis
WDNR River Coordinator
608/275-3304

Pat Sheahan
WDNR Environmental Grant Specialist
608/275-3315

TRM and UNPS&SW Grants
Mary E. Wagner
WDNR Watershed Bureau
608/266-9260

Clean Water Fund Program
Becky Scott
WDNR Bureau of Community Financial Assistance
Environmental Loans Section
608/267-7584

Knowles–Nelson Stewardship Local Assistance Program
Stefanie Brouwer
WDNR Land Acquisition and Recreation Grants Specialist
608/275-3218; fax 608/275-3338

Dam Grants
WDNR Dam Safety Program
608/266-8030

County Land and Water Conservation Departments
Columbia County
608/742-9670

Green Lake County
920/294-4051

Nongovernmental organizations
Ducks Unlimited, Inc.
GLARO
311 Metty Dr., Suite 4
Ann Arbor, MI 58103
734/623-2000

Wings Over Wisconsin, Inc.
Rick Steel
Wildlife Project Coordinator
Wings Over Wisconsin, Inc.
8 South Main St.
PO Box 202
Mayville, WI 53050
920/387-5298

Waterfowl USA
John Wilke
7396 Territorial Rd.
Evansville, WI 53536
608/882-4146

Pheasants Forever
Jeff Gaska
Regional Biologist
Pheasants Forever
W9947 Ghost Hill Rd.
Beaver Dam, WI 53916
920/927-3579

Wisconsin Waterfowl Association
PO Box 180496
78 Enterprise Rd., Suite A
Delafield, WI 53018-0496
262/646-5926

CHAPTER 6. RECOMMENDATIONS

After evaluating many different options for the management of Park Lake and its watershed, the Water Resources Management group recommends several steps to the Park Lake Management District for improving Park Lake. As a result of our investigation of the problems of Park Lake, we make the following recommendations:

- Purchase piece of land located in the NE¼ NE¼ NW¼ section 15, T13N, R11E, and restore this wetland and fill the channels draining it for the purposes of reducing nutrient loading to Park Lake.
- Adopt sanitary district powers to control sanitary sewage, consider stormwater ordinances, educate shoreline owners on best management practices (BMPs), consider enlarging the PLMD boundaries, and be mindful of Smart Growth legislation.
- Map the storm sewer system and hire a consultant to evaluate the impact of the sewer system's impact on water quantity and quality.
- Remove carp in upper Fox River (greatest extent observed at Highway E crossing) and Park Lake, either by the use of chemical or mechanical methods.
- Increase outreach to landowners around the lake about water-quality issues in residential areas.
- Increase outreach to farmers in the upper watershed about funding available for conservation practices.
- Hire a person to begin outreach programs, correspond with citizens in the lake management district and throughout the watershed, and apply for grants for improvement of the lake.
- Decrease the use of salt on roads in the winter; increase the use of sand.
- Consider dam removal for restoration of the stream if the lake continues to degrade or the citizens of Park Lake voice a desire for stream restoration.
- Consider selectively dredging Park Lake and/or drawing down the lake to create areas for new and innovative land use.

Park Lake, its watershed, and the Fox River, are valuable assets. We hope that these recommendations are helpful in protecting and improving the resources of the Park Lake area.

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APPENDIX A: SURVEY RESULTS

Park Lake Management District Survey Results
Summer 2001

Introduction

In order to collect information on public perception and attitudes of Park Lake, the Water Resource Management Practicum, in conjunction with the Evaluation Unit of the Environmental Resources Center, administered a survey to residents in the Park Lake Management District. One of the primary objectives of the survey was to determine prioritized lake management options held by residents in the Park Lake Management District. This information will be important to the Park Lake Management District when deciding upon future management decisions that will not only optimize financial and natural resources, but foster resident support as well. The Park Lake Management District Survey Results are divided into six sections: 1) methodology; 2) survey highlights; 3) full responses; 4) written comments; 5) a sample letter and survey; and 6) acknowledgements.

I. Methodology

The Park Lake Management District includes the Village of Pardeeville, in addition to the towns of Marcellan and Wyocena. The randomly selected addresses were generated from the land records system database managed by the Columbia County Land Information Department. The first round of surveys were mailed out in June 2001. Residents that had not returned their surveys by the beginning of July 2001 were mailed another survey in mid - July. All of the surveys included a cover letter that explained the project's purpose, in addition to a pre-addressed stamped envelope for the returned survey. To ensure confidentiality of survey responses, resident names were not included on the surveys.

The 8–page survey was limited to 25 questions, with space on the last page for additional comments and concerns. The survey addressed the following four topics: 1) recreational uses of Park Lake; 2) water quality in Park Lake; 3) preferred management activities for Park Lake; and 4) personal information.

Final survey results were prepared in August 2001. Of the 500 residents randomly chosen to complete the survey, 21 responded that the survey was not applicable for various reasons. A total of 290 surveys were answered, resulting in a 61% response rate.

II. Survey Highlights

1) Uses of Park Lake

(Highest percentages reported)

Top three recreational activities in Park Lake within the past 12 months: (n*=286)

- 66% Fishing
- 58% Scenic Enjoyment
- 53% Boating

* n = the number of respondents

1) Uses of Park Lake (continued)

Top three restrictions on recreational activities in Park Lake: (n=227)

- 49% jet skiing
- 18% water skiing
- 10% boating (motor/pontoon)

53% indicated that the quality of their use of Park Lake has either decreased or greatly decreased since their first exposure (n=281).

2) Water Quality of Park Lake

(Highest percentages reported)

42% indicated that the overall water quality in Park Lake is fair (n=269).

Top three occurrences that were rated either as problems or major problems in Park Lake:

- 58% Sedimentation (n=257)
- 53% Excessive weeds (n=265)
- 49% Algal blooms (n=256)

Top three largest threats to water quality in Park Lake:

- 43% Fertilizers and pesticides (agricultural) (n=268)
- 42% Stormwater run-off from streets/highways (n=263)
- 40% Stormwater run-off (agricultural) (n=263)

3) Preferred Management Activities for Park Lake

(Highest percentages reported)

Top three preferred lake management activities: (n=271)

- 61% Cutting weeds, Stocking sport fish
- 52% Stocking fish for biomanipulation
- 45% Dam maintenance

Top two lake management activities that would most improve the water quality in Park Lake (n*=470)

- 19% Cutting weeds
- 16% Dredging

Top two lake management activities that would least improve the water quality in Park Lake (n*=413)

- 29% Dam removal
- 14% Lake water drawdown

Top three lake management activities that would increase recreational activities:

- 66% Stocking sport fish (n=247)
- 44% Cutting weeds, Stocking fish for biomanipulation (n=244)
- 40% Dredging (n=238)

* Note that each respondent could select two items on the list; the value indicates the total number of responses.

Top three lake management activities that would increase property values

- 48% Stocking sport fish (n=235)
- 37% Shoreline restoration (n=228)
- 36% Stocking fish for biomanipulation (n=228)

74% would be willing to pay additional fees for lake management activities (n=262).

4) Personal Information

(Highest percentages reported)

40% own or lease property on Park Lake (n=281).

The mean number of years that residents have either owned or rented property on Park Lake is 16 years, ranging from 1 to 64 years (n=107).

31% live along the Park Lake shoreline and 32% live within ¼ mile from the Park Lake shoreline (n=278).

66% expressed interest in attending future Park Lake Management District meetings (n=274).

Park Lake Management District Survey

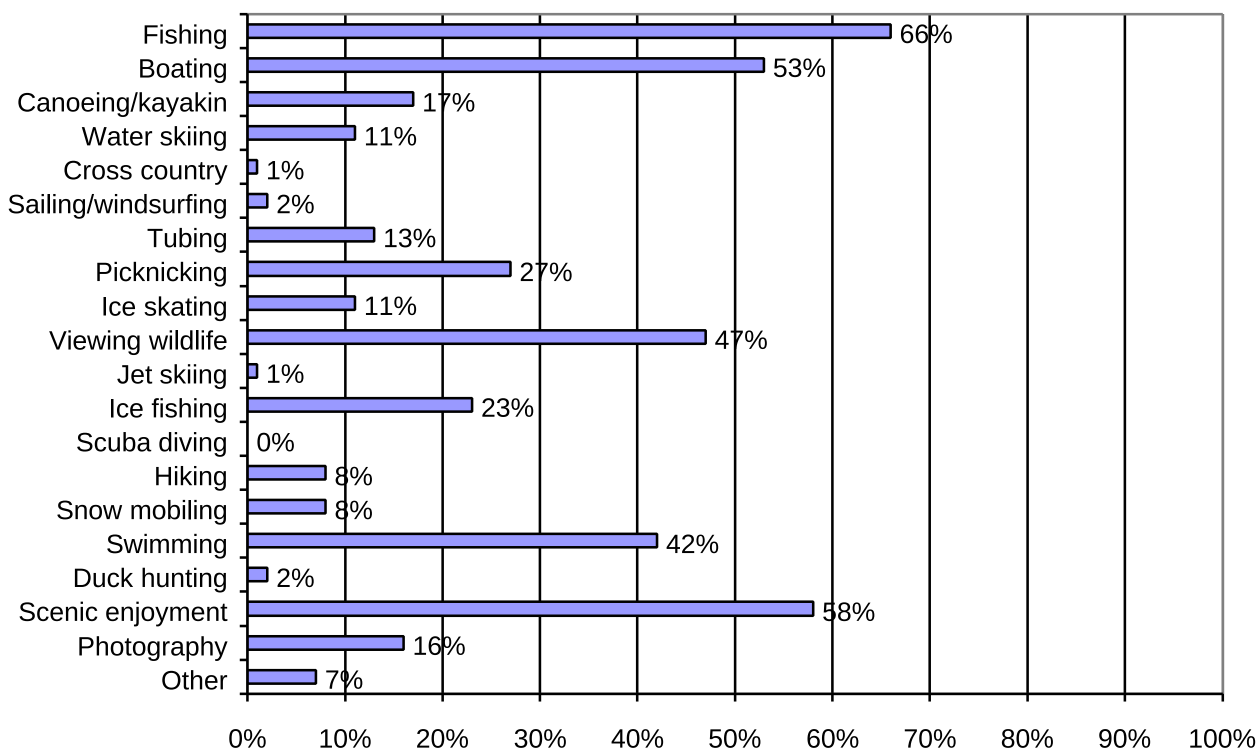
III. Full Responses

Please tell us about how you use Park Lake.

1. In the last 12 months, which of the following activities have you participated in at Park Lake?

Total Responses
286

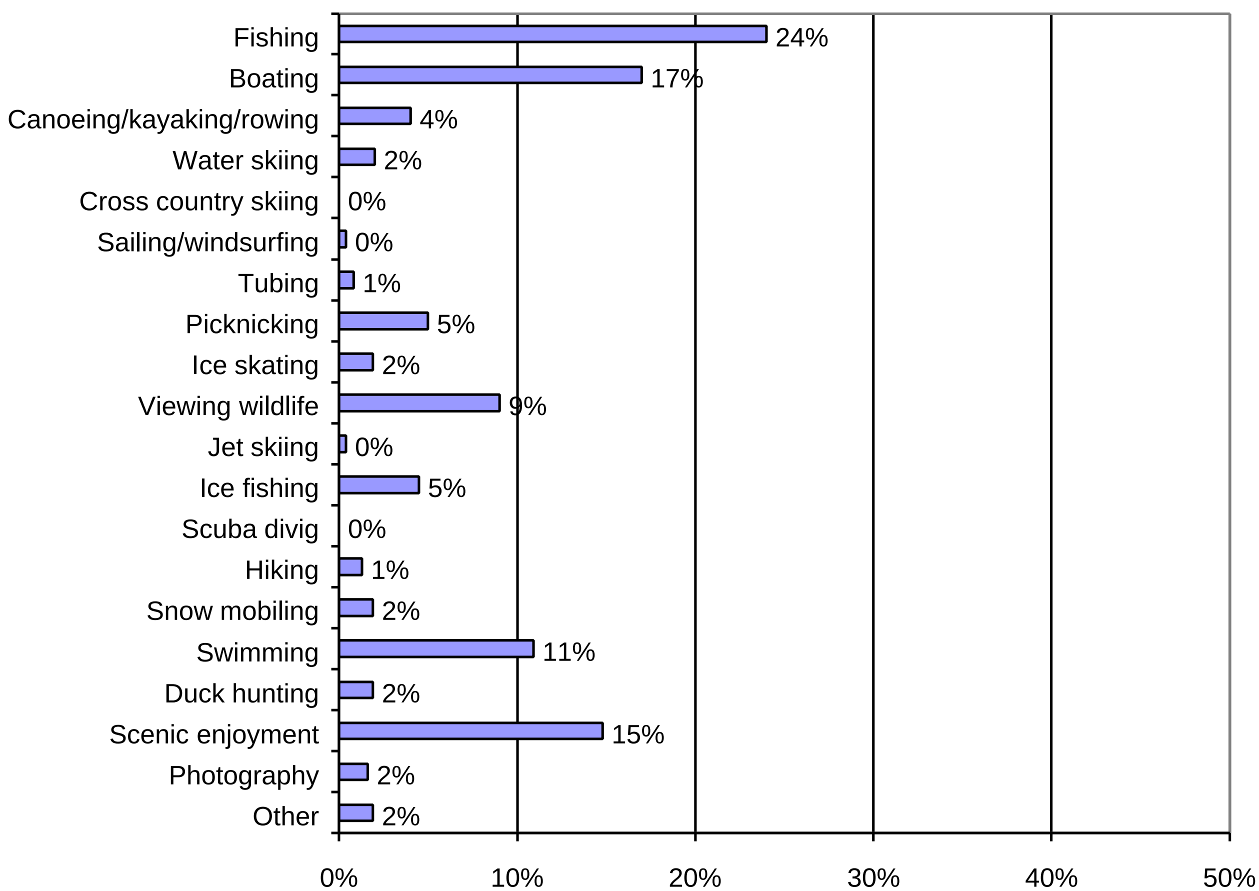
66%	Fishing	2%	Sailing/windsurfing	1%	Jet skiing	42%	Swimming
53%	Boating (motor/pontoon)	13%	Tubing	23%	Ice fishing	2%	Duck hunting
17%	Canoeing/kayaking/rowing	27%	Picnicking	0%	Scuba diving	58%	Scenic enjoyment
11%	Water skiing	11%	Ice skating	8%	Hiking	16%	Photography
1%	Cross country skiing	47%	Viewing wildlife	8%	Snow mobiling	7%	Other



2. For the above activities, which three do you value the most?

Total Responses
733*

24%	Fishing	<1%	Sailing/windsurfing	<1%	Jet skiing	11%	Swimming
17%	Boating (motor/pontoon)	1%	Tubing	5%	Ice fishing	2%	Duck hunting
4%	Canoeing/kayaking/rowing	5%	Picnicking	0%	Scuba diving	15%	Scenic enjoyment
2%	Water skiing	2%	Ice skating	1%	Hiking	2%	Photography
0%	Cross country skiing	9%	Viewing wildlife	2%	Snow mobiling	2%	Other

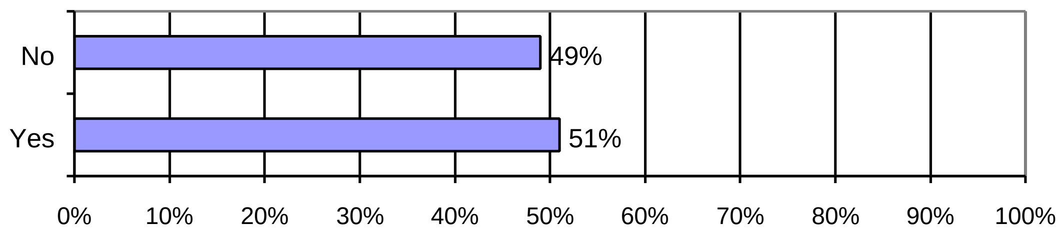


* Note that each respondent could select three items on the list; the value indicates the total number of responses.

3. Would you like to see restrictions on any of the above activities?

Total Responses
269

No	49%
Yes	51%

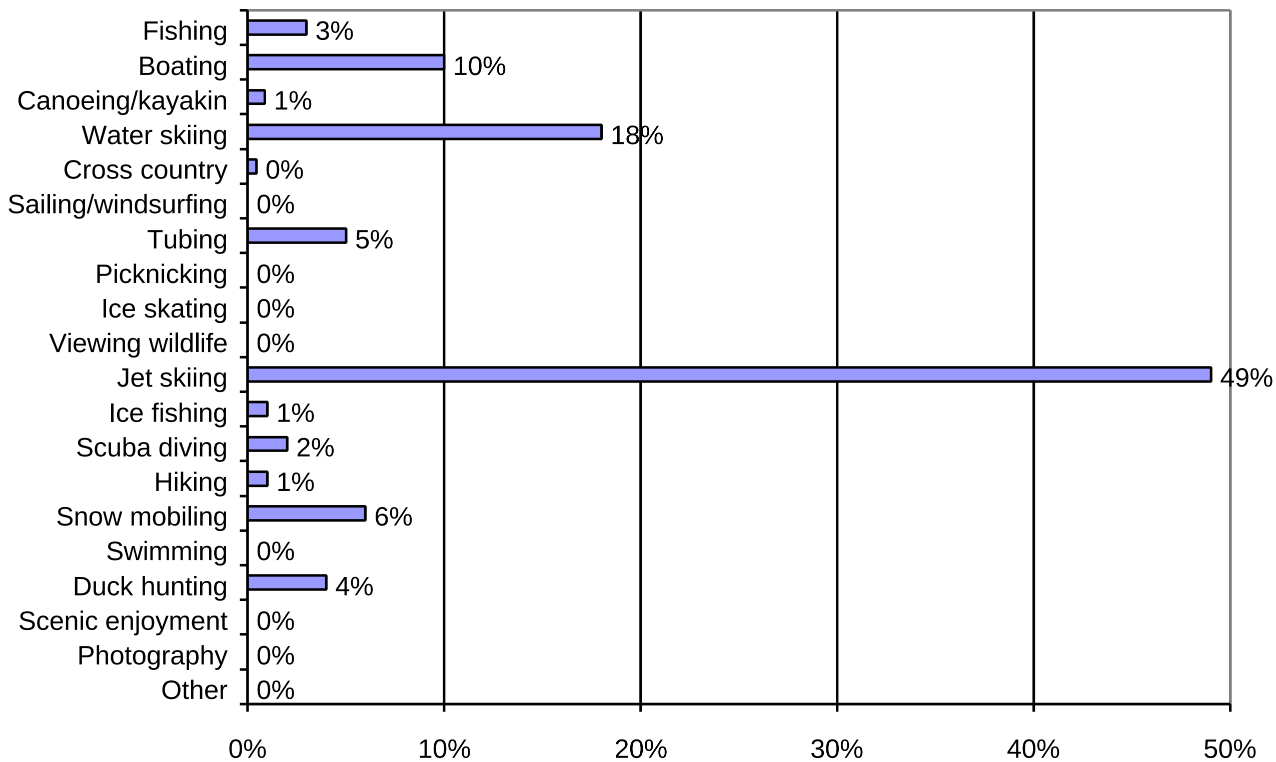


Which one(s)?

Total Responses
227

3%	Fishing	0%	Sailing/windsurfing	49%	Jet skiing	0%	Swimming
10%	Boating (motor/pontoon)	5%	Tubing	1%	Ice fishing	4%	Duck hunting
1%	Canoeing/kayaking/rowing	0%	Picnicking	2%	Scuba diving	0%	Scenic enjoyment
18%	Water skiing	0%	Ice skating	1%	Hiking	0%	Photography
<1%	Cross country skiing	0%	Viewing wildlife	6%	Snow mobiling	0%	Other

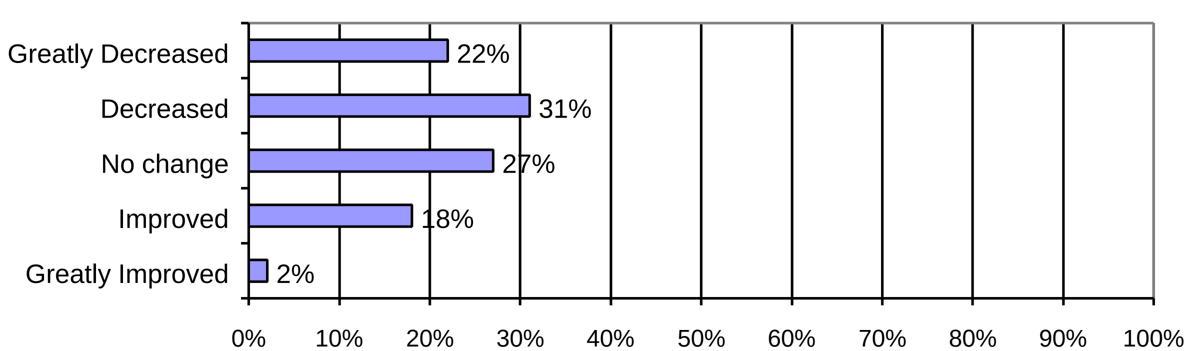
3. Would you like to see restrictions on any of the above activities? (Continued)



4. How has the quality of your use of Park Lake changed since your first exposure to the lake?

Total Responses
281

Greatly Decreased	22%
Decreased	31%
No Change	27%
Improved	18%
Greatly Improved	2%



5. Based on your knowledge of present conditions in Park Lake, if you could change three things about the lake to increase its value to you, what changes would you propose?

The following comments were the most frequently suggested:

- Remove weeds
- Improve water quality and clarity
- Remove sediment
- Improve fishing
- Remove carp and shad
- Impose jet-ski restrictions

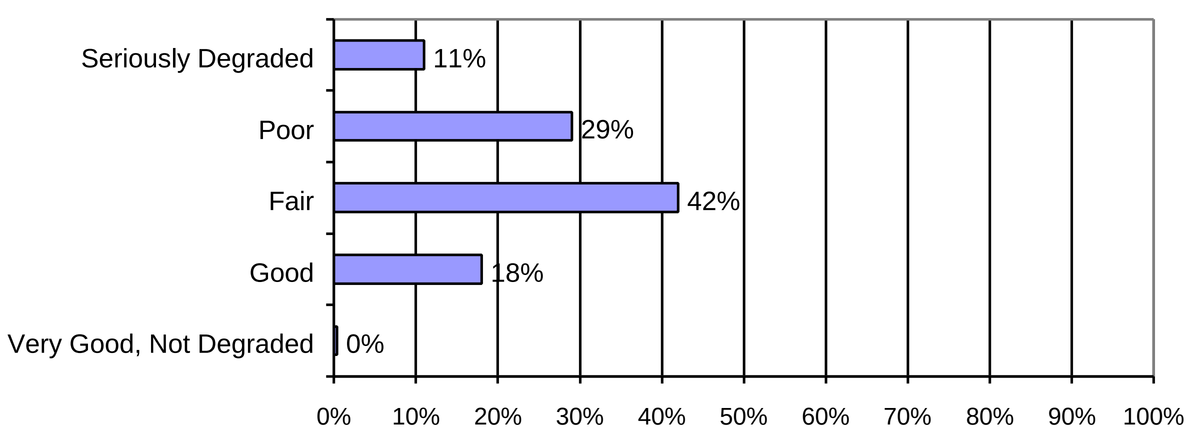
For a complete list of all comments, refer to Section IV. Written Comments

Please tell us about the water quality of Park Lake.

6. How would you describe the overall water quality of Park Lake?

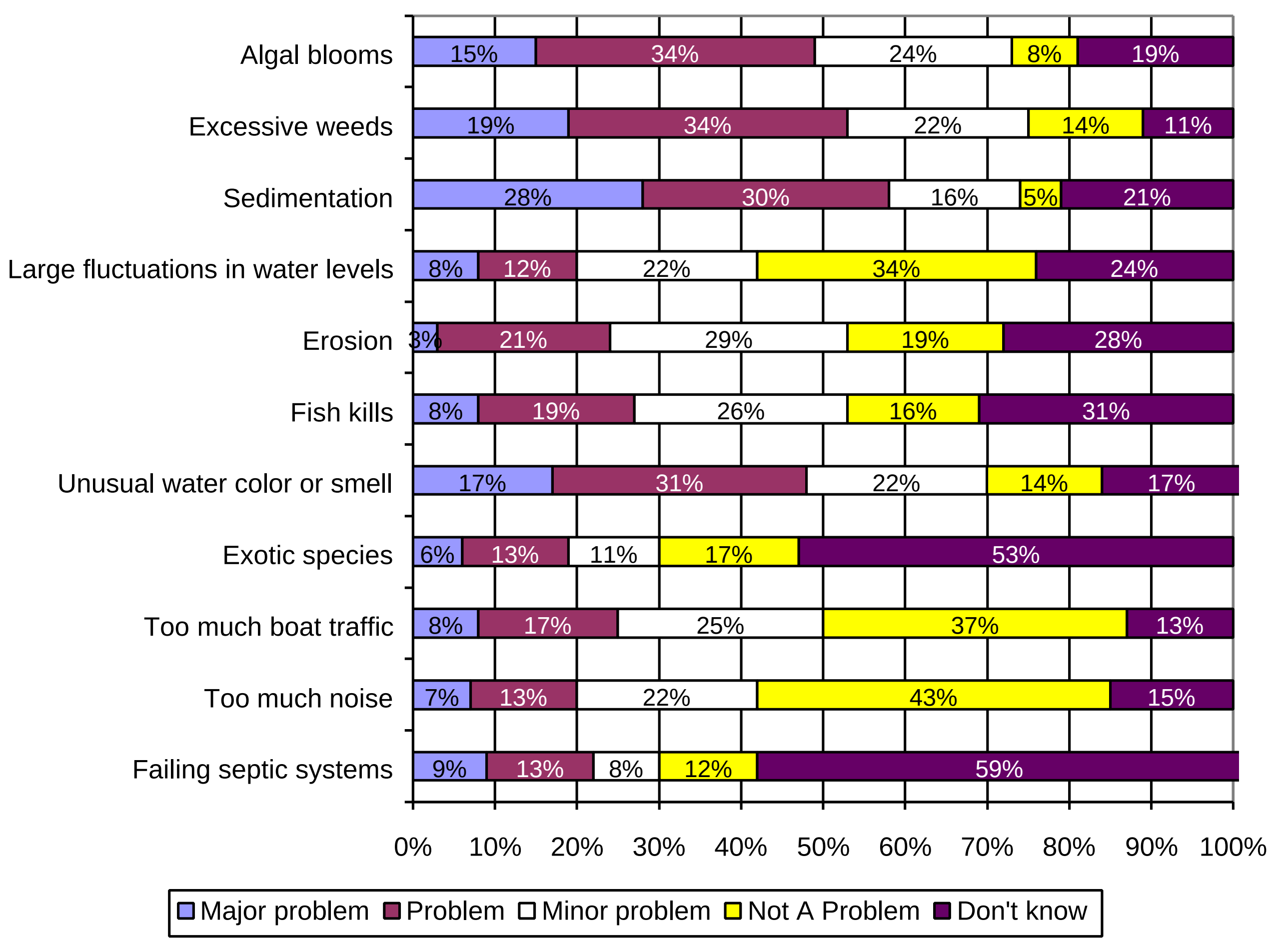
Total Responses
269

Seriously Degraded	11%
Poor	29%
Fair	42%
Good	18%
Very Good, Not Degraded	<1%



7. How would you rate the following occurrences in Park Lake?

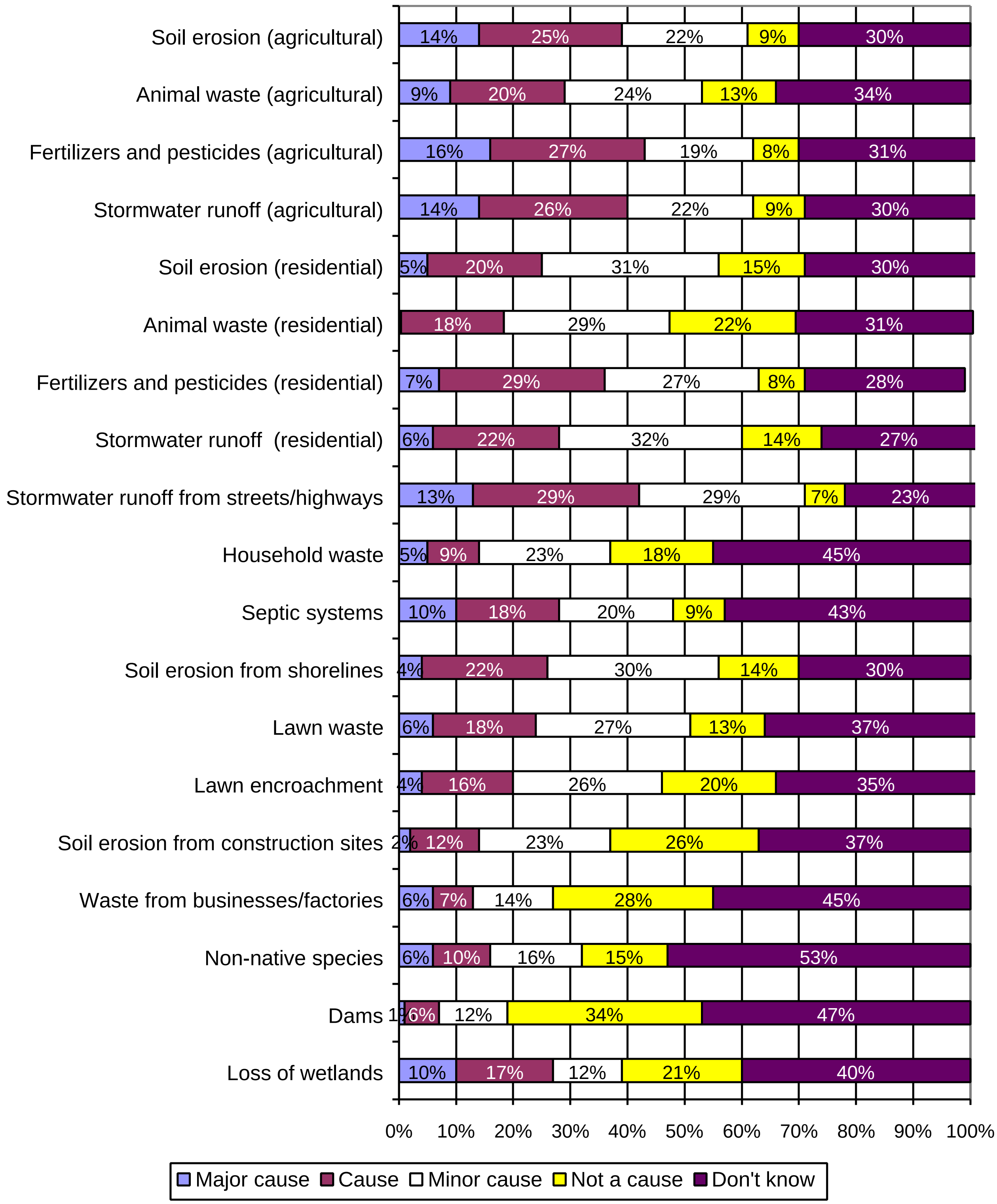
	Occurrence	Major Problem	Problem	Minor Problem	Not A Problem	Don't Know	Total Responses
A.	Algal blooms	15%	34%	24%	8%	19%	256
B.	Excessive weeds	19%	34%	22%	14%	11%	265
C.	Sedimentation	28%	30%	16%	5%	21%	257
D.	Large fluctuations in water levels	8%	12%	22%	34%	24%	256
E.	Erosion	3%	21%	29%	19%	28%	251
F.	Fish kills	8%	19%	26%	16%	31%	251
G.	Unusual water color or smell	17%	31%	22%	14%	17%	253
H.	Exotic species	6%	13%	11%	17%	53%	240
I.	Too much boat traffic	8%	17%	25%	37%	13%	255
J.	Too much noise	7%	13%	22%	43%	15%	251
K.	Failing septic systems	9%	13%	8%	12%	59%	253



8. In your opinion, which of the following factors pose a threat to water quality in Park Lake?

	Item	Major Cause	Cause	Minor Cause	Not A Cause	Don't Know	Total Responses
A.	Soil erosion from agricultural areas	14%	25%	22%	9%	30%	265
B.	Animal waste from agricultural areas	9%	20%	24%	13%	34%	262
C.	Fertilizers and pesticides from agricultural areas	16%	27%	19%	8%	31%	268
D.	Stormwater runoff from agricultural land	14%	26%	22%	9%	30%	263
E.	Soil erosion from residential areas	5%	20%	31%	15%	30%	261
F.	Animal waste from residential areas (i.e. pets, geese, etc.)	<1%	18%	29%	22%	31%	261
G.	Fertilizers and pesticides from residential areas	7%	29%	27%	8%	28%	267
H.	Stormwater runoff from house roofs, driveways, and residential land	6%	22%	32%	14%	27%	260
I.	Stormwater runoff from streets, highways, and/or parking lots (i.e. road salt, gasoline, automotive oils)	13%	29%	29%	7%	23%	263
J.	Improper disposal of household chemicals (i.e. paints, automotive oils, antifreeze)	5%	9%	23%	18%	45%	256
K.	Septic systems	10%	18%	20%	9%	43%	265
L.	Soil erosion from shorelines	4%	22%	30%	14%	30%	261
M.	Yard or grass clippings and/or leaves being disposed of in lake	6%	18%	27%	13%	37%	262
N.	Displacement of natural shoreline vegetation by lawns	4%	16%	26%	20%	35%	258
O.	Soil erosion from construction sites	2%	12%	23%	26%	37%	258
P.	Discharge and waste from factories and/or businesses	6%	7%	14%	28%	45%	258
Q.	Introduction of non-native plant and/or animal species	6%	10%	16%	15%	53%	257
R.	Dams	1%	6%	12%	34%	47%	258
S.	Loss of wetland areas	10%	17%	12%	21%	40%	261

8. In your opinion, which of the following factors pose a threat to water quality in Park Lake? (Continued)



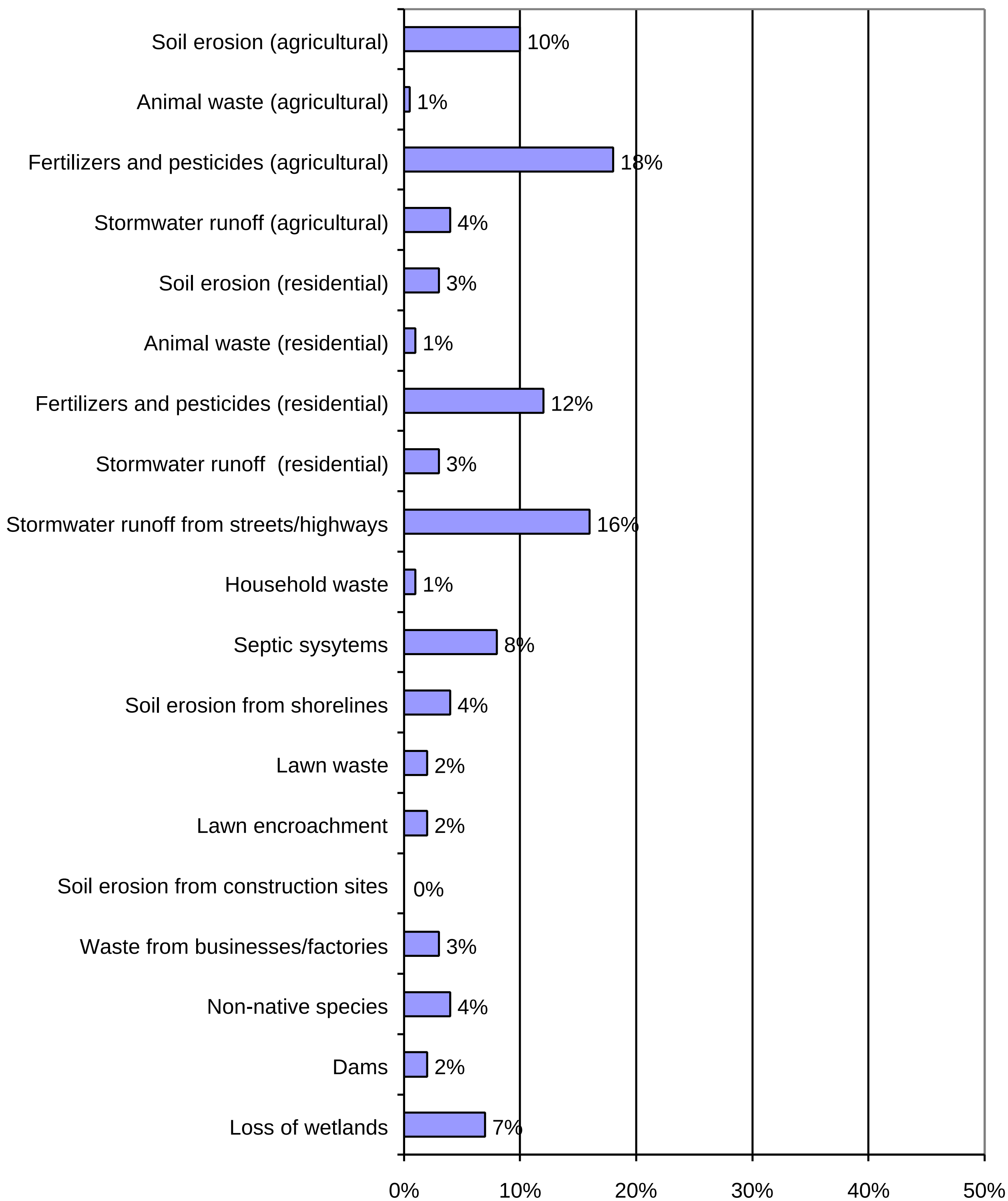
Note: Values less than or equal to one percent are not labeled on the chart.

9. Of the items listed above, which one do you feel contributes most to water quality problems in Park Lake?

Total Responses
193

	Item	Major Cause
A.	Soil erosion from agricultural areas	10%
B.	Animal waste from agricultural areas	<1%
C.	Fertilizers and pesticides from agricultural areas	18%
D.	Stormwater runoff from agricultural land	4%
E.	Soil erosion from residential areas	3%
F.	Animal waste from residential areas (i.e. pets, geese, etc.)	1%
G.	Fertilizers and pesticides from residential areas	12%
H.	Stormwater runoff from house roofs, driveways, and residential land	3%
I.	Stormwater runoff from streets, highways, and/or parking lots (i.e. road salt, gasoline, automotive oils)	16%
J.	Improper disposal of household chemicals (i.e. paints, automotive oils, antifreeze)	1%
K.	Septic systems	8%
L.	Soil erosion from shorelines	4%
M.	Yard or grass clippings and/or leaves being disposed of in lake	2%
N.	Displacement of natural shoreline vegetation by lawns	2%
O.	Soil erosion from construction sites	0%
P.	Discharge and waste from factories and/or businesses	3%
Q.	Introduction of non-native plant and/or animal species	4%
R.	Dams	2%
S.	Loss of wetland areas	7%

9. Of the items listed above, which one do you feel contributes <u>most</u> to water quality problems in Park Lake? (Continued)



10. In your opinion, are there other sources that contribute to water quality problems in Park Lake?

The following comments were the most frequently suggested:

- Litter
- Sediment
- Carp and other rough fish
- Weed removal
- Large horse powered boats
- Fluctuating water levels

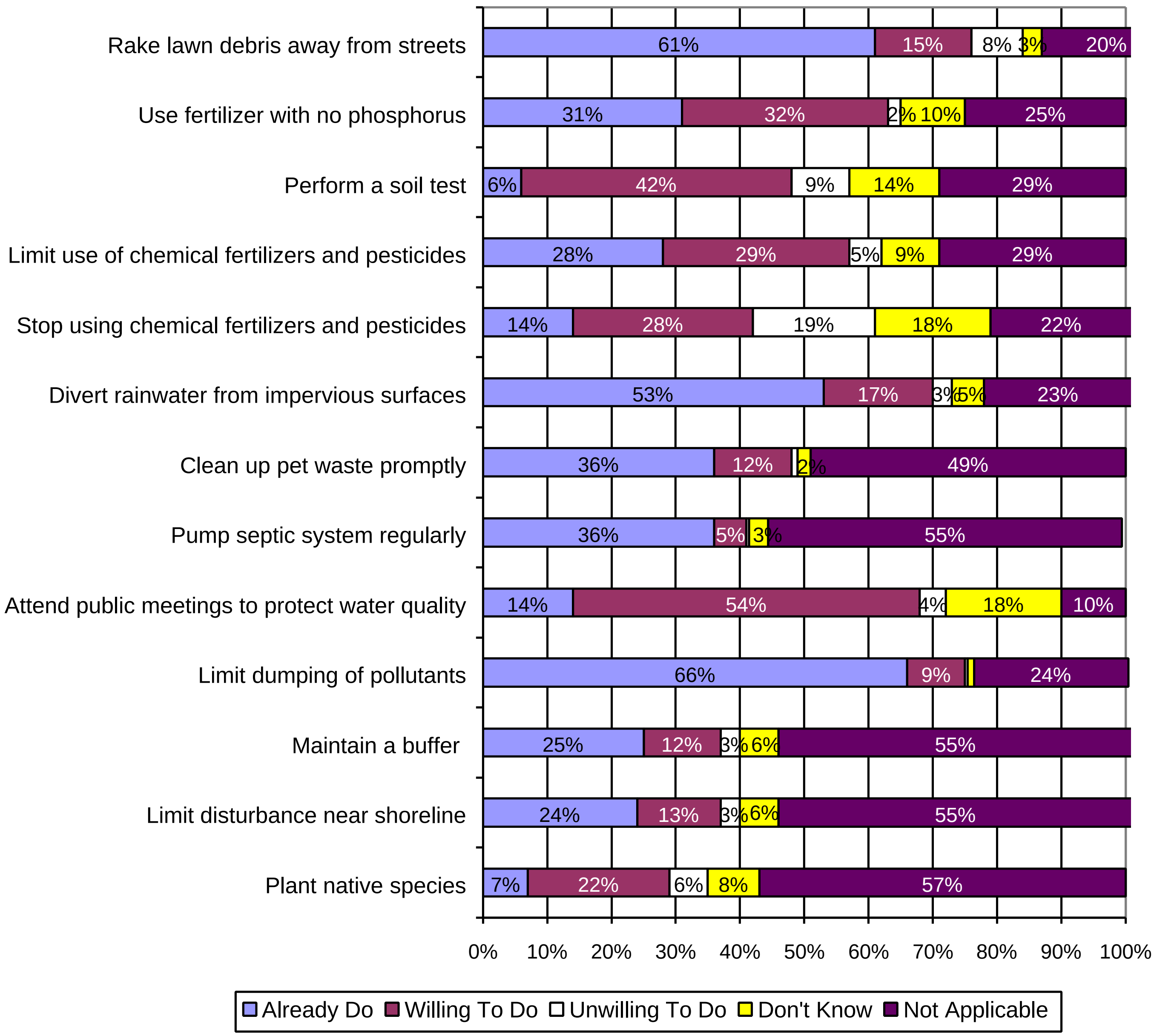
For a complete list of all comments, refer to Section IV. Written Comments

Please tell us about what management activities you support on Park Lake.

11. There are specific actions that all residents can do to reduce the amount of pollutants entering surface water bodies (lakes and rivers), in addition to groundwater sources. Which of the following activities are you willing to do on your property?

Activity	Already Do	Willing To Do	Unwilling To Do	Don't Know	Not Applicable	Total Responses
A. Rake leaves away from streets and curbs	61%	15%	8%	3%	20%	259
B. Use a lawn fertilizer that does not contain phosphorus	31%	32%	2%	10%	25%	260
C. Perform a soil test before deciding to apply fertilizers	6%	42%	9%	14%	29%	249
D. Apply chemical fertilizers and pesticides once per year	28%	29%	5%	9%	29%	253
E. Stop using chemical fertilizers and pesticides	14%	28%	19%	18%	22%	246
F. Modify roof gutters and downspouts on your home to divert rain water away from roads, sidewalks, and driveways	53%	17%	3%	5%	23%	252
G. Clean up pet waste promptly	36%	12%	1%	2%	49%	256
H. Pump septic system at least once every three years	36%	5%	<1%	3%	55%	258
I. Attend public meetings on how to protect water quality	14%	54%	4%	18%	10%	251
J. Limit dumping of pollutants (oil, gas, etc.) into water	66%	9%	<1%	1%	24%	258
K. Maintain a vegetative buffer along your shoreline	25%	12%	3%	6%	55%	254
L. Limit mowing, raking, and brush cutting adjacent to your shoreline	24%	13%	3%	6%	55%	256
M. Plant native species along your shoreline	7%	22%	6%	8%	57%	253

11. There are specific actions that all residents can do to reduce the amount of pollutants entering surface water bodies (lakes and rivers), in addition to groundwater sources. Which of the following activities are you willing to do on your property? (Continued)

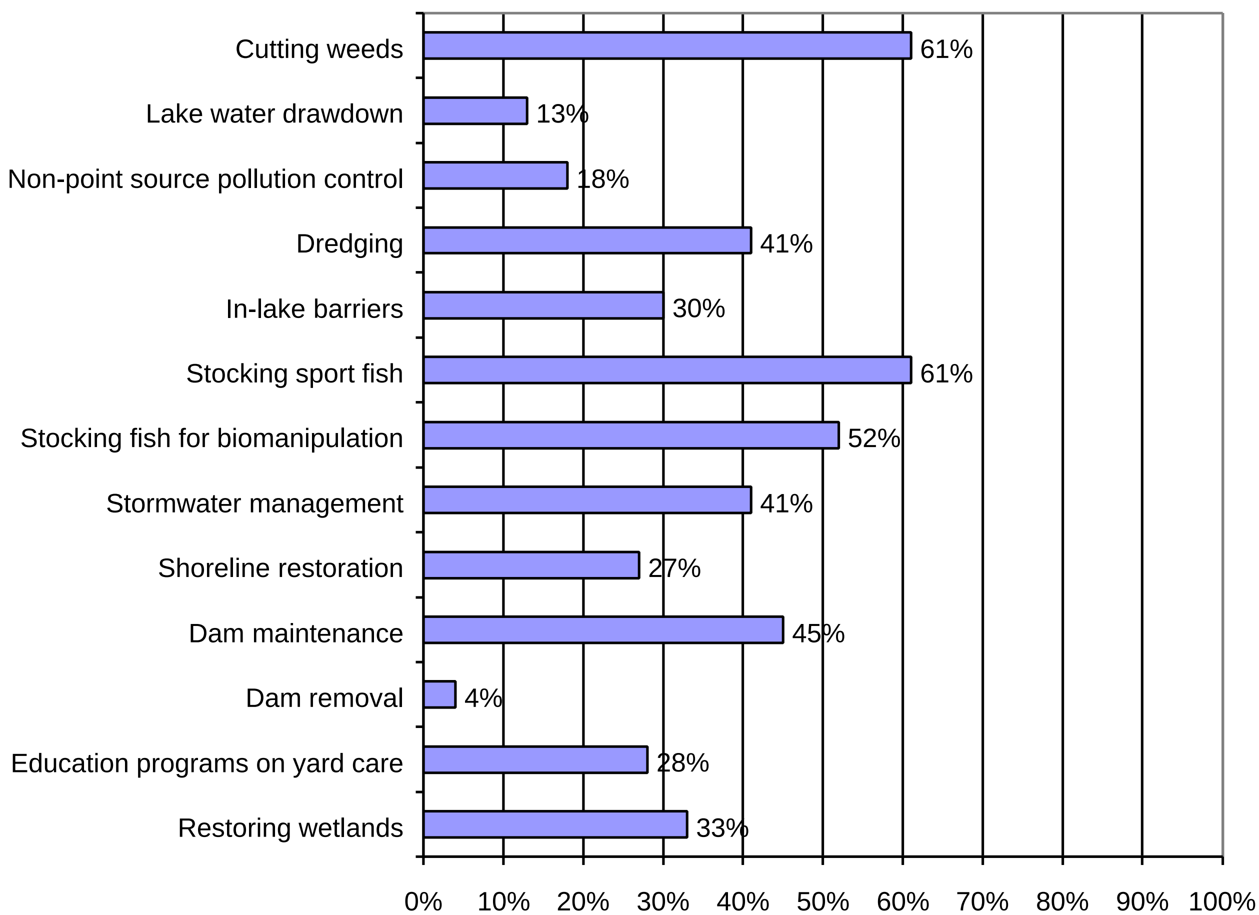


Note: Values less than or equal to one percent are not labeled on the chart.

12. Which lake management activities would you prefer the <u>Park Lake Management District</u> to support financially?

Total Responses
271

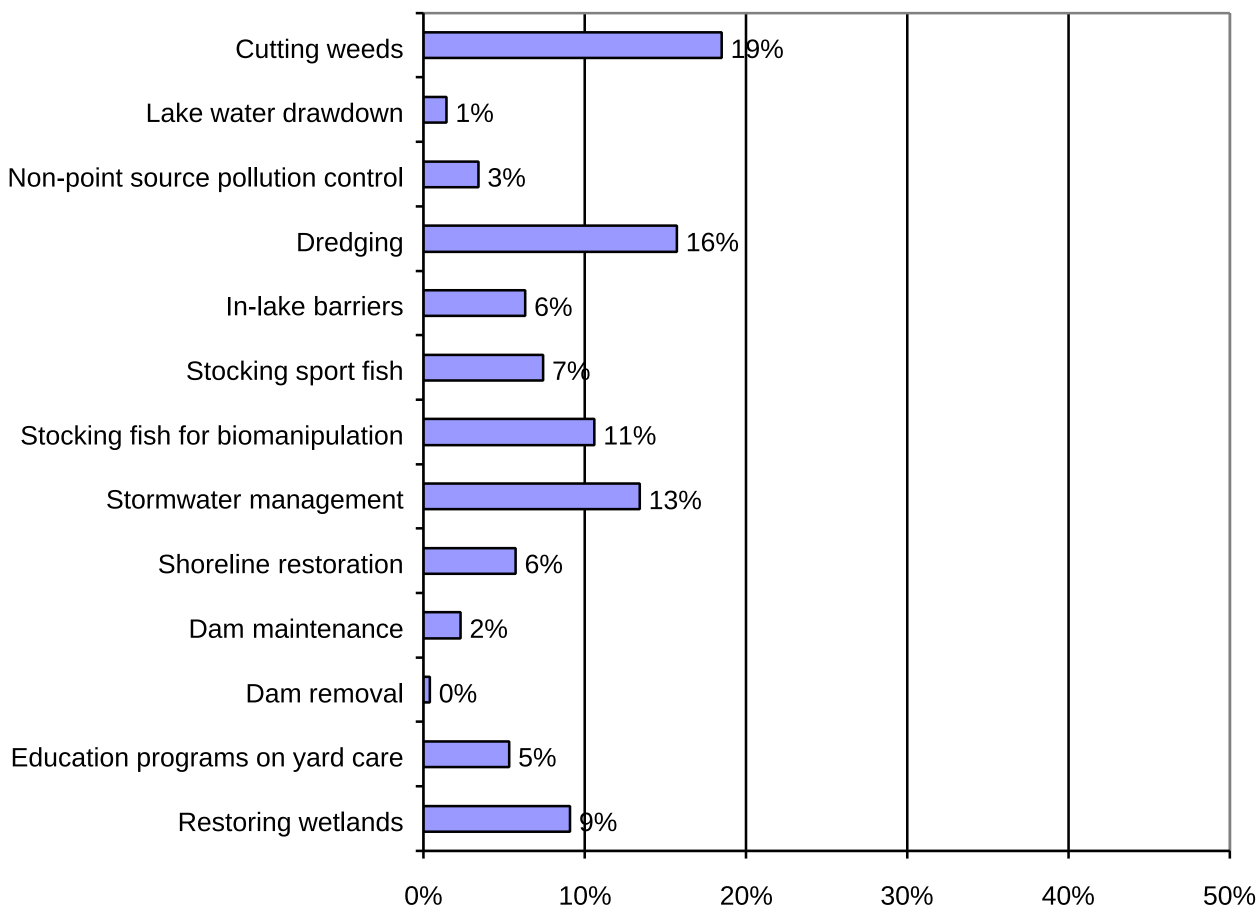
A.	61%	Cutting weeds
B.	13%	Lake water drawdown
C.	18%	Non-point source pollution control (e.g. buffer strips)
D.	41%	Dredging
E.	30%	In-lake barriers (i.e. in-lake sediment control structures)
F.	61%	Stocking sport fish
G.	52%	Stocking fish for biomanipulation (indirectly controls algae)
H.	41%	Stormwater management
I.	27%	Shoreline restoration
J.	45%	Dam maintenance
K.	4%	Dam removal
L.	28%	Education programs on yard care (e.g. demonstration sites)
M.	33%	Restoring wetlands



13. Of the lake management activities listed above, which two do you feel would <u>most</u> improve the water quality in Park Lake?

Total Responses
470*

A.	19%	Cutting weeds
B.	1%	Lake water drawdown
C.	3%	Non-point source pollution control (e.g. buffer strips)
D.	16%	Dredging
E.	6%	In-lake barriers (i.e. in-lake sediment control structures)
F.	7%	Stocking sport fish
G.	11%	Stocking fish for biomanipulation (indirectly controls algae)
H.	13%	Stormwater management
I.	6%	Shoreline restoration
J.	2%	Dam maintenance
K.	0%	Dam removal
L.	5%	Education programs on yard care (e.g. demonstration sites)
M.	9%	Restoring wetlands

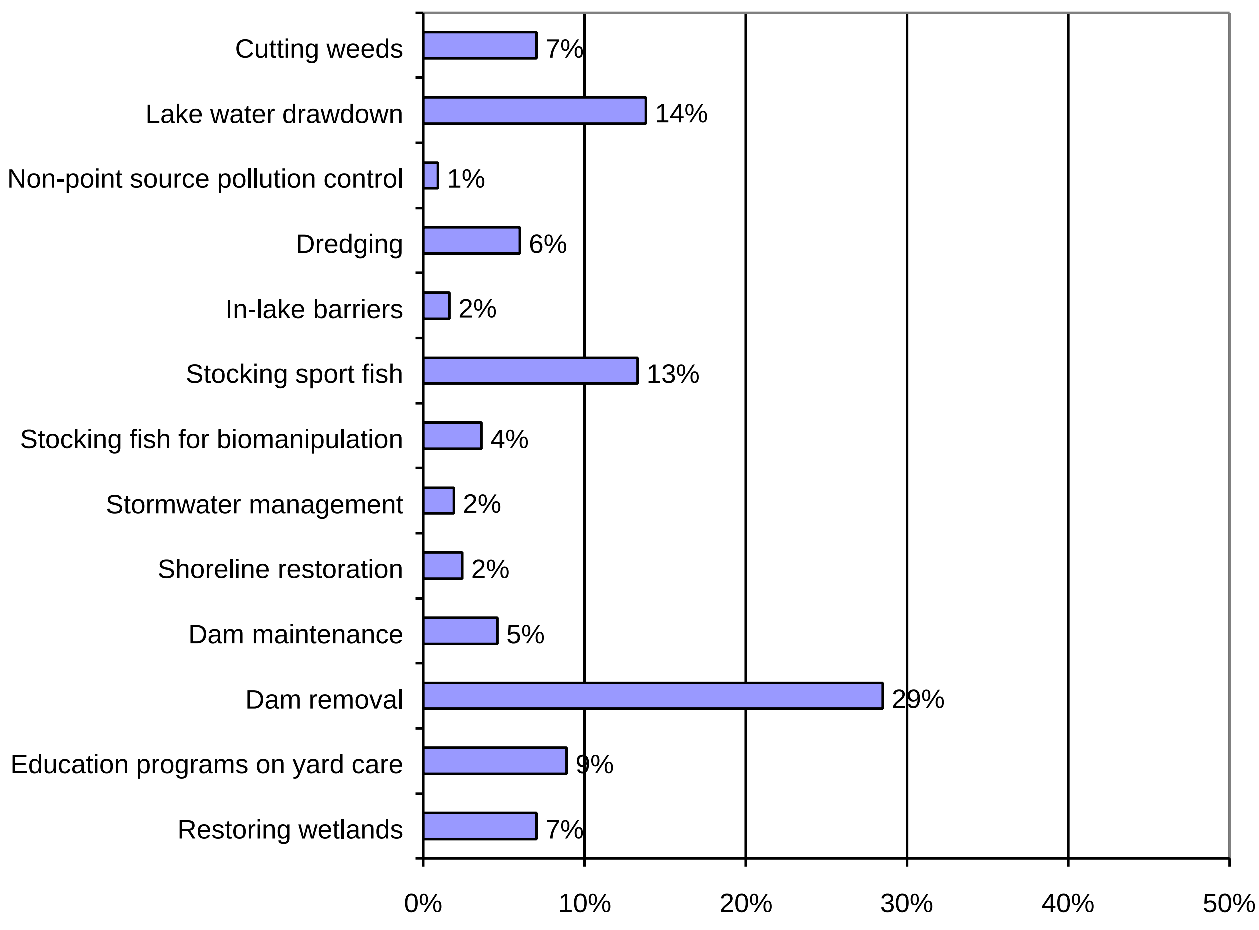


* Note that each respondent could select two items on the list; the value indicates the total number of responses.

14. Of the lake management activities listed above, which two do you feel would <u>least</u> improve the water quality in Park Lake?

Total Responses
413*

A.	7%	Cutting weeds
B.	14%	Lake water drawdown
C.	1%	Non-point source pollution control (e.g. buffer strips)
D.	6%	Dredging
E.	2%	In-lake barriers (i.e. in-lake sediment control structures)
F.	13%	Stocking sport fish
G.	4%	Stocking fish for biomanipulation (indirectly controls algae)
H.	2%	Stormwater management
I.	2%	Shoreline restoration
J.	5%	Dam maintenance
K.	29%	Dam removal
L.	9%	Education programs on yard care (e.g. demonstration sites)
M.	7%	Restoring wetlands



*Note that each respondent could select two items on the list; the value indicates the total number of responses.

15. Do you have suggestions for other types of lake management activities that should be supported financially by the Park Lake Management District?

The following comments were the most frequently suggested:

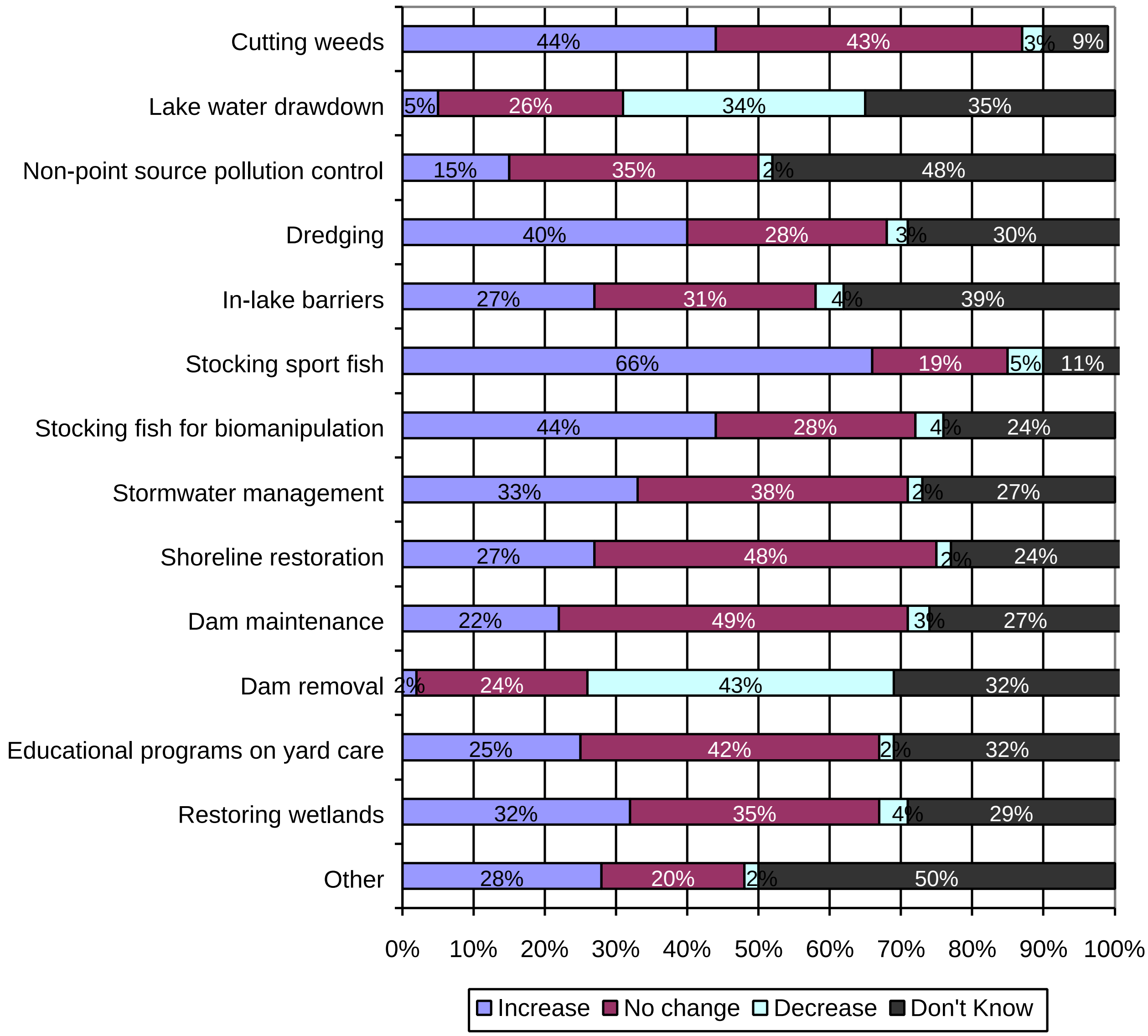
- Remove carp and other rough fish
- Check septic systems
- Remove trash
- Put up no-wake signs
- Sediment capture and removal

For a complete list of all comments, refer to Section IV. Written Comments

16. In your opinion, how would the following lake management activities affect your recreational use(s) of Park Lake?

	Activity	Increase	No change	Decrease	Don't Know	Total Responses
A.	Cutting weeds	44%	43%	3%	9%	244
B.	Lake water drawdown	5%	26%	34%	35%	238
C.	Non-point source pollution control (e.g. buffer strips)	15%	35%	2%	48%	230
D.	Dredging	40%	28%	3%	30%	238
E.	In-lake barriers (i.e. in-lake sediment control structures)	27%	31%	4%	39%	233
F.	Stocking sport fish	66%	19%	5%	11%	247
G.	Stocking fish for biomanipulation (indirectly controls algae)	44%	28%	4%	24%	235
H.	Stormwater management	33%	38%	2%	27%	237
I.	Shoreline restoration	27%	48%	2%	24%	234
J.	Dam maintenance	22%	49%	3%	27%	233
K.	Dam removal	2%	24%	43%	32%	226
L.	Education programs on yard care (e.g. demonstration sites)	25%	42%	2%	32%	232
M.	Restoring wetlands	32%	35%	4%	29%	235
N.	Other – please list ____________	28%	20%	2%	50%	54

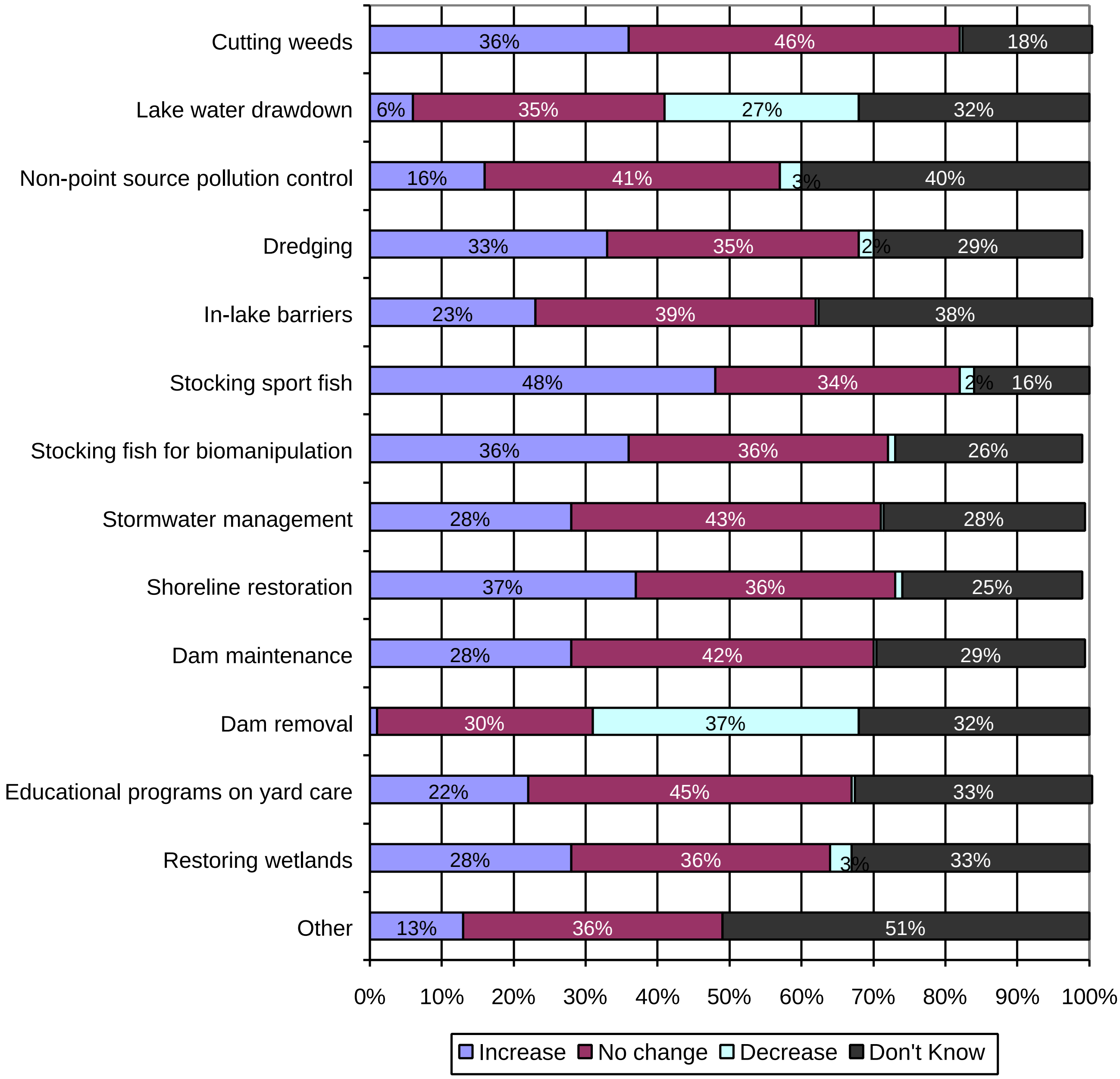
16. In your opinion, how would the following lake management activities affect your recreational use(s) of Park Lake? (Continued)



17. In your opinion, how would the following lake management activities impact your property value?

	Activity	Increase	No change	Decrease	Don't Know	Total Responses
A.	Cutting weeds	36%	46%	<1%	18%	232
B.	Lake water drawdown	6%	35%	27%	32%	225
C.	Non-point source pollution control (e.g. buffer strips)	16%	41%	3%	40%	222
D.	Dredging	33%	35%	2%	29%	228
E.	In-lake barriers (i.e. in-lake sediment control structures)	23%	39%	<1%	38%	226
F.	Stocking sport fish	48%	34%	2%	16%	235
G.	Stocking fish for biomanipulation (indirectly controls algae)	36%	36%	1%	26%	228
H.	Stormwater management	28%	43%	<1%	28%	225
I.	Shoreline restoration	37%	36%	1%	25%	228
J.	Dam maintenance	28%	42%	<1%	29%	229
K.	Dam removal	1%	30%	37%	32%	221
L.	Education programs on yard care (e.g. demonstration sites)	22%	45%	<1%	33%	224
M.	Restoring wetlands	28%	36%	3%	33%	222
N.	Other – please list ________________	13%	36%	0%	51%	72

17. In your opinion, how would the following lake management activities impact your property value? (Continued)

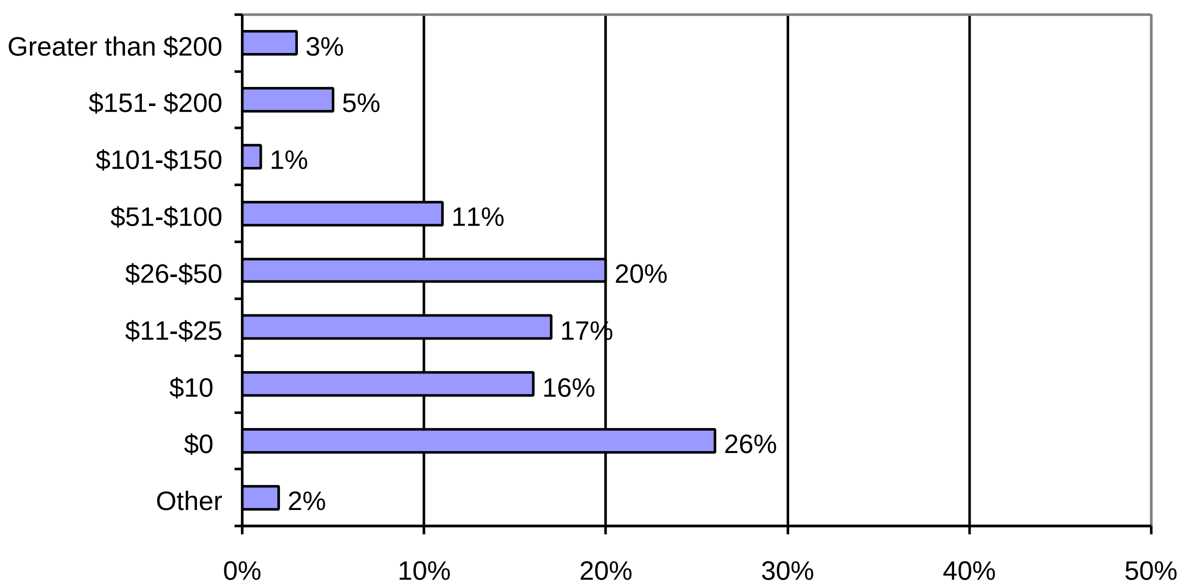


Note: Values less than or equal to one percent are not labeled on the chart.

18. Currently, fees in the Park Lake Management District are $20 for property on the lake, $10 for property off the lake. These fees go towards lake management activities. How much more would <u>you</u> be willing to pay annually to improve the water quality in Park Lake?

Total Responses
262

Greater than $200	3%
$151 - $200	5%
$101 - $150	1%
$51 - $100	11%
$26 - $50	20%
$11 - $25	17%
$10	16%
$0	26%
Other amount: $	2%

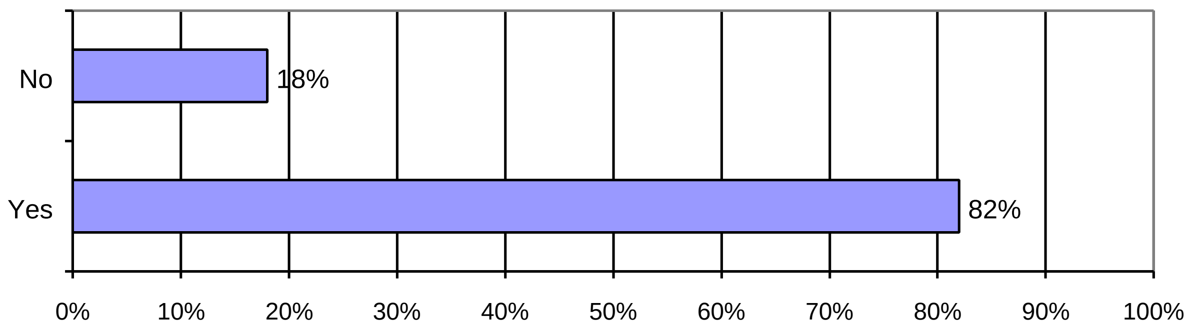


Please provide information about yourself.

19. Prior to receiving this survey, had you ever heard of the Park Lake Management District?

Total Responses
280

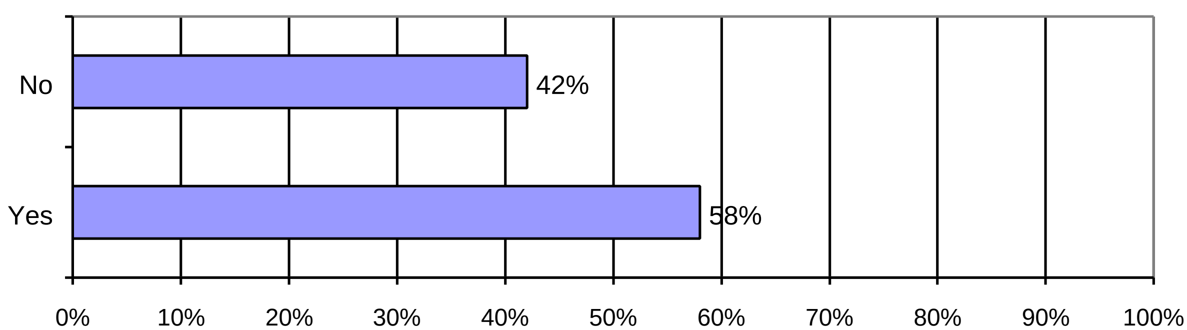
No	18%
Yes	82%



20. Do you currently receive the Park Lake Management District newsletter?

Total Responses
265

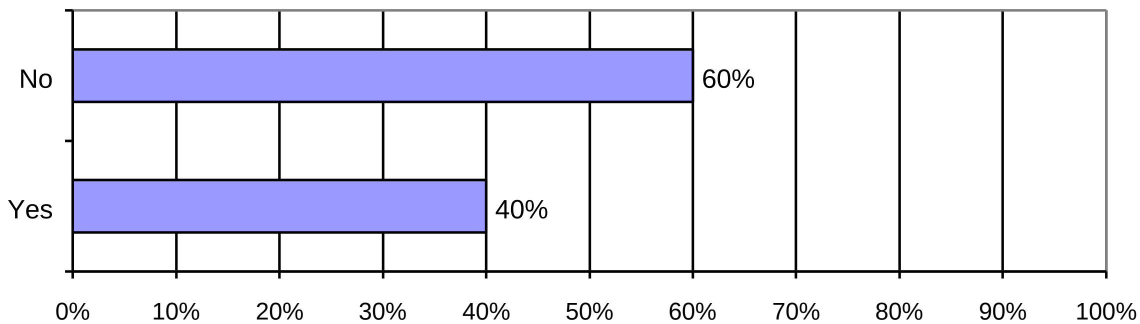
No	42%
Yes	58%



21. Do you own or lease property on Park Lake?

Total Responses
281

No	60%
Yes	40%



How long have you owned or leased this property?

Total Responses	Mean	Range
107	**16 years**	**1 – 64 years**

What was your principal reason for purchasing or leasing this property?

Total Responses
111

Water recreation	56%
Place to entertain	18%
Investment	40%
Natural beauty/solitude	63%
Other (please describe)	28%

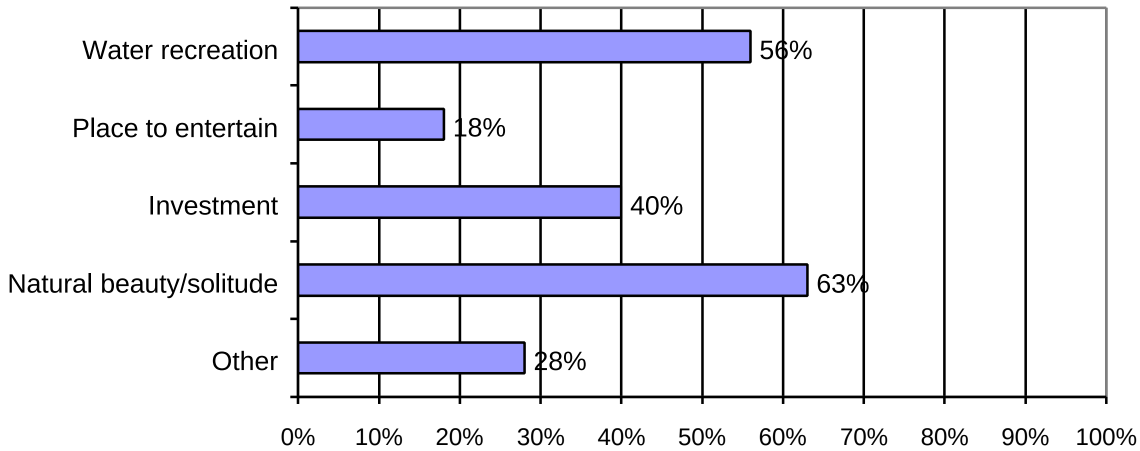
Other:

The following comments were the most frequently mentioned:

- Retirement
- Fishing
- Inheritance

For a complete list of all comments, refer to Section IV. Written Comments

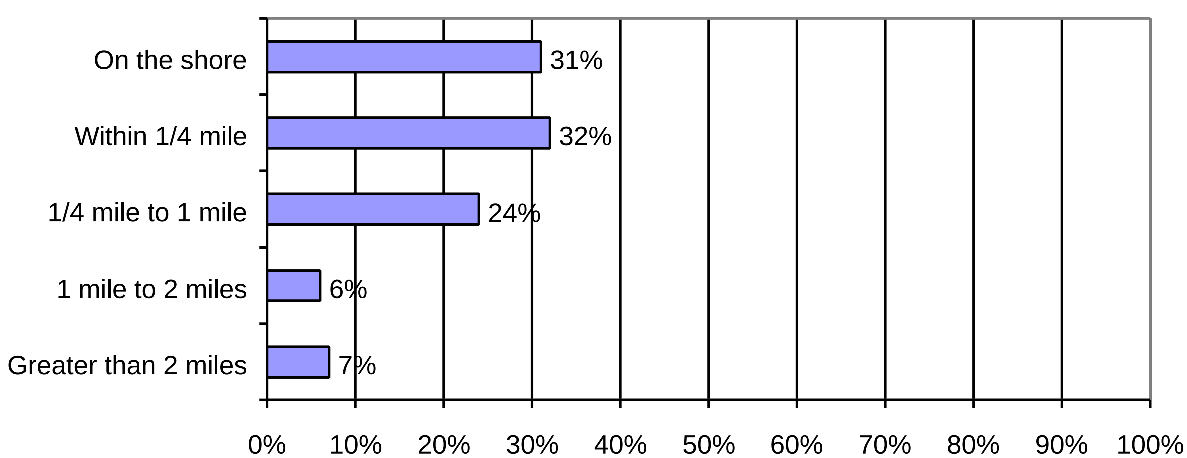
What was your principal reason for purchasing or leasing this property? (Continued)



22. How far away do you live from the Park Lake shoreline?

Total Responses
278

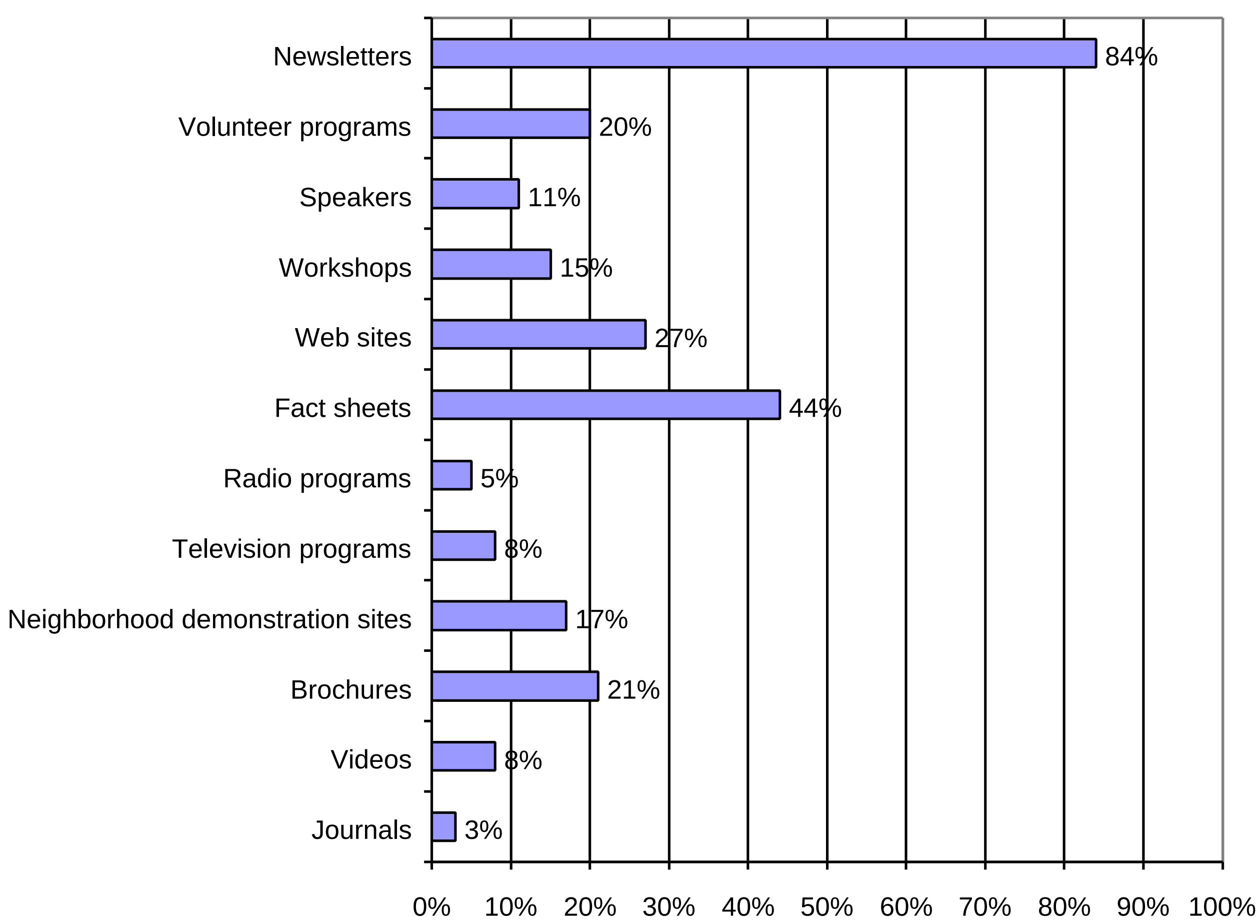
On the shore	31%
Within ¼ mile	32%
¼ mile to 1 mile	24%
1 mile to 2 miles	6%
Greater than 2 miles	7%



23. Which of the following educational opportunities about lake management activities would interest you?

Total Responses
235

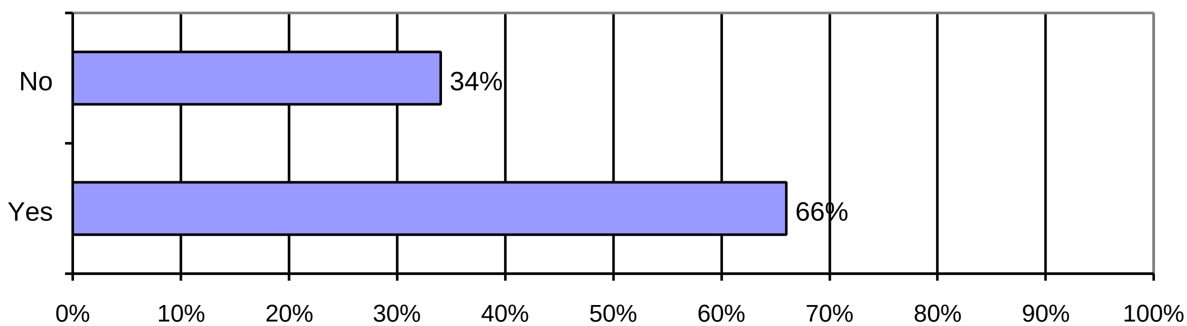
Newsletters	84%	Radio programs	5%
Volunteer programs	20%	Television programs	8%
Speakers	11%	Neighborhood demonstration sites	17%
Workshops	15%	Brochures	21%
Web sites	27%	Videos	8%
Fact sheets	44%	Journals	3%



24. Would you be interested in attending future Park Lake Management District meetings to learn more about management practices on Park Lake?

Total Responses
274

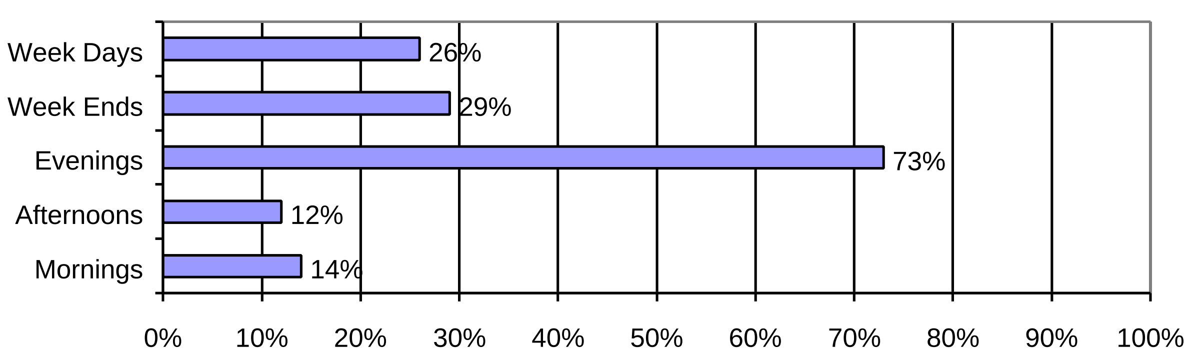
No	34%
Yes	66%



What is a convenient meeting time?

Total Responses
111

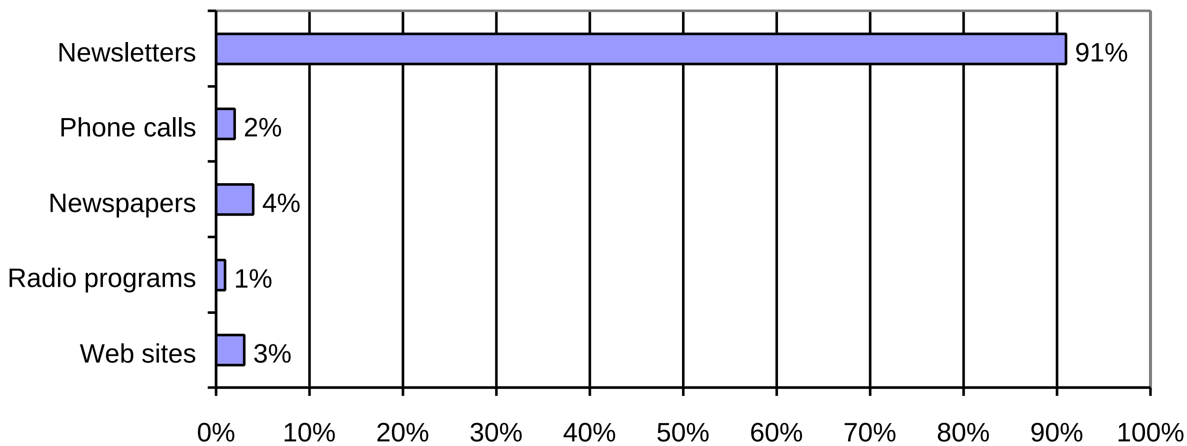
Week Days	26%
Week Ends	29%
Evenings	73%
Afternoons	12%
Mornings	14%



25. In what format would you prefer to get information about upcoming Park Lake Management District meetings?

Total Responses
204

Newsletters	91%
Phone calls	2%
Newspapers	4%
Radio programs	1%
Web sites	3%



IV. Written Comments

The following comments are copied as they were written on the surveys. An ellipsis was inserted when the writing was illegible.

1. In the last 12 months, which of the following activities have you participated in at Park Lake?

Comment	
4	Paddle boat.
85	Peddle boating, boat racing.
168	Birding.

2. For the above activities, which three do you value the <u>most</u>?

Comment	
182	Boat parade: 4th of July. Watermelon festival.

3. Would you like to see restrictions on any of the above activities?

Comment	
23	Raise the limits on fish.
41	Noisy motors.
47	No loud music.
52	Jet skis excessive speed and too close to the shoreline.
69	As in no wake area.
88	Speed of boats …
96	High powered boats (45 HP plus).
130	Times of day to allow fishing.
458	Restrict cruising and loitering in the park.

4. How has the quality of your use of Park Lake changed since your first exposure to the lake?

Comment	
27	Used to visit, now we live in town.
167	Greatly decreased: No fish!
178	I swam in it when it was clear and clean.
179	Decreased: fishing. Improved: swimming beach.
629	Please improve the bathrooms!
716	Decreased: Fishing.

5. Based on your knowledge of present conditions in Park Lake, if you could change three things about the lake to increase its value to you, what changes would you propose?

Comment	
1	Reduce weeds. Clean lake. Stock with fish.
2	Clean up bottom. Water quality. More fish - lake needs panfish, walleye, northern, less carp.

3	Ban jet skis. Increase weed control. Make … clean up his junkyard along southeast shoreline.
5	Stock northern, walleye, and muskie.
6	Water clarity improved. Decrease weeds. Less dead fish and trash in the lake.
7	Algae. Weeds. Water clarity.
8	Sedimentation. Weed control. Fishing.
9	Weed control. Nice beach.
10	Populate lake with fish. Reduce or eliminate motor boats (especially those over 5 HP). Limit or restrict further housing around lake.
11	Improve water quality. Better weed control. Improve the fish stocking and care.
12	Improve water quality. Re-establish the fishery. Restrict jet skis.
14	Water clarity. Keep the weeds down. Improve sport fishing.
15	No jet skis on small lake. 0 tolerance in no wake areas. Designated areas for ice skating, observed by snow-mobiling and ice fisherman, etc.
16	Increase fishing quality. Increase water quality. Ban jet skiing.
17	Improve water clarity. Restrict boating activity. Reduce fish quotas.
18	Cleaner water for swimming. Clean up graffiti on bathrooms. Better police protection in the evenings.
20	Better fish management.
22	Improve clarity of water. Decrease algae blooms. Increase amount of small weed bed, which could act as fish shelters and water filtering systems.
23	Take measures to get rid of the carp problem.
26	Cleaner water. Less weeds near shores and piers. More panfish.
27	New to the area – really enjoy the lake. Not too well informed on problem conditions.
28	Remove more weeds from the north inlet of lake. Remove shads. Remove carp.
29	Fish and water management.
30	Clean up water.
31	More walleyes. Less carp. More city activities.
32	Improve water quality. Time of day restriction on jet skis. Bag limit restrictions – lake is over-fished
34	Sediment – where river enters – can't wade in water from our boat dock – mud plus three feet in depth. I can lean over side of boat – can't reach solid bottom with my cane. Weeds some years. Algae some years wind blow full.
36	We need to get some type of weed growth back in the lake. The weeds filter the water and give the fish a place to hide and feed. Get rid of the Muskie Club, get us back to the natural fish in the lake. Did they bring the shad into the lake as feed for the muskie. Quit spending all the Lake District money on studies and do something to get the lake back to the years when it was fun to fish in our lake.
37	We never swim in it past July 4th because of weeds and water condition. Too many health risks. Something's wrong. Lots of dead fish float up to the access near where we live.
39	Clear up the water. Control weeds. Clear the trees to the North of the old Mobil station so people driving by have a nice view of the lake, as this is the only point on Hwy 22 the lake is visible to passerby's.
40	Forget about the larger fish, get rid of the carp and shads and get the blue gill and crappie fish back.
42	Increase water depth. Maintain water depth at high water level. Clear up the water and remove some of the muck.
44	Speed of boats. Boating and skiing too close to piers. Lots of carp last two years.
45	Eliminate run-off from the roads around the lake. Let residents know what could be put in culverts to neutralize road run-off.
47	Shouldn't cut grass to shoreline.
48	Getting rid of weeds, jet skiing, boats with big, loud motors.
49	Stock more game fish.
50	Get rid of the muskies. Boat motor size under 75 Horse.
51	Fishing quality.
52	Clean the water quality. Cut down on amount of…
53	Cleaner.
54	Less algae. Less weeds. Less pollution.
55	Carp. Weeds. River height.
56	Stock panfish. Cleaner water. Erratic water level.
58	Dredge the muck. Weed control.
59	Decrease carp – shad populations. Increase aquatic vegetation. Remove silt in specific areas.
60	Water quality for safe swimming. More panfish and less carp and shad (? sp.). Better boat ramp.
61	Get rid of carp, shad, and muskies. Get good weeds for smaller fish.

62 Continue to control weeds.
64 Cleaner water. Better fishing. Less weeds.
65 More enforcement on no wake zone. The speed at which jet skis run decreased. Littering enforced.
66 Check fish population. Add fish if needed when available. Jet skiing – cut down hours they can ski.
67 Better boat landings – the ones now are in need of repair badly! Cleaner water.
68 Clean lake out. Kill carp.
69 Carp and rough fish have greatly increased.
70 Improve fishing/create more public fishing areas/boat rentals. Improve beach/ add beach house/ add snack bar/ add ice-skating rink. Improve water quality and clarity/ remove street run-off.
71 Try to rid lake of existing sediment. Try to reduce future sediment. Try to reduce erosion, fertilizers, and pesticides.
73 Get rid of mud on bottom. Algae floating on top of water needs to go. Clean up to murky water.
75 Cleaner water for swimming and boating.
76 Get rid of weeds. Get rid of carp. Repair dam.
77 Implement a no wake rule between the hours of 5pm and 9am.
78 Find ways to decrease sediment in bottom of lake. Bays and lagoons are slowly filling in.
79 Dredge. Clean up the river (inlet) and upstream. Restock – anything but muskies.
80 Better weed control. Cleaning of debris and garbage. Bathroom facilities available.
82 It needs some sort of vegetation. The main part of the lake is mud bottom with no structure. More fish!
83 Clean up algae. Make beach more attractive.
85 Elimination of jet skiing on lake. Time limits in lake. Time limits for water skiing – am and pm. Horse-power restrictions on all motors.
87 Get better fish in the lake. Less restrictions for boats. Cleaner weed conditions.
88 Cleaner water – less weeds, cleaner water, not green water. Nicer beach with lifeguard supervision. Nice shelters/beautification such as gazebo.
89 Sewer all around lake. Improve river flowing into lake. Stock more fish and remove shad.
90 Dredging. Shoreline restoration.
91 An increase of water plant life to where it would decrease algae growth. Plants that so not reach the surface (I've seen on Northern Wisconsin lakes). No more muskies planted in the lake (it was over done).
92 Limit speed boats, jet skis, and water skiing.
93 Water quality. Fish quantity. Restriction to pleasure boaters.
95 Weed control.
96 Water quality. Limit high power boats. Hold back on ice fishing tournament for a couple of years. Let the fish population grow in size.
97 Water clarity. Weed growth. Algal blooms.
99 Restart weed removal. Put in wind dam up river.
100 Water quality.
101 Get rid of the carp. More panfish. Weeds.
105 Eradicate carp. Dredge river portion. Raise/maintain higher water level.
106 Improve fishing. Clean up lake.
107 Many carp. Dredge bottom, get rid of silt. Too much boat activity for small lake. Too much lawn fertilizer use.
108 Fish management – panfish.
111 Better (more) fishing. Better for swimming. More of a chance for local people using shelters.
114 Better fish management. Weed control. Better habitat for fish.
115 Better fish management. Better boat access. Skiing time restrictions.
118 Boat etiquette.
121 Improve water quality and clarity. Improve fishing. Increase restrictions on high-powered boats and speed control.
122 Stop and remove sedimentation thru developing or pumping.
123 Reduce carp pollution. Increase game fish (perishable weeds, etc.), cribs, etc.
127 Reduce or eliminate the carp population. Reduce or eliminate the noise of jet skis. Monitor water quality for fish and wildlife.
128 Make lake deeper. Improve fishing habitat. Clean up dirty water.
129 Better maintained and staffed beach. Clean up dead fish more often. Make a skating rink for winter sports.
130 Dredge it deeper. Clean out carp. Stop draining waste and street run-off into it!

131 Swimming. Fishing. Scenic enjoyment.

133 Increase water quality or address problems that prohibit sustainable fishing habitat.

134 Keep algae and mosquitoes down. Un-chaperoned kids.

136 Skimming weeds better. Too many get into swimming area. Trim trees. Too many fallen branches get into swimming area. Add a raft for swimmers to go to.

138 Not such large motors. Get limit on motor size.

139 Lake drawdown to kill rough fish. Re-stock game fish. Dredge North end of lake.

140 Get rid of the carp, shad, and muskies. Control weeds and algae blooms. Dredge lake deeper.

142 Clean up the old buildings downtown (businesses). Tear dam – make lake more useable. Promote cleanup weekend – weeds on shore and … in mid summer.

144 Size of lake on East side. Size of beach area. Expand park.

146 Reduce fish die off. Make more places for non-boating fishing. Diving ramp and other swimming related activities.

147 More restrictions on larger boats. More emphasis on water quality.

150 Clean up the garbage off the bottom.

152 No more muskie transplants. Take Park Lake off DNR list as muskie lake – (too many lake fishing boats). No jet skis – (noisy).

155 Try to clean up the carp and shad out of the lake.

157 Stop killing the weeds. The weeds in the river act as a filter. Improve fishing. Improve water quality.

159 Move swimming beach to “Frog pond.” Open entire lake to skiing (impose and enforce a “speed limit with proximity to shoreline.” Improve boat launches.

160 Fishing. Swimming. Weed control.

161 Dredging of the channel and lake. Setting up a silt catch basin upstream. Lower the level in winter and dredge.

163 Improve game fish habitat.

164 Improve fishery and add structure (cribs, etc.). Improve water quality (coffee looking). Get rid of carp and shad.

165 Limit the size of motor. Let some weeds grow for the fish.

166 Enforce the no wake rule. Bring back panfish (eliminate shad). Rid the lake if silt – dredge to the sandy bottom.

167 New boat landing – thought it was to happen last year – rocks at landing. Get fish in the lake.

169 Stop jet ski. No speed boats. Get rid of weeds.

170 Dredge old mill pond. Approx 8 acres of water that has been neglected for 30 years and widen and straighten channel into lake. This was bass haven. Keep beaver from damming channel. Dredge pond in Park. Dredge all along HWY 44 in the narrows and get rid of beaver dams in the Little Fox River to get some current flowing.

171 Water quality. Less boat use.

173 Reduce carp and shad populations. Drawdown. Poison. Keep fish away from dams. Shockers. Introduce walleyes.

174 Remove some weeds. Restock fish.

176 Drain (Lower Lake) and dredge. Clean out silt and sediment. Kill off shad.

178 Limit or outlaw motorboat use. Limit or … run-off into lake.

179 More fish.

180 Limit source and non-source point run-off and pollution, especially lawn and field fertilizers. Dredge sludge if freezable. Maintain ice skating area for winter park recreation.

181 Clean up the water at certain times of the year. Improve the fishing.

186 Get most of the rocks out of the Park. Get the lagoon cleaned out. Patrolled more to keep druggies out of Park.

188 Better fishing. Better boat landing on HWY 44. Dredge.

189 Upgrade boat landing. Better water quality to swim at the beach.

192 More foliage on edge of lake (brush). Clean the water. Silt traps.

195 Restrict motor horsepower. No jet skis. No wake law enforced.

196 Clean Frog Pond.

198 Clean it up – especially beach area. Would go swimming there more often then. Bring in more fish. Build new restrooms (2 or 3 in different locations).

199 Jet skiing. Speedboats. No boat 35 HP. Pontoon 50 HP.

201 Cleaner water to increase fish population. Cleaner water for swimming.

202 Better fish numbers and quality.

422 Weed control.
427 Putting in sediment pond North of town line: bridge. Set hrs for jet skis and skiing.
429 Cleaner.
439 Improve fishing. Improve clarity of water.
441 It’s really nice.
446 An increase in panfish.
448 Improve fishing.
450 Water quality. Weed control. Jet ski ban.
453 Remove green algae on eastern end.
456 Stock fish. Keep water level even.
457 Clean it up.
458 Young people use the park as a hangout. Cars speeding through the park is the norm. Increased police patrol would help!
461 Regulate jet ski craft. Control weed growth. Inspect septics.
462 Remove lake weeds. Control algal blooms. Restore wetlands.
464 Stop the lakeside bottle shop from selling liquor – access from lake pier and so close to boat landing. Restrict PWC. Restrict farm fertilizer use.
468 Better fishing. Less carp.
469 Improve fishing. Cleaner water.
474 Increase depth of 1ake. Decrease shoreline erosion – or improve shoreline. Control weeds.
477 Less weeds. Better swimming.
479 Prevent future silt build-up and remove some of it. Carp removal and control. Restore and protect weeds beneficial to the fish population.
487 No wake zone in channel into river. Leave some weeds for better fishing. Repair boat ramps.
488 A little clearer water.
489 Improve access to the dam for fishing.
492 Improve water quality.
493 Decrease water weeds near my shore.
494 Increase water quality. Put time restrictions on jet skis and water skiing.
495 Get the carp out. More panfish.
497 Better fish management.
498 Stock more fish. Enforce 200’ rule for skiers.
500 Decreasing the silt buildup by use of a silt pond. Keep the level a little higher.
518 We were very unhappy with the large amount of dead fish in Spring Lake (lower) lake this spring/early summer. DNR told us they had been pumped out of Park Lake. Would rather not smell these fish!
523 The lake should have sewer and water all the way around.
542 Weeds. Odor.
549 Put more game fish in water. Try to rid of some carp. Try to stop more run-off.
557 Extended beach area
569 Too much boat traffic. Too much noise.
570 Cleaner water. Larger sports fish. No carp.
593 Try to make water cleaner if possible
597 Stop erosion (shoreline). Stop fluctuation of water level. Another boat launch.
599 More for children.
600 Weeds. Cleaner water. Fishing.
607 Clean up small sand. Better bathroom facilities.
621 Dredge silt down to the natural sandy soil. Prohibit jet skis. Enforce 200 ft. no wake with large posted regulations.
629 Clean up the pond. Bathrooms.
638 Improvement on the shoreline.
648 Channel cleaned out for spawning and boats back of …. Property. Weed control and lily ponds in backup waters. Change channel depth to all the same.
660 Fix up restrooms and maybe add more in other areas. Cleaner water. Keep the punks away from the basketball court – the ones that hang out.
664 Remove no wake zones. Algae blooms. Weeds.
689 Try to remove the weeds. Plant more fish. Do not plant muskies in the lake.
696 Open up skiing (when skiers were allowed to ski the lake was a lot cleaner).
716 No jet skiing. More game fish.

718	Better fishing.
726	Clean water. Reduced weeds. Reduced algae.
751	Clean water way (improve flow). Improve fishing. Stop storm sewer drainage.
761	Get rid of pond. More clean-up of water at edge.
768	Remove muskies, carp, shad. Restock panfish. Stop silt from entering lake via Fox River.

6. How would you describe the overall water quality of Park Lake?

No Comments

7. How would you rate the following occurrences in Park Lake?

Survey Number	Comment
50	Too much noise: Big boats, 100 Horse
67	Beach stinks like dead fish or ?
91	Failing septic systems: was at one time, I no longer know.
105	Exotic species: carp and loosestrife.
135	Failing septic systems: Could be a problem. When we have had activities in the park, have noticed smell sometimes and weeds.
159	Too much noise: wave runners.
164	Fish kills: Northern lacking. Too much noise: jet skis.
180	Too much noise: snowmobiles

8. In your opinion, which of the following factors pose a threat to water quality in Park Lake?

Survey Number	Comment
8	Carp harvest, sediment trap on Haynes Rd.
32	Gas/oil discharge from boats, littering and dumping of refuse into lake.
44	Possibly Fox River.
85	Major cause: High-speed boat traffic in shallow lake.
88	All would pose a threat if they are happening but I'm not sure what is causing it.
127	Septic systems: Is there a problem?
164	Introduction of non-native plant and/or animal species: carp and shad.
166	Introduction of non-native plant and/or animal species: shad and muskie.
170	Too many carp, gizzard shad, and suckers. Beaver dams cutting off current from Little Fox River.
660	Improper disposal of household chemicals: tires by dam.
768	Major cause: Soil erosion from marshland.

9. Of the items listed above, which one do you feel contributes <u>most</u> to water quality problems in Park Lake?

Survey Number	Comment
6	We don't know, perhaps sediment brought in from river is a major cause.
55	Weeds.
135	Some of these could be a cause – some people careless.
151	Weeds.
192	Natural soil and unnatural soil erosion upstream.

10. In your opinion, are there other sources that contribute to water quality problems in Park Lake?

Survey Number	Comment
2	Erosion or sediment has greatly decreased depth of lake. Bottom content affects fish spawning and decreases populations.
4	People throw bottles, cans, etc. in the lake. When trees and weeds are cut along shore – they let branches and weeds float away.
6	River sediments improper dumping of waste including dead animals; depth of lake; better balance of aquatic species.
7	I believe Park Lake gets a lot of impurities from the Fox River and without the dam water levels … on its own.
9	Animal waste – geese, cranes, etc. – protected.
10	Boat pollution, residential shoreline restriction.
11	Litter dumped into lake. Beer and pop cans, glass bottles, limbs, wood chunks, etc.
12	Carp causing turbidity and eliminating aquatic plants, which provide habitat for desirable species.
17	Cleaning the weeds out.
18	People (young people) throwing litter in the lake such as cigarettes, pop cans, food wraps. Adults are also among the litterers.
22	The number of large HP motors which keep the sediment constantly in suspension = they act as mix-masters - keeping everything blended into a high nutrient soup.
27	Careless people – discarded trashcans and bottles, fishing lines, etc.
28	Gas and oil leaking from motors. Grease from wheels of trailer bearings.
30	People using it as a toilet.
39	The lake seems fairly clean in the year and as speedboat increases, so does the quality of the water decrease.
40	None serious.
42	Carp keep my shoreline stirred up all spring.
48	Carp. Ice fishermen throwing debris in the lake.
52	Homeowners using lake water to water their lawn.
60	Gas and oil from boats and jet skis.
61	Bad population of shad and carp.
67	2-cycle boats or pwc (oil consumption). 4-cycle crafts recommended.
73	Too many carp.
82	Rough fish.
85	Fluctuating water levels. As much as 8”- 12” in one day.
88	Lack of weed and algae management.
90	Too much fluctuation of the water levels and no weeds.
91	The size of the area that drains into Park Lake (watershed). Whatever decreased the frog population from 50 years ago.
92	In the past, soil erosion from upstream caused much of the sediment. Since this has stopped the sediment has not increased.
93	Boat traffic. Aquatic life (fish and plants) healthy. Lakes take care of themselves.
96	Fuel leak from boat motors. Septic systems of home on the lake.
97	Gas and oil from motorboats – refuse thrown from boats.
101	Too many boats and wave runners.
103	Abundance of carp, shad, and cormorants.
106	Weeds.
113	Tires, bathtubs, down trees in Lower Park Lake.
121	High-powered motors and jet skis that churn up the bottom – too many carp and shad. Agricultural usage of land along the river (i.e. animal waste and destruction of shoreline plant life).
123	The carp uproot native plants.
127	Septic systems have been listed and I don’t know if this is or has been a problem – If they are failing then this surely will pose a threat to water quality of the lake.
128	Excess carp and trash fish dominate the lake’s fish population may have some effect on water clarity.
130	Upstream sources.
131	Boats, motors, gasoline leakage. Garbage thrown in lake.

132	Silt from wherever it’s coming from.
136	Over-growth of weeds. Untrimmed shoreline trees. There has been a recent problem with drug paraphernalia.
137	Too much State controls – i.e. too much involvement with DNR.
140	Way too many carp, which stir up the excessive sediment in the shallow lake bottom. Kill the majority of the carp and it would be much cleaner.
141	Boating.
142	I have lived here (Pardeeville) most of my life – I feel that the quality is better than it has been in past.
144	The frog pond in the middle of the park should be dredged and the weeds taken out, other wise the smell of it gets bad.
152	DNR putting non-native fish in lake.
157	How can the average homeowner answer 8 – 9 intelligently?
163	It is my understanding that a large population of carp are causing problems with turbidity resulting in reduced vegetation.
166	The lake is shallow and heavy use by large boats and motors causes excessive turbidity.
178	Motor boats. Lawn fertilizers. Agricultural run-off.
192	Motorized boat traffic. Bare shorelines. Lawn chemicals, clippings, fertilizers, herbicides. Silting in of mill ponds.
195	Heavy build up of silt.
199	Dredge the lake.
201	People are slobs. They pollute a lot more then they used to.
420	The introduction of muskies, shad, and carp.
439	Killing too many weeds over the years (and not harvesting).
458	Stagnant water in the pond and litter build up in pond. Partial solution recirculating water, i.e. Portage Pauquette pond duplication.
468	Don’t know. DNR should know.
479	Suspect past lake management attempts at weed control were wrong; coupled with shore owners participation as well: also, the silting should have been addressed long ago.
492	Build up of sediment lowers water depth and increases temperatures – this leads to lower water quality (algae).
495	Too many carp and shad.
557	Garbage from picnickers, kids, etc.
597	The water level fluctuates quite often and causes much erosion from the river entering into the lake. Carp are eating game fish young.
621	Drainage ditches directly into Fox River where crops are being grown.
648	Muskrats. Beavers. They destroy shorelines – fill lake with debris and plug up flow of water.
737	The use of too many pesticides and fertilizers and other chemicals.
751	Sediment collection on bottom after 50 plus years of usage.
768	Silting of wetlands entering lake.

11. There are specific actions that all residents can do to reduce the amount of pollutants entering surface water bodies (lakes and rivers), in addition to groundwater sources. Which of the following activities are you willing to do on your property?

Survey Number	Comment
69	My house is 5’ from shoreline.
170	The body of water that I’m on dredging and keep beaver dams out of channel is the only solution.
176	Restoring wetlands and fish spawning areas.
448	I own lot across street from Park Lake – none apply.
469	We don’t fertilize.
582	Pump septic system at least once every three years: Required by township at Green Lake.
608	I don’t live on lake shoreline.

12. Which lake management activities would you prefer the Park Lake Management District to support financially?

Survey Number	Comment
34	Lake water drawdown: temporary for dredging.
36	Stock sport fish except muskie.
60	We don't need muskies in Park Lake.
85	Policing of all boating activities on a more regular basis.
89	Require sewer or proper operating septic systems.
91	Stocking sport fish: not muskie.
103	Lake water drawdown: eliminate carp and shad.
127	Dredging: Up river areas of silt collected over years.
202	Stormwater management: Should involve Village Sewer Department, Dam removal: If needed.
492	Dredging: Without drawdown.
710	Stocking panfish.
768	Stocking sportfish, small fish.

13. Of the lake management activities listed above, which two do you feel would most improve the water quality in Park Lake?

Survey Number	Comment
89	Septic system controls. "Enforce" the laws.
164	Carp removal.
170	In-lake barriers: I don't know if it is too shallow to do any good.
192	Silt removal.

14. Of the lake management activities listed above, which two do you feel would least improve the water quality in Park Lake?

Survey Number	Comment
40	Remove carp and shad.

15. Do you have suggestions for other types of lake management activities that should be supported financially by the Park Lake Management District?

Survey Number	Comment
2	Put in water slow down system on river by Haynes Rd.
3	Remove the shoreline junkyard on the South-east side of the lake, target the oil and gas machinery.
4	Clean shoreline day similar to Park clean up day done by boaters, owners, and volunteers.
6	We have none at this time but are willing to be on a committee set up to evaluate this problem.
7	Is Pardeeville's waste treatment plant operating properly?
28	Install more fish cribs.
32	Septic system testing on properties adjacent to the lake.
55	Removal of carp.
34	There needs to be a hole dredged North of Haynes Rd to collect sediment and prevent it from entering Park Lake. That would keep sediment in one spot that could be dredged more economically as needed instead of spoiling the whole lake.

36 Get the weeds back, cut the weeds along the shorelines, not poison. We do not need the whole lake weed free. Lazy lake in Fall River is weed choked, but the water is clean and fishing great.
42 Re-stocking panfish as there currently is no or very little reproduction.
48 Spraying weeds when and where needed to control the weeds and algae.
57 Build dam at Haynes Rd. Stop wasting money on boats and giving it away.
59 Carp – shad removal.
60 We need more information! I'm a year-round resident and get what I can – my neighbors who have summer homes know nothing.
78 In order to restore to the lake you want – you must fix the problem first.
85 Better boating activities. Policing more no wake areas in places where safety and erosion can be a problem.
89 Support the enforcement of present septic system requirements. We really appreciate the boat parade and fireworks.
91 If the Village will not clean leaves, debris, etc. from storm sewer grades, the Lake District should. (The Village does not clean up grades).
113 Cleaning up tires, bottles, cans, and excess trash from both Park Lake and Lower Lake.
121 Clean out carp and shad. Check septic system. Leach bed into lake.
128 Remove excess carp and trash fish.
130 Launch and parking. Water testing/reporting.
140 Carp, shad, and muskie removal.
144 Weed harvesting and public docks for boats.
152 Leave the lake alone! Find something else to do!
157 Hire someone who knows what they are doing to manage the lake.
164 Carp and shad removal.
166 Post large no wake and other rules. Shad and panfish spawn in the same shallow water – shad are ruining panfish spawning areas. Forget muskie and keep the pan and walleye increasing.
173 Keep water level high in spring so game fish can spawn and eggs have time to hatch.
178 Control of motorboats and jet skis.
180 Massive dredging and sludge control measures.
185 We live on Spring Lake and would like to see improvements made to this lake instead of using it simply as an overflow and dumping ground for Park Lake. Spring Lake has been ignored and all monies are spent on Park Lake. Meanwhile, we have tires and garbage wash up on our shoreline – would this be allowed to happen on Park Lake?
188 Fishing has been very poor for the last 3 – 4 years. Stock game fish. Remove carp and shad.
189 What is the purpose of the lagoon in Chandler Park? Could that be more useful?
192 Dredge – to keep water temperatures down. Upstream sediment capture and removal.
195 Post large no wake rules. Encourage no growing of crops on drained marshland.
200 Install a series of sediment control ponds up river from lakes to settle out sediment and dredge that regularly to return sediment to farm lands.
425 More toilet facilities for public: summer and winter.
458 Make the park a safe place. Manage people first then water, vegetation, and fish.
487 No wake zone in channel from lake into Fox River.
497 Stocking panfish.
518 Removal of dead fish – don't pump into Lower Lake.
621 Get rid of carp and other rough fish.
646 Weed cutting.
751 Inlet and outlet for pond in back of ball diamond.

16. In your opinion, how would the following lake management activities affect your recreational use(s) of Park Lake?

Survey Number	Comment
3	Clean up junk along Southeast side of lake to remove contaminants.
27	Survey would be better answered if these issues were explained in more detail.
32	Jet ski restrictions.
40	Plant bluegills.
42	Maintain high water level.
52	Fishing pier/docks.
59	Remove carp-shad.
85	Policing of boating activities at least tri-weekly.
89	Dredging: waste of money.
91	Dam removal: drastic change. Someone should clean street storm grades.
93	Control boat traffic.
121	Getting lakeshore and river shore landowners to realize what pollutes the water and degrades it.
128	Swim.
136	Trimming trees.
140	Carp, shad, and muskie removal.
146	Better swimming facility.
458	Visible law enforcement.
464	Forbid use of glass bottles.

17. In your opinion, how would the following lake management activities impact your property value?

Survey Number	Comment
3	Ban jet skis.
32	Jet ski restrictions.
42	Stock panfish.
59	Remove carp-shad.
69	Lake water drawdown: temporary I hope!
88	Septic system laws.
113	Clean up garbage – eye sores.
121	Remove carp, shad, and other garbage fish.
128	Water quality.
166	Eliminate shad.
170	Nothing has been done to the body of water I live on: except some of my neighbors keep the beaver dam open and one neighbor keeps helping the beaver.
192	If quality of the lake improves, property value will improve.
458	People management.
464	Eliminate broken glass in lake.
657	Dredging: Never do anything.

18. Currently, fees in the Park Lake Management District are $20 for property on the lake, $10 for property off the lake. These fees go towards lake management activities. How much more would <u>you</u> be willing to pay annually to improve the water quality in Park Lake?

Survey Number	Comment
11	Boat landing and lake use fees.
26	$5.

27	Really enjoy living near the lake – would be willing to keep it clean, safe, and pretty.
28	I have been paying $10 per year for 10 years and seen the lake decrease, get worse every year. Money is not the issue. What's done with it is.
34	More if dredging would be done North of Hwy 44 boat landing.
36	If this means more money taken for studies and no action seen: $0. If something would actually get done: $50.
38	Keep same.
47	Lake owners should pay $100 per year; off lake $20 per year.
48	None, they haven't used the money that they have been collecting to improve the lake as it is. The only thing the Lake District has used money for is the DNR to take surveys and to stock sport fish, muskie, in the lake, which has practically eliminated the panfish population. The last meeting I went too, the people voted against the stocking of sport fish (muskie) in the lake. As I was leaving, I overheard one of the DNR men tell the president of the Lake District that they could stock them (muskie) anyway. So I quit going to the meetings.
55	We are located on the river and get no advantage. We have 2 properties on the river.
57	All you do is waste money.
60	Greater than $200: If used wisely.
79	I would like to see a plan in effect before I could answer this.
88	We have 2 properties in town so we already pay double.
91	The keyword is improve.
93	$26-$50: off-lake property.
121	If we pay more, I would like it to go toward improving water quality, rather than purchasing C.D.'s from a bank.
127	$26-$50: or more – but the need has to be determined first.
138	As is.
140	$151-$200: If carp were remove and lake was dredged.
142	$100: Off lake.
160	Other: $100 on lake, $20 off lake.
166	Greater than $200: Providing dredging and wetland restoration takes place.
188	I would like to know where this money we are charged has gone. Weed cutting has not been done for at least 3 years.
192	No more than every resident in Pardeeville pays. We do not use the lake anymore than anyone. Probably less than most because of the quality of the lake. Personally, I would put my big toe in it and I'd sooner swim in the toilet.
458	Escalate fees as other issues are resolved. Management of the park and environmental issues are separate problems. The park is a youth hangout – dominated by a small group. The park is not comfortable unless the activity is organized. The lake becomes less significant to the locals due to the way the park is used. Perhaps additional police patrols would eliminate the problem.
501	We think the people that own waterfront property should be the ones who pay the tax and they need to be the responsible parties in the care and upkeep of the lake.
618	$0: Because I am retired on a very small income.
657	$0: What I pay now is more than I should because nothing is ever done.
718	People that live on the lake should pay for the increase not people off the lake.
768	I consider this a classic case of fleecing of America. The fishing has been destroyed, silting goes on after major rains and continues for long periods of time. Carp, stripers, shad, muskies have taken over the lake. These fees collected have don nothing other than create a job for someone.

19. Prior to receiving this survey, had you ever heard of the Park Lake Management District?

Survey Number	Comment
167	Taxed in it.

20. Do you currently receive the Park Lake Management District newsletter?

Survey Number	Comment
60	Do you mean the information that comes with the electric bill?
134	If I do, I don't read it.

21. Do you own or lease property on Park Lake?

Survey Number	Comment
4	Nice neighbors.
8	Close to home.
12	Peace.
28	Retirement .
40	Fishing .
55	On Fox River.
56	Fishing.
57	Farm.
58	Retirement.
60	My family has owned this property since 1937. Family roots.
62	Residence.
87	The home.
105	Value and location.
118	Enjoyment for children.
121	Weekend escape.
127	Reminded me of the areas I spent my summers at as a child.
157	Fishing.
166	Homestead.
448	Planned to build retirement home some day.
458	Mother was prior owner. Solitude fading.
461	First property bought in 1975.
467	Inherited.
468	Great fishing 30 years ago.
472	Fishing.
475	Retirement.
479	Prevent development.
487	Fishing and small boating.
495	Retire.
500	Fishing.
502	Our home.
549	Retirement home.
621	Homestead.
657	Lower Park - Spring Lake.
695	Given to us by relatives.

22. How far away do you live from the Park Lake shoreline?

Survey Number	Comment
202	I have rental properties within ¼ mile and ¼ mile to1 mile, and I live 1 mile to 2 miles.
501	We own an undeveloped lot that is not on the lake.

23. Which of the following educational opportunities about lake management activities would interest you?

Survey Number	Comment
192	Actually doing something besides talking about it.
751	Get something done.

24. Would you be interested in attending future Park Lake Management District meetings to learn more about management practices on Park Lake?

Survey Number	Comment
60	Don’t care.
192	To this point they have done nothing but spend money and do nothing.
492	Live out of town.

25. In what format would you prefer to get information about upcoming Park Lake Management District meetings?

Survey Number	Comment
192	Action.
501	We don’t feel we need any correspondence.

Additional Comments:

Survey Number	Comment
4	This is quite long and wordy – some may not respond as they would if it was shorter – more concise. We like having a life guard at the beach – where is the chair?
7	In regards to your survey you will be sending me about Park Lake. I do not live on Park Lake but I do live on West Lake which is about 1.5 miles west of Lower Lake and Park Lake. In 1969 or so, a pipeline was installed at the east end of West Lake. The landowner at the time was … (now deceased) did not feel a culvert was necessary even though there was a small waterway that ran thru that end of the lake. In 1970 or so, there was a hard freeze on the lake and there were big fish like Northern 40” + in length. Large mouth bass, perch, bluegill, and sunfish. This in my opinion was caused from the shutoff of that small waterway which seem to come from Park and Lower Lakes. Ever since then we have a terrible weed problem and what also seems to be a lowering of the lake water level. We also gad the West Lake Weed Association (the owners around West Lake) search for solutions also, even had the DNR come out and evaluate and identify our weeds. Cutting and harvesting was all we could do. I have witnessed a nice clear, weed-less lake to a lake that is so overrun with weeds that it is hard to row or paddle a boat, or even fish or swim. This is also what seems to be happening to Park and Lower Lakes. In 1961, there was an aerial photo taken and that small waterway that I mentioned earlier was noticeable. A closer look into this may reveal why our lakes are slowly dying. Any efforts into this matter would be greatly appreciated. Hopefully this may be the solution to your weed and algae problem as well as ours. Thank you for your time in this matter.

16 There are too many non-native species of fish in Park Lake. Namely, the shad , carp, and striped bass. I would like to see some dredging done and maybe a complete removal of all fish and a restocking of the fish found in the lake 30 years ago. Non-the less, large mouth bass, bluegills. I think this would help the water quality a lot. Cutting weeds is a "band-aid" idea. Don't waste money on it. I think there are not an unlimited amount of funds available. Raise the fees.$50 for property owners and $25 for others is not unreasonable. Have all state and federal grants been explored?

22 I've lived in Pardeeville over 60 years. 50 years on one lake or the other. The last 30 years on the Lower Lake. As a boy there were fewer boats, smaller motors, a lot less pressure on such a small body of water to be on a multi-use facility. There was a problem with weed beds, but the water was clear and the swimming and fishing were great. In fact, the ice from the lake was harvested and used for cooking good and beverages in the summer months.

42 Keep the water level high. Remove sediments or biodegrade if possible. Re-stock panfish that have vanished. Determine the cause of the cloudy, unclear water. Whatever is in the water ruins the finish on the boats left in the water more than one or two days. Get a carp/rough fish removal project going and keep it going for a few years. Higher water levels will give the fish-spawning habitat. It seems the water is lowest during the spring when fish seek spawning shorelines.

52 Use of fund raising event or benefit dinner to help offset costs for lake management activities.

60 I'm sorry I couldn't answer all of your questions. My impression was that by doing the WRMP program we would get the information we need to make the plans to improve Park Lake and information on which practices were polluting us. I'm concerned about information I read about clean up in the lakes in Oshkosh/Appleton. Will the pollutants they stir up travel down the Fox River to us? At the last Park Lake Management Annual Meeting, something was casually mentioned about a sewer line going across the lake into town. In this monitored and maintained? What a tragedy it would be if anything happened to it and raw sewage was released into the lake.

61 Get rid of the shad, carp, and muskies. Put in bass, northern, crappie, bluegills, perch. Don't plant muskies in Park Lake.

66 Please check the lake for fish population – stock more fish when available.

75 I'm very pleased that the Village is using the Park more this summer with a new park and recreation director who cares about the community and its residents. Now that the beach is being used again, I would like to see the water improved.

85 Park Lake is a very shallow lake overall. There are many other lakes in this area that are also shallow, but water clarity, algal blooms and the overall general health of these lakes is better beyond any comparison with that of Park Lake. In my opinion the only determining factor that clearly stands out in comparing these lakes is high-powered boat traffic control, which is restricted in most shallow lakes and eliminated in others by horsepower limits or electric motors only. When the ice goes out of Park Lake in the spring, it is crystal clear. It doesn't take a rocket scientist to figure out that 150 – 250 HP motors traveling 60mph in 7' of water can cause unfavorable water quality.

86 The boats that are too large for our lake should be banned and boats come too close to piers.

91 The causes of Park Lake's problems I am sure are well known. Doing things to correct the problems is the age-old problem.

97 I am concerned about specific cases of runoff from cattle yards diverted into the lake – also fertilizer from all sources.

113 There is a need for Lower Park Lake renovations. Lower Park Lake is often forgotten!

119 I have only used Park Lake about 6 times in the 9 years I have lived here. When we purchased our home, the lake had no effect on our purchasing it.

128

121 We need to do more than discuss the issues. We need to take ACTION. In the four years we have owned property on the lake, there have been good ideas generated, but little or no follow-up action. We would like newsletters keeping us informed of ACTION in progress.

152 Park Lake is a … river, for crying out loud! It will never be a pristine lake, as it cannot be so. Leave the lake alone so it can be what it "naturally" is. Get the DNR out – their goal is to make every lake in Wisconsin a tourist attraction in order to get the tourist revenue. In the process, they destroy what we local residents enjoy (two years ago a DNR rep. Called the Yellow Bass "a problem" lumping it with carp and other rough fish). It's only a problem to the DNR because it doesn't attract tourists like walleye and muskie do. I've heard many a lament at the decline of the "striper." Manage the lake by leaving it alone. Clean up the sewers. Put the money in the bank and save it until sewers can be run around the entire lake. How foolish the money so far has been wasted on programs that accomplish nothing except harm!

158 I am too old to participate. The lake has always been there in my lifetime. I've never cared for water sports – fishing, swimming, etc. The lake is an asset to the Village and should be kept clean.

167 I don't live on the lake, but being taxed on it – like 95% of the public. There's no fish in the lake – and it's dirty. I feel this survey was a waste of your money – just send it to the shoreline owners! What happened to the boat landing repair? We don't need grills, we need a decent landing. The pier isn't secure and there are holes in the shoreline. It's a joke. Put the money there!

170 I am a Village trustee as of April and was assigned to Park Lake Committee. I would like to learn more about lake management and I am retired but not by choice. I don't do mornings, but otherwise I am at … Pardeeville at … I do have some ideas about how to save Park Lake and keep the cost down. I've seen this lake up and down - weeds, no weeds, algae, hardly any algae, etc. It is time to really do something other than stock it.

428 In reply to your survey: the reason why we did not complete the survey is that we have not used Park Lake. We would love to have the time to go fishing and water skiing and all those other fun recreational activities. However, we started a small business and between that and building a home, we just haven't had the time to use the lake. Since we moved to Pardeeville almost six years ago, the lake has seemed to improve. We don't see as much skum floating on the surface as we did in 1995. The condition of the lake, one bay in particular on the north end, kept us from buying a home on the lake. We lived on Turtle Trail up until one year ago. We were at least two blocks off the lakefront. Since then we have moved. We now live approximately five miles from the lake. We wish we could be of more help, but if we filled out the survey, it would be with incorrect data, which would not help you in your lake management.

436 I have rental property here – but do not use the lake personally.

438 I currently live in IL. I rent my house in Pardeeville to … I don't use the lake and don't think my answers would be helpful.

442 I live in Madison and have no knowledge of Park Lake. I have a tenant in a home there.

448 I feel that as an absentee owner of lot across from Park Lake that decisions should be made by people who live there. Thank you.

458 Park Lake Management District has improved environmental issues with Park Lake. The lake is used for recreation by a very small portion of the population living next to the lake. Environmentalists are too often opposed by recreational users. Since Park Lake is a public lake – it is a very public environmental issue. As in most public issues – we wonder how significant our voice are.

463 Have never used Park Lake. I simply own rental real estate in Pardeeville.

480 We do not use the lake anymore and are in the process of selling our property.

490 Have not lived in Pardeeville for years. My opinion would have no foundation. Thank you.

491 Don't use Park Lake and don't live on it. So, I know nothing about Park Lake or the water.

494 Even though we still own property on the Park Lake, our use has decreased. Due to the increase lake activity of skiing and boating, we have moved further north. I am not familiar lately with the quality of the water – weed – algae conditions. I do think a Lake Management Organization is a good plan.

501 The people on the lake would need to discontinue use of gasoline engines on boats to solve a major part of the problem and I'm sure they are unwilling to do that.

503 I have not used the lake this year. I was 91 in June 29th.

528 Do not use Park Lake.

536 Only use Park Lake when grandchildren visit.

550 My house is for sale, therefore I have not answered all questions.

582 I'm happy to see interest in preserving Park Lake.

613 Don't know where the lake is! Quit sending survey.

627 I don't use Park Lake so I can't answer your questions.

629 Please improve the quality of the bathrooms for the park and do something with the pond (stagnant water) in center of Park! Thank you.

645 I don't spend anytime at the Park Lake. I live on a farm and stay on the farm all the time. Sorry I can't help with your survey.

650 I don't use the lake for anything.

656 We don't use the Lake.

657 I don't live on Park Lake – I don't live on Spring Lake also known as Lower Park Lake. Nothing is ever done to Spring Lake. In back of my house is the marsh, which you are not allowed to do anything with (neither does the Village). The following things float in the waters off my lawn: tires, wood, foam rubber, dead fish in the spring, oil barrel, and tree branches. This is the reason I am a bit out of sorts.

724 I have not lived at Breezy Point for the last 4 years. Home was sold to … Thank you.

758 Have been taxed for lake management for years and have realized no benefits. Please take me off your mailing list for future surveys. I am the largest shoreline owner in the Village of Pardeeville. Thank you. But no thanks!

V. Sample Letter and Survey

Park Lake Management District

Village Hall

Pardeeville, WI 53954

June 2001

Dear

The Park Lake Management District is currently working with the University of Wisconsin – Madison Water Resource Management Program to develop a lake management plan for Park Lake. The information that you provide will be extremely helpful to us in determining prioritized lake management activities for Park Lake.

In this survey, we are interested in learning about your recreational uses of Park Lake, your perceptions about water quality, your support of Park Lake management activities, and personal information about yourself. All of the information that you provide will be kept confidential. Your name will not be used in any report that includes survey results.

The entire survey is 8 pages in length. Please feel free to use the last page to include any additional comments or concerns you may have.

A pre-addressed, stamped envelope has been enclosed for your convenience. Thank you for your time and assistance. If you have any questions, feel free to call Sherm Van Drisse, the Park Lake Management Secretary, at (608) 429-4477.

Sincerely,

David C. Roberts

Chairman, Park Lake Board of Commissioners

Park Lake Management District Survey

Please take a moment to read and answer the following questions. This survey was designed to gather your opinions about Park Lake in order to assist the Park Lake Management District and the Water Resource Management Practicum students develop a comprehensive management plan for Park Lake. Your responses will be kept confidential.

This survey addresses the following four topics: 1) your recreational uses of Park Lake; 2) your perceptions about water quality; 3) your support of Park Lake management activities; and 4) personal information about yourself.

Please tell us about how you use Park Lake.

1. In the last 12 months, which of the following activities have you participated in at Park Lake? *Please check all that apply*.

A.	? Fishing	F.	? Sailing/windsurfing	K.	? Jet skiing	P.	? Swimming
B.	? Boating (motor/pontoon)	G.	? Tubing	L.	? Ice fishing	Q.	? Duck hunting
C.	? Canoeing/kayaking/rowing	H.	? Picnicking	M.	? Scuba diving	R.	? Scenic enjoyment
D.	? Water skiing	I.	? Ice skating	N.	? Hiking	S.	? Photography
E.	? Cross country skiing	J.	? Viewing wildlife	O.	? Snow mobiling	T.	? Other

2. For the above activities, which three do you value the <u>most</u>? *Please enter the <u>letter</u> of selected choices in the spaces below.*

1. ____________ 2. ____________ 3. ____________

3. Would you like to see restrictions on any of the above activities? *Please check one.*

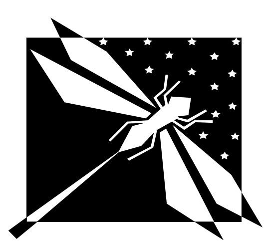
? No
? Yes → Which one(s)?

Please enter the <u>letter</u> of selected choices in the space below.

____

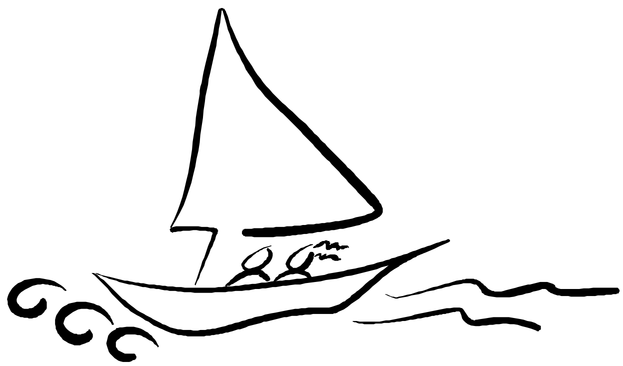
4. How has the quality of your use of Park Lake changed since your first exposure to the lake? *Please check one.*

? Greatly Decreased ? Decreased ? No Change ? Improved ? Greatly Improved



5. Based on your knowledge of present conditions in Park Lake, if you could change three things about the lake to increase its value to you, what changes would you propose? ***Please list in the space below.***

1.
2.
3.



Please tell us about the water quality of Park Lake.

6. How would you describe the overall water quality of Park Lake? ***Please check one.***

? Seriously Degraded ? Poor ? Fair ? Good ? Very Good, Not Degraded

7. How would you rate the following occurrences in Park Lake? ***Please check one box for each lettered item.***

	Occurrence	Major Problem	Problem	Minor Problem	Not A Problem	Don't Know
A.	Algal blooms	?	?	?	?	?
B.	Excessive weeds	?	?	?	?	?
C.	Sedimentation	?	?	?	?	?
D.	Large fluctuations in water levels	?	?	?	?	?
E.	Erosion	?	?	?	?	?
F.	Fish kills	?	?	?	?	?
G.	Unusual water color or smell	?	?	?	?	?
H.	Exotic species	?	?	?	?	?
I.	Too much boat traffic	?	?	?	?	?
J.	Too much noise	?	?	?	?	?
K.	Failing septic systems	?	?	?	?	?

8. In your opinion, which of the following factors pose a threat to water quality in Park Lake? ***Please check one box for each lettered item.***

	Item	Major Cause	Cause	Minor Cause	Not A Cause	Don't Know
A.	Soil erosion from agricultural areas	?	?	?	?	?
B.	Animal waste from agricultural areas	?	?	?	?	?
C.	Fertilizers and pesticides from agricultural areas	?	?	?	?	?
D.	Stormwater runoff from agricultural land	?	?	?	?	?
E.	Soil erosion from residential areas	?	?	?	?	?
F.	Animal waste from residential areas (i.e. pets, geese, etc.)	?	?	?	?	?
G.	Fertilizers and pesticides from residential areas	?	?	?	?	?
H.	Stormwater runoff from house roofs, driveways, and residential land	?	?	?	?	?
I.	Stormwater runoff from streets, highways, and/or parking lots (i.e. road salt, gasoline, automotive oils)	?	?	?	?	?
J.	Improper disposal of household chemicals (i.e. paints, automotive oils, antifreeze)	?	?	?	?	?
K.	Septic systems	?	?	?	?	?
L.	Soil erosion from shorelines	?	?	?	?	?
M.	Yard or grass clippings and/or leaves being disposed of in lake	?	?	?	?	?
N.	Displacement of natural shoreline vegetation by lawns	?	?	?	?	?
O.	Soil erosion from construction sites	?	?	?	?	?
P.	Discharge and waste from factories and/or businesses	?	?	?	?	?
Q.	Introduction of non-native plant and/or animal species	?	?	?	?	?
R.	Dams	?	?	?	?	?
S.	Loss of wetland areas	?	?	?	?	?

9. Of the items listed above, which one do you feel contributes <u>most</u> to water quality problems in Park Lake? ***Please enter the letter of selected choice in the spaces below.***

_____ Most Important Cause

10. In your opinion, are there other sources that contribute to water quality problems in Park Lake? ***Please explain in the space provided.***

____

____

____

____

Please tell us about what management activities you support on Park Lake.

11. There are specific actions that all residents can do to reduce the amount of pollutants entering surface water bodies (lakes and rivers), in addition to groundwater sources. Which of the following activities are you willing to do on your property? ***Please check one box for each lettered item.***

	Activity	Already Do	Willing To Do	Unwilling To Do	Don't Know	Not Applicable
A.	Rake leaves away from streets and curbs	?	?	?	?	?
B.	Use a lawn fertilizer that does not contain phosphorus	?	?	?	?	?
C.	Perform a soil test before deciding to apply fertilizers	?	?	?	?	?
D.	Apply chemical fertilizers and pesticides once per year	?	?	?	?	?
E.	Stop using chemical fertilizers and pesticides	?	?	?	?	?
F.	Modify roof gutters and downspouts on your home to divert rain water away from roads, sidewalks, and driveways	?	?	?	?	?
G.	Clean up pet waste promptly	?	?	?	?	?
H.	Pump septic system at least once every three years	?	?	?	?	?
I.	Attend public meetings on how to protect water quality	?	?	?	?	?
J.	Limit dumping of pollutants (oil, gas, etc.) into water	?	?	?	?	?
K.	Maintain a vegetative buffer along your shoreline	?	?	?	?	?
L.	Limit mowing, raking, and brush cutting adjacent to your shoreline	?	?	?	?	?
M.	Plant native species along your shoreline	?	?	?	?	?

12. Which lake management activities would you prefer the <u>Park Lake Management District</u> to support financially? ***Please check all that apply.***

A. ? Cutting weeds
B. ? Lake water drawdown
C. ? Non-point source pollution control (e.g. buffer strips)
D. ? Dredging
E. ? In-lake barriers (i.e. in-lake sediment control structures)
F. ? Stocking sport fish
G. ? Stocking fish for biomanipulation (indirectly controls algae)
H. ? Stormwater management
I. ? Shoreline restoration
J. ? Dam maintenance
K. ? Dam removal
L. ? Education programs on yard care (e.g. demonstration sites)
M. ? Restoring wetlands

13. Of the lake management activities listed above, which two do you feel would <u>most</u> improve the water quality in Park Lake? ***Please enter the <u>letter</u> of each management activity in the spaces below.***

1. ____________ 2. ____________

14. Of the lake management activities listed above, which two do you feel would <u>least</u> improve the water quality in Park Lake? ***Please enter the <u>letter</u> of each management activity in the spaces below.***

1. ____________ 2. ____________

15. Do you have suggestions for other types of lake management activities that should be supported financially by the <u>Park Lake Management District</u>? ***Please list in the space provided.***

____

____

____

____

16. In your opinion, how would the following lake management activities affect your recreational use(s) of Park Lake? ***Please check one box for each lettered item.***

	Activity	Increase	No change	Decrease	Don't Know
A.	Cutting weeds	?	?	?	?
B.	Lake water drawdown	?	?	?	?
C.	Non-point source pollution control (e.g. buffer strips)	?	?	?	?
D.	Dredging	?	?	?	?
E.	In-lake barriers (i.e. in-lake sediment control structures)	?	?	?	?
F.	Stocking sport fish	?	?	?	?
G.	Stocking fish for biomanipulation (indirectly controls algae)	?	?	?	?
H.	Stormwater management	?	?	?	?
I.	Shoreline restoration	?	?	?	?
J.	Dam maintenance	?	?	?	?
K.	Dam removal	?	?	?	?
L.	Education programs on yard care (e.g. demonstration sites)	?	?	?	?
M.	Restoring wetlands	?	?	?	?
N.	Other – please list ____________________	?	?	?	?

17. In your opinion, how would the following lake management activities impact your property value? ***Please check one box for each lettered item.***

	Activity	Increase	No change	Decrease	Don't Know
A.	Cutting weeds	?	?	?	?
B.	Lake water drawdown	?	?	?	?
C.	Non-point source pollution control (e.g. buffer strips)	?	?	?	?
D.	Dredging	?	?	?	?
E.	In-lake barriers (i.e. in-lake sediment control structures)	?	?	?	?
F.	Stocking sport fish	?	?	?	?
G.	Stocking fish for biomanipulation (indirectly controls algae)	?	?	?	?
H.	Stormwater management	?	?	?	?
I.	Shoreline restoration	?	?	?	?
J.	Dam maintenance	?	?	?	?
K.	Dam removal	?	?	?	?
L.	Education programs on yard care (e.g. demonstration sites)	?	?	?	?
M.	Restoring wetlands	?	?	?	?
N.	Other – please list ____________________	?	?	?	?

18. Currently, fees in the Park Lake Management District are $20 for property on the lake, $10 for property off the lake. These fees go towards lake management activities. How much more would <u>you</u> be willing to pay annually to improve the water quality in Park Lake? ***Please check one.***

? Greater than $200

? $151 - $200

? $101 - $150

? $51 - $100

? $26 - $50

? $11 - $25

? $10

? $0

? Other amount: $__________

Please provide information about yourself.

19. Prior to receiving this survey, had you ever heard of the Park Lake Management District? *Please check one.*

? No
? Yes

20. Do you currently receive the Park Lake Management District newsletter? *Please check one.*

? No
? Yes

21. Do you own or lease property on Park Lake? *Please check one.*

? No
? Yes → How long have you owned or leased this property? ________ Years

What was your principal reason for purchasing or leasing this property?
Please check all that apply.

? Water recreation

? Place to entertain

? Investment

? Natural beauty/solitude

? Other (please describe) ________________________________

22. How far away do you live from the Park Lake shoreline? *Please check one.*

? On the shore ? Within 1/4 mile ? 1/4 mile to 1 mile ? 1mile to 2 miles ? Greater than 2 miles

23. Which of the following educational opportunities about lake management activities would interest you? *Please check all that apply.*

? Newsletters	? Radio programs
? Volunteer programs	? Television programs
? Speakers	? Neighborhood demonstration sites
? Workshops	? Brochures
? Web sites	? Videos
? Fact sheets	? Journals

24. Would you be interested in attending future Park Lake Management District meetings to learn more about management practices on Park Lake? ***Please check one.***

? No

? Yes → What is a convenient meeting time? *Please check all that apply*

? Week Days ? Week Ends ?Evenings ? Afternoons ? Mornings

25. In what format would you prefer to get information about upcoming Park Lake Management District meetings? ***Please check one.***

? Newsletters
? Phone calls
? Newspapers
? Radio programs
? Web sites

Thank you very much for participating in this survey.

We would appreciate any comments or concerns you may have.

VI. Acknowledgements

Kristen Anderson, Columbia County GIS Specialist
Barbara Borns, Institute for Environmental Studies Student Services Program Manager
Ken Genskow, Environmental Resources Center Evaluation Unit Coordinator
Fred Madison, Water Resource Management Practicum Advisor
Jim Miller, Institute for Environmental Studies Program Assistant
David Nolan, Environmental Resources Center Financial Specialist
David Roberts, Park Lake Management District President
Cheryl Sandeen, Institute for Environmental Studies Program Assistant
Robin Shepard, Water Resources Education Program Coordinator
Sherm Van Drisse, Park Lake Management District Secretary

A special thank you to the Park Lake Management District residents who took the time to answer the surveys.

APPENDIX B: WATER QUALITY DATA

Table A1. *General water chemistry measurements for major ions.*

some words

	1986		1987		1993		2001	
	3 ft depth	12.5 ft depth	1.5 ft depth	12.5 ft depth	1.5 ft depth	23 ft depth	3 ft depth	9 ft depth
Dissolved silica	1.1	1.2	7.7	7.7	2.7		3.43	3.89
Dissolved iron	13	10	11	12	<50		<.02	<.02
Dissolved manganese	1	2	3	2	<40		<.001	0.08
Dissolved calcium	52	52	56	56	44		45.83	52.91
Dissolved magnesium	30	32	31	31	24		31.98	32.4
Dissolved sodium	4	4.2	3.9	3.8	4.1		6.23	6.31
Dissolved potassium	2.2	2.2	2.1	2.1	3		2.15	2.17
Alkalinity, as $CaCO_3$	223	225	227	233	180		213	213
Hardness, as $CaCO_3$	250	260	270	270	210		245.69	265.1
Dissolved sulfate	20	19	22	22	17		6.1	7.9
Dissolved chloride	12	12	11	10	10		14.3	15
Nitrite nitrogen	0.02	0.02	0.02	0.02				
Nitrate nitrogen	0.88	0.88	1.38	1.28	0.23	0.17	0.5	0.62
Ammonia nitrogen	0.02	0.02	0.03	0.03	0.01	0.59	0.18	0.12
Total nitrogen	1.9	1.8	4.3	3.4	1.2	1.7	27.93	31.42
Total phosphorus	0.04	0.045	0.056	0.062	0.173	0.36	0.092	0.207
Chlorophyll a	34		10		66		95	
Secchi disk depth	1.6		2.1		0.7		2	

samples run at Soil and Plant Analysis Laboratory
all other samples run at State Laboratory of Hygiene

samples taken in July of the year
all other samples taken in April or May

Table A2. Water quality data taken by WRM Workshop 5/22/2001 and 7/17/2001.

	Site	Sample ID	Depth ft	Field Parameters Temp C	Specific cond uS	DO ppm	pH	alkalinity ppm	Lab Values chlorophyll-a ug/L	total P ppm	diss K ppm	diss Ca ppm	diss Mg ppm	diss S ppm	diss Zn ppm	diss B ppm	diss Mn ppm	diss Fe ppm	diss Cu ppm	diss Al ppm	diss Na ppm	diss Si ppm	Hardness Ca, Mg	NO_3-N ppm	NH_4-N ppm	SO_4-S ppm	Cl^- ppm	Total N ppm	Alkalinity $mgCaCO_3/L$
22-May-01																													
Secchi depth (ft)	1	1	1.5	19	440	6	8.1				5.16	43.80	33.44	6.40	<0.08	<0.03	< 0.001	<0.02	<0.003	<0.03	10.04	3.43	246.61						
1.8		2	3	18.8	439	8	8.2	250																0.45	0.20	6.1	13.70	44.79	191
		2b	3	18.8	439	8	8.2	251																					
Total depth (ft)		3	3	18.8	439	8	8.2	252			3.77	45.68	32.63	6.93	<0.08	0.06	0.03	<0.02	<0.003	<0.03	8.51	3.31	247.99						
12.5		4	6	18.8	436	6	8.2				3.17	42.97	32.47	6.30	<0.08	0.34	< 0.001	<0.02	<0.003	<0.03	6.30	3.49	240.55						
		5	9	18.8	211.5	6	8.2				2.99	44.03	32.43	6.31	<0.08	<0.03	<0.001	<0.02	<0.003	<0.03	6.02	3.47	243.06						
		6	11	18.7	211.7	5	8.2	250																0.37	0.21	6.7	13.70	31.47	200
		7	11	18.7	211.7	5	8.2	250			2.75	45.78	31.67	6.15	<0.08	0.10	0.04	<0.02	<0.003	<0.03	7.12	3.39	244.30						
		8	1.5						68																				
Secchi depth (ft)	2	9	1.5	18.8	442.2	7	8.4				2.58	42.52	32.23	6.75	<0.08	0.47	< 0.001	<0.02	<0.003	<0.03	5.63	3.50	238.42						
1.75		10	3	19.2	442.9	7	8.4				2.48	43.11	32.05	6.19	<0.08	<0.03	<0.001	<0.02	<0.003	<0.03	5.52	3.50	239.17						
		11	6	19.1	442.5	6	8.4				2.38	43.16	32.08	6.19	<0.08	<0.03	<0.001	<0.02	<0.003	<0.03	5.44	3.42	239.43						
Total depth (ft)		12	7.5	18.6	442.5	6	8.5				2.33	43.06	31.96	6.24	<0.08	<0.03	<0.001	<0.02	<0.003	<0.03	5.39	3.45	238.69						
9		13	1.5						72																				
Secchi depth (ft)	3	14	1.5	18.4	445.5	7	8.4				2.23	45.55	32.40	6.20	<0.08	0.54	< 0.001	<0.02	<0.003	<0.03	5.32	3.70	246.69						
1.75		15	3	18.5	452.1	7	8.5	250			2.15	45.83	31.98	6.14	0.10	0.06	<0.001	<0.02	<0.003	<0.03	6.23	3.43	245.69	0.50	0.18	6.1	14.30	27.93	213
		16	6	18.5	453.5	6	8.4				2.09	46.52	32.98	6.19	<0.08	<0.03	<0.001	<0.02	<0.003	<0.03	5.32	3.85	251.54						
Total depth (ft)		17	9	18.3	455.3	6	8.4	250			2.17	52.91	32.40	6.18	<0.08	0.10	0.08	<0.02	<0.003	<0.03	6.31	3.89	265.10	0.62	0.12	7.9	15.00	31.42	213
10.5		18	1.5						90																				
Secchi depth (ft)	4	19	1.5	16.9	485.5	7	8.6				1.89	52.21	33.48	6.16	<0.08	0.30	<0.001	<0.02	<0.003	<0.03	5.13	4.68	267.79						
1.3		20	3	16.9	487.4	7	8.7				1.90	52.84	33.74	6.12	<0.08	<0.03	<0.001	<0.02	<0.003	<0.03	5.13	4.67	270.44						
		21	4.5	16.9	487	7	8.7				1.91	53.68	34.12	6.22	<0.08	0.44	<0.001	<0.02	<0.003	<0.03	5.17	4.71	274.09						
Total depth (ft)		22	1.5						113																				
5.5																													
17-Jul-01																													
Secchi depth (ft)	1	23	1.5						95																				
2		24	1.5	26.5	410	6.7	8.7			0.092																			
		25	3	26.1	410	6.5	8.7			0.098																			
Total depth (ft)		26	6	26.2	413	6.6				0.103																			
9.4		27	8	26.2	412.5	6.6				0.107																			
	1		(m)																										
	deep		3.3	26.4		6.9																							
	hole		6.6	26.2		6.2																							
			9.8	26		3																							
			13.1	23.5		1																							
			16.4	21.2		0.85																							
			18							0.207																			
Secchi depth (ft)	2	28	1.5						70.8																				
2.2		29	1.5	26.5	410	7.5	8.8			0.098																			
		30	3	26.6	400	6.9	8.7			0.117																			
Total depth (ft)		31	6	26	415	6	8.7			0.123																			
9.3		32	8	26	415	5.8	8.7			0.138																			
Secchi depth (ft)	3	33	1.5						89																				
2		34	1.5	26.8	408	7.9	8.9			0.109																			
		35	3	26.5	412	6.9	8.8			0.101																			
Total depth (ft)		36	6	26.2	414	5.7	8.8			0.096																			
10.1		37	8.5	26	417	4.8	8.6			0.119																			
Secchi depth (ft)	4	38	1.5						138																				
1.9		39	1.5	27.2	407	11.5	9			0.149																			
		40	3	27	407	10.2	9			0.172																			
Total depth (ft)		41	4.5	25.9	426	8.4	8.9			0.158																			
5.7																													

(shaded) lab measurements done at UW Soil and Plant Analysis Laboratory

all other lab values obatined from Wisconsin State Laboratory of Hygiene

Table A3. Secchi depth, total phosphorus, chlorophyll a, dissolved oxygen, and trophic state indices (TSI) for all data collected on Park Lake.

Date	Secchi Depth (ft)	TSI secchi	Depth (ft)	Total phosphorus (mg/L)	TSI phosphorus	Chlorophyll a (ug/L)	TSI chlorophyll a	Dissolved oxygen (mg/L)
4/23/86	3.3	42.79	3	0.044	61.195122	26	58.5601299	
4/23/86			12.5	0.038	59.081309			
6/17/86	2.3	47.99	3	0.046	61.836053	33	60.3865859	
6/17/86			24	0.071	68.09427			
7/23/86	1.6	53.22	3	0.04	59.820885	34	60.6152881	
7/23/86			12.5	0.045	61.519149			
8/22/86	1.1	58.63	3	0.087	71.024532	120	70.2767572	
8/22/86			13.5	0.062	66.139897			
2/27/86			3					12
2/27/86			12					0.4
4/23/86			1					13.6
4/23/86			13					13.8
6/17/86			2					10.8
6/17/86			24					0
7/23/86			1					14.5
7/23/86			13					0
8/22/86			1					16.6
8/22/86			14					0.2
4/8/87	2.6	46.22	1.5	0.045	61.519149	20	56.5501691	
4/8/87			12.5	0.078	69.450034			
6/11/87	2.6	46.22	3	0.04	59.820885	40	61.8603382	
6/11/87			23.5	0.078	69.450034			
7/14/87	2.1	49.3	1.5	0.056	64.672336	10	51.24	
7/14/87			23.5	0.062	66.139897			
8/17/87	1.6	53.22	1.5	0.094	72.140338	150	71.9862498	
8/17/87			23.5	0.157	79.536362			
2/26/87			2					18.6
2/26/87			14					8.6
4/8/87			2					14.7
4/8/87			13					12
6/11/87			3					8.8
6/11/87			24					0
7/15/87			0					8.2
7/15/87			21					0.1
8/17/87			3					8.4
8/17/87			24					0
6/3/93	1.4	55.15	1.5	0.043	60.863646	22	57.2803361	12.3
6/3/93			24	0.2	83.026689			0
6/16/93	1	60	1.5	0.06	65.667115	46	62.9310482	12
6/16/93			23	0.21	83.730174			0
6/30/93	0.6	67.37	1.5	0.069	67.682283	60	64.9665881	10
6/30/93			22	0.17	80.683397			0
7/14/93	0.7	65.14	1.5	0.173	80.935624	66	65.696755	11
7/14/93			23	0.36	91.501736			0
7/28/93	0.7	65.14	1.5	0.097	72.593315	77	66.8776964	14.3
7/28/93			23	0.69	100.88228			0
8/12/93	0.6	67.37	1.5	0.07	67.889748	51	63.7215379	18.5
8/12/93			22	0.77	102.46399			0.1
8/26/93	1	60	1.5	0.047	62.146142	25	58.2596618	>15
8/26/93			22	0.87	104.22453			0
9/11/93	0.6	67.37	1.5	0.08	69.815081	100	68.88	12
9/11/93			22	0.78	102.65003			0.1
9/25/93	1	60	1.5	0.056	64.672336	69	66.037298	11.4
9/25/93			23	0.09	71.513345			5.2
11/9/93	1.2	57.37	1.5	0.042	60.52437	41	62.0495072	11.9
11/9/93			23	0.049	62.747003			11.2
5/22/01	1.8	51.52	1.5			68	65.9254572	6
5/22/01			11					5
7/17/01	2	50.01	1.5	0.092	71.830249	95	68.4870444	6.7
7/17/01			8	0.107	74.008035			6.6
7/17/01			16.4					0.85
7/17/01			18	0.207	83.522709			

APPENDIX C. ESTABLISHMENT OF SPECIAL PURPOSE DISTRICTS FOR THE MANAGEMENT OF WASTEWATER IN WISCONSIN: SEWRPC STAFF MEMORANDUM

One of the recommendations of the document is for the PLMD to adopt sanitary district powers. This appendix, which is Southeast Wisconsin Regional Planning Commission Staff (SEWRPC) Memorandum, April 1996, by Jeffrey Thornton, outlines the current legal administrative process that the PLMD would need to follow if it chose to implement this recommendation for Park Lake. This memorandum was based on Wisconsin State Statues, Chapter 33.22(3).

I. PUBLIC INLAND LAKE PROTECTION AND REHABILITATION DISTRICT (Ch. 33, Stats)

A. Municipalities may establish district (S. 33.23, Stats)

1. A Town, Village, or City may establish a public inland lake protection and rehabilitation district (also known as a lake management district) if the total lake frontage of the lake falls within the jurisdiction of the municipality.

2. Where a lake falls into more than one municipality, the County may establish a public inland lake protection and rehabilitation district (also known as a lake management district)—see below.

3. Before a lake management district can be formed, a petition must be filed requesting the establishment of a district; the petition must be signed by 51 percent of the landowners—as determined from the tax roll filed on the third Monday of December immediately prior to the submission of the petition—or by the owners of 51 percent of the land within the boundaries of the proposed district. Municipalities may sign on behalf of the persons owning land within their jurisdictions.

4. The petition must include (i) the name of the proposed district, (ii) the necessity for the proposed district, (iii) a statement that the public health, comfort, convenience, necessity or welfare will be served by the proposed district, and (iv) a description and plat map of the boundaries of the proposed district.

5. The municipality must hold a public hearing within 30 days of receipt of the petition; notice of this hearing must be published as a Class I public notice in a newspaper in general circulation within the proposed district, and written notice mailed to each landowner within the proposed district.

6. If, within 3 months of the hearing on the establishment of the district, the committee or board conducting the hearing finds that (i) the petition has been signed by the requisite land owners, (ii) the district is necessary, (iii) the district will promote the public health, comfort, convenience, necessity or welfare, (iv) the properties included in the district will be benefited from the district, and (v) the district will not cause or contribute to long-range environmental pollution, it will recommend creation of the district to the board, and, if it concurs, the board will issue an order creating the district within 6 months of the hearing on the establishment of the district.

7. A district created through this procedure may be delegated town sanitary district powers by the town with the largest portion of the equalized valuation and exercise these powers within the entire district save for that portion within an incorporated municipality, in which case the incorporated municipality must consent to such an exercise of sanitary district powers by the district.

8. Governance of the district is by a board of commissioners. In the case of municipalities, the board of commissioners is the municipal board unless, by petition of 20 percent of landowners

within the district, the district electors request establishment of a board of commissioners, which consists of five or seven commissioners—one appointed by the county with the greatest equalized valuation, one appointed by the municipality with the greatest equalized valuation, and three or five electors or property owners within the district, at least one of whom must be resident within the district.

B. Conversion and merger of town sanitary districts (S. 33.235, Stats)

1. A town board may by resolution convert a town sanitary district into a public inland lake protection and rehabilitation district (also known as a lake management district) if the total lake frontage of the lake falls within the jurisdiction of the municipality.

2. Where a lake extends beyond the boundaries of a town sanitary district, the sanitary district commissioners may petition the county to create a lake management district; if necessary to achieve the 51 percent of the landowners or 51 percent of the lands, the requisite signatures of landowners outside of the town sanitary district must be obtained—the town sanitary district commission can sign the petition on behalf of the landowners within their jurisdiction.

3. Where a town sanitary district and lake management district coexist or are contiguous, resolutions of the boards of commissioners and ratified by a majority of voters at the annual or special meeting of the lake management district and by referendum of the town sanitary district are required to merge the districts; after merger the lake management district is presumed to have town sanitary district powers, provided the town board which created the sanitary district approves of the merger.

C. County board may establish district (S. 33.24, Stats)

1. Where a lake falls into more than one municipality, the County may establish a public inland lake protection and rehabilitation district (also known as a lake management district).

2. Before a lake management district can be formed, a petition must be filed requesting the establishment of a district; the petition must be signed by 51 percent of the landowners—as determined from the tax roll filed on the third Monday of December immediately prior to the submission of the petition—or by the owners of 51 percent of the land within the boundaries of the proposed district. Municipalities may act on behalf of the persons owning land within their jurisdictions and sign for all such landowners.

3. The petition must include (i) the name of the proposed district, (ii) the necessity for the proposed district, (iii) a statement that the public health, comfort, convenience, necessity or welfare will be served by the proposed district, and (iv) a description and plat map of the boundaries of the proposed district.

4. The county must hold a public hearing within 30 days of receipt of the petition; notice of this hearing must be published as a Class I public notice in a newspaper in general circulation within the proposed district, and written notice mailed to each landowner within the proposed district.

5. If, within 3 months of the hearing on the establishment of the district, the committee conducting the hearing finds that (i) the petition has been signed by the requisite land owners, (ii) the district is necessary, (iii) the district will promote the public health, comfort, convenience, necessity or welfare, (iv) the properties included in the district will be benefitted from the district, and (v) the district will not cause or contribute to long-range environmental pollution, it will recommend creation of the district to the county board, and, if it concurs, the county board will issue an order creating the district within 6 months of the hearing on the establishment of the district.

6. A district created through this procedure may be delegated town sanitary district powers by the town with the largest portion of the equalized valuation and exercise these powers within the entire district save for that portion within an incorporated municipality, unless the incorporated municipality consents to such an exercise of sanitary district powers by the district.

7. Governance of the district is by a board of commissioners initially appointed by the county forming the district. The board of commissioners consists of five or seven commissioners—one appointed by the county with the greatest equalized valuation, one appointed by the municipality with the greatest equalized valuation, and three or five electors or property owners within the district, at least one of whom must be resident within the district.

D. District may assume sanitary district powers (Ss. 33.22 (3), Stats)

1. After April 9, 1994, lake management districts may assume sanitary district powers by resolution of the annual meeting.

2. Districts so formed may not exercise sanitary district powers within incorporated municipalities unless the governing body of the municipality consents; where a town sanitary district already exists, the lake management district may only undertake sanitary district functions under contract to the town sanitary district or following merger of the town sanitary district into the lake management district.

3. Governance of the lake management district is by a board of commissioners initially appointed by the county forming the district. The board of commissioners consists of five or seven commissioners—one appointed by the county with the greatest equalized valuation, one appointed by the municipality with the greatest equalized valuation, and three or five electors or property owners within the district, at least one of whom must be resident within the district.

[Notes: Nothing in Chapter 33, Stats, shall limit the authority of the Wisconsin Department of Natural Resources to establish a town sanitary district—see below.]

II. TOWN SANITARY DISTRICT (Ch. 60, Stats)

A. Creation by town board order (S. 60.71, Stats)

1. A Town may establish one or more town sanitary districts within the jurisdiction of the municipality.

2. Where a town sanitary district falls into more than one municipality, the Town with the largest portion of the equalized valuation may establish the district.

3. Before a town sanitary district can be formed, a petition must be filed requesting the establishment of a district; the petition must be signed by 51 percent of the landowners or by the owners of 51 percent of the land within the boundaries of the proposed district.

4. The petition must include (i) the name of the proposed district, (ii) the necessity for the proposed district, (iii) a statement that the public health, comfort, convenience, necessity or welfare will be served by the proposed district, and (iv) a legal description and plat map of the boundaries of the proposed district.

5. At least 15 days prior to the public hearing described in 6. below, a personal or surety bond must be filed by the petitioners to cover the cost connected with the proceedings to establish the district in the event the town board refuses to organize the district; an additional bond may be required and is payable within 10 days of the order requiring such additional payment.

6. The municipality must hold a public hearing within 30 days of receipt of the petition signed by the requisite landowners; notice of this hearing must be published as a Class 2 public

notice in a newspaper in general circulation within the proposed district, and written notice mailed to the Wisconsin Departments of Industry, Labor, and Human Relations (DILHR), and Natural Resources (DNR).

7. If, within 30 days of the hearing on the establishment of the district, the town board conducting the hearing finds that (i) the district is necessary, (ii) the district will promote the public health, comfort, convenience, necessity or welfare, and (iii) the properties included in the district will be benefitted from the district, it will issue an order creating the district. The town board may issue an order creating an amended district by deleting from the district those lands not benefitted by the district, or continue the hearing, with publication of an additional Class 2 notice for a further period not to exceed 30 days, in order to incorporate additional lands into the district.

8. The district must be registered with the county registrar of deeds in each county where the district is located, with a copy provided to the town clerk of each town affected by the district.

9. Governance of the district is by a board of commissioners. The board of commissioners is the town board unless a board of commissioners is appointed by the town board. If the board of commissioners is appointed, subsequent commissioners are elected for two-year terms at town elections, all of whom must be resident within the district.

B. Creation by the Department of Natural Resources (S. 60.72, Stats)

1. The Wisconsin Department of Natural Resources (DNR) may establish a town sanitary district.

2. The DNR must notify by mail each town clerk in the area to be affected by the sanitary district at least 30 days prior to the public hearing; notice of this hearing must be published by the town clerk as a Class 2 public notice in a newspaper in general circulation within the proposed district, and include a description of the area proposed for inclusion in the district.

3. If, after the hearing on the establishment of the district, the DNR finds that private sewage systems or private domestic water supply systems, or both, in the affected town(s) constitute a threat to the public health, safety, convenience, or welfare, or pollute the waters of the State, and that there is no local action to correct the situation, the department may order the creation of a town sanitary district by designating properties to be included in the district.

4. Upon receipt of the DNR order, a town may order the establishment of a town sanitary district.

5. If within 45 days of receipt of the DNR order, a town fails to establish a town sanitary district, the DNR may order the establishment of a district.

6. The district must be registered with the county registrar of deeds in each county where the district is located, with a copy provided to the town clerk of each town affected by the district.

7. Governance of the district is by a board of commissioners. The board of commissioners is the town board unless a board of commissioners is appointed by the town board. If the board of commissioners is not appointed, the DNR may appoint commissioners, constitute itself as the commission, or provide for election of commissioners. Subsequent commissioners are elected for two-year terms at town elections, all of whom must be resident within the district.

III. UTILITY DISTRICT (Ch. 66, Stats)

A. Creation by towns, villages and 3rd or 4th class cities (S. 66.072, Stats)

1. A Town, Village, or 3rd or 4th Class City—a city with between 1,000 and 10,000 inhabit-

ants as established by federal census—may establish utility districts within the jurisdiction of the municipality by majority vote of the town board in towns, and by three-quarters vote of the governing bodies in villages and cities.

2. Before a utility district can be formed, a public hearing must be held not less than 10 but not more than 40 days after publication of the notice of this hearing as a Class 1 public notice in a newspaper in general circulation within the proposed district, and mailing of written notice mailed to interested parties. Towns may post notice in lieu of publication in three public places, one of which must be within the proposed district. Said notice should describe the proposed boundaries of the district.

3. If a town sanitary district exists within the boundaries of the utility district created under this section, the town may dissolved the sanitary district and transfer its functions to the utility district; where a town sanitary district incorporates the territory of more than one municipality, the majority approval of the town boards in which the town sanitary district is located is required.

4. Governance of the district is by the governing body of the municipality forming the district.