

Park Lake Comprehensive Management Plan



August 2007

Pardeeville Lakes Management District Commissioners

2007

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TABLE OF CONTENTS

Chapter 1 - Introduction.....	1
Chapter 2 - Planning Process.....	9
Chapter 3 - Lake Characteristics	15
Chapter 4 - Shallow Lake Management Concepts	28
Chapter 5 - Historical Lake & Watershed Management	38
Chapter 6 - Lake Management Alternatives	42
Chapter 7 - Water Monitoring Study Plan.....	61
Chapter 8 - A Watershed Plan	67
Chapter 9 - In-Lake Restoration Plan	79
References	87
Appendix A	A1
Appendix B	B1
Appendix C	C1
Appendix D.....	D1

MAPS, TABLES, GRAPHS, FIGURES

MAPS

#1	Pardeeville Lakes Management District	Page 7
#2	Park Lake Watershed	Page 8
#3	Spring and Park Lake	Page 15

TABLES

#1	Planning Schedule	Page 10
#2	Participation	Page 11
#3	Ten Year Abundance Comparison for Park Lake Fishery	Page 17
#4	Park Lake Aquatic Plant Species Abundance and Diversity from 1978 – 2003	Page 18
#5	1991-2003 Park Lake Watershed Line Transect Relative Soil Loss	Page 20
#6	2004-2007 Park Lake Watershed Line Transect Relative Soil Loss	Page 20
#7	Trophic Classification of Wisconsin Lakes	Page 23
#8	Pardeeville Lake Management District - Aquatic Lake Permit History	Page 39

Graphs

#1	Park Lake Watershed 2007 Total Phosphorous	Page 24
#2	Park Lake In-Lake Secchi Disc-Deep Hole	Page 25

FIGURES

#1	Being Part of a Participation Process	Page 9
#2	Alternative Stable States Model	Page 30
#3	Stability of Each Alternative State	Page 31
#4	Bio-manipulation to Maintain Plant-Dominated State	Page 36

Chapter 1

INTRODUCTION

Overview

The purpose of this document is to set the stage for the long-term management and restoration of Park Lake and the Park Lake watershed. Park Lake is a 312 acre impoundment located along the Fox River. Park Lake is located in the Village of Pardeeville and the Town of Wyocena. Park Lake has a 53.4 square mile watershed that drains an agricultural watershed through three main tributaries. The Park Lake Watershed lies within the municipal boundaries of the Village of Pardeeville, Town of Wyocena, Town of Scott, Town of Marcellon, Town of Randolph, the Town of Springville and Green Lake County (Map 2, pg. 8).

Historically, Park Lake has had an excellent fishery dominated by bluegill, bass and northern pike along with a water column dominated by native aquatic plant life. By 1989, WDNR lake vegetation surveys showed that the species richness of aquatic plant life was low, although the amount of overall plant material was very high. During this high overall plant period, much activity and discussion around Park Lake focused on aquatic plant management options. By 2001, the plant growth throughout the entire lake was declining and limited in areas to less than 3 feet of depth and the diversity of plants had dropped to seven species. In a very short time, Park Lake had switched from a clear-water system dominated by aquatic plant communities, to a turbid state, dominated by decreased water clarity and decreased plant growth. The turbid-water condition led to a severe decrease in plant communities, which has resulted in a slow and steady decrease in quality and quantity of fish community.

Park Lake is a shallow warm water impoundment, very typical of many southern Wisconsin shallow water systems. Park Lake is in the upper eutrophic to lower hypereutrophic productivity category. What sets it apart from many other nutrient rich shallow water systems is that it has progressed from nutrient rich, clear-water, plant-dominated water body to a hypereutrophic turbid-water body. Once a system like this progresses into a turbid condition, they become very stable, this stability makes the return to a clear-water, plant-dominated community very improbable and that much more challenging.

This document details the efforts and outcomes of a year-long public participation planning process to complete a comprehensive lake management plan to help set a course returning Park Lake to a clear-water, plant-dominated community. The development of this plan focused on the use of best available science combined with public input. This plan was designed to focus and direct restoration efforts for Park Lake now and into the future. This plan will be a tool for use at many levels, including PLMD, Columbia County, Village of Pardeeville and the DNR.

Goals

The primary goals when laying out the planning process:

1. Create a public participation planning process
2. Utilize factual and scientific data

The primary goals as determined by the visioning statement:

1. Foster community involvement and education
2. Promote recreational use of our lakes
3. Insure sound lake management practices for future generations
4. Provide a healthy functioning ecosystem

The unique *value statements (a)* and goals (b) of the finished plan:

1.
 - a. *Balanced and fair lake management is right for our community because our families, particularly our children, deserve to have a clean, healthy lake to enjoy.*
 - b. Create and protect a clear water, macrophyte-dominated Park Lake with self sustaining fishery while allowing for recreational boating.

2.
 - a. *The community, families, and future generations deserve to have a lake with clean water to use and enjoy.*
 - b. Restore water clarity, protect water clarity, prevent algae blooms, and reduce nutrient levels in the lake.
3.
 - a. *It is not fair for one land use to hurt what the rest of the people value; clean water for a healthy Park Lake.*
 - b. Reduce sediment and nutrient loads from watershed.
4.
 - a. *Healthy lake ecosystems are vital and valuable natural resources for lake shore property owners. A self-sustaining fishery will be restored, monitored and protected by protecting high quality aquatic plant communities and managing angler harvests.*
 - b. Restore and protect a healthy self-sustaining blue gill, northern pike and bass fishery.
5.
 - a. *Restoring and protecting high quality aquatic plants will help maintain the restored clear water state while providing critical habitat for a self sustaining fishery.*
 - b. Restore and sustain native aquatic vegetation.
6.
 - a. *We need to invest in the health of our lakes; balanced and sound lake management is what is right for Park Lake.*
 - b. Implement water monitoring strategy to develop a model, thus quantifying nutrient and sediment loads.

7.
 - a. *Restoring and protecting native buffers will provide privacy and tranquility, as well as a natural space for families to enjoy nature. Our families and community expect maintained water quality and lake protection provided from a native shore land buffer. Furthermore; native shore lands increase the value of the lake increasing the value of our families' property values.*
 - b. Restore and protect healthy, stable shore land habitats (public and private) with native buffers.
8.
 - a. *It is un-American and not fair for a few people to get their way when it hurts what the rest of us value; clean water and a healthy fishery.*
 - b. Evaluate current boating ordinances in order to develop new boating ordinances to protect the newly restored Park Lake.
9.
 - a. *It is not fair for a few people to continue to add nutrients to the lake (1# P = 500#'s of Algae) when it hurts what the rest of us value; clean water, a healthy fishery and high property values.*
 - b. Work to create Phosphorous Management Legislation at the state and federal level.
10.
 - a. *Basing decisions on sound data allows the PLMD Board the ability to allocate a finite tax base in a responsible and effective manner on behalf of the PLMD District and the Pardeeville community.*
 - b. Use future studies as bases to make future decisions.
11.
 - a. *Our community deserves to know current ordinances are sound and up to date, as well as being enforced.*
 - b. Analyze county septic ordinances and enforcement protocol

MANAGEMENT RESPONSIBILITIES OF PARK AND SPRING LAKE

There are several governmental bodies and agencies that have some level of responsibility for the overall management of Park Lake. There will likely be some areas of overlap in regards to resource management. Cooperation between these entities is crucial in achieving the objectives of this comprehensive lake management plan. This section is an attempt to highlight many of the responsible parties and their roles.

The State of Wisconsin is charged with the responsibility of protecting public waters for the public's use and enjoyment. The Public Trust Doctrine is a body of state constitutional, statutory, administrative and common law that protects the public rights to fish, swim, boat, and hunt, while enjoying the natural scenic beauty of Wisconsin waterways. The Wisconsin Department of Natural Resources (WDNR) is the specific state agency responsible for the enforcement of regulations concerning waterways including lakebed alterations, aquatic plant management, water quality, boating, fishing, hunting and dam functions. The Wisconsin Department of Agriculture, Trade and Consumer Protection's Soil and Water Resource Management Bureau, have specific statutory responsibilities regarding soil and water conservation on the agricultural landscape. DATCP provides oversight and management of several state funded conservation programs including the Land and Water Resource Management Program, Nutrient and Pesticide Management Program and the Farmland Preservation Program. The Columbia County Land and Water Conservation Department (LWCD) is the local delivery mechanism for these DATCP programs.

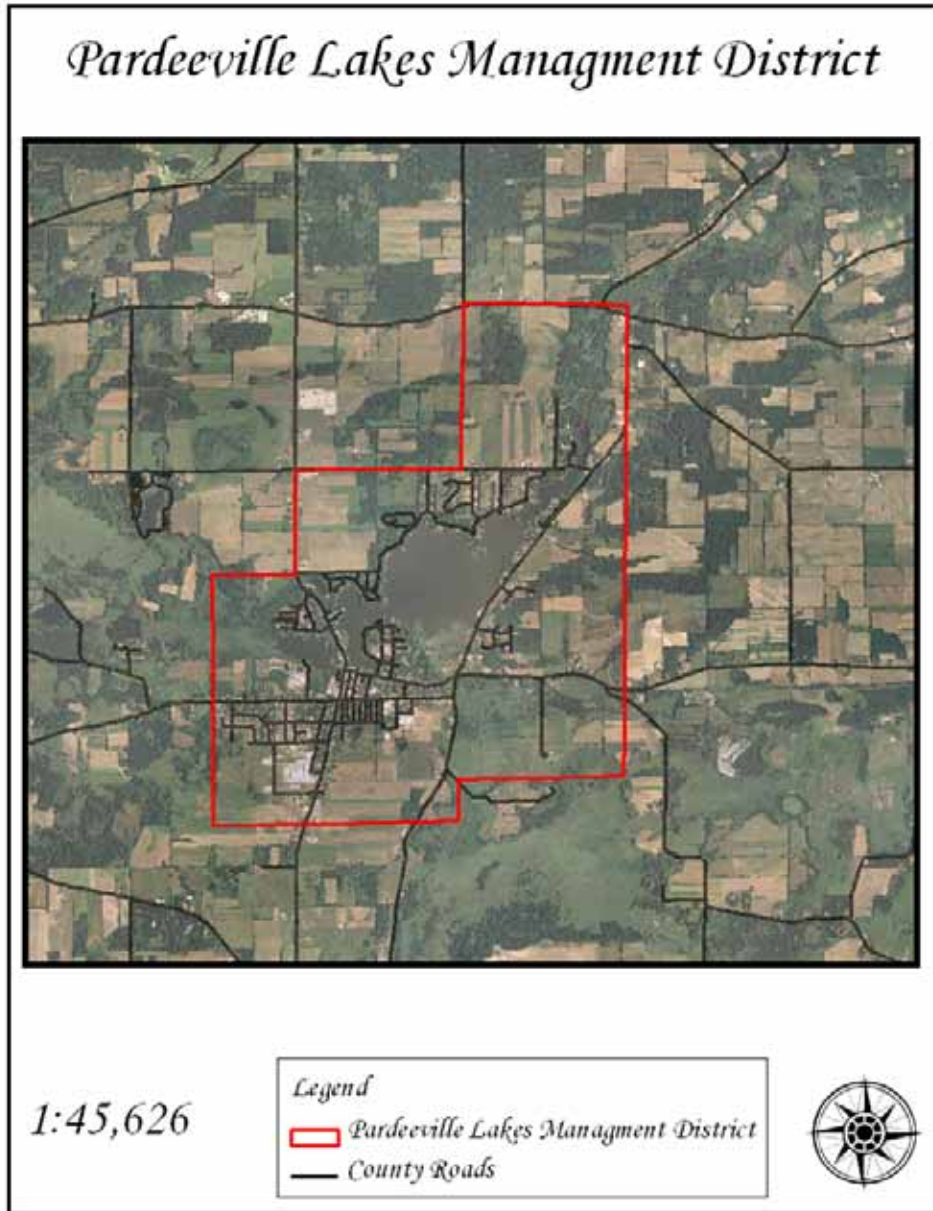
The United States federal government has several agencies that play a role in the management and protection of Park Lake and its watershed. The U.S. Army Corp of Engineers reviews applications and issues permits for alterations of waterways and conducts studies as applicable. The United States Geological Survey (USGS) conducts water quality monitoring, operates water level gauging stations and conducts studies. The Natural Resource Conservation Service (NRCS) is the federal conservation partner to the Columbia County LWCD. NRCS administers a wide range of conservation programs targeted at water quality, land preservation and soil erosion. This agency is responsible for monitoring and assuring conservation compliance for all federal farm program participants. The U.S. Fish and Wildlife Service (USFWS) conducts a number of programs on both public and private lands focused on fisheries management, wildlife management and overall habitat improvement.

Columbia County has two departments that play a role in the management and protection of Park Lake. The Columbia County Planning and Zoning Department is directly responsible for programs such as shore land zoning, land-use planning, and zoning/septic

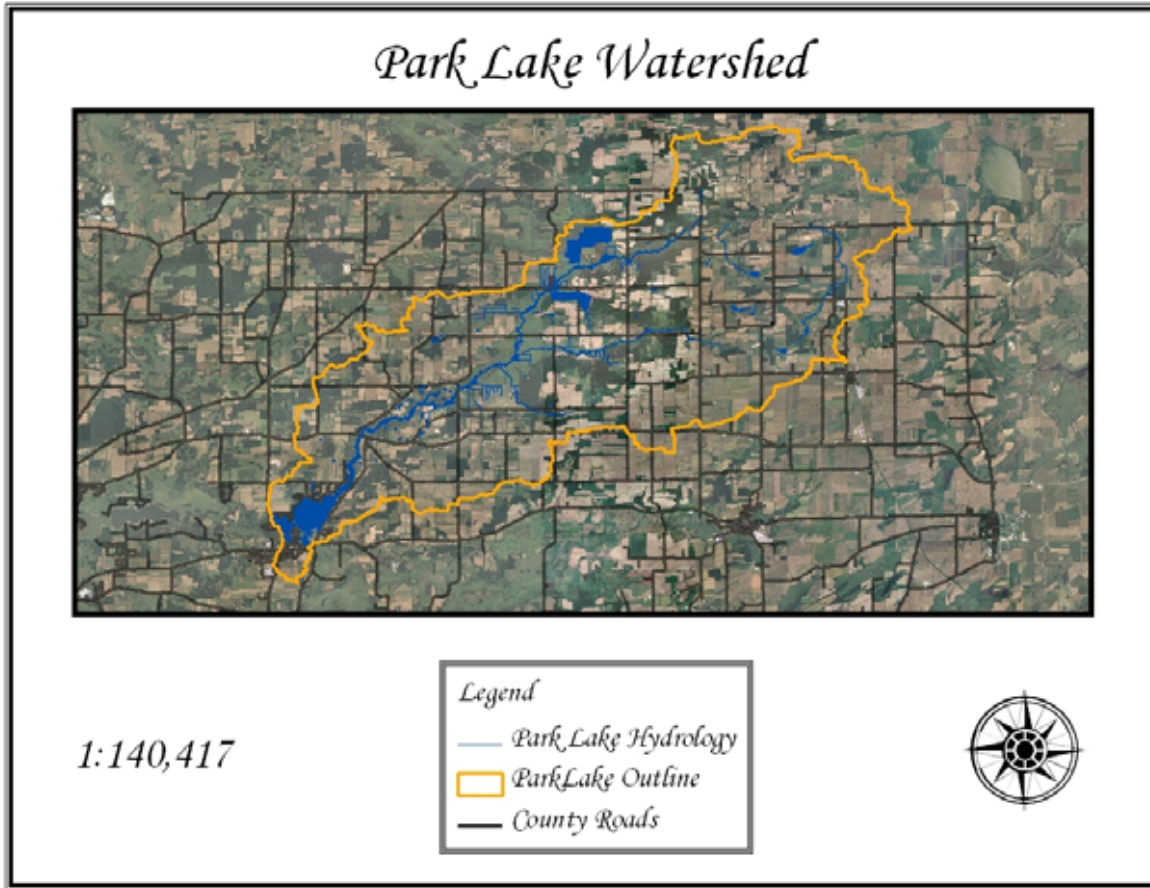
system oversight. The Columbia County Land and Water Conservation Department has a mission to “Protect, Promote and Enhance the Natural Resources of Columbia County”. These efforts are carried out through a combined effort of ordinance enforcement and water quality management program implementation. This department is directly responsible for the implementation of best management practices that control and reduce non-point source impacts in the watershed. This department continues to provide local program implementation through a partnership with the PLMD. The LWCD is well versed in accessing a wide array of financing options through various grants.

The boundaries of Park Lake fall within the municipal boundaries of both the Village of Pardeeville and the Town of Wyocena. The Village of Pardeeville is responsible for implementation of applicable local ordinances such as shore land zoning, land use, building codes, erosion control and storm water management. The Town of Wyocena is also responsible for the implementation of its own applicable local ordinances.

In 1974, the Wisconsin legislature enacted laws enabling individual lakes to form inland lake protection and rehabilitation districts. The law allowed local residents to choose to create local government taxing entities to help focus local financial resources on local priorities. The Park Lake Management District was created in August of 1985. The district boundaries were drawn to include riparians (landowners with lake frontage) and other landowners within a certain proximity (Map 1, pg. 7). These property owners are assessed a special charge to finance lake management projects. A board of commissioners makes decisions and sets goals for lake management. The current Pardeeville Lakes Management District Board of Commissioners includes two appointed positions, one each from Columbia County and the Village of Pardeeville, and five members elected at large.



Map 1. Pardeeville Lakes Management District



Map 2. Park Lake Watershed

Chapter 2

Public Participation Planning Process

Introduction

One core value that was shared at the beginning and throughout the planning process used to create the *Park Lake Comprehensive Lake Plan* was that public participation (see figure 1, “Being Part of a Participative Process”) in decisions about the future development and improvement of the PLMD would be fundamental to achieving lasting and possible solutions. Collaborative problem solving generally can be accomplished with less confrontation and fewer occasions of “gridlock,” since participants understand what opportunities are available and also whatever resources or other constraints must be considered. Involving citizens also ensures that the solutions (and possibly some very creative or unconventional solutions) are tailored to local needs.

A facilitated strategic planning process was engaged to create this *Plan*. The process included:

- pre-agreed upon roles and responsibilities of participating agencies (PLMD Board, Columbia County Land and Water Department and Columbia County UW-Extension);
- open meetings, posted agendas and meeting outcomes;
- agreed upon ground rules;
- team building activities, and,
- a public participative process that lead to consensus decision-making.

BEING PART OF A PARTICIPATIVE PROCESS:

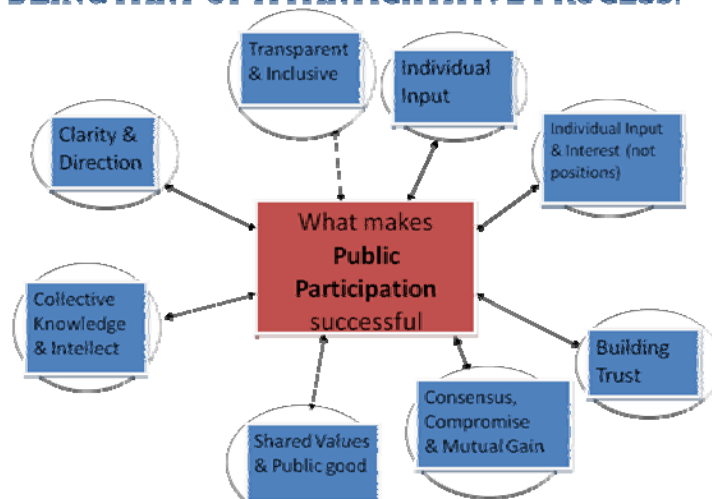


Figure 1.

A carefully constructed participation program encourages an open exchange of information and ideas. Together the participants establish a collective vision for the future, and share responsibility for problems as well as their solutions. Those engaged in the planning process -- PLMD board members, Village of Pardeeville Officials and Staff, Town of Wyocena Officials, PLMD property owners, Technical Advisors, Columbia County Staff – were involved in many ways to influence decision-making. Table 1 (below) documents the participatory activities and results, from the beginning of the process to the creation of this Plan:

Schedule

Date	Type of Meeting	Where	Who
1/30/2007	Mission Statement Workshop	Pardeeville Village Hall @ 7:00	PLMD Board
2/15/2007	Vision Statement Workshop	Columbia County Annex @ 6:30	Bd., Planning Group (PG) & Public
2/26/2007	Vision Statement Workshop	Columbia County Annex @ 6:30	Bd., Planning Group (PG) & Public
3/7/2007	Vision Statement Workshop	Columbia County Annex @ 6:30	Bd., Planning Group (PG) & Public
4/4/2007	Issue Identification	Columbia County Annex @ 6:30	Bd., Planning Group (PG) & Public
5/2/2007	Decision and Criteria	Columbia County Annex @ 6:30	Bd., Planning Group (PG) & Public
5/30/2007	Six PLMD Strategy Scenarios Presentation Seeking Public Input	Pardeeville HS Library @ 6:30	Bd., Planning Group (PG) & Public
6/6/2007	Present Three Rehabilitation Blueprints	Pardeeville HS Library @ 6:30	Bd., Planning Group (PG) & Public
6/27/2007	Goal Statement Strategization	Pardeeville HS Library @ 6:30	Bd., Planning Group (PG) & Public
7/2	Goals Statement Review	Pardeeville HS Library @ 6:30	Bd., Planning Group (PG) & Public
7/18	Present Goals	Pardeeville HS Library @ 6:30	Bd., Planning Group (PG) & Public

Table 1. Planning Meeting Schedule

Participation

Date of Meeting	Topics of Meetings	Participants
1/30/2007	Mission Statement Workshop	Full Board Present
2/15/2007	Vision Statement Workshop	11
2/26/2007	Vision Statement Workshop	17
3/7/2007	Vision Statement Workshop	15
4/4/2007	Issue Identification	23(Present) 15 (Lists submitted)
5/2/2007	Decision and Criteria	21
5/30/2007	Six PLMD Strategy Scenarios Presentation Seeking Public Input	34
6/6/2007	Present Three Rehabilitation Blueprints	11
6/27/2007	Goal Statement Strategy Development	9
7/2/07	Goals Statement Review	12
7/18/07	Present Goals	14

Table 2. Public Participation

Planning Meetings Review

With the conclusion of the Pardeeville Lakes Management District Watershed/Lake Plan we wanted to chronicle the planning meetings.

We have been delighted that the community-based planning effort has appealed to volunteers from such a diverse cross-section of the community. The volunteers in attendance have been drawn to the process by a common desire to provide the community they love, as well as, their families, particularly their children, with a clean, healthy lake to use and enjoy.

The planning effort has drawn volunteers from various town boards, several members of the Village of Pardeeville Board of Trustees and Public Works, Park Lake residents, agricultural producers from Park Lake Watershed, the current Pardeeville Lakes

Management District (PLMD) members, as well as, old PLMD board members and various other people interested in the future of Park Lake.

On January 30, the planning effort began with a **Mission Statement** workshop for the Pardeeville Lakes Management Board.

Pardeeville Lakes Management District (PLMD) Mission Statement

The Pardeeville Lakes Management District is a non-profit, special taxing, governing organization committed to preserving and protecting the integrity of the Pardeeville Lakes through education, conservation, water quality control and rehabilitation methods. It is our intent through innovative leadership, planning and utilization of factual and scientific data to form solid partnerships with our citizens, resource professionals and state/county/local representatives in fulfilling this mission.

The following week with a complete mission statement in hand, the community based planning effort officially began with a **vision statement workshop**. The community, through several exercises, worked together thinking as individuals and then as groups. Although it had not been planned that way, the workshop had to be carried out through three nights, 2/15, 2/26 and 3/7, in order to allow the participants to work amongst themselves to develop their vision statement.

Pardeeville Lakes Management District (PLMD) Vision Statement

PLMD leadership, along with community involvement and education, will provide a healthy, functioning ecosystem, promote recreational use of our lakes and insure sound lake management practices for future generations.

On April 4th, the next step for the community was **issue identification**. We received issues through the planning meeting, emails, cards, letters, outlines, as well as, a list developed by the Village of Pardeeville Board. The list, developed from a good cross-section of the community, was comprehensive in scope. It should be noted that the developed list was very similar to results found in the 2002 Park Lake Management District Survey. Although 5-6 years have passed, we concluded the state of the lake is very similar and found the community's feelings and expectations for Park Lake are still very similar.

The next step was on May 2, Decision Criteria. At this meeting, the participants developed a list detailing how they were going to make decisions by establishing decision criteria.

As with any good citizen-based planning effort, the momentum of the planning movement starts to develop a life of its own. As the planning meetings progressed, there was a desire to structure future meetings differently than had been previously thought.

One change which was proposed during the Decision and Criteria Meeting on May 2, suggested the remainder of the planning meetings be held in Pardeeville. As a result, we had decided to move the remainder of scheduled planning meetings to Pardeeville High School Library (as seen in Table 1, pg. 10).

Furthermore, the structure of the meetings was changed as well. As the data was collected and gathered in the planning and technical meetings, it allowed for the Goals and Objectives meeting originally scheduled for May 30, to be replaced with two meetings addressing the future In-Lake Strategies.

The first meeting, titled Strategy Scenarios, was held on May 30, at 6:30 in the Pardeeville High School Library. At this meeting, the community was presented with six conceptual ideological scenarios which were to be considered for Park Lake.

The next planning meeting took place on June 6th at 6:30 in the Pardeeville High School Library. At this meeting, the Columbia County Land and Water Conservation Department then presented three rehabilitation blueprints called Strategy Blueprints A, B and C.

After reviewing and considering the public's comments and concerns, the Pardeeville Lakes Management District had a formal board meeting on June 13th at the Village Hall, announcing their decision on which scenario and which blueprint they decided to recommend on behalf of the planning group.

On June 27th, the planning group was presented with the Pardeeville Lakes Management District Board's recommended strategy scenario and rehabilitation blueprint. At this meeting the planning group was shown examples of how issues and goals are developed from their recommended strategy scenario and rehabilitation blueprint. The group then established their strategy for developing their Goals and Objectives.

On July 2nd, the group was presented with goals for various previously determined issues. The group filled out comment sheets relating to each goal.

The planning process was concluded on July 18th, when the planning group was presented with various issues; value statements, goals, strategies, actions, local government participation, community participation, technical expertise, PLMD **Initiator** and funding sources.

Technical Team

The Columbia County Land and Water Conservation Department led the coordination of this lake management planning effort by identifying the necessity to bring together a core group of scientific lake management professionals to help identify the best available science-based options for the restoration of Park Lake. Please see the acknowledgement section of this plan for a full list of participants on this technical team. The value of the technical team and its input was very critical to the success of this planning effort.

The technical team conducted three full day in-person meetings over the last year. The first meeting was held on November 27, 2006. During the first meeting the technical team spent its time accessing the current scientific information that was available for Park Lake. The review and explanation of the current information allowed us to migrate into our second round of discussions held on December 18, 2006.

This second meeting allowed us to use this historical data to begin discussion about actual restoration options for Park Lake. At the end of the second meeting, the technical team had a very solid understanding of what challenges faced Park Lake and what the potential options would be. These options ranged from maintaining a turbid-water condition to restoring a clear-water condition. During this meeting, we were joined by Dave Tracey and Barry Pufahl representing the Village of Pardeeville. They provided us information on dam operations and associated issues. We set our third and final meeting date for April 11, 2007.

At this third meeting, we spent the entire day discussing what the real options were for Park Lake. Several options existed, but each of them had different levels of degrees of probability associated with success. If the general public wanted to sustain a lake in a turbid state, have very little aquatic plant growth, degrading water quality and a struggling self-sustaining warm water fishery then there really was nothing that needed to be done. Park Lake was providing that already. If the general public supported something different, they had three blue prints for restoration they could follow. These blue prints are outlined in the In-Lake Management Alternatives, Chapter 6. The technical team ended this third meeting reaching consensus that these were the options that were scientifically available to them.

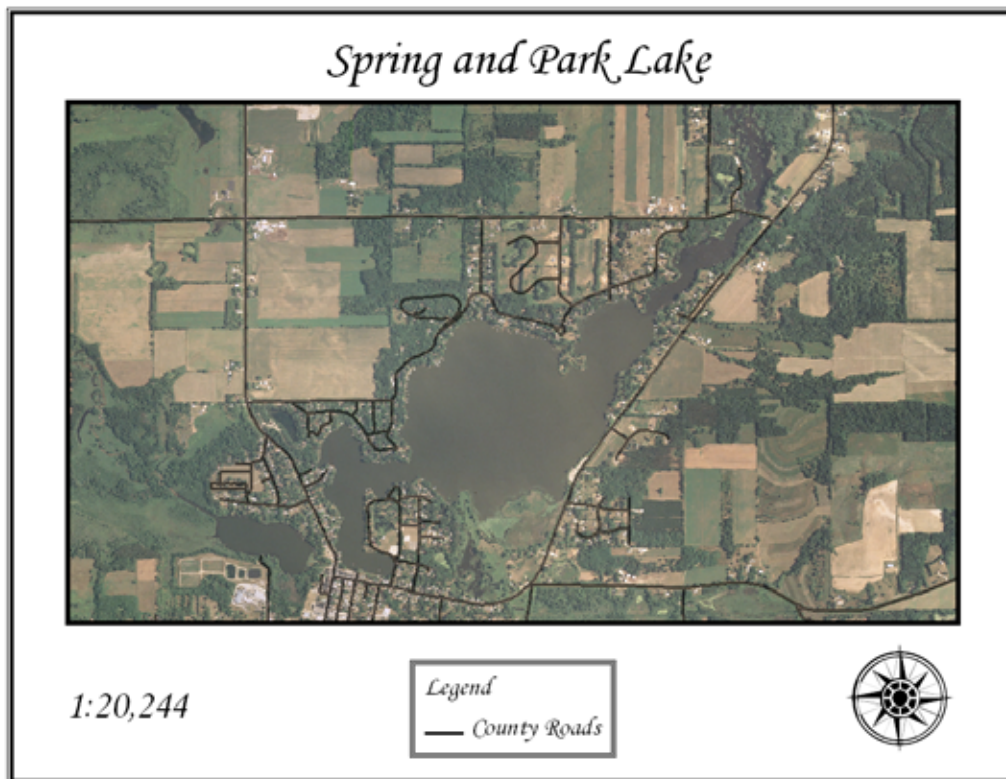
The technical team provided insight and support throughout this planning process via phone calls and emails. The technical team will continue to be a very important player in regards to the implementation of this plan. We feel the work accomplished by this technical team was outstanding and has provided a solid scientific footprint for the management and restoration options for Park Lake.

Chapter 3

LAKE CHARACTERISTICS

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 (Map 3). 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). Traditionally, 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. It has a maximum depth of 27 feet with 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). *(Water Resource Management Workshop 2002)



Map 3. Spring and Park Lake

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 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. (Committee, 1990). *(Water Resource Management Workshop 2002)

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). *(Water Resource Management Workshop 2002)

Fishery

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 Water Resource Management 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(2001), 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). *(Water Resource Management Workshop 2002)

Following the 2001 Water Resource Management Workshop, the Park Lake Management District (PLMD) implemented a biological control program designed to lower the gizzard shad abundance. At this point the WDNR implemented a three year (2003-2006) walleye stocking program (stocking of high densities of walleye) designed to lower the gizzard shad numbers. Despite the three year campaign, the “fall 2006 walleye population estimate was considered to be too low to control shad.” (Fishery Update, PLMD Newsletter, 2007)

Currently the Park Lake fishery has many issues associated with it. The most obvious trend associated with the fishery since 1996, indicates a trend in declining species abundance. Tim Larson, Wisconsin Department of Natural Resources Fisheries Biologist, said, “When the good diversity and density of aquatic plants disappeared as documented

between the 1998 and 2000 plant surveys, so did the desirable fish species.” (Fishery Update, PLMD Newsletter, 2007)

Ten Year Abundance Comparison for Park Lake Fishery

Species	1996	2007
Bluegill	458 per net/day	62 per net/day
Crappie	340 per net/day	26 per net/day
Largemouth Bass	23 per mile	7 per mile

Table 3. (Numbers from Fishery Update, PLMD Newsletter, Summer 2007)

Vegetation

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 supported dense aquatic plant growth, especially near the inlet of the Fox River, this growth was 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 1998 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. *(Water Resource Management Workshop 2002)

The loss of submerged aquatic plants in shallow lakes and the subsequent change from a plant-dominated to an algal-dominated community has been directly linked to increased amounts of phosphorus entering the aquatic system (Phillips et al., 1999). *(Water Resource Management Workshop 2002)

Park Lake was also monitored by Wisconsin DNR for invasive plants and animals in 2006. They did not find any zebra mussels or spiny or fishhook water fleas, but did find rusty crayfish, Eurasian water milfoil and curly-leaf pondweed. (Park Lake Water Quality, 2006)

Park Lake Aquatic Plant Species Abundance and Diversity from 1978 - 2003

Species	1978	1998	2001	2003
Ceratophyllum Demersum	X	X	X	
Elodea Species	X	X		
Lemna Species	X			
Myriophyllum Exalbescens	X			
Myriophyllum Spicatum		X	X	X
Najas Flexilis	X	X		
Nelumbo Lutea				
Nuphar Variegata	X	X	X	X
Nymphaea Odorata	X	X	X	X
Potamogeton Crispus	X	X		
Potamogeton Illinoensis		X		
Potamogeton Nodosus				
Potamogeton Pectinatus	X	X		X
Potamogeton Praelongus	X			
Potamogeton Pusillus	X			
Potamogeton Zosteriformis	X	X		
Sagittaria Species	X			
Scirpus Validus	X	X	X	X
Typha Latifolia	X		X	X
Vallisneris Americana				
Zosterella Dubia				

Table 4.**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). *(Water Resource Management Workshop 2002)

In Park Lake watershed, stream flow and extensive hydrologic studies in the Park Lake watershed have been conducted. Included in this is the U.S. Geological Survey (USGS) (Kammerer, 1996) which did monitor the watershed during 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. *(Water Resource Management Workshop 2002)

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. *(Water Resource Management Workshop 2002)

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 Precambrian 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. * (Water Resource Management Workshop 2002)

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). *(Water Resource Management Workshop 2002)

Watershed soil loss

In 1999, the Wisconsin Department of Agriculture, Trade and Consumer Protection (WDATCP) supported the collection of annual field data on soil loss at the watershed level for most of the state. They sampled each watershed randomly by using roadside transects every 0.5 miles. The data shown in Tables 5 and 6 are based on 69 sample points collected per year from 1999 -2007.

1991-2003 Park Lake Watershed Line Transect Relative Soil Loss

Column1	%	1999	%2	2000	%3	2001	%4	2002	%5	2003
<= T/A	83%	15031	87%	15822	87%	15822	81%	14767	83%	14503
1-2 T/A	10%	1846	7%	1318	9%	1582	13%	2373	9%	1582
2-3 T/A	4%	791	3%	527	1%	264	3%	527	3%	527
>4 T/A	1%	264	3%	527	3%	527	3%	527	2%	264
Unknown	1%	264	0%	0	0%	0	0%	0	3%	527
Total	100%	18196	100%	18194	100%	18195	100%	18194	100%	17403

Table 5.

2004-2007 Park Lake Watershed Line Transect Relative Soil Loss

Column1	%6	2004	%7	2005	%8	2006	%9	2007
<= T/A	84%	15294	84%	15294	84%	15294	87%	15822
1-2 T/A	9%	1582	9%	1582	12%	2110	10%	1846
2-3 T/A	3%	527	3%	527	3%	527	1%	264
>4 T/A	1%	264	4%	791	1%	264	1%	264
Unknown	3%	527	0%	0	0%	0	0%	0
Total	100%	18194	100%	18194	100%	18195	100%	18196

Table 6.

The accuracy of the data collected in the Park Lake Watershed is unknown, but is comparable to county wide data for Columbia County, which has 460 sample points and a confidence interval of 90 percent , ± 5 percent error. (L. Olsen, WDATCP, verbal communication, 2001. *(Water Resource Management Workshop 2002)

When looking at the eight years worth of transect data (tables 5 & 6), it should be noted that the breakdown of percents of tons/acre/year is not as important as the summation of the acres of agriculture and the average erosion in tons/acre/year. It should be understood that the federal standard for Tolerable Soil Loss, "T", is an arbitrary number, and inferences regarding the number of acres meeting or not meeting T cannot be made to the general condition of the watershed. Whether or not a particular agricultural field is meeting T is not as important as the fact that erosion occurs and the erosion is additive to the other erosion in the watershed. Looking at sedimentation from the Park Lake Watershed, although there is a concern for the fields with higher erosion rates, the primary concern is the accumulative erosion rate within the watershed.

In 2001, when using the Universal Soil Loss Equation (USLE), WDATCP estimated an average of 2.75 tons/acre/year of topsoil had eroded in this watershed. When looking at

the average of 18,195 acres of agricultural land in the Park Lake Watershed and applying the average of 2.75 tons/acre/year we get 50,036 tons/acre/year of erosion in the Park Lake Watershed. *(Water Resource Management Workshop 2002)

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)*(Water Resource Management Workshop 2002)

For Park Lake, sediment delivery is transported via the Fox River. Although the sources have not been quantified to geographical sub-watersheds yet, through a comprehensive water monitoring effort, the Pardeeville Lakes Management District is currently in the first year of a larger 3-phase monitoring plan (See Chapter 7, Water Monitoring Plan). At the conclusion of phase 2, there will be sediment delivery numbers based on WILMS (Wisconsin Lake Modeling Suite) and SWAT (Soil & Water Assessment Tool) modeling.

For now though, the Land and Water Conservation Department will continue to use the Wisconsin Department of Agriculture, Trade, and Consumer Protection's transect survey for quantifiable erosion data (tons/acre). *(Water Resource Management Workshop 2002)

When thinking about the sources of sediment, the 1990 Park Lake Development Committee listed farm runoff, bank erosion and natural runoff from fields, woods and wetlands as the most probable sources. In the Park Lake watershed, the sandy and loamy texture of the majority of the soils makes for good soil types for rotational crops; however, these soil types tend to be moderately to highly erodible (USDA-NRCS, 1977, 1978). *(Water Resource Management Workshop 2002)

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. *(Water Resource Management Workshop 2002)

Historically, agricultural runoff has been the primary source of sediment which has been transported 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 has

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. *(Water Resource Management Workshop 2002)

Through the beginning of the new millennium, the amount of enrolled wetland restoration has dramatically slowed down due to a new process for appraising property owner compensation. With the introduction of the new USDA Farm Bill in 2008 a new compensation calculator may be implemented which could bring the Wetland Reserve Program back to its original prominence in Columbia County.

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. *(Water Resource Management Workshop 2002)

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 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. *(Water Resource Management Workshop 2002)

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 lakes 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 tilling a standard football field, including the end zones, to the height of a 110-story building. *(Water Resource Management Workshop 2002)

Water quality

Since the completion of the dam in 1856 the dam has become a settling basin for the section of the Fox River from Park Lake to the head waters. Sediments, nutrients and other materials have been settling into the lake bottom of Park Lake for over a hundred and fifty years. As a result, there has been a degradation of water quality.

With Donna Sefton, Wisconsin Department of Natural Resources, Lake Monitoring and Aquatic Invasives Specialist, as a lead, Park Lake now has five volunteers monitoring various water quality parameters on a regular monthly interval.

Eutrophication

Although other variables are present, healthy lakes exist in a state of balanced nutrients. When the balance shifts so that nutrients are excessively high, the state of the lake is defined as eutrophic. Eutrophication is “the process by which lakes are enriched with nutrients, increasing the production of rooted aquatic plants and algae”. (Understanding Lake Data, Shaw et al.)

Below in Table 7, there are clear-cut quantifiable parameters for classifying water monitoring data.

Trophic Classification of Wisconsin Lakes

Trophic Class	Total Phosphorous mg/l	Chlorophyll A µg/l	Secchi Disc Feet
Oligotrophic	0.003	2	12
	0.01	5	8
Mesotrophic	0.018	8	6
	0.027	10	6
Eutrophic	0.03	11	5
	0.05	15	4
Highly Eutrophic	> 0.15		

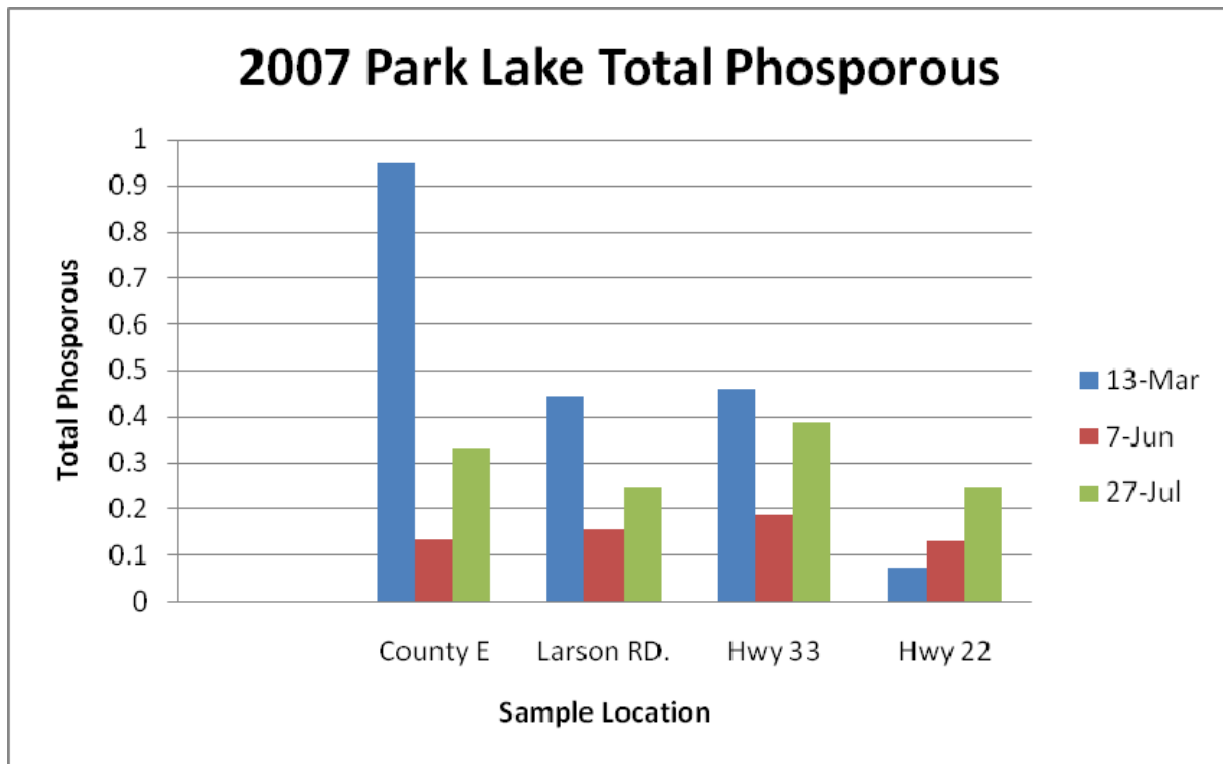
Table 7.

Total Phosphorous

It is documented that Park Lake is a water body with phosphorous levels considered to be in the upper eutrophic to highly eutrophic categories. Phosphorous is the nutrient which tends to promote excessive aquatic plant growth. Typically, the primary source of phosphorous includes but is not limited to human and animal wastes, soil erosion, detergents, septic systems and runoff from farmland or lawns.

In Park Lake, total phosphorous tends to fluctuate throughout the season. Between the time period of May 13, 2006 to August 13, 2006, Park Lake’s in-lake water monitoring had total phosphorous fluctuations ranging from .099 mg/l on July 13 to as high as 0.161 mg/l on August 13. (Park Lake Water Quality, 2006) Over this time frame, all three samples were at least 50% over the poor standard or eutrophic level as seen in Table 7, *Trophic Classification of Wisconsin Lakes*.

However, from March 13, 2007 to July 27, 2007 the Hwy 22 bridge sampling location, a Park Lake outlet, has had total P levels ranging from 0.072 to 0.247 mg/l. While the Hwy 33 sample location, the last site entering Park Lake, has had total P levels ranging from 0.185 to 0.485 mg/l over the same time period. This can be seen in Table 7, Park Lake Watershed 2007 Total Phosphorous.



Graph 1. Park Lake Watershed 2007 Total Phosphorous

Chlorophyll-A

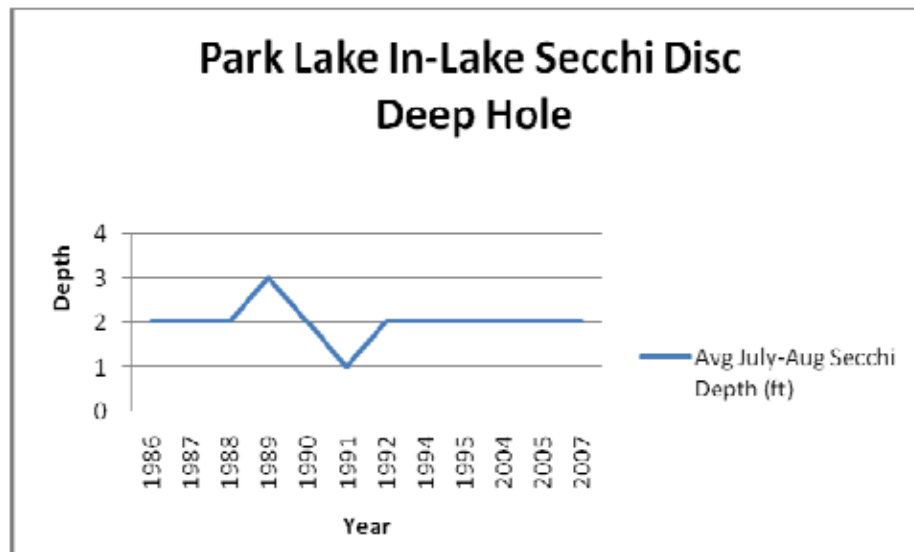
Chlorophyll-A is used as a common indicator of water quality. Chlorophyll-A is actually a green pigment present in all plant life and is a necessary component for photosynthesis. The quantity of chlorophyll-A present is dependent on the amount of algae present. The result of the correlation between chlorophyll-A present and algae present is an index (as seen in Table 7). When chlorophyll-A is used with other indices, water quality can be quantifiably assessed.

In Park Lake, chlorophyll-A had a similar trend as total phosphorous. The measurements ($\mu\text{g/l}$) were as low as 48.6 on June 15, 2006, and as high as 141 on August 13, 2006. When looking at Table 7, we see these levels are 2 to 9 times higher than the poor cutoff level.

Secchi Disc

A Secchi disc is an 8-inch diameter plate with alternating quadrants painted black and white that is used to measure water clarity or light penetration. (Understanding Lake Data, Shaw et al.) While working off the shaded side of a boat, the disc is lowered into the water until it can no longer be seen, and the depth is recorded. At this point, it is raised to confirm the depth it can be seen again. The average of these two depths is recorded as the Secchi disc reading. Best results occur on days with sunny calm conditions.

On Park Lake, the Secchi disc readings ranged from 1 foot at the Fox River inlet to 2.5 feet at the dam on June 25, 2006. The notes from the volunteers state the water was murky and stained brown when all samples were taken.



Graph 2. Park Lake In-Lake Secchi Disc-Deep Hole

Summary

The following summary is from Donna Sefton's Park Lake Water Quality, 2006.

It is important to look at long term trends, rather than individual samples when evaluating Secchi, phosphorus and chlorophyll-A data. The average total phosphorus for 2001 – 2004 was 0.131 mg/l, while the average for 2006 was 0.131, no difference. Average chlorophyll-A for 2001 – 2004 was 99.36, while the average for 2006 was 82.8, not significantly different. The average Secchi transparency in 2006 was 1.8 feet, as compared to 2.0 feet in 2004, not significantly different.

All three parameters (total phosphorus, chlorophyll-A, and Secchi disc) put Park Lake in the upper eutrophic to lower hypereutrophic productivity category. Water clarity is low, causing light-limited productivity, dissolved oxygen is low in the bottom waters and the fish are limited to the upper 15 feet. They consist of warm water and rough fish.

A water sample near the beach for blue-green algae prior to the triathlon found low levels – well below the World Health Organization levels of concern.

Water Chemistry Thresholds

When restoring a lake, water chemistry thresholds are established. These thresholds become the objectives to obtain when managing a lake in the clear-water state.

The PLMD is currently embarking on a three-phase water monitoring program. As a result of this monitoring effort thresholds will be established which will then become objectives to obtain for water chemistry in Park Lake after the drawdown, when Park Lake is restored to a clear-water state. The idea will be if these thresholds are obtained, Park Lake will increase its probability for maintaining a clear-water state.

The PLMD recognizes the importance of thresholds for total P, suspended solids, chlorophyll-A and Secchi disc and when these are developed in spring of 2008, they will be added and used as objectives in the Park Lake Watershed Management Plan.

Chapter 4

Shallow Lake Management Concepts

INTRODUCTION

The ecology of shallow lakes is quite different from that of deep lakes. Shallow lakes tend to have higher nutrient concentrations, resulting in greater productivity and biodiversity. Shallow lakes are also more easily affected by fluctuations in water level. They do not develop thermal stratification in summer and mixing readily cycles phosphorus and other nutrients from the sediment. Restoration efforts that have been successful on deep lakes - reversing eutrophication through phosphorus reduction have often failed on shallow lakes. Therefore, shallow lakes require a specialized management approach. ******(Big Muskego Lake and Bass Bay – Management Plan)

ALTERNATIVE STABLE STATES MODEL

Researchers have found that shallow lakes tend to be in one of two stable states. Over a wide range of nutrient concentrations, both plant-dominated and algal-dominated states can exist as alternatives (Scheffer, 1990, and 1998; Moss, 1998). The preferred plant-dominated condition is typified by seasonal windows of clear water where algae are grazed to low levels, macrophytes (rooted aquatic plants) dominate and game fish like bluegill, pumpkinseed, northern pike, and largemouth bass are dominant. The alternative algal-dominated state is typified by high available phosphorus levels, turbid water, dominance of algae, a relative absence of macrophytes and is dominated by benthivorous fish (bottom feeding fish like carp and bullhead). Turbid water puts sight-feeding game fish at a disadvantage, and often results in slower growth rates and size. Figure 2 graphically illustrates the two stable states. ******(Big Muskego Lake and Bass Bay – Management Plan)

Shallow lakes can shift or "switch" between these states, although the reasons are often difficult to pinpoint. Lake researchers have identified conditions that resist a switch and have termed these "buffers". They have also identified conditions that will likely induce a switch between the two states. ******(Big Muskego Lake and Bass Bay – Management Plan)

Figure 3 illustrates the relative stability of each state under various nutrient conditions (Scheffer, 1993). The "marbles" in the valleys of the landscape diagram correspond to stable ecological conditions. In the oligotrophic (nutrient poor) situation in the top diagram, the plant-dominated, clear state is the only stable condition. Likewise, in the hypertrophic (extremely nutrient rich) condition on the bottom diagram, the algal-dominated, turbid state is the only stable condition. The middle three diagrams show

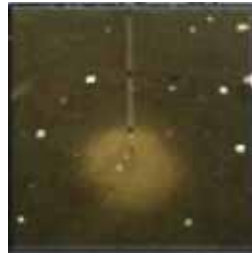
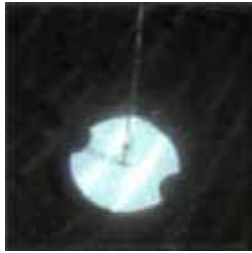
how the marble may rest within two alternative valleys, but how nutrient enrichment affects which state within which the marble is more likely to rest. Continued nutrient enrichment gradually causes the stability of the clear state to shrink to nil, where the lake is more vulnerable to perturbations that would shift the equilibrium to the turbid state.

** (Big Muskego Lake and Bass Bay – Management Plan)

Alternative Stable States Model

Plant-Dominated State

Algal-Dominated State



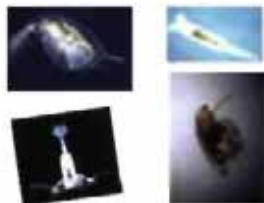
Clear Water

Turbid Water



Plants Proliferate

Algae Proliferates



More Zooplankton

More Phytoplankton (Algae)



Balanced Fishery with good numbers of Top Predators

Unbalanced Fishery dominated by small fish and Carp

Figure 2: Alternative Stable States Model

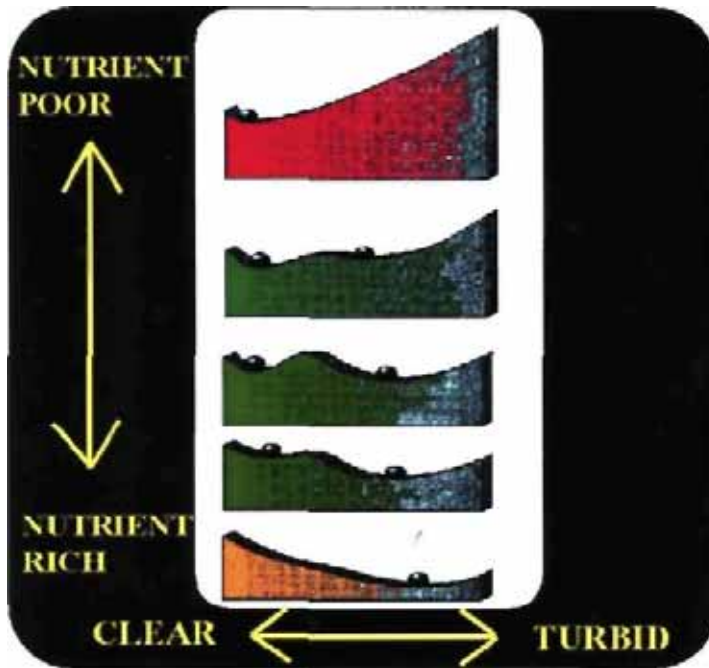


Figure 3: Stability of Each Alternative State

Buffers for the Plant-dominated (Clear-Water) State

Moss (1998) identifies particular sets of buffer mechanisms that can stabilize each of the alternative states. The plant-dominated state is buffered by the following factors:

1. Suppression of wave action or eddy currents. Stands of rooted emergent plants reduce open fetch areas, which in turn lessen the likelihood of submergent plants becoming uprooted. Beds of submergent plants also absorb wave energy, reducing the re-suspension of sediments and resulting turbidity. This turbidity could in turn, block sunlight to the plants causing their decline.
2. Uptake of nutrients by plants. Plants take up large amounts of both nitrogen and phosphorus (luxury consumption) compared to their immediate growth needs.
3. Structural refuges for zooplankton. Plant photosynthesis changes the chemistry of water located near it. Through inorganic carbon equilibrium, carbon dioxide and bicarbonate are withdrawn and pH values can rise above 9. This appears to inhibit fish activity and thus a refuge from fish predation is created for zooplankton within the bed of aquatic plants (Beklioglu and Moss, 1996).
4. Allelopathy and provision of habitat for grazers of periphyton. Periphyton algae can pose a threat to aquatic plants by forming a fur of growth on their surface and compete for sunlight, nutrients and carbon dioxide. Laboratory experiments show that plants secrete substances that inhibit the growth of algal cultures (Forsberg, et. al., 1990). In addition to this allelopathy, plants provide habitat for periphyton grazers such as snails, mayfly nymphs and chironomid larvae.
5. Production of structured sediment suitable for plant germination. At the end of the growing season, plants lay down coarse material that stabilizes sediments and provides a good rooting medium for the following year.

** (Big Muskego Lake and Bass Bay – Management Plan)

Buffers of the Algal-Dominated (Turbid-Water) State

1. Maintenance of open habitat conducive to wind mixing. Greater fetches of open water can produce larger waves with greater energy to stir sediments that block sunlight and inhibit the establishment of rooted plants. Phytoplankton also rely on eddy currents to keep them suspended and re-supplies nutrients.
2. Early algal growth competing with plants for sunlight and carbon dioxide. Algae grow rapidly because they have shorter diffusion pathways for the uptake of dissolved substances.
3. Maintenance of structureless habitat with no refuge for large zooplankton against fish predation. In shallow open water, lacking of structure and deep dark layers to provide refuges for zooplankton, fish easily remove large, efficient grazers such as water fleas (Cladocera). With grazing intensity reduced, phytoplankton flourish.
4. Production of small algal species with high capacity for light absorption. Small algal species are easily moved through the water column and can photosynthesize toward the surface. Their greater surface area to size ratio also makes them more efficient photosynthesizers.
5. Production of amorphous, high water-content sediment unsuitable for plant regeneration. Dead material from phytoplankton is more fluid and amorphous than that from plants. This creates an unstable rooting medium and is also vulnerable to resuspension resulting in turbidity that reduces light for plant development.
6. Maintenance of fish communities with high numbers of small fish. Structureless habitat favors large populations of small fish because their predators, such as northern pike and largemouth bass, need cover from which to ambush their prey.

**(Big Muskego Lake and Bass Bay – Management Plan)

Switches or Flips

The events or manipulations to a shallow lake system that cause a change between plant-dominated and algal-dominated states are known as a switch or flip (Moss, 1998). A change from plant dominance to algal dominance is referred to as a forward switch. Reverse switches cause a change from algal dominance to a plant-dominated system and are often associated with intentional human efforts to restore a shallow water system. **(Big Muskego Lake and Bass Bay – Management Plan)

Forward Switches or Forward Flips

Two types of forward switches occur in shallow lakes: those that directly destroy the plant structure, and those that indirectly affect the plant structure by preventing buffer mechanisms from operating. The direct type includes mechanical harvesting of plants, the application of herbicides or damage done by boating. It can also include natural damage from wind, storms, ducks and geese (Moss 1998, Sondergaard et al 1996). Examples of indirect forward switches include the leakage of pesticides and other toxins that kill zooplankton, the addition of nutrients from surface run-off and introduction of common carp. There is a strong correlation between the presence of pesticides in sediment and zooplankton mortality (Stansfield et al

1989). With populations of zooplankton reduced, lakes become susceptible to algal domination. ******(Big Muskego Lake and Bass Bay – Management Plan)

Water level in a lake is an important control variable with respect to aquatic macrophyte dominance. Vegetation can withstand turbid water more easily if a lake is shallower. A small shift in critical turbidity, resulting from a higher water level, can cause a loss of macrophyte coverage and a forward switch to the algal-dominated state (Scheffer, 1998). ******(Big Muskego Lake and Bass Bay – Management Plan)

Reverse Switches or Reverse Flips

Drawdown

One of the buffers of the algal-dominated state is the maintenance of open water habitat conducive to wind mixing. Lake drawdown can be used to induce a switch or flip to a plant-dominated state (figure 2). Reduced water levels and an exposed lakebed can promote the growth of stands of emergent vegetation, which will reduce wind fetch. Reduced wind mixing subsequently keeps water clearer and promotes the growth of rooted submergent plants. Depending on the goal of management, either a partial or a complete drawdown may be employed. Chemical eradication of the fishery may also accompany a lake drawdown project if the carp population is at a nuisance level. ******(Big Muskego Lake and Bass Bay – Management Plan)

There is also a scenario where a lake drawdown may be considered even if the lake is in a plant-dominated state. A drawdown may be considered if a nuisance aquatic plant, particularly Eurasian Water Milfoil (EWM), dominates the plant community. EWM has a growth habit of topping out on the water's surface and can preclude boating activity. Excessive EWM can also negatively affect fish populations and effective biomanipulation may not be possible.

******(Big Muskego Lake and Bass Bay – Management Plan)

Biomanipulation

Biomanipulation is an ecological management approach that manipulates the biomass of a particular level of the food web to have an effect on the biomass of another. The term originally encompassed a range of techniques applied to terrestrial and aquatic ecosystems. In aquatic systems, it typically refers to top-down manipulation of fish communities, i.e. enhancement of piscivorous (fish-eating) fish populations and reduction of zooplanktivores and/or benthivores (Perrow et al., 1997). In one of the earliest published reports, Caird (1945) hypothesized that stocking of largemouth bass was responsible for reductions in phytoplankton through food chain

interactions. Several researchers (Hrbacek et al., 1961; Brooks and Dodson, 1965; Hurlbert et al., 1971) found that planktivorous (plankton-eating) fish can severely reduce or eliminate *Daphnia*, the largest, most efficient grazers of phytoplankton. These results suggested that lowered planktivorous fish densities would maintain greater densities of *Daphnia*, and thus control algal biomass. **(Big Muskego Lake and Bass Bay – Management Plan)

A reverse switch can involve biomanipulating the fish community to reinstate the plant buffers and destroy the buffers of algae-dominance. An abundance of small, zooplanktivorous fish can quickly reduce the population of *Daphnia* that efficiently graze algae. Biomanipulation seeks to replenish the zooplankton population by reducing the population of their predators. To decrease populations of small zooplanktivorous fish, top predators, such as pike, are added to the system. At larger sizes, panfish become more piscivorous in their feeding habits and help reduce the numbers of small, zooplanktivorous fish. Lower predation pressure allows the zooplankton community to thrive and prey on planktonic algae. Biomanipulation is graphically depicted in Figure 4. **(Big Muskego Lake and Bass Bay – Management Plan)

Biomanipulation to attain a plant-dominated state can also involve eliminating common carp and/or gizzard shad from the system, not just because of their zooplanktivorous habits, but more importantly, their behavior of stirring sediments and the resultant turbidity that inhibits plant growth. Because it is impractical to selectively remove carp while maintaining desirable fish species, total fish eradication is often performed for a biomanipulation project. The lake is then restocked with healthier balance of fish including more "top predator" piscivorous fish. In Park Lake, northern pike (*Esox lucious*) occupy the role as the post-restored top predator. Other piscivorous fish include largemouth bass and bluegill (at larger sizes). These fish keep the population of zooplanktivorous fish under control by preying on eggs and juvenile fish so that large zooplanktons such as *Daphnia* are allowed to flourish and consume phytoplankton (algae). As a result, the water becomes clearer, allowing sunlight penetration and the proliferation of the submergent aquatic plant community. The established aquatic plant community utilizes the nutrients (i.e. nitrogen and phosphorus) that were the main food source of the algae, and the algae diminish. Overall, biomanipulation can be extremely successful, but often only for short periods of time. In order for it to be successful in the long term, the piscivore and zooplanktivore populations in the lakes must be closely monitored to prevent a forward switch. **(Big Muskego Lake and Bass Bay – Management Plan)

Special fishing regulations for Park Lake will be necessary post-restoration to serve as a component of the restoration strategy. The Pardeeville Lakes Management District will work with the Wisconsin Department of Natural Resources fisheries biologist to develop new size and bag limits for Park Lake. For example, an eight-inch size limit and 15 fish bag limit result in a pan fish population with a larger size structure. At larger sizes, pan fish become more piscivorous in their feeding habits. As an example, the use of an 18-inch size limit for largemouth bass also maintains a population of larger sized bass.

Cattail Response to Water Level Changes

The ability of cattails to grow within various water depths is linked to the conditions in which the plants convert stored carbohydrates to the energy needed for shoot growth (U.S. Fish & Wildlife Service, 1993). Starches stored in the rhizomes (fleshy, root-like stems) can be converted to energy both aerobically (with oxygen) and anaerobically (without oxygen). Passageways called "aerenchyma" located within living or dead cattail leaves supply a means through which the rhizomes can utilize oxygen from above the water. Aerobic starch conversion is much more efficient so stored energy is available to grow roots through greater depths of water. Conversely, if oxygen is not available, shoots emerging from the rhizomes have less energy to grow through the water column. For this reason, cattails are generally found growing in water less than four feet deep. The process outlined in Chapter 11, *Recommended In-lake Restoration Plan*, has implications for the management of cattail coverage in marshes, bays or the lake. Cattail growth can be stimulated through complete exposure of the lakebed, which causes germination of seeds. Lowering water levels without exposing the substrate can also encourage cattail growth from the rhizomes of adjacent plants. In contrast, raising water levels can reduce the growth of cattails. Cutting of shoots and stems below the water necessitates the inefficient conversion of starches within cattail plants and causes a reduction in growth.

Populations of muskrats (*Ondatra zibethicus*) help keep cattails in check. These mammals utilize leaves for building lodges and the shoots and stems for food. Muskrats create open pockets of water that are utilized by nesting waterfowl.

BIOMANIPULATION TO MAINTAIN PLANT-DOMINATED STATE

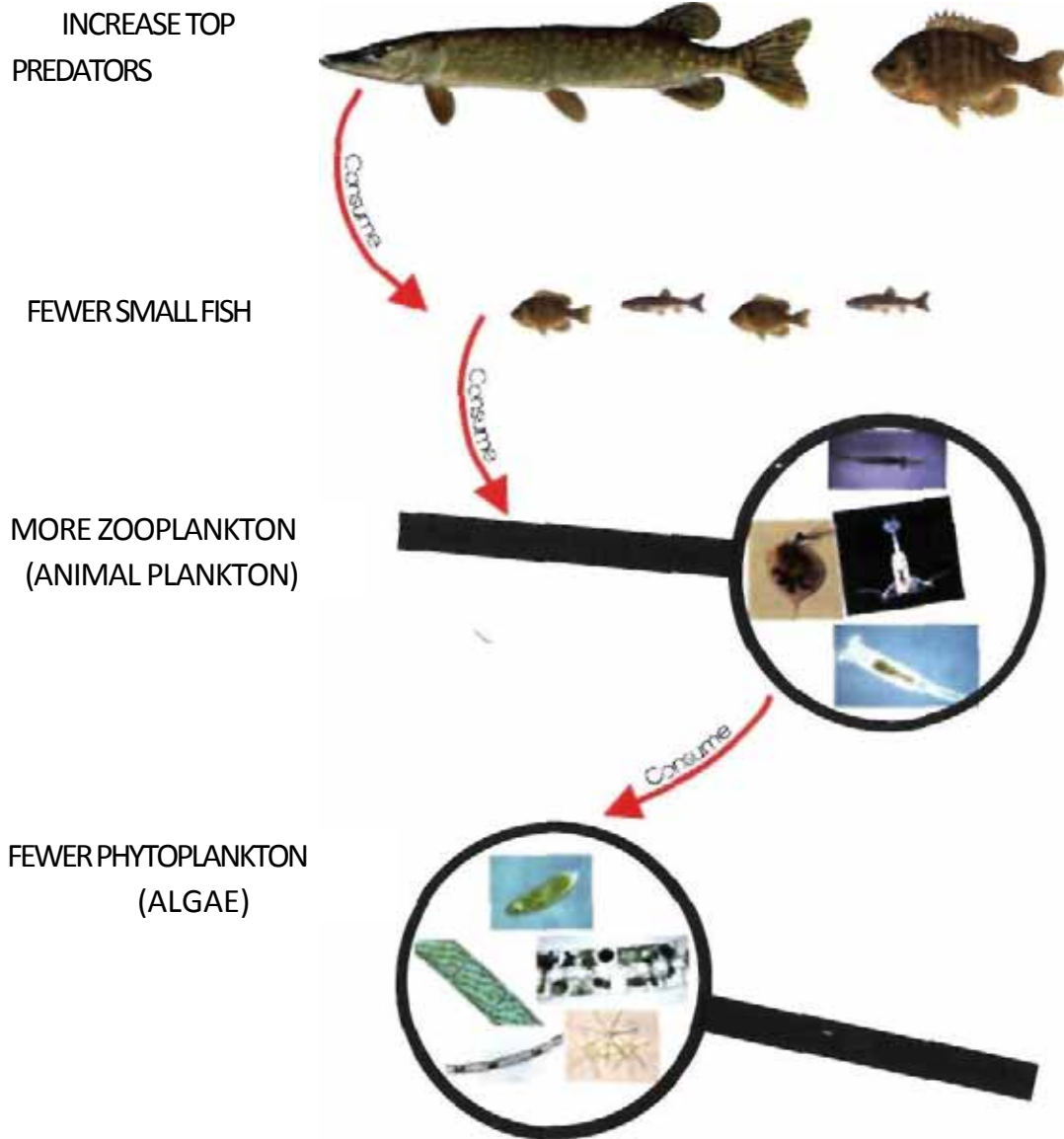


Figure 4: Biomanipulation to Maintain Plant-Dominated State

Chapter 5

Historical Lake and Watershed Management

Introduction

Park Lake is a 312 acre impoundment that was formed by the construction of two small dams that were completed in 1856 resulting in the flooding of a deep-water marsh in the Fox River system. The north dam drains to the Fox River. The south dam is a hydroelectric power plant and discharges water to Spring Lake. These dams are controlled by the Village of Pardeeville and regulated by the Wisconsin Department of Natural Resources.

Historical In-Lake Management

Historically, Park Lake has had an excellent fishery and a water column dominated by native aquatic plant life. By 1989, WDNR lake vegetation surveys showed that the species richness was low, although the amount of plant material was very high. The lake has a history of both chemical and mechanical aquatic plant management efforts (Table 8.). By 2001, plant growth was all but limited to areas of less than 3 feet of depth and diversity of plants had dropped to seven species. At this same time, shad populations were on the increase. Park Lake had now become a turbid system, with small amounts of aquatic plant life. The WDNR and PLMD embarked on a biomanipulation effort that included stocking walleyes in Park Lake to prey on the young-year shad. Following a number of years of monitoring, the WDNR has determined that the bio-manipulation was not successful. By 2002, the PLMD was working hard to try and find answers and opportunities to take the steps necessary to restore this system. Since that time, the PLMD has been partnering with the Columbia County Land and Water Conservation Department to accomplish this goal. From 2005-2006 a watershed inventory was completed by the Columbia County LWCD and the first Targeted Runoff Management Grant was applied for and awarded. The PLMD/LWCD have used several DNR Lake Management Planning Grants to gain knowledge of both in-lake and watershed issues. This process culminated in 2007 with the year-long public input process of developing a comprehensive lake management plan for Park Lake.

Dam operations are dictated by court-appointed water levels. During the time frame of December – April the minimum is 806.7 and the maximum is 807.2. Between the timeframe of April – December the minimum is 807.2 and the maximum is 807.7.

In Table 8, Pardeeville Lake Management District - Aquatic Lake Permit History shows our best attempt to state the history of In-lake aquatic vegetation management. These notes were provided by the PLMD and we cannot support or refute the information presented in Table 8.

Pardeeville Lake Management District - Aquatic Lake Permit History

Table 8.

	Algae	Coontail	Curlyleaf Pondweed	Duckweed	Elodea	Filamentous Algae	Milfoil	Planktonic Algae	Acreage Requested	Acreage Treated	Herbicide Used
1989		X		X		X	X	X	20	22	
1990		X		X				X	16	20	Diquat, CuSO ₄ , 2, 4-D
1991			X			X			?	20	2, 4-D & CuSO ₄
1992		X	X	X			X		24	2.4	
1993	X				X				24	0	
1994						X		X	14	0	
1995									14	0	

Historical Watershed Management

Park Lake lies within a 53.4 square mile watershed that drains into the Fox River. The dominate land use in the watershed is agricultural. As is inevitably the case with impounded lakes, Park Lake has experienced a great deal of sedimentation and nutrient inputs into the lake. In this natural 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. In 150 years of agricultural land use, many things have changed. We have seen much more adoption of conservation farming practices in this watershed. Our most recent transect survey results showed as that over 80% of the cropland in the watershed is now meeting the tolerable soil loss value. This is great news in regards to soil savings, but we also must realize that even when soils are meeting this tolerable soil loss value they are still eroding 2-5 tons/acre annually, some of which is still available to impact the water resource. Historically, livestock numbers have gone down in the watershed. It would be easy to assume that if the livestock numbers have decreased, so have the impacts of those animals on nutrient loads. In many cases, we are finding soil test data on crop fields, where livestock manure had typically been applied, still in the high to excessively high phosphorus levels. These high levels of soil test P values coupled with the existing numbers of livestock that remain on the landscape could provide one a likely source of some of the input P values we are seeing. There are possibilities associated with the potential sources of phosphorus that are entering this system. Many of them include current agricultural land use in the watershed, but some may also be coming from discharge points in wetlands located adjacent to the Fox River. These sources will hopefully be better defined as the advanced water quality monitoring program implemented in 2007 advances towards the development of a Total Maximum Daily Load (TMDL) module for the watershed.

The Park Lake watershed was nominated and was awaiting selection for the Wisconsin DNR Priority Watershed Management Program. This program ended before Park Lake made its way to the top of the list for designation. This program would have provided a direct avenue for cost share and staff resources to work with non-point sources of pollution in this watershed. In 2006, Park Lake was added to the US EPA 303(D) list of Impaired Water Resources in the State of Wisconsin. The loss of watershed improvement opportunities for the Park Lake watershed through the closing of Priority Watershed Program will require a more localized approach towards addressing watershed management issues. The ongoing and future proposed watershed management strategy is outlined more specifically in the watershed management plan found in this document.

It has been noted by a number of lake management professionals that they are surprised that this system maintained a non-turbid state for as long as it did. The implementation of this Lake Management Plan should provide the opportunities to restore Park Lake to the historical recreational value it had. Management of the watershed and its inputs will be a very important component to the success and future of this system.

Chapter 6

Lake Management Alternatives

Introduction

Under the scope of lake management alternatives there are two components: watershed management alternatives and in-lake management alternatives. Watershed management alternatives in the largest scope include non-point source pollution, land use planning and village and county zoning. In-lake management for Park Lake consist of all in-lake options, fish regulations (bag limits & size limits), fish stocking, chemical, mechanical and biological aquatic plant control, water level management and other treatments available.

In-Lake Management Alternatives

The contents of the following section will provide a wide array of tools which have been used as accompaniments for lake rehabilitations, as well as, outline the options presented to the Pardeeville Lakes Management District during the 2007 watershed planning effort. Except for strategy scenario 1, the other options are designed to manage the system from the ecosystem approach. The outcome for 5 of the 6 alternatives is to improve water quality through a holistic approach. Strategy scenarios 3-6 all require an accompanying rehabilitation strategy blueprint or concept; those are discussed later in this chapter in the section titled Strategy Concepts or Blueprints for Strategy Scenarios 3-6.

As a result of the current highly eutrophic, stable turbid state of Park Lake, there instantly becomes two main challenges for the system. The first, if desired, is to flip or switch the system from a turbid, algal-dominated state to a clear-water plant-dominated state (Chapter 3, Figure 2). The second challenge for the system will be to maintain the clear-water state after the restoration.

Maintaining the Turbid State

Strategy Scenario 1

“Status Quo”

When presenting options for management ideologies or alternatives the option to maintain the status quo or do nothing must be presented. In this option, the community would have to accept that the current state of Park Lake will, in a best case scenario, stay the same and more likely than not will continue to deteriorate.

This option will present Park Lake with a system such as the following:

Water Related

- Poor water quality
- Low water clarity
- Continued stable turbid state

Fishery Related

- Fishery dominated by rough fish (gizzard shad, carp)
- Continued loss of bluegill, bass, and northern pike

Plant Related

- Algal-dominated floating plant community
- Increase in algae blooms
- Invasive-dominated submergent plant community

Ex. Curly-leaf pondweed and Eurasian milfoil

Sedimentation and Nutrient Related

- Loss of lake depth through sedimentation
- Continued nutrient loading from adjacent lake lots and storm water system

Miscellaneous

- Decline in real estate value of lake front properties

Complete System Restoration

Strategy Scenario 2

Dam Removal

The second option was only an option because the planning group and community have to be aware that Park Lake is an impoundment and as such, dam removal has to be understood as a conceivable option. Dam removal presents an option within itself. The first alternative when looking at dam removal consists of a complete stream and native habitat restoration. This would still have the original lake with a native flowing Fox River. The second alternative implemented after dam removal, as presented in the University of Wisconsin Extension Water Resources Management Workshop 2001, this option could also be done so the stream restoration would be surrounded with natives within the confines of the a 18 hole golf course.

This option will present Park Lake with a system such as the following:

Water Related

- Free-flowing Fox River system
- Increased flow rate
- Decreased water temperatures - reducing/no more algal blooms
- Fishery with increased cold-water region
- Natural surface water body
- Increased water clarity

Fishery Related

- Fishery with thriving game species

Sedimentation and Nutrient Related

- Sedimentation will continue as it has in past
- Nutrient loading will continue although effect might be reduced from free-flowing system

Miscellaneous

- Loss of majority of surface water
- 3-6 year stream restoration effort

Creating a Clear Water Macrophyte-Dominated State

Strategy Scenarios 3-6 are ideologies relating to active lake restoration options accompanied with a PLMD approach toward the watershed. The actual strategy blueprints to achieve the lake restoration are shown later in this chapter. All strategy scenarios have two major components: restoring Park Lake with a flip or switch and how does the PLMD interact with the watershed work. Restoring Park Lake with a flip or switch can happen now or later. The term “now” refers to the idea that the PLMD will work in a timely manner to take the appropriate steps toward a lake flip. The term “later” refers to the idea that the PLMD will allow the watershed to react to the conservation work geared toward lowering non-point pollution, sedimentation and nitrification.

The strategy scenarios 3-6 are designed to restore a clear-water plant dominated system instead of the current stable turbid algal-dominated system. Earlier in Chapter 4, Shallow Lake Management Concepts, the ecological concepts relating to Park Lake are presented. The information presented in Chapter 4 shows how a plant-dominated state provides a clear-water state, while producing a thriving self-sustaining fishery.

Strategy Scenario 3

Flip Lake Now & Work on Watershed with Traditional Funding

This option will present Park Lake with a system such as the following:

Water Related

- Higher water quality
- Increased water clarity

Plant Related

- Increased abundance of aquatic plant community
- Increased diversity of aquatic plant community

Fishery Related

- Sport fish-dominated fishery
- Northern pike, large mouth bass, panfish
- Sustainable natural-reproducing sport fish fishery

Sedimentation and Nutrient Related

- Phosphorous stored in non-plant available form
- Slower process to reduce phosphorous and sedimentation
- Deeper lake – Sediment compaction

Miscellaneous

- Watershed might not be ready for flipping the lake
- Lower probability regarding time lake will stay in clear-water state

Strategy Scenario 4

Flip Lake Now & Work on Watershed with Traditional Funding + PLMD-Raised Funds

This option will present Park Lake with a system such as the following:

Water Related

- Higher water quality
- Increased water clarity

Plant Related

- Increased abundance of aquatic plant community
- Increased diversity of aquatic plant community

Fishery Related

- Sport fish-dominated fishery
- Northern pike, largemouth bass, panfish
- Sustainable natural-reproducing sport fish fishery

Sedimentation and Nutrient Related

- Faster process to reduce phosphorous and sedimentation
- Phosphorous stored in non-plant available form
- Deeper lake – Sediment compaction

Miscellaneous

- Watershed might not be ready for flipping the lake
- Slightly higher probability for time lake will stay in clear-water state

Strategy Scenario 5

Flip Lake Later & Work on Watershed with Traditional Funding

Water Related

- Higher water quality
- Increased water clarity

Fishery Related

- Sport fish-dominated fishery
- Northern pike, large mouth bass, panfish
- Sustainable natural-reproducing sport fish fishery

Plant Related

- Increased abundance of aquatic plant community
- Increased diversity of aquatic plant community

Sedimentation and Nutrient Related

- Phosphorous stored in non-plant available form
- Slower process to reduce phosphorous and sedimentation
- Allows watershed to reduce sedimentation loads entering lake
- Allows watershed to reduce nutrient loads entering lake
- Deeper lake from sediment compaction

Miscellaneous

- Increased probability lake will stay in clear water state
- No guarantees on time lake will stay in clear water state
- Slower timeline for results in watershed
- Lake flip will not occur till watershed responds to Best Management Practice

Strategy Scenario 6

Flip Lake Later & Work on Watershed with Traditional Funding Opportunities + PLMD-Raised Funds

Water Related

- Higher water quality
- Increased water clarity

Plant Related

- Increased abundance of aquatic plant community
- Increased diversity of aquatic plant community

Fishery Related

- Sport fish-dominated fishery
- Northern pike, largemouth bass, panfish
- Sustainable natural-reproducing sport fish fishery

Sedimentation and Nutrient Related

- Phosphorous stored in non-plant available form
- Faster process to reduce phosphorous and sedimentation
- Allows watershed to reduce sedimentation loads entering lake
- Allows watershed to reduce nutrient loads entering lake
- Deeper lake from sediment compaction

Miscellaneous

- Increased probability lake will stay in clear-water state
- No guarantees on time lake will stay in clear-water state
- Faster timeline for results in watershed
- Lake flip will occur at earliest possible point to assure the highest probability of the flipped lake staying in clear-water state

Strategy Concepts or Blueprints for Strategy Scenarios 3-6

When considering any of the ideological approaches in strategy scenarios 3-6 for restoring Park Lake to a macrophyte-dominated clear-water state, one must use one of the strategy concepts or blueprints as developed by the technical team. The three blueprints were developed by the technical team that was established on behalf of the Pardeeville Lakes Management District Watershed Planning Process.

The technical team used the best science available to develop three rehabilitation concepts or blueprints and objectives for Park Lake. The three concepts/blueprints are all designed to restore Park Lake to a macrophyte-dominated clear-water system from the current stable algal-dominated turbid state.

The three concepts/blueprints are not set in stone and the actions listed within the three options are subject to further and possible refinement. For example, the first review will occur at the lake planning grant/plan approval by Wisconsin Department of Natural Resources (WDNR). After the plan has been approved, the implementation stage will subject aspects of the plan (not all) to further review. For example, two reviews that will be necessary for the drawdown component of the plan are the NR 150 and Wisconsin Environmental Policy Act (WEPA) compliance review. However, components such as the boating ordinance revision are not subject to NR 150 and WEPA review; they are subject to local government approval and then consequent approval from WDNR game warden and WDNR Recreational Safety Warden.

As a result, it should be fully understood that the below listed strategy concepts or blueprints are based on the best science available and as new information becomes available (future studies and modeling), there can be revisions through the review process.

The strategy scenarios differ in their approach to achieve the macrophyte-dominated clear-water system. The approach differs by changing the tools used within each strategy scenarios and the scope of each tool is used. By changing your tools and the scope the associated degrees of probability for success and risk associated with each strategy scenario changes.

Strategy Blueprint A

Highest Probability of Success

- 1) Drawdown
 - a. Duration
 - i. 14 Month
 1. Timing
 - i. Empty in Fall (September), Winter, Spring, Summer, Fall, Winter, Refill Spring
 - b. Desired Outcome
 - i. Clear Water
 1. Water clarity goals
 - i. Spring/Summer
 - i. 5'-9'
 - ii. Average Secchi Depth Readings of 3'
 - ii. Plants
 1. Increased abundance of plants
 - i. Native dominance
 2. Increased diversity (richness) of plants
 - i. $N \geq 12$ species
 3. Increased rooting depth
 - i. $\geq 5'$ Water
 - iii. Compaction
 1. Increased Lake Depth
 - i. Increased compaction rate as soils have higher amounts of organics
- 2) Full chemical rehabilitation
 - a. Resurvey all tributaries in the Park Lake Watershed
 - b. Chemical treatment in Lake
 - i. Done after drawdown
 1. Reduces Chemical used
 - i. Reduces Cost
 2. Concentrates fish, increasing kill %
 - c. Chemical Treatment of all areas with rough fish present
 - i. Carp
 - ii. Gizzard Shad
 - d. Funding will be part of Lake Protection Grant
 - 3) Post-Restoration Plant Management
 - a. After Plant establishment
 - i. Plant Survey
 - ii. Very Limited Plant Management
 1. Low amount Chemical Treatments
 2. Low amount Mechanical Treatments

- 4) Reintroduction of native fish
 - a. Fish Restocking
 - i. Fish stocking
 - 1. Bass
 - 2. Bluegills
 - 3. Northern Pike
 - ii. Fish Objectives
 - 1. Piscovore/Planktivore Ratio
 - i. Desired
 - i. $\geq .3$
 - ii. Currently
 - i. .039
 - 2. Bluegill and Largemouth Dominance
 - i. Piscovores (fish that eat other fish)
 - i. ≥ 60 fish/mile
 - ii. Largemouth Bass
 - 1. 30-50 fish/mile
 - ii. Planktivores (fish that eat algae)
 - i. ≥ 75 fish/mile
- 5) Ordinance changes necessary
 - a. Sport fish Regulations to protect fishery
 - i. High Size Limits
 - 1. Bass
 - 2. Northern Pike
 - ii. Lower Bag Limits
 - b. Boating Ordinances
 - i. No-Wake and/or Focused Disturbance areas
 - 1. Currently all areas within the Village are “No-Wake”
 - 2. Park Lake Area in Town of Wyocena
 - i. Through local ordinance
 - i. Establish “No-Wake”
 - ii. Focused disturbance
 - 1. Limit wake boating to non-shallow areas

Strategy Blueprint B

High risk with no models; Innovative-Never been done

- 1) Drawdown
 - a. Duration
 - i. 14 month
 - 1. Timing - Empty in Fall (September), Winter, Spring, Summer, Fall, Winter, Refill Spring
 - ii. Adaptive Management
 - 1. Monitor aquatic vegetative response

2. Timing - Empty in Fall (September), Winter, Spring, Monitor plant response in early summer or roughly 10 months
 - i. Plant response is increasing (abundance/diversity)
 1. Adequate response
 - a. Increased abundance of plants
 - i. Native dominance
 - b. Increased diversity (richness) of plants
 - i. $N \geq 12$ species
 - c. Increased rooting depth
 - i. $\geq 5'$ Water
 2. Start to refill
 3. Continue drawdown through for 8 more months (fall, winter, spring)
 - b. Desired Outcome of drawdown
 - i. Clear Water
 1. Water clarity
 - i. Spring/Summer
 - i. 5'-9'
 - ii. Average Secchi Depth Readings of 3'
 - ii. Plants
 1. Increased abundance of plants
 - i. Native dominance
 2. Increased diversity (richness) of plants
 - i. $N \geq 12$ species
 3. Increased rooting depth
 - i. $\geq 5'$ Water
 - iii. Compaction
 1. Increased Lake Depth
 - i. Increased compaction rate as soils have higher amounts of organics
 - ii. Increased compaction rate the longer the drawdown is done
 - i. Estimate compaction rate with analysis
 - ii. Cannot set objective
 1. What we get is what we get
- 2) No chemical rehabilitation planned
 - a. Chemical treatment done through adaptive management
 - i. Treat Lake only if fish monitoring determines necessary
 1. Rough fish \geq Piscivores and Planktivores
 - i. Rotenone application if determined necessary
 - ii. Funding if necessary will be part of Lake Protection Grant

3) Post-Restoration Plant Management

- a. During drawdown
 - i. Monitor Plant Establishment in early summer
- b. After Plant establishment
 - i. Plant Survey
 - ii. Very Limited Plant Management
 - 1. Low amounts of Chemical Treatments
 - 2. Low amounts of Mechanical Treatments

4) Fishery

- i. Fish Objectives
 - 1. Piscovore/Planktivore Ratio
 - i. Desired
 - i. $\geq .3$
 - ii. Currently
 - i. .039
 - 2. Bluegill and Largemouth Dominance
 - i. Piscovore (fish that eat other fish)
 - i. ≥ 60 fish/mile
 - ii. Largemouth Bass
 - 1. $\geq 30-50$ fish/mile
 - ii. Planktivores (fish that eat algae)
 - i. ≥ 75 fish/mile
- ii. If chemical treatment was determined to be necessary
 - 1. Fish stocking
 - i. Bass
 - ii. Bluegills
 - iii. Northern Pike

5) Ordinance changes necessary

- a. Sport fish Regulations to protect fishery
 - i. Maybe less regulation than Platinum Plan
- b. Boating Ordinances
 - i. No-Wake
 - 1. Currently all areas within the Village are “No-Wake”
 - ii. Park Lake Area in Town of Wyocena
 - i. Through local ordinance
 - i. Establish “No-Wake”
 - ii. Focused disturbance
 - 1. Limit wake boating to non-shallow areas

Strategy Blueprint C

High risk with no models; Innovative-Never been done

1) Drawdown

a. Duration

i. Short Term

1. Timing for draw down
 - i. Ice Out to Mid-May
2. Start to refill
 - i. Mid-May
 - ii. Strive to see results by July
3. Plant response is increasing (abundance/diversity)
 - i. Adequate response
 - i. Increased abundance of plants
 1. Native dominance
 - ii. Increased diversity (richness) of plants
 1. $N \geq 12$ species
 2. Increased rooting depth
 - a. $\geq 5'$ Water

b. Desired Outcome of drawdown

i. Clear Water

1. Water clarity
 - i. Spring/Summer
 - i. 5'-9'
 - ii. Average Secchi Depth Readings of 3'

ii. Plants

1. Increased abundance of plants
 - i. Native dominance
2. Increased diversity (richness) of plants
 - i. $N \geq 12$ species
3. Increased rooting depth
 - i. $\geq 5'$ Water

iii. Compaction

1. Increased Lake Depth
 - i. Increased compaction rate as soils have higher amounts of organics
 - ii. Increased compaction rate the longer the drawdown is done
 - i. Estimate compaction rate with analysis
 - ii. Cannot set objective
 1. What we get is what we get
 - 2.

- 2) No chemical rehabilitation planned
 - a. Chemical treatment done through adaptive management
 - i. Treat Lake only if fish monitoring determines necessary
 1. Rough fish \geq Piscivores and Planktivores
 - i. Rotenone application if determined necessary
 - ii. Funding if necessary will be part of Lake Protection Grant
- 3) Post-Restoration Plant Management
 - a. During drawdown
 - i. Monitor Plant Establishment in early summer
 - b. After Plant establishment
 - i. Plant Survey
 - ii. Very Limited Plant Management
 1. Low amounts of Chemical Treatments
 2. Low amounts of Mechanical Treatments
- 4) Fishery
 - a. Fish Objectives
 - i. Piscivore/Planktivore Ratio
 1. Desired
 - i. $\geq .3$
 2. Currently
 - i. 0.39
 3. Bluegill and Largemouth Dominance
 - i. Piscivore (fish that eat other fish)
 - i. ≥ 60 fish/mile
 - ii. Largemouth Bass
 1. $\geq 30-50$ fish/mile
 - ii. Planktivores (fish that eat algae)
 - i. ≥ 75 fish/mile
 - ii. If chemical treatment was determined to be necessary
 1. Fish stocking
 - i. Bass
 - ii. Bluegills
 - iii. Northern Pike
 - 5) Ordinance changes necessary
 - a. Sport fish Regulations to protect fishery
 - i. Maybe less regulation than Platinum Plan
 - b. Boating Ordinances
 - i. No-Wake
 1. Currently all areas within the Village are “No-Wake”

- ii. Park Lake Area in Town of Wyocena
 - i. Through local ordinance
 - i. Establish “No-Wake”
 - ii. Focused disturbance
 - 1. Limit wake boating to non-shallow areas

Lake Management Tools

Drawdown and Chemical Fish Eradication

If common carp and gizzard shad reach a density in which they have a detrimental impact on the fishery and cause excessive turbidity, chemical eradication of the fishery may be warranted. However the decision to chemically eradicate the fishery should be done carefully. Chapter 4 discusses how an algal-dominated state may be induced or buffered by factors other than a carp-dominated fishery. To restore the current turbid-lake condition, chemical fish eradication does have to accompany a drawdown, although, it might not in the future. Therefore, fish eradication and the costs involved do not necessarily have to accompany a lake drawdown. This is an important fact to realize when monitoring the post-restoration efforts for Park Lake. ******(Big Muskego Lake and Bass Bay – Management Plan)

For Park Lake, a drawdown will create a smaller and more economical area of treatment. Although the objective is to remove carp and gizzard shad, it was not feasible to selectively remove a single species. It has been proposed through the planning effort to develop a Fish Salvage Plan. If the Pardeeville Lakes Management District can work with the WDNR Fishery Biologist to develop a Fish Salvage Plan, then the chemical treatment will begin after capturing a good proportion of the desirable game fish and panfish and transferring them to Spring Lake. Following refill, the lake will be stocked with appropriate proportions of salvaged fish and other stocking means.

Drawdown

One of the buffers of the algal-dominated state is the maintenance of open water habitat conducive to wind mixing. Lake drawdown can be used to induce a switch to a plant-dominated state (Figure 2). Reduced water levels and an exposed lakebed can promote the growth of stands of emergent vegetation, which will reduce wind fetch. Reduced wind mixing subsequently keeps water clearer and promotes the growth of rooted submergent plants. Depending on the goal of management, either a partial or a complete drawdown may be employed. Chemical eradication of the fishery may also accompany a lake drawdown project if the carp population is at a nuisance level.

******(Big Muskego Lake and Bass Bay – Management Plan)

There is also a scenario where a lake drawdown may be considered even if the lake is in a plant-dominated state. A drawdown may be considered if a nuisance aquatic plant, particularly Eurasian Water Milfoil (EWM), dominates the plant community. EWM has a growth habit of topping out on the water's surface and can preclude boating activity. Excessive EWM can also negatively affect fish populations and effective biomanipulation may not be possible. ******(Big Muskego Lake and Bass Bay – Management Plan)

Partial Drawdown

A partial lowering of the lake level can also promote the growth of emergent aquatic plants. Shallower water levels can allow sprouting of cattails from rhizomes due to increased aerobic conversion of carbohydrates. Therefore, if the management goal is to promote more mid-lake stands of cattails a partial drawdown could be employed. ******(Big Muskego Lake and Bass Bay – Management Plan)

A partial drawdown actually mimics low lake level from dry natural weather patterns. This is a good management tool to overcome the consistent water levels found on Park Lake.

Nuisance Aquatic Plant Management Alternatives

Chapter 4 described how it is desirable to manage a shallow lake for a plant-dominated state. However, aquatic plants themselves often can pose as a nuisance. Growths of certain aquatic plants, particularly non-native plants can be invasive and cause negative impacts to fish and wildlife habitat and human recreation. Control measures are needed to minimize the nuisance level.

Chemical Controls

Chemical treatment of aquatic plants in all waters of the state, public or private, requires an approved permit from the Wisconsin DNR. Only chemicals registered for aquatic use with the U.S. Environmental Protection Agency (EPA) and the State of Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) can be used. In many cases, a licensed applicator, certified by DATCP must apply the chemicals. ******(Big Muskego Lake and Bass Bay – Management Plan)

Aquatic vegetation that is killed with an herbicide/algaecide will decompose. Decomposition utilizes dissolved oxygen and in turn increases the likelihood of a fish kill. When aquatic

vegetation has accumulated to the point at which massive amounts are present, the decomposition that occurs after an herbicide/algicide application could result in oxygen demand so great that there is not enough to sustain fish life, and a fish kill may occur. This problem can be avoided if chemical weed control efforts are carried out before there is a large accumulation of vegetation. ******(Big Muskego Lake and Bass Bay – Management Plan)

2, 4-D

The chemical herbicide 2, 4-D (2, 4-dichlorophenoxyacetic acid) is selective in killing dicotyledonous or broadleaf plants. It has been found to selectively control infestations of EWM at low concentrations and short exposure times (Killgore, 1984; Miller and Trout, 1985). The goal of treatment is to reduce the distribution and density of EWM and allow native plants to flourish. ******(Big Muskego Lake and Bass Bay – Management Plan)

Floridone/Sonar

Floridone, more commonly known as SONAR, is a slow-acting systemic chemical herbicide that must remain in contact with target plants for up to ten weeks. Floridone is effectively absorbed and translocated by both plant roots and shoots. It will control a broad range of submerged and floating aquatic plants and some emergent plants, but is particularly effective for duckweed and water milfoil control. When applied at reduced rates, Floridone can be used to selectively control undesirable, nonnative species. In 30-90 days after application, the target weeds will be controlled and effects can last up to two years. Disadvantages of this control method include its relatively high cost and its effect on non-target plant species. ******(Big Muskego Lake and Bass Bay – Management Plan)

Alum

Aluminum sulfate or alum is used to reduce internal phosphorus release from the lake bottom. On contact with water, alum forms a fluffy aluminum hydroxide precipitate called "floc." Aluminum hydroxide reacts with phosphorus to form an insoluble aluminum phosphate compound. On the bottom of the lake the floc forms a layer that acts as a phosphorus barrier by combining with phosphorus as it is released from the sediments. Although alum is effective in preventing phosphorus from entering the water column, rooted aquatic plants are still capable of utilizing phosphorus within the sediment. Therefore alum is primarily used as a control of algae, rather than aquatic macrophytes. ******(Big Muskego Lake and Bass Bay – Management Plan)

Glyphosate

The chemical glyphosate formulated for use over water, such as the brand name Rodeo, can be used to control invasive purple loosestrife. Foliar formulations will also kill any non-target plants in the zone of spraying because the chemical is a broad-acting vegetation killer. A selective but more labor-intensive method is to cut individual purple loosestrife stems and apply a more concentrated formulation of herbicide to the cut end. This control method is impractical for large areas and is best employed to eliminate small colonizing stands of this invasive plant. ** (Big Muskego Lake and Bass Bay – Management Plan)

Manual Controls

Manual removal of submergent or emergent aquatic plants by hand pulling or raking is an effective means of controlling nuisances in small areas. NR 109 of the Wisconsin Administrative Code allows riparian owners to remove vegetation in a 30-foot wide area without a permit. The Code also allows for hand removal of non-native aquatic vegetation beyond the 30-foot area, provided the native vegetation is not removed or harmed.

Weed Barriers

Bottom weed barriers require DNR permits. The most commonly used bottom weed barriers are constructed of fiberglass mesh or polyvinyl fabric. The barriers are laid on top of aquatic plants and weighted down with bricks, chain, stakes or other anchoring devices. Plants become crushed and sunlight is blocked. Barriers may require removal and cleaning every 1 to 3 years. Barriers are appropriate management tools for controlling aquatic plants along docks and in deeper swimming areas. Initial cost for the barriers is relatively high, but they can usually be used for 5 or 10 years with proper care and maintenance.

Biological Controls

Biological controls for aquatic plants and algae are in the developing stages and include pathogens (bacteria or fungi) and herbivores (insects, crustaceans or fish). Bacterial treatments are commonly used in small fish-rearing ponds. Presently, fish and crustaceans are not legal control options in the state of Wisconsin. It is illegal to transport or stock grass carp or live crayfish into Wisconsin waters.

Weevils (*Euhrychiopsis lecontei*) are tiny native aquatic insects found to feed heavily upon milfoil species. Adult weevils cause lesions that make the plant more susceptible to bacteria and fungi, while the larval stage burrows into the stems. Subsequent tissue damage causes the plants to lose buoyancy and collapse (Sheldon, 1995).

Biological controls are also being employed for the control of purple loosestrife. Two Chrysomelid beetles (*Galerucella pusilla* and *G. californiensis*), which feed exclusively on purple

loosestrife, have been imported from Eurasia. Releases of these insects have been shown to significantly reduce stands of purple loosestrife within a three-year period. An aggressive propagation and release program is underway in Wisconsin to utilize this biological control.

Mechanical Harvesting

Mechanical harvesters are large floating machines that cut plants below the water surface. Harvesting is considered a short-term technique that temporarily removes nuisance plants. To achieve maximum removal of plant material, harvesting is usually performed during summer when submerged and floating-leafed plants have grown to the water's surface. Conventional single-staged harvesters combine cutting, collecting, storing and transporting vegetation into one piece of machinery. Cutting machines are also available which perform only the cutting function. Maximum cutting depths for harvesters and cutting machines range from 5 to 8 feet with a swath width of 6.5 to 12 feet.

Mechanical harvesting can efficiently remove nuisance aquatic vegetation from large areas and facilitate greater recreational use of a waterway. Mechanical harvesting removes aquatic plants from the system, thereby reducing the build-up of organic sediment and removing nutrients that were tied up within the tissue of the plants.

There are some drawbacks to mechanical harvesting however:

It is generally not possible to operate a mechanical harvester in water depths less than two feet; the reduced competition from macrophytes can result in greater algal growth. Young-of-the-year fishes are often captured along with aquatic plants and equipment, maintenance, and staffing are costly.

The Wisconsin DNR regulates mechanical removal of aquatic vegetation through Administrative Code Chapter NR 109. This code requires persons sponsoring or conducting mechanical harvesting of aquatic plants to obtain an aquatic plant management permit. The permit application can require that the sponsor develop an aquatic plant management plan. Should the Pardeeville Lakes Management District decide to employ mechanical harvesting, this document will likely serve as the basis to fulfill that requirement. An addendum would be needed to establish operation parameters and identify specific removal areas

Burning

Controlled or prescribed burning can be used to control cattails and promote other native plants such as sedges and bulrushes. Cattail burns are most effective when flooding follows as it inhibits cattail regrowth. Controlled burning conducted within navigable waters is regulated under NR 109 and requires a permit.

Chapter 7

Water Quality Monitoring Plan

Water Quality Monitoring Plan

The concept of water quality monitoring is often at the forefront of resource management discussions. Why? Because good, up-to-date science-based water quality monitoring helps resource managers make good, up-to-date decisions and provide a solid foundation for statistical guidance. As important as water quality monitoring data is, it's often one of the most under-utilized and under-funded tools for resource management. Water quality monitoring efforts can establish baseline levels from which to gauge future measurements from. For Park Lake, there are two levels of water quality monitoring, advanced water quality monitoring and volunteer citizen monitoring. In both cases, monitoring can be for both in-lake and watershed tributaries.

In 2006, the Columbia County Land and Water Conservation Department received a DNR Lake Planning Grant to facilitate the development of both a citizen and advanced monitoring program for Park Lake. The development and use of the citizen monitoring program should continue to be developed and enhanced. The PLMD should be involved in supporting and garnering support and participation from its citizens. This type of monitoring provides high-quality, basic water quality indicator information, along with strong educational and personal growth opportunities for participants. The advanced monitoring side of the program is a more analytical approach to monitoring with a long-term goal of analytical and statistical modeling. This includes the establishment of regular monitoring locations, water lab analysis and other related stream sampling techniques. In 2007, the LWCD worked with the DNR to try and get funding through some internal DNR program funds to facilitate the growth of this monitoring program. The funding application was not successful. It is recommended that the PLMD continue to work with DNR in future years to try and gain access to these funds. As a follow-up to this, the LWCD has submitted two additional DNR Lake Management Planning Grants to further advance this 2007 monitoring effort into 2008. It is very important for the PLMD to continue to search out funding opportunities both internal and external to continue this effort. The more years of data that can be collected, the better the modeling results will be. Along with the establishment of baseline numbers, these efforts will allow for a more enhanced targeted approach to watershed management both on the in-lake side and in the Fox River watershed.

The costs associated with the development and implementation of a monitoring program vary greatly depend on the depth of detail. Water quality monitoring costs can range from \$10,000 on up to \$100,000 or more per year depending on the level of detail. As we move deeper into this process, the costs will likely increase as we get towards the development of a TMDL (Total Maximum Daily Load). It is recommended that the PLMD continue to work with the staff at the University of Wisconsin-Stevens Point Center for Watershed Science and Education.

The following is a synopsis of the 2008 DNR Lake Planning Grant application; this should provide the reader a solid understanding of the focus of the monitoring efforts and the process that is being utilized.

Development of a TMDL for the Park Lake Watershed Phase 1 (As submitted August 1, 2007)

Description of Project Area

The focus of this project area is the Upper Fox River, which makes up the major surface water resource of the Swan Lake watershed. This entire watershed is an 81 square mile watershed that includes the headwaters of the Fox River. It is located in north central Columbia County and a small part of southern Green Lake County. The Park Lake watershed focus will include sections of the Fox River located in the Townships of Marcellon, Scott and Randolph. The map included in this application details the location of the Fox River and our monitoring sites. Agriculture is the dominant land use in this watershed with approximately 78% of the land being cropped or pastured. Park Lake is on the DNR 303(d) list of impaired water from NPS Pollution. This source is the upper Fox River and its watershed.

Background Information

Park Lake has recently been the focus of interest in regards to improvement and restoration of this water body. The Park Lake Management District has utilized a number of previous DNR planning grants to work towards this reality. In 2005-2006, the Columbia County Land and Water Conservation Department used a DNR lake planning grant to help fund a watershed inventory process for this system. In 2007, the Columbia County LWCD led a comprehensive lake planning effort for Park Lake. A completed lake planning grant will be submitted to DNR by the end of 2007. In 2007, the Columbia County LWCD applied for and received a DNR lake planning grant to establish the foundation of a long-term water quality monitoring program for Park Lake. At that time, this current grant application was referenced as a follow-up process to the original grant. Park Lake has been a technical challenge for even the most experienced lake management planners. Past USGS modeling has shown that large amounts of P are entering the system. Our first year of data is confirming the availability and discharge rates of P into the system. We are pursuing this more advanced TMDL monitoring process because of the need to have more information in regards to volume and sources of nutrient loading. This will help the

Park Lake Management District with the implementation of their lake management plan. It will help further identify loads and sources and better understand the reduction level necessary to sustain a long-term in-lake restoration. We have applied for DNR and TMDL internal funding, but we were not selected for 2007. We hope the inclusion of a couple more years of data collection from grants such as this will keep us moving along on this process.

Description Of Problems To Be Addressed Including Goals And Objectives

Previous research and modeling on this portion of the Fox River and the downstream reservoir of Park Lake have led us to believe that nutrient and sediment loading from the watershed is severely impacting the water quality of Park Lake. The intent of this monitoring program is to get some current up-to-date water quality information. Our goal is to continue to invest in a citizen monitoring program while moving forward with an advanced monitoring program that will allow us to eventually develop a TMDL; this TMDL will help in working towards the removal and restoration of Park Lake from the 303(d) list. This information will establish a baseline level for water quality monitoring and will help us evaluate and understand needs for improvement within the watershed. Along with creating a baseline, it will help us assess the value of working towards water quality goals and BMPs (Best Management Practices). Currently Columbia County LWCD has inventoried the entire watershed, looking at all sources of nutrients (croplands/barnyards). The next step to the development of the TMDL is to model this watershed. The two objectives of this study are 1) Quantify the phosphorus export from the watershed 2) Link the water quality with nutrient loss from the land. The models that will be used will be SWAT and WILMS. In the later phases of this project the modeling would be conducted by UWSP, under the supervision of the Center for Watershed Science and Education. Once the lake and its watershed have been sampled, inventoried and modeled, we will move forward in developing a TMDL. This information will lead us towards identifying priority areas to target our implementation efforts.

Description of Methods, Activities and Data To Be Collected

This grant application will be used to address one component of a multiple phase project. This grant will be part of **Phase 1** (Data Collection). Once adequate monitoring data has been collected, we will move into the future phases, which include **Phase 2** (Data Modeling, Compilation and Recommendations) and **Phase 3** (TMDL Development and Lake Management Plan Integration).

In early spring 2007, staff gauges and pressure transducers were put in place at three sites above Park Lake and one at the outflow. Columbia County staff have been measuring weekly stream flow to develop rating curves for these instruments. The staff gauges were installed at each site to enable evaluation of stream elevation into the future. Grab samples for water quality have been collected during events, however this project would enable the collection of samples at a regular twice/month interval (March-November) and monthly (December-February). In addition, event samples would be collected during the initial stages (siphon sampler) and within/after the event (grab) five times per year. Currently each of the four sites has a single siphon sampler; however we would like to collect up to three samples/site/event so we are requesting funding for an addition eight siphons. Sampling will be conducted by County staff. Volunteers in the watershed will record daily precipitation between April and November at three sites.

Based on evaluation of the first year of data, additional sample points may be added further into the watershed to better resolve the relationship between land use, water quality and assessment of the ability of the wetlands to function as phosphorus sinks.

Any additional future sampling locations will be selected to provide a mixture of land cover and land use to provide a data set that could be used to calibrate several water quality modeling tools. We would anticipate that the phosphorus loading would be correlated with spatial characteristics (e.g., distance to waterway) and physiographic features (e.g., soils) to refine the export coefficients approach to nutrient export. The data would also provide a data set that could be used to calibrate process-based water quality models such as the Soil and Water Assessment Tool (SWAT). As part of this project, we would develop a comparison of export coefficient approach (Wisconsin Lake Modeling Spreadsheet: WILMS), modified WILMS and SWAT.

Some lake data would be collected. This would include sampling once during spring and fall (overturn) and five times during the summer. Columbia County Land and Water Conservation Department staff will collect summer samples and UWSP staff will collect overturn samples. Weekly Secchi measurements will be collected by volunteers from the lake management district or by the Columbia County Land and Water Conservation Department staff.

Existing And Proposed Partnerships

This project will consist of many existing partnerships. The project will continue an ongoing partnership between LWCD and the Park Lake Management District working towards the implementation of their recently completed lake management plan. The fostering of this

monitoring program has brought together the following partners on this endeavor: The Columbia County Land and Water Conservation Department, Columbia County NRCS, Park Lake Management District, Pardeeville Garden Club, Village of Pardeeville, Town of Wyocena, Town of Marcellon, Town of Scott, Town of Randolph, WDNR and UWSP CWSE.

Deliverables And Plan For Sharing Of Project Results

LWCD will have several information/education opportunities throughout the project. Once the project is successfully funded, a news release will be produced to give an overview of the project. As we move ahead with this more advanced monitoring program, LWCD will be providing the Park Lake Management District and the general public updates through regular meetings and announcements. Information will be provided through a presentation at the annual meeting of Park Lake Management District and other regular meetings. Upon completion of the multiple phases outlined as part of this study, a TMDL report will be completed and this information will be used as a guiding document. This TMDL will be the final report for this long-term program.

Role Of Project In-Lake Management

The goal of this monitoring program is to attain the monitoring data to utilize modeling programs to develop a TMDL for Park Lake. This will directly aid in the evaluation of water quality impacts and the status of the watershed as a whole. The implementation of several components that are outlined in the Park Lake Management Plan will directly hinge on the outcome of this study. The relationship to in-lake management options is directly related to the nutrient loading coming from the watershed. This information will help focus staff and financial resources throughout this process.

Timetable Discussion

If both grants that we are applying for are approved in this grant cycle, we will be able to utilize these resources to begin implementation of this more advanced monitoring process as soon as funds become available. It will allow us to transition directly from our existing monitoring grant into this one.

This process will begin no later than January 2008 and the funding outlined in the budget will allow us to accomplish the following actions in 2008: 1) Grab samples for water quality have been collected during events, however this project would enable the collection of samples at a regular twice/month interval (March-November) and monthly (December-February). 2) Event samples would be collected during the initial stages (siphon sampler) and within/after the event (grab) five times per year. Currently each of the four sites has a single siphon sampler; however we would like to collect up to three samples/site/event so we are requesting funding for an additional eight siphons. Sampling will be conducted by County staff. Volunteers in the watershed will record daily precipitation between April and November at three sites.

Based on evaluation of the first year of data, additional sample points may be added further into the watershed to better resolve the relationship between land use, water quality and assessment of the ability of the wetlands to function as phosphorus sinks.

Please Note: The accomplishments included in this outline, will require the award of both grants we have applied for in this grant cycle. The guidelines for this planning grant program allow for the application of two grants per cycle. We have asked for two grants in the amount of \$8990 each. The inclusion of both of these grants total a grant application amount of \$17,980.

Chapter 8

Watershed Management Plan

Lake management alternatives include both watershed management measures and in-lake rehabilitation techniques. Watershed management, including land-use planning and zoning and non-point source pollution control, is used to maintain or improve the quality of water before it reaches the receiving boundary of water. In this section, we will focus on the discussion of implementing watershed management in Park Lake.

Managing inputs into very nutrient-rich systems such as Park Lake is very important if we want to provide for long-term water quality improvements. Managing and reducing these inputs is traditionally done through the identification, design and installation of best management practices (BMPs). BMPs are actions or structures that are designed to reduce non-point source pollution at construction sites, agricultural lands and developed areas. BMPs include things such as barnyard runoff systems, silt fences, detention or retention ponds, manure storage, buffer strips, reduced tillage and other associated practices.

There are many individual sources of non-point source pollution within any one watershed. The biggest and most important challenge is to identify and remediate as many of those sites as you can. Some areas of concern may seem very small-scale. It is very important to realize that the cumulative impacts from multiple small sources are the biggest hurdle associated with winning the battle over non-point source pollution. Issues that seem small at first can have huge cumulative impacts as you move downstream, combining the impacts associated with over 40,000 acres of small sources. In 2007, the Columbia County LWCD began to implement a long-term water quality monitoring program in the Park Lake watershed. As this project moves into the advanced stages over the next several years, the goal is to be able to utilize these loading rates to determine more specifically sub-watershed sources throughout the watershed to help focus reduction and conservation efforts. The water quality monitoring section of this plan provides more details related to the specifics associated with this endeavor.

For the purpose of the Park Lake watershed we have divided them into 4 main categories, including ***Storm Water Management and Construction Site Erosion Control, Septic System Management, Riparian Property Management and Upland Agricultural Source Management***. These individual categories represent different levels of severity and necessity within the overall scope of implementing a watershed management plan. The overall watershed management perspective hinges on the ability to actively reduce the amount of phosphorus and sediment entering the system.

Storm Water Management and Construction Site Erosion Control

Storm water runoff has the ability to impact water resources by increasing the amount of runoff from impervious areas such as roofs and driveways. The increased runoff travels overland picking up contaminants and deposits them in local waterways. The increased volume of runoff combined with the increased rate of runoff can create increased erosion on upland sites. Impacts from storm water runoff have not yet been fully assessed. There are likely opportunities to increase efficiency and effectiveness of current local and state storm water management requirements. It would be important for the PLMD to be the catalyst in a process to analyze current storm water issues affecting Park Lake. This would include a cooperative effort between the Village of Pardeeville, Town of Scott, Town of Wyocena, Town of Marcellon and Town of Springvale. The implementation of a county-wide storm water ordinance would help streamline the effectiveness of storm water impacts on a watershed basis. The control of erosion coming from sources such as construction sites could also be a potential source of increased sedimentation. Currently, erosion control measures are required under several local and state permit requirements. The PLMD could promulgate a process to work closely with local municipalities to identify areas of concern associated with construction site erosion control. As is often the case, there is typically a need for increased utilization and regulation of the BMPs required for construction sites. Both of these factors will largely depend on the amount of land-use changes we see within the Park Lake watershed. It will be very important for the PLMD and the community to embrace and understand the associated implications of land-use changes.

Septic System Management

The Village of Pardeeville has a sewage treatment plant that has a capacity of 330,000 gallons per day. This system, completed in 1985, 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. 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 phosphorous loading and possible fecal coliform contamination. The level of impact associated with current individual septic systems has been discussed as a possible source of increased nutrients. Many of the discussions have focused on the correction or location of failing septic systems around Park Lake. It is likely there

are a number of systems on the lake that are not functioning the way they were designed or they are very undersized. It's important to realize that septic systems themselves, new or old, are not designed as nutrient removal systems. They are designed to remove bacteria and solids at calculated loading rates. If bacteria discharge to the lake is identified as a major issue, then there is value in searching out systems that are failing to remove bacteria. If removal of nutrients and bacteria together are identified as a point of concern, then working towards expansion of the sewerage system to the north and east side of Park Lake would be an important step. Information related to the relevance of nutrient loading associated with septic systems on Park Lake will come forward as we move further into the more advanced stages of our water quality monitoring program. In-lake nutrient loading compared to upland watershed nutrient loading will help us make those assessments.

Riparian Property Management

Riparian properties are those defined as lands directly adjacent to water. In this case, the majority of riparian owners will be those directly located on Park Lake. One of the defining characteristics of the residential lots adjacent to Park Lake is that they fall under the category of non-conforming use. This is defined by lot size, minimum setbacks and other associated requirements found in shore land zoning regulation. This situation sets the stage for further analysis of current non-conforming uses and ordinances to determine impacts on surface and groundwater quality. When comparing Wisconsin turf lawns to native cover, Wisconsin soils with sod cover produce a phosphorous load 4 to 7 times greater than a site in native cover. Knowing this, we can identify opportunities for nutrient load reductions in the watershed from the majority of riparian properties along Park Lake. The normal riparian shoreline has a turf lawn up to the lake instead of native cover. If we look at traditional turf management practices, we will likely see an import of commercial fertilizer also being brought into the mix on turf sites. The inclusion of native buffers along the shoreline of Park Lake, combined with a reduction in use of commercial phosphorus fertilizer, will provide a reduction in overall nutrient loading from riparian properties and provide increased fish and wildlife habitat while reducing landowner maintenance costs. The PLMD should promote and foster a program targeted at increasing adoption and acceptance of native shoreline buffers and proper utilization of commercial lawn-care fertilizers. The use of a cost share/demonstration project funded through the PLMD would be an ideal avenue to gain acceptance of native buffers. There are opportunities to install buffers on both public and private land holdings.

Upland Agricultural Source Management

Access to the most current water quality monitoring data shows us that the Fox River watershed is carrying large amounts of phosphorus downstream and depositing them into Park Lake. Science has proven that phosphorus is the typical limiting nutrient responsible for promoting algae and aquatic plant growth. The current and historical nutrient loads into this system have provided a surplus amount of nutrients and are a factor in the lake's recent transition from a plant-dominated community to an algae-dominated system. This turbid condition has many factors, but the best available science has proven that reduction of phosphorus levels entering the system will be very important for the vitality and restoration of this system. It is very unlikely that the reduction of nutrients from the watershed alone will provide a high enough level of change to flip this system back to a clear-water plant-dominated community. The necessity and long-term success of any in-lake manipulation to help flip the lake back to a clear-water state is greatly dependent on nutrient reduction from the watershed. The success of the chosen in-lake management option will likely increase as the nutrient levels are reduced in the watershed. It is recommended that the PLMD continue to put a large amount of current and future management efforts into nutrient and sediment reduction from the watershed.

The Columbia County Land and Water Conservation Department has been working with the PLMD on watershed improvement efforts since 2001. In 2006, the Columbia County LWCD completed a watershed-scale inventory to identify issues in the watershed. This inventory provides a solid foundation to begin to understand many of the challenges we face in regards to nutrient reductions. A summary of inventory data is included to help summarize and define the inventory process and the results. We have also projected watershed improvement costs based on the information found in our inventory. This information will help the PLMD understand the conditions now and associated costs. The costs associated with agricultural watershed improvement efforts are often not well understood and under-estimated by the general public. The costs and associated funding options will also help the PLMD understand and set realistic timelines for stepped watershed improvements.

Summary Interpretation of Inventory Data

Park Lake Watershed

The following information was provided as a summary to the inventory work completed for the Park Lake Watershed in 2006. We realize this information is always changing in regards to land use, but it provides a solid picture of the challenges that we face in trying to reduce non-point source impacts in the watershed through the implementation of BMPs.

The completion of this planning grant and the culmination of these various data sets related to this inventory have provided us the opportunity to look at and compare this data. Following is a summary and interpretation of some of the data in regards to watershed improvement efforts.

Direct Runoff From Livestock Operations

A total of 59 livestock operations were inventoried. A total of 14 of them have obvious runoff issues related to NR 151. These 14 operations include a total animal count of 1432 Dairy/Beef Cows. 12 of these direct runoff issues are ranked as either medium or high in regards to environmental degradation.

Unlimited Cattle Access to Stream/Adequate Sod Cover Maintained

A total of nine out of the 59 livestock operations have cattle with unconfined access to water. Six out of the nine are not maintaining adequate sod and the cattle should be removed from the stream.

Existing Rill or Gully Erosion Present

This question was asked to all 59 operations. Fifty of the 59 felt that they had no erosion taking place anywhere. We think this is worth noting, because it holds true to the idea that many operators see some level of erosion as normal and do not associate it with being a problem. The reality is, that in a watershed of this size, and with phosphorus level exceeding high in many of the soils, even the smallest amount of erosion and sediment delivery can have a large impact. More education and understanding is probably needed within the agricultural community.

Existing Manure Storage Structures

A total of eight out of 59 operations have a manure storage structure. Two of these structures need to be abandoned, five of them have potential problems and four of them are in need of upgrades.

Utilization of Manure Stacks:

Twenty-three of the 59 livestock operations stack manure for a period of time. Five of them stack manure within the NR 151 WQMA (Water Quality Management Area) adjacent to a stream/lake or water body.

Clean Water Diverted from Feedlot

Fourteen of the 59 livestock operations were adequately diverting clean water from their feedlot. Thirty-seven of them are in need of some form of clean water diversion. Seven of the operations are in need of earthen surface water diversion and 35 are in need of 5135 feet of roof runoff diversions.

Existence of a 590 Nutrient Management Plan (NMP)

Only four of the 59 livestock operations have a certified 590 NMP plan. The remaining 55 operations need to develop a 590 NMP plan.

Updated Conservation Plan to meet “T”

Only 11 of the 59 operations inventoried were aware of their conservation plan, and knew it was updated. The remaining 48 operators were not aware of the status of their plan. It's likely that many farms are meeting T without an updated plan, but it is also likely that just as many operations are not meeting T because they are not referencing a conservation plan. This will continue to be a concern as the demand for corn grows. We also realized that a high percentage of our highly erodible sites were directly adjacent to our sensitive areas.

Livestock Populations in Watershed

It was determined that there are about 1920 dairy animals in the watershed. This represents 97% of the reported high/low herd range. These 1920 dairy animals exist on 26 individual operations. There are 21 operations housing 1612 beef animals in the watershed. There are 401 hogs and about 181 sheep. There are numerous other smaller populations of horses, dogs and other smaller-scale animal operations in the watershed.

Note: The Columbia County Land and Water Conservation Department has developed and is maintaining a GIS (Geographic Information System) database that includes all related inventory results and supporting documentation. We have not included a complete summary of the inventory results in this document. The LWCD can provide you copies and/or access to this information upon your request. The inventory data and supporting information was submitted to DNR as part of the final report for our 2006 DNR Lake Planning Grant that helped us complete this inventory.

- 1) We set out to complete an inventory of the Park Lake watershed with the following criteria as our starting point:
 - a. Identify and locate all livestock operations in the watershed
 - b. Identify livestock operations that fall within the WQMA as referenced in NR 151
 - c. Determine compliance of livestock operations with water quality performance standards found in NR 151
 - d. Locate and identify sensitive areas
 - e. Determine areas in need of riparian buffers
 - f. Determine areas that would be potential wetland restoration sites
 - g. Locate obvious areas of gully/soil erosion

- 2) We have included GIS developed maps that show the following relationships from our data:
 - a. Location of all livestock operations
 - b. Wetlands and highly erodible soils (sensitive areas)
 - c. Farmland Preservation Program acres
 - d. Acres under NPM 590 plan
 - e. Locations of potential wetland restoration sites
 - f. Existing manure storage structure locations
 - g. CREP eligible buffer sites

- 3) Our GIS database that we have utilized throughout this process contains the following data layers to help us interpret and use the data:
 - a. a. Tax parcel
 - b. b. Livestock sites
 - c. c. Manure storage structure locations
 - d. d. Township range
 - e. Section
 - f. ¼ Section
 - g. Roads
 - h. Soils
 - i. Erosion sites (aerial interpretation)
 - j. 4' Contour
 - k. Potential WRP
 - l. Watershed boundary
 - m. Hydrology
 - n. DNR map of watersheds
 - o. Parcels adjacent to water
 - p. Zoning
 - q. Wetlands
 - r. Nutrient management plans
 - s. Farmland Preservation Program

- t. CREP 150'
- u. Permitted animal waste structures
- v. Location of existing BMPs
- w. Land cover
- x. Columbia County high resolution aerials (black and white)
- y. NAIP –1 meter resolution color
- z. Original vegetation

In 2006, we spent some time taking video footage of the entire existing shoreline and its condition. This video is now being converted to DVD for future reference for lake improvement efforts.

Projected Park Lake Watershed Improvement Costs

The following is a conservative attempt to quantify anticipated costs associated with non-point source pollution abatement efforts in the Park Lake watershed. These costs have been estimated based on using the inventory data collected by the Columbia County LWCD. These costs have been defined to help understand not only the BMPs needed, but also the cost of implementing a large-scale watershed improvement effort. In most cases, we are outlining the dollar costs associated with the actual installation of the conservation project. Projected staff and resource costs are discussed separately. It's very important to realize that realistic watershed improvement timelines will be in direct relation to the amount of available cost share and staff resources.

Control of Director Runoff Issues from Existing Livestock Operations

We have identified 14 out of 59 livestock operations that are in need of some BMP assistance to control direct runoff of manure into the Fox River system. We estimate a cost of **\$500,000-\$850,000** to provide cost sharing to implement these BMPs.

Control of areas where livestock have unconfined access to streams

We have documented six livestock operations that still allow cattle access to the stream to the point that adequate sod cover is not being maintained. We estimate a cost of **\$30,000** to provide cost sharing to implement a plan to control the amount of cattle access.

Control of Existing Rill and Gully Erosion

Based on our review of the watershed, and interpretation of aerial photography combined with feedback during inventory process, we feel there is still a lot of work that should be done in regards to waterway, terrace, grade stabilization and overall upland sediment control. We estimate a cost of **\$100,000-\$200,000** to provide cost sharing to implement these BMPs.

Manure Storage systems and Location of Manure Stacks

We have documented that the majority of the livestock operations in this watershed do not have any manure storage structures. Only eight of 59 have some form of storage. Several of the existing structures need to be abandoned and a number of them have obvious problems. We also have a number of operators who are stacking manure within the WQMA. In an attempt to address the obvious manure storage related issues, we estimate a cost of **\$250,000-\$750,000** to provide some level of cost sharing assistance to implement changes. The cost associated with manure storage options vary from site to site. These numbers do not reflect the concept of providing manure storage options for all livestock owners. This only addresses structures and stacking related issues from the inventory. Controlling phosphorus inputs could be directly related to a livestock producer's available storage and land base.

Provide for Clean Water Diversions Away from Livestock Operations

We identified that 14 of the 59 livestock operations in the watershed were adequately diverting clean water away from manure sources. We did find that the balance of them could benefit from some level of roof runoff management and seven of them could use some earthen clean water diversion upslope from their feedlots. We estimate a cost of **\$150,000** to provide cost share assistance to implement these BMPs.

Development and Utilization of 590 Nutrient Management Planning

We identified that only four of our existing 59 livestock operations have a 590 NPM plan. Remaining livestock operators and the balance of the cashgrain operations in the watershed will need to be provided cost share payments to help assist in the development of these plans. We estimate a need of **\$850,000** dollars to provide the required cost share allocation to develop 590 NPM plans on the remaining 30,000 acres of cropland in the watershed. This practice could prove to be very important as we work towards reduction of phosphorus levels.

Implementation of Riparian Buffers in Watershed

We have identified 549 acres of cropland that would be eligible for inclusion in the CREP Buffer Program. The implementation of buffers in this watershed could prove to be very important in regards to upland sediment/phosphorus reductions. We estimate it would cost **\$3,200,000** of CREP payments to achieve implementation of these buffers.

Upland Sediment Control through Conservation Plan Implementation

We found that only a small percentage of the livestock operations inventoried were aware of what their conservation plan allowed. It would be very important to begin a process of revising conservation plans for all livestock and cash grain operations in this watershed. We estimate that it would take a minimum of 3000 hours of LWCD staff resources to work with and develop revised conservation tillage plans for the 30,000 acres of cropland in this watershed. We estimate a cost of **\$150,000-\$175,000** of staff resources to accomplish this.

Summary of Costs

Watershed Improvement Best Management Practices

We estimated a total need of about **\$2,830,000** to implement the stand-alone BMPs identified in the watershed. We estimate the need for an additional **\$3,200,000** in funding from the CREP program to cover the cost of implementing buffers throughout the watershed.

Staff Resources Associated with Watershed Improvement Best Management Practice Installation

It must be realized that the availability alone of the cost sharing resources identified above will not provide enough resources to see those BMPs through installation. Earlier we identified a need of **\$175,000** of staff resources to develop and help landowners implement revised conservation tillage plans. We also estimate a cost of **\$1,200,000** of LWCD staff resources to identify, design, install and certify the above mentioned BMPs.

The implementation plan for the Upland Agricultural Source Management component of this watershed management plan hinges of time and resources. Because traditional watershed improvement programs such as those found under the now closed Priority Watershed Program are none existent, it will be important for Park Lake to develop its own methods and resources

to accomplish the watershed improvement efforts. The Columbia County Land and Water Conservation Department along with the Natural Resource Conservation Service will be important partners in financial, marketing and engineering design services.

The cost of implementing a watershed improvement plan in the Park Lake watershed has two major components; they include staff resources and best management practice installation resources. The Columbia County Land and Water Conservation Department will serve as the lead agency in regards to working individually with landowners throughout the watershed. The LWCD will provide ongoing program marketing and engineering and implementation services. The level of staff time and resources that the LWCD will be able to provide will be directly related to current staffing levels and financial resources available. The PLMD will continue to work in partnership with the LWCD to help provide financial assistance to offset costs associated with staff time.

The funding needed to work with landowners to install best management practices in the watershed will come from several sources. Currently, the Columbia County LWCD has been utilizing the DNR Targeted Runoff Management Grant Program to target specific projects in the watershed. This annual competitive grant program should continue to be utilized by the LWCD to further gain the financial resources necessary to work in the watershed. This grant program is highly competitive and currently underfunded at the state level. Success rates depend on the number of applications and funding available. Upon approval of this plan, the PLMD should look at the utilization of the DNR Lake Protection Grant Program as a second source of funding BMPs in the watershed. Annual grant applications are accepted and the Columbia County LWCD can provide the lead on these grants. The Columbia County LWCD will continue to encourage landowners to enroll in the NRCS EQIP federal cost share program. This program is a voluntary program that landowners can enroll in to be eligible for BMP cost sharing. The LWCD will continue to provide a focused effort of conservation compliance for all Farmland Preservation Program participants in the Park Lake watershed. Schedules of compliance will be developed and implemented as staff resources allow. The LWCD will continue to focus funds from our Land and Water Resource Management Program as they become available. Currently, funding levels are low, but beginning in 2008, we expect to see an increase in funding opportunities for Nutrient Management Planning.

The implementation of a watershed management plan such as this can often seem very overwhelming. It is very important to realize that these are long-term attempts to reduce inputs over a long period of time. We know that the access to several million dollars in cost sharing assistance will take many years to gain. We will work at the pace allowed by both the available cost sharing programs and the amount of staff time available. It is very important to realize that the level of cost share dollars must be directly related to staff resources. Currently,

program implementation is often as limited by the availability of staff resources as it is by the availability of cost sharing resources.

The inclusion of more years of advanced water quality monitoring in the Park Lake watershed will prove to be a very important tool for focused watershed improvement efforts. As we move forward with our advanced water quality monitoring program, the data will allow us to further determine loading rates from individual sub-watersheds within the larger Park Lake watershed. This will help us evaluate areas to concentrate BMP installation and reduction success. Our water quality monitoring program is moving towards the development of a TMDL plan. This plan will allow us to set reduction goals by the sub-watershed. Once we have those realistic reduction goals, it will help us further our implementation of this watershed plan.

Chapter 9

Recommended In-Lake Restoration Plan

Introduction

The recommended In-Lake Restoration Plan is one component of the comprehensive plan. The other sections are: Water Monitoring Plan, Watershed Plan, Fisheries Management Plan and Aquatic/Nuisance Plant Management Plan.

This chapter presents a recommended Comprehensive Management Plan for Park Lake. The plan is based upon all of the current scientific information, including but not limited to watershed, water quality, aquatic plants, fishery, wildlife and human uses, while accounting for future data needed and expected to be obtained.

As stated in Chapter 4, there are two options when managing a shallow water lake. The first option is a plant-dominated clear-water state. The second is a turbid state dominated by algae. Currently, Park Lake is the latter. As seen in Figure 3, Stability of Each Alternative State, the turbid lake is very stable. In its current turbid state, Park Lake is considered to be very stable. Despite the multitude of variables which played a part in the forward flip or switch in the late 90s, it is not as important as the fact that the result was and is a turbid algae-dominated Park Lake. As a result, the stable, turbid Park Lake needs something to “shock” the system.

As seen, based on the recommendations by the technical team and any and all available science, this “shock” can only be obtained from a drawdown.

The Pardeeville Lakes Management District (PLMD) Board on June 13th, based on public input recommended Strategy Scenario 4 with, Strategy Blueprint A.

Adopted Lake/Watershed Management Philosophy

Strategy Scenario 4

The first step for the PLMD Board was to adopt a philosophy toward the restoration. As seen in Chapter 6, Strategy Scenarios; Pardeeville Lakes Management District had six ideological approaches toward working with Park Lake. The PLMD Board would like to work in a timely manner “now” to a reverse flip or switch. The PLMD does understand that using the term “now” is relative. The PLMD Board realizes “now” means having to go through the proper processes and procedures, in accompaniment with working in the community. A thorough information and education campaign to gather community support will result in an implementation effort consisting of a minimum of several years.

The PLMD has also recognized the health of Park Lake is directly correlated to the state of the Park Lake watershed. As a result, the PLMD Board has expressed a desire to take a more active role in working toward a healthy Park Lake watershed and recommend this strategy scenario.

Strategy Blueprint A

The next decision made by the Pardeeville Lake Management District Board was the selection of a Strategy Blueprint. The PLMD Board selected the Strategy Blueprint A. This option presents the PLMD the highest probability of success.

The blue print is not set in stone and the actions listed below are subject to further review and possible refinement. After the plan has been approved, implementation stage will subject aspects of the plan (not all) to further review. As a result, it should be fully understood that the below listed strategy blueprint is based on the best science available and as new data becomes available (future studies and modeling), there can be revisions though the review process.

Water Level Manipulation

The plan recommends a 14 month drawdown for Park Lake, as the tool used to cause a reverse flip or switch from algae dominance. The plan anticipates a drawdown occurring with a fall (September) start date. The drawdown will be carried out through the winter, into the spring, summer, fall, and following winter. As the second winter concludes, Park Lake will be refilled with the spring thaw.

Desired Outcomes of Drawdown

Water Clarity

First and foremost, the desired outcome of the plan calls for clear water. Clear water for a Park Lake restoration is being defined by a minimum of Secchi Disc readings in spring/summer of 5' to 9' and average annual readings of 3'.

Plants

The drawdown should affect Park Lake's plant community by increasing the abundance and diversity of the aquatic plant community. The desired outcome will be an aquatic plant community dominated by native species. It is expected that Park Lake's aquatic community should have equal or greater than 12 different native species. It is expected that Park Lake at a minimum will need and must have plants in all the areas with at least 5' of depth. This means that Park Lake must have plants in at least 5' if not greater to maintain a clear water state. This should not be viewed as only 5' of depth. It can be expected that plants will be in areas of greater depth.

Fish Salvage Plan

The plan calls for the PLMD to work with the WDNR fishery biologist to develop a fish salvage plan. The salvage plan will be implemented after drawdown but before the chemical rehabilitation.

Full Chemical Rehabilitation

All tributaries in the Park Lake watershed will be surveyed by the WDNR fishery biologist. After the data is reviewed from the tributary surveying, a chemical treatment plan for the tributaries will be developed. This action is designed to remove, to the best degree possible, all rough fish, carp and gizzard shad from the system.

Aquatic Plant Management

Issue: Aquatic Plants

Value Statement: Restoring and protecting high quality aquatic plants will help maintain the restored clear-water state while providing critical habitat for a self-sustaining fishery.

Goal: Restore and sustain native aquatic vegetation.

Before Drawdown

Within the aquatic plant management, there are no pre-drawdown recommendations.

After Drawdown

Aquatic Plant Inventory

After the lake has completed the draw down stage of the restoration, it will be necessary to start managing the new aquatic plants. The first step for the PLMD will be to hire a consultant to conduct an aquatic plant management plan. The PLMD will have to apply for WDNR Lake Planning Grant up to \$10,000 or 75% including a 25% local match. The information obtained from the inventory will be used to develop the Aquatic Plant Management/Cutting Plan.

Aquatic Plant Management/Cutting Plan

When the PLMD hires the consulting firm to obtain the services of the aquatic plant inventory, they will also be hiring the firm to produce their aquatic plant management/cutting plan. Based upon the response from the seed bank and the findings of the environmental consulting firm, a document will be produced stating what is necessary.

1. Maintain travel corridors
2. Protect sensitive aquatic areas (fish spawning beds, plants in the \leq 5-6 feet of water plus buffer)
3. Aquatic invasive/nuisance plants

Future Aquatic Plant Monitoring

As stated earlier in the Future Fish Monitoring section, the WDNR fishery biologist conducts annual fish population surveys. This is done twice a year, once in the spring and once in the fall. When the fishery biologist is conducting the survey, he takes notes on aquatic plants. This will provide the PLMD with annual aquatic plant information. Based on this information, they will be able to determine at what point in the future they will need to conduct an aquatic plant inventory. Using the information in the post-restoration aquatic plant inventory, the annual information from the WDNR fishery biologist and any future plant inventories, the PLMD, with the WDNR, will be able to readjust the goals and objectives in their Aquatic Plant Management/Cutting Plan.

Adjusting the Management Plans

When receiving the annual aquatic species list from the fishery biologist and the aquatic plant inventory, the PLMD will need to reevaluate the goals and objectives of the Aquatic Plant Management/Cutting Plan. The PLMD should use the data collected annually to make sure their aquatic invasive/nuisance management is working and to make sure they are effectively protecting their sensitive areas. If it is determined they are not protecting the sensitive areas, the action items to obtain their objectives must be reestablished.

Fisheries Management

Issue: Fisheries

Value Statement: Healthy lake ecosystems are vital and valuable natural resources for lake shore property owners. A self-sustaining fishery will be restored, monitored and protected by protecting high quality aquatic plant communities and managing angler harvests.

Goal: Restore and protect a healthy self-sustaining blue gill, northern pike, and bass fishery.

Pre-Draw Down

Tributary Surveying

The first step towards restoring the fishery for Park Lake will be a surveying of all the tributaries in the Park Lake watershed. This will be done by the WDNR fishery biologist. They will be looking to quantify the species abundance and diversity with the intent of looking for rough fish. This information will be used to develop the chemical treatment plan.

Fish Salvage

The plan calls for the PLMD to work with the WDNR fishery biologist to develop a fish salvage plan. The salvage plan will be implemented after drawdown but before the chemical rehabilitation.

Chemical Treatment

As part of the restoration plan, Park Lake and the tributaries will receive a full chemical treatment. In the lake this will be done after the drawdown. This will reduce the gallons of lake water, reducing the amount of chemical needed, thus lowering cost. Furthermore, concentrating the fish into a smaller area increases the probability of increased mortality. Funding for the chemical treatment will come through a WDNR Lake Protection grant.

Post-Restoration

Fish Restocking

Currently the WDNR does not rear all species necessary for the restoration of Park Lake's fishery. This is currently under review and in the future the WDNR fish hatcheries might include all species necessary for Park Lake. After the lake has completed the drawdown stage of the restoration, Park Lake's fishery will be restocked as a largemouth bass, panfish, and northern pike fishery. The management goals for the piscivore (fish that eat other fish)/planktivore (fish that eat plants) ratio will be .33. Within the piscivore stocking, the goal will be ≥ 60 fish per mile. Of that the goal for largemouth bass is 50 fish/mile. The planktivore goal will be ≥ 75 fish per mile.

Fishery Ordinance Changes

When the fishery is restored there should be new regulations in place to protect it. The PLMD will work with the WDNR fishery biologist to develop new bag limits for all species. There will also have to be new size limits in place for all species.

Future Fishery Monitoring

Currently the WDNR fishery biologist surveys species abundance and diversity twice a year. It is strongly recommended that the PLMD continue to work with the WDNR fishery biologist to obtain and analyze the data each year. The PLMD and the WDNR fishery biologist should then be able to develop an understanding of what the current population numbers are. Based on the annual population numbers and trend analysis, the PLMD can re-evaluate what is necessary to meet the desired piscivore/planktivore ratio of .33.

Boating Ordinances Revision

In order to protect the investment and the undertaking of restoring Park Lake, it will be necessary to establish new boating ordinances for Park Lake. The PLMD will have to work with the WDNR to establish the focused boating area.

The focused boating area will be in the east lake. The PLMD will have to place a no-wake buffer, identifying the area around the shore on the 6-7' contour. By marking the 6' contour the PLMD will be protecting the plants in the areas < 5' with a "no-wake" buffer. The area on the inside of this "no-wake" buffer will be the focused boating area. This is the area where the high speed boating should take place.

The PLMD will also have to select the travel corridors connecting the two main bodies of water, east and west, as well as marking the travel corridor through the North Bay. These areas should also be marked to increase the probability of compliance and enable enforcement.

The last sensitive area in need of protection will be the spawning beds for the fishery. Based on the aquatic plant inventory and aquatic management and cutting plan (to be conducted after the restoration), the PLMD will have the spawning beds identified. These areas should be marked and protected through a "no-wake" designation.

Future Studies

The plan recommends the PLMD receive certain studies as necessary for a successful implementation process. Studies vital to the probability of success for the comprehensive plan will be marked with a "*". The plan also recommends other studies based on the needs and desires of those involved in the planning process. These studies will be marked with "***".

Before Drawdown

1. Watershed Monitoring* - Determine sediment and nutrient load
2. Palio Core Study**- Develop an in-depth understanding of history through sediment analysis
3. Dredging Feasability Study ** - Determine understanding of components determining practicality of dredging

It should be stated that dredging is not advised until after the watershed sediment loading issue has been quantified and significantly remedied; if the PLMD goes against recommendations then it is advised to complete this study.

After Drawdown

1. Watershed/In-Lake Water Monitoring* – See Watershed Monitoring Plan on Chapter 7
2. Aquatic Plant Inventory* – See Aquatic Plant Management on page 83, Chapter 9
3. Recreational Carrying Capacity Study* – After Park Lake has been restored and people develop their recreational styles on the newly-restored Park Lake, it will be highly recommended for the PLMD to hire a consultant to develop a Recreational Carrying Capacity Study.
4. Annual Fishery Monitoring* - See Fishery Management Plan on page 84, Chapter 9
5. Analyze Current County and Village Ordinances and Enforcement Protocol*- The residential lots adjacent to Park Lake, in general, are non-conforming uses. It is recommended the PLMD analyze what impact the current ordinances are having on surface and ground water quality.
6. Analyze Current Storm Water System* – It is recommended that the PLMD hire a consultant to analyze the current storm water system and quantify the impact on Park Lake. If Park Lake can receive a TMDL study as stated in Chapter 7 Watershed Monitoring Plan, this would be included in such a study.

Recommended Management Plan for Spring Lake

Spring Lake is a small, deep, natural lake immediately downstream from the electric powerhouse discharge of Park Lake. In the 2005 revision of the Columbia County Land and Water Resource Management Plan, the DNR fishery biologist reported that a variety of fish species exist with good sizes of bass, northern pike, catfish and panfish present. In recent years, there have been concerns relating to the peak operation of the electric turbine and the related impacts it has on downstream water levels in Spring Lake. There are concerns that fluctuating water levels might pose a threat to fish spawning.

Many of the management approaches outlined for Park Lake are also very applicable and necessary for the continued management and productivity of Spring Lake. Although Spring Lake is a natural lake, it is hydrologically connected to Park Lake and its watershed. So management activities that will improve and maintain water quality for Park Lake will also be beneficial and important for Spring Lake and should be looked at and managed in partnership. Spring Lake's ability to remain a nutrient-rich water body that provides good water quality and dynamic reproducing fishery will depend on its ability to reduce and manage nutrient loads,

provide healthy native plant communities and manage current and future land use considerations.

It is recommended that an in-lake water quality monitoring process be established and maintained for Spring Lake. This should include the use of regular staff gauge monitoring of water levels to log water level fluctuations and determine potential impacts to the overall management and health of Spring Lake. The use of an aquatic plant management survey would be very important for Spring Lake. Documenting the volume and species of existing native and exotic plant species would be of great value. It would be recommended that an aquatic plant management survey be conducted in collaboration with the proposed post-restoration Park Lake aquatic plant management survey. The use of this survey will help guide future aquatic plant management planning, including the control and removal of exotic plant species. Park Lake and Spring Lake should be managed holistically while identifying the differences and challenges each of them face individually.

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Appendix A

Planning Process Results

Pardeeville Lakes Management District (PLMD) Mission Statement

The Pardeeville Lakes Management District is a non-profit, special taxing, governing organization committed to preserving and protecting the integrity of the Pardeeville Lakes through education, conservation, water quality control and rehabilitation methods. It is our intent through innovative leadership, planning and utilization of factual and scientific data to form solid partnerships with our citizens, resource professionals and state/county/local representatives in fulfilling this mission.

Pardeeville Lakes Management District Vision Statement

PLMD leadership, along with community involvement and education, will provide a healthy functioning ecosystem, promote recreational use of our lakes and insure sound lake management practices for future generations.

Summarized Issue Statements as Captured on 4/4/07

It should be noted that when an issue statement has words in (), those were added. The original statement was incomplete and what was believed to be implied was added to the statement.

Planning Process

1. How do we get more people involved in this (planning) process?

Storm water

2. What can be done to encourage detention ponds and other storm water management practices that reduce runoff pollution?
3. What can be done to promote buffers along the lakeshore to help reduce runoff?
4. To what effect does storm water pollution & nutrient load our watershed and lakes?
5. How can we address the restoration of shoreline plants with residential properties?
6. What can residents do to prevent nutrient runoff into the lake?
7. (What can be done about) water runoff?
8. Faxed 4/5/2007
9. (What can be done about) polluted runoff?
10. Emailed 3/5/2007
11. (What can be done about) polluted runoff?
12. Emailed 3/5/2007 from a person other than one who authored above comment

Erosion

13. What can be done to reduce devastation of natural shoreline on Park Lake, which is critical to every aspect of the ecosystem?
14. (How can we) stop soil erosion and silt (deposits) in the lake?
15. (Can we establish) the use of retention ponds in new subdivisions?
16. Emailed 3/6/2007
17. How can we support and follow ordinances that limit soil erosion from construction sites?
18. (Can we/should we) maintain good river banks with grass & rip rap?

19. Issue List received on 2/26/07

Ground Water

20. (What can be done about) contaminated ground water?

21. Emailed 3/5/2007

22. (What can be done about) ground water contamination?

23. Emailed 3/5/2007

Air Pollution

24. What is the magnitude of polluted air on our lakes and watershed?

25. How can we strengthen controls to reduce mercury released from coal burning plants?

26. Does acid rain have an effect on the lake?

27. Does this (acid rain) affect the pH balance?

28. How can we encourage the safe but conservative use of salt on roads and limit applications to critical areas?

Invasive

29. What can we do about carp and other invasive animals?

30. (Can we) remove carp?

31. Issue List received on 2/26/07

32. (Can we) control weeds?

33. Issue List received on 2/26/07

Nutrient Loading/Sedimentation

34. How can we improve the phosphorous level in Park Lake?

35. How can we ban phosphorus fertilizer on lakeside lawns?

36. What can we do to reduce the use of phosphorous fertilizer in the village, on the lake and in the watershed?

37. Is it understood that phosphorous can also run off woodlands and forest?

38. Could Columbia County become a phosphorous-free fertilizer county? i.e. Dane County

39. Where are our high phosphate load zones and how can they be controlled/reduced?

40. What can be done to reduce detrimental runoff from farm(s) and (the) village?

41. How can the Lake District impact sediment/nutrient deliveries into the river (and) lake?

42. What effect does the wildlife droppings have on the water quality?

43. (How can we) keep cattle/animals out of (water) ways?

44. Can some of the runoff from cattle waste be reduced by inexpensive buffers and/or water diversions?

45. (Can we) create buffer(s) in water shed?

46. How can we promote the creation of more buffer zones in the watershed?

47. (How can) we control high fertility and chemicals in watershed?

48. (How can we) stop soil erosion?

49. How can the contamination of the watershed be controlled?

50. (What can be done about) fertilizer on lawns adjacent to the lake?

51. Faxed 4/5/2007

52. Should more waterways be stabilized?

53. Should sediment basins be developed upstream?

54. (What can be done about) erosion?

55. Faxed 4/5/2007

56. (What can be done about) too much silt?

57. Emailed 3/5/2007

58. (What can be done about) too much silt?

59. Emailed 3/5/2007 from a person other than one who authored above comment

60. (What can be done about) lake is becoming too shallow?

61. Emailed 3/5/2007

62. (What can be done about) lake is becoming too shallow?
63. Emailed 3/5/2007 from a person other than one who authored above comment
64. (What can be done about) over abundance of phosphorous in the watershed?
65. Emailed 3/5/2007
66. (What can be done about) over abundance of phosphorous in the watershed?
67. Emailed 3/5/2007 from a person other than one who authored above comment
68. What is the makeup of the sediment?
69. Emailed 3/13/2007
70. Is it (sediment) mineral or organic?
71. Emailed 3/13/2007
72. How much of the soft sediments are actually from the watershed, or were they here before the dam was constructed?
73. Emailed 3/13/2007
74. (Can we) restore the lake to its original depths?
75. Emailed 3/6/2007
76. (Will it help to) dredge sediment?
77. Issue List received on 2/26/07
78. (Can we) control sediment?
79. Issue List received on 2/26/07
80. (Can we) create a retention pond?
81. Issue List received on 2/26/07
82. (Can we) control phosphorous from (sources such as) septic (systems) and animals?
83. Issue List received on 2/26/07
84. (Can we) install manure structures?
85. Issue List received on 2/26/07
86. (Can we) control lawn fertilizers?
87. Issue List received on 2/26/07

External Factors

88. How does ethanol and political push for ethanol affect the ecosystem?
89. Emailed 4/5/2007
90. What can be done to encourage more sustainable renewable energy in the community?
91. Emailed 4/5/2007
92. How can we address climate change and how does this affect the ecosystem?
93. Emailed 4/5/2007
94. How can the district incorporate adaptive management into the planning process and adapt to changes (local, regional, national) that influences land use changes?
95. Emailed 4/5/2007

Issues Related to Park Lake, Spring Lake and Fox River

Boating

96. (What can be done about) powerboats causing shoreline damage?
97. Emailed 3/5/2007
98. (What can be done about) powerboats causing shoreline damage?
99. Emailed 3/5/2007 from a person other then one who authored above comment
100. (What can be done about) lake (is) too small for large powerboats?
101. Emailed 3/5/2007
102. (What can be done about) lake (being) too small for large powerboats?
103. Emailed 3/5/2007 from a person other then one who authored above comment
104. (Can we establish a) lake patrol on weekends for boating violators?
105. Emailed 3/6/2007
106. (Can we get the) reestablishment of no wake zones to what they naturally were?
107. Emailed 3/6/2007
108. (Can we) ban motorboats & pontoon boats?

109. Issue List received on 2/26/07

Turbidity

- 110. How do we get through to the lake users the results of boat motor use in the shallow areas of the lake?
- 111. What can be done to reduce the turbidity in Park Lake?
- 112. (What can be done about the) turbulence of the water caused by large motors?
- 113. Faxed 4/5/2007

Water Level Management

- 114. What type of structure is needed to manage water levels that promote a healthy ecosystem?

Lake Water Chemistry

- 115. How can the O2 levels be maintained?
- 116. (What can be done about) poor water quality?
- 117. Emailed 3/5/2007
- 118. (Can we/should we) control water temperature?
- 119. Issue List received on 2/26/07

Noise Pollution

- 120. (What can be done about) noise pollution i.e. personal watercraft?
- 121. Emailed 3/5/2007
- 122. (What can be done about) noise pollution i.e. personal watercraft?
- 123. Emailed 3/5/2007 from a person other than one who authored above comment

Aquatic Plants

- 124. What can be done to promote better aquatic vegetation?
- 125. Restore weeds (aquatic plants) to filter water contaminants out and cover for baitfish?
- 126. How can we restore good weeds (aquatic plants) and keep them from overtaking the lake?
- 127. How can PLMD address invasive plants in the lake?
- 128. What can we do to create a natural, non-evasive aquatic plant growth to create a natural, self-sustaining natural habitat for fish?
- 129. How do we balance vegetation with other lake use issues?
- 130. (What can be done about) lack of bottom rooted plants?
- 131. Emailed 3/5/2007
- 132. (What can be done about) lack of bottom rooted plants?
- 133. Emailed 3/5/2007 from a person other than one who authored above comment
- 134. (Can we) control algae growth?
- 135. Issue List received on 2/26/07

Wildlife Habitat

- 136. How can we provide nesting habitat to encourage the return of wildlife to our public waterways?
- 137. (Can we) enhance desirable flora?
- 138. Issue List received on 2/26/07

Fisheries

- 139. What can we do to create a self-sustaining fish habitat with controlled levels of shad and carp?
- 140. (What can we do to) restore balance of fish (and) remove trash fish?
- 141. What can be done to improve fishing?
- 142. What does it mean to have "better fishing"?
- 143. What is needed to restore pan fish to Park Lake?
- 144. What can we propagate cover and spawning areas for fish; such as gravel bars and/or fish cribs?
- 145. How do we eradicate rough fish?
- 146. What species of fish can we expect to introduce and balance in the future successfully?
- 147. Is it necessary for the village of Pardeeville to fluctuate the lake levels and thereby reduce spawning habitat?
- 148. (Can we) reestablish fishing?
- 149. Emailed 3/6/2007

Septic Systems

150. Do we have safe, non-polluting septic systems surrounding our lakes and watershed?
151. Are they (septic systems) regularly, independently inspected?
152. What can we do to govern and impose septic (systems) on all properties that affect our lake?
153. How to change storm water drainage in older development and who will pay for it?
154. (What can be done about) failing septic systems?
155. Emailed 3/5/2007
156. (What can be done about) failing septic systems?
157. Emailed 3/5/2007 from a person other than one who authored above comment
158. (Can we) work with government and state to address old septic fields which do not have to be checked?
159. Emailed 3/5/2007
160. (Can the entire lake) install sewer?
161. Issue List received on 2/26/07
162. Spring Lake and Fox River Specific
163. What can be done to keep Spring Lake a "spring" feed lake?
164. Water levels on Spring Lake (not sure about issue)
165. How can we restore the fox rivers natural path of travel to encourage spring fish run from Swan (Lake)?

Issues Predominately Related to Watershed

Best Management Practices

166. What can be done to foster upstream land/use management practices?
167. How can we get more farmers enrolled in the various cost sharing programs to protect our watershed?
168. (Does) watershed needs waterways?
169. (Can we/should we) Keep animals out of waterways?
170. (Can we/should we) install manure structures?
171. Issue List received on 2/26/07
172. (Can we/should we) implement nutrient management plans?
173. Issue List received on 2/26/07
174. (Can we/should we) control pesticides?

Decision Criteria Outcomes Captured From the 5/02/07

<u>Planning Group Term</u>		<u>Term Created</u>	<u>Rating Scale</u>
<i>Risk Feasibility</i>	=	<i>Ecological Success Rate</i>	<i>Low, Medium, High</i>
Cost	=	Cost	Low, Medium, High
<i>Chronologic/Timeline</i>	=	<i>Chronological Timeline</i>	<i>Short, Medium, Long</i>
Staff/Expertise Needs Required	=	Technical Requirements	Low, Medium, High
<i>Political Environment</i>	=	<i>Political Support Needed</i>	<i>Low, Medium, High</i>
Social Support	=	Community Support Needed	Low, Medium, High
<i>Scientific Data/ Credibility</i>	=	<i>Research-Based Credibility</i>	<i>Experimental</i>
			<i>Or</i>
			<i>Research-Based</i>
Technological	=	Technology Needed	Low, Medium, High
<i>Legal Enforcement</i>	=	<i>Law Enforcement Required</i>	<i>Easy, Moderate, Complex</i>
Scope of Strategy	=	Comprehensive Plan	All Plans Will Be Comprehensive
<i>Feasibility</i>	=	<i>Scenario Feasibility</i>	= <i>Ecological + Social + Political</i>

Issue: Park Lake Restoration

Value Statement: Balanced and fair lake management is right for our community because our families, particularly our children, deserve to have a clean, healthy lake to enjoy.

Goal: Create and protect a clear-water, macrophyte-dominated Park Lake with self-sustaining fishery while allowing for recreational boating

TIMELINE	STRATEGIES	ACTIONS	LOCAL GOVERNMENT PARTICIPATION (PUBLIC/PRIVATE)	COMMUNITY PARTICIPATION	TECHNICAL EXPERTISE	PLMD INITIATOR	FUNDING
	Get Clear Water	1. Flip Lake	1. LWCD, PLMD, Village of Pardeeville, Town of Wyocena	1. Community	1. Project Coordinator/PLMD	1. PLMD REP	1. Lake Protection Grant
	Restore Fishery	1. Salvage Fish 2. Remove all other fish 3. Restock fishery 4. Monitor Fishery 5. Adjust stocking Goals	1. LWCD, PLMD, Village of Pardeeville, Town of Wyocena 2. LWCD, PLMD, Village of Pardeeville, Town of Wyocena 3. PLMD, WDNR 4. PLMD, WDNR 5. PLMD, WDNR	1. Community 2. Community 3. Community 4. PLMD District 5. PLMD District	1,2,3. Project Coordinator/PLMD, WDNR 4 WDNR Fishery Biologist 5 WDNR Fishery Biologist	1. PLMD REP 2. PLMD REP 3. PLMD REP 4. PLMD REP 5. PLMD REP	1, 2, 3 WDNR Lake Protection Grant Up to \$200,000 or (75%) with 25% Local Match 4. Done through WDNR 5. None Needed
	Protect Lake	1. Develop Controlled Boating areas 2. Develop new bag limits and size limits for fishery 3. Lower Nutrient/Sediment load entering lake 4. Restore shore land buffers	1. PLMD, Village of Pardeeville, Town of Wyocena 2. PLMD, WDNR 3. LWCD, PLMD, Village of Pardeeville, Town of Wyocena 4. PLMD	1. Community 2. Community 3. Community 4. Community	1. WDNR 2. WDNR 3. LWCD 4. Project Coordinator	1. PLMD Rep 2. PLMD Rep 3. PLMD Rep, Project Coordinator 4. PLMD Rep, Project Coordinator	1&2 WDNR Lake Protection Grant Up to \$50,000 or (75%) with 25% Local Match 3. TRM Grants, Lake Protection, 4. Lake Protection Grant

Issue: Future Studies Needed

Value Statement: Basing decisions on sound data allows the PLMD Board the ability to allocate a finite tax base in a responsible and effective manner on behalf of the PLMD District and the Pardeeville community.

Goal: Use certain studies as bases to make future decisions

TIMELINE	STRATEGIES	ACTIONS	LOCAL GOVERNMENT PARTICIPATION	COMMUNITY PARTICIPATION	TECHNICAL EXPERTISE	PLMD INIATITOR	FUNDING
BEFORE DRAW DOWN	<ol style="list-style-type: none"> Understand degree of Compaction obtained from Drawdown-Compaction Study Develop an in depth understanding of history through sediment analysis – Palio Core Study Determine sediment and nutrient load - Watershed Monitoring Determine understanding of components determining practicality of Dredging - Dredging Feasibility Study 	<ol style="list-style-type: none"> Obtain Lake Planning Grant(August 1 deadline) to hire Consulting firm to conduct study Obtain Lake Planning Grant(August 1 deadline) to hire Consulting firm to conduct study Obtain Lake Planning grant (Aug 2007) to continue monitoring in 2008 Obtain Lake Planning Grant(August 1 deadline) to hire Consulting firm to conduct study 	<ol style="list-style-type: none"> PLMD PLMD PLMD and LWCD PLMD 	<ol style="list-style-type: none"> PLMD Support PLMD Support PLMD Support PLMD Support 	<ol style="list-style-type: none"> Consultant, Army Core, USGS, Center For Watershed Science Consultant, Army Core, USGS, Center For Watershed Science LWCD, Center For Watershed Science, and others Consultant 	<ol style="list-style-type: none"> PLMD Rep/Project Manager PLMD/ Project Manager LWCD/Project Manager PLMD/ Project Manager 	<ol style="list-style-type: none"> 1, 2, 3, 4 WDNR Lake Planning Grant Up to 10,000 or (75%) with 25% Local Match
AFTER DRAW DOWN	<ol style="list-style-type: none"> Watershed/In-Lake Water Monitoring Aquatic Plant Inventory Recreational Carrying Capacity Study Annual Fishery Monitoring 	<ol style="list-style-type: none"> Continue to collect data to complete in lake BATHTUB Model Hire Consultant to complete Aquatic Inventory Study/Management Plan Hire Consultant to Complete CC Study 3A. Based on results, restructure ordinances to fit the desires of the PLMD Board Use WDNR Fisheries Data as Monitoring Data 	<ol style="list-style-type: none"> PLMD, LWCD, WDNR PLMD PLMD 3A. PLMD Board, Village of Pardeeville PLMD, WDNR 	<ol style="list-style-type: none"> PLMD Support PLMD Support 3A PLMD Support PLMD Support 	<ol style="list-style-type: none"> LWCD, Center For Watershed Science, and others/ Project Manager Consultant/ Project Manager 3A Consultant/ Project Manager WDNR Fishery Biologist/ Project Manager 	<ol style="list-style-type: none"> PLMD Rep/ Project Manager PLMD Rep/ Project Manager 3A PLMD Rep/ Project Manager WDNR Fishery Biologist/PLMD Rep 	<ol style="list-style-type: none"> 1, 2, 3 WDNR Lake Protection Grant Up to 200,000 or (75%) with 25% Local Match or WDNR Lake Planning Grant Up to 10,000 or (75%) with 25% Local Match
LONG TERM	<ol style="list-style-type: none"> Watershed/In-Lake Water Monitoring Aquatic Plant Inventory Recreational Carrying Capacity Study Annual Fishery Monitoring 	<ol style="list-style-type: none"> Use data sets from future to develop trend analysis (Determine who watershed is responding) Use Aquatic Plants Data from WDNR fisherman to notice patterns to decide when a comprehensive study should be completed in future If needed Use WDNR annual fishery monitoring data 	<ol style="list-style-type: none"> PLMD, LWCD, WDNR PLMD PLMD, PLMD, WDNR 	<ol style="list-style-type: none"> PLMD Support PLMD Support PLMD Support PLMD Support 	<ol style="list-style-type: none"> LWCD, Center For Watershed Science, Project Manager and others WDNR Fishery Biologist(annually) and Consultant for Comprehensive Study(when needed)/ Project Manager Consultant if/when ever needed for second time/ Project Manager WDNR Fishery Biologist 	<ol style="list-style-type: none"> PLMD Rep/ Project Manager PLMD Rep/ Project Manager PLMD Rep/ Project Manager PLMD Rep/ Project Manager 	<ol style="list-style-type: none"> 1, 2, 3 WDNR Lake Protection Grant Up to 200,000 or (75%) with 25% Local Match or WDNR Lake Planning Grant Up to 10,000 or (75%) with 25% Local Match

Issue: Clear, High Quality Water

Value Statement: The community, families, and particularly our children deserve to have a lake with clean water to use and enjoy.

Goal: Restore water clarity, protect water clarity, prevent algae blooms, and reduce nutrient levels in the lake

TIMELINE	STRATEGIES	ACTIONS	LOCAL GOVERNMENT PARTICIPATION	COMMUNITY PARTICIPATION	TECHNICAL EXPERTISE	PLMD INITIATOR	FUNDING
BEFORE DRAW DOWN	<ol style="list-style-type: none"> Take appropriate steps to go from turbid state to clear-water state (drawdown). LWCD works in Park Lake Watershed following approach outlined in Watershed Component of Comprehensive Lake Plan 	<ol style="list-style-type: none"> Proceed with Draw Down Planning Develop PLMD's interaction with Watershed Conservation (Nutrient/Sediment Loading) 	<ol style="list-style-type: none"> PLMD, Village of Pardeeville, Town of Wyocena PLMD 	<ol style="list-style-type: none"> Must have community support PLMD must have community support to support watershed expenditures 	<ol style="list-style-type: none"> Project Coordinator Watershed implementation facilitated through LWCD 	<ol style="list-style-type: none"> PLMD Rep None Needed 	<ol style="list-style-type: none"> WDNR Lake Protection Grant Up to 50,000 or (75%) with 25% Local Match LWCD will use TRM Grants, Lake Protection Grants, Land And Water Conservation Funds
AFTER DRAW DOWN	<ol style="list-style-type: none"> Aquatic protection Water Monitoring(internal lake load, watershed) Decrease nutrient/sediment loading 	<ol style="list-style-type: none"> Aquatic inventory <ol style="list-style-type: none"> Use Inventory to Designate Sensitive Areas in need of Protection ($\leq 6'$ of water, breeding beds, etc...) Implement Water Monitoring Plan Implement Watershed Plan 	<ol style="list-style-type: none"> PLMD, Village of Pardeeville, Town of Wyocena PLMD PLMD and LWCD 	<ol style="list-style-type: none"> PLMD District PLMD District PLMD District 	<ol style="list-style-type: none"> Project Coordinator Project Coordinator 	<ol style="list-style-type: none"> PLMD Rep None Needed 	<ol style="list-style-type: none"> WDNR Lake Protection Grant Up to 200,000 or (75%) with 25% Local Match TMDL, Lake Protection, USGS, etc.. TRM, Lake Protection, Land And Water Conservation Funds
LONG TERM	<ol style="list-style-type: none"> Decrease nutrient/sediment loading Reevaluate Goals and Objectives annually 	<ol style="list-style-type: none"> Implement Water Monitoring Plan Review plans goals and objectives prior to annual meeting 	<ol style="list-style-type: none"> PLMD, LWCD PLMD, LWCD 	<ol style="list-style-type: none"> PLMD District PLMD District 	<ol style="list-style-type: none"> Project Coordinator Project Coordinator 	<ol style="list-style-type: none"> PLMD Rep PLMD Board 	<ol style="list-style-type: none"> TRM, Lake Protection None needed

Issue: Native buffers

Value Statement: Restoring and protecting native buffers will provide privacy and tranquility, as well as a natural space for families to enjoy nature. Our families and community expect maintained water quality and lake protection provided from a native shore land buffer. Furthermore, native shore lands increase the value of the lake increasing the value of our families' property value.

Goal: Restore and protect healthy, stable shore land habitats (public and private) with native buffers

TIMELINE	STRATEGIES	ACTIONS	LOCAL GOVERNMENT PARTICIPATION (Public/Private)	COMMUNITY PARTICIPATION	TECHNICAL EXPERTISE	PLMD INITIATOR	FUNDING
BEFORE DRAW DOWN	<ol style="list-style-type: none"> Care for and maintain the Frog Pond Plug Planting Implement phase 2 of the Frog Pond Buffer Project Develop Pardeeville Lakes Terrestrial Shore land Buffer Cost/Share Program After frog pond completion - Identify and plan for possible future terrestrial shore land buffers on other public properties 	<ol style="list-style-type: none"> Create PLMD Rep to become liaison with the Village of Pardeeville Director of Public Works to assure the Plug plantings continues to prosper PLMD Rep should work with Village of Pardeeville, LWCD, and WWA to continue moving forward on the spring 08 seed planting. Work with LWCD (if needed) to develop program and to apply for lake protection grant PLMD Rep should work with Village and LWCD(if needed) to discuss options surrounding future 	<ol style="list-style-type: none"> PLMD, Village of Pardeeville PLMD, Village of Pardeeville PLMD, Village of Pardeeville PLMD, Village of Pardeeville 	<ol style="list-style-type: none"> Community Community PLMD District Community 	<ol style="list-style-type: none"> If anything a Project Coordinator Project Coordinator Project Coordinator/Ecologist Project Coordinator 	<ol style="list-style-type: none"> PLMD Rep PLMD Rep PLMD Rep PLMD Rep 	<ol style="list-style-type: none"> Should not require much more Wisconsin Waterfowl Association WDNR Lake Protection Grant Up to 200,000 or (75%) with 25% Local Match Any listed above
AFTER DRAW DOWN	<ol style="list-style-type: none"> Continue to promote Pardeeville Lakes Terrestrial Shore land Buffer Cost/Share Program with new addition of aquatic plantings 	<ol style="list-style-type: none"> Should have funding through grant which started program 	<ol style="list-style-type: none"> PLMD, Village of Pardeeville 	<ol style="list-style-type: none"> PLMD District 	<ol style="list-style-type: none"> Project Coordinator/Ecologist 	<ol style="list-style-type: none"> PLMD Rep 	<ol style="list-style-type: none"> WDNR Lake Protection Grant Up to 200,000 or (75%) with 25% Local Match
LONG TERM	<ol style="list-style-type: none"> Reevaluate land use adjacent to lake and reestablish goals for program 	<ol style="list-style-type: none"> Re video Park Lake shore line and determine what has been accomplished with Pardeeville Lakes Terrestrial Shore land Buffer Cost/Share Program. Determine strategy to address what still requires work 	<ol style="list-style-type: none"> PLMD, LWCD, 	<ol style="list-style-type: none"> PLMD District 	<ol style="list-style-type: none"> Project Coordinator/Ecologist 	<ol style="list-style-type: none"> PLMD Rep 	<ol style="list-style-type: none"> None should be needed

Issue: Phosphorous Loading

Value Statement: It is not fair for a few people to continue to add nutrients to the lake (1# P = 500#'s of Algae) when it hurts what the rest of us value; clean water, a healthy fishery and high property values.

Goal: Work to create Phosphorous Management Legislation, at the state and federal level.

TIMELINE	STRATEGIES	ACTIONS	LOCAL GOVERNMENT PARTICIPATION	COMMUNITY PARTICIPATION	TECHNICAL EXPERTISE	PLMD INITIATOR	FUNDING
Before Draw Down	<ol style="list-style-type: none"> Individual Support for State Wide Phosphorous Ban Lake District Support for State Wide Phosphorous Ban Village Support for State Wide Phosphorous Ban Lobby for Phosphorous Management standards in the New Farm Bill 	<ol style="list-style-type: none"> Encourage community members to write all your elected officials to show support for the currently proposed Phosphorous Ban PLMD should send a letter to all your elected officials to show support for the currently proposed Phosphorous Ban Village should send a letter to all your elected officials to show support for the currently proposed Phosphorous Ban As a community members, as PLMD, and the Village Contact Russ Feingold, Tammy Baldwin and Herb Kohl to lobby for their support at the federal level. 	<ol style="list-style-type: none"> PLMD PLMD Village of Pardeeville PLMD, Village of Pardeeville 	<ol style="list-style-type: none"> Community PLMD District PLMD District Community 	<ol style="list-style-type: none"> None Needed None Needed None Needed None Needed 	<ol style="list-style-type: none"> Board Board Board Board 	<ol style="list-style-type: none"> None needed None needed None needed None needed

Issue: Nutrient/Bacteria Loading from Septic Systems

Value Statement: Our community deserves to know current ordinances are sound and up-to-date, as well as, being enforced.

Goal: Analyze county septic ordinances and enforcement protocol

TIMELINE	STRATEGIES	ACTIONS	LOCAL GOVERNMENT PARTICIPATION	COMMUNITY PARTICIPATION	TECHNICAL EXPERTISE	PLMD INITIATOR	FUNDING
BEFORE DRAW DOWN	<ol style="list-style-type: none"> 1. Review current County Ordinances regarding Septic Systems 2. Based on finding of Septic Ordinance Review work with Douglas Richmond, Chair of Planning and Zoning Governing Committee, Columbia County for ordinance change and enforcement protocol 3. Analyze potential for full Lake Sanitary System 	<ol style="list-style-type: none"> 1. Meet with Ordinance Experts from Center for Land Use Education to analyze current ordinance and enforcement protocol 1A. If needed establish recommendations based on review 2. PLMD Board should send P and Z Chair a letter explaining your views on septic, past efforts, and desires for future. 3. PLMD must work with Town of Wyocena and Village of Pardeeville to determine feasibility 	<ol style="list-style-type: none"> 1. PLMD, Village of Pardeeville 2. PLMD, Village of Pardeeville, Town of Wyocena 3. PLMD, Village of Pardeeville, Town of Wyocena 	<ol style="list-style-type: none"> 1. PLMD Board 2. Community 3. Community 	<ol style="list-style-type: none"> 1. Ordinance Experts (Center for Land Use Education) 2. Ordinance Experts (Center for Land Use Education) 3. Engineers 	<ol style="list-style-type: none"> 1. PLMD Rep 2. PLMD Rep 3. PLMD Rep 	<ol style="list-style-type: none"> 1. WDNR Lake Protection Grant Up to 50,000 or (75%) with 25% Local Match 2. WDNR Lake Planning Grant \$10,000 (75% with 25% local Match) 3. None Needed 3. WDNR Lake Protection Grant Up to 50,000 or (75%) with 25% Local Match WDNR Lake Planning Grant \$10,000 (75% with 25% local Match)

Issue: Non-conforming uses and outdated ordinances, in both county and village, which lead to the degradation of water quality

Value Statement: Reviewing the current ordinances is an investment in the future by protecting what the community values because clean water and a healthy fishery increases property values, creates jobs and supports the local economy.

Goal: Reevaluate current ordinances to deal with non conforming uses while protecting ground and surface water.

TIMELINE	STRATEGIES	ACTIONS	LOCAL GOVERNMENT PARTICIPATION	COMMUNITY PARTICIPATION	TECHNICAL EXPERTISE	PLMD INITIATOR	FUNDING
BEFORE DRAW DOWN	1. Analyze current non-conforming uses and ordinances to determine impacts on surface and ground water	<p>1A. Bring in Lynn Markham, Center for Land Use Education to discuss the impacts of non-conforming uses</p> <p>1B. Through Lynn Analyze current ordinances (Village and County)</p> <p>1C. After analyzing the ordinances work with Village, Town, and County to Reevaluate Ordinances based on analyses</p>	<p>1A. PLMD, Village of Pardeeville, Town of Wyocena</p> <p>1B. PLMD, Village of Pardeeville, Town of Wyocena, Columbia County</p> <p>1C. PLMD, Village of Pardeeville, Town of Wyocena, Columbia County</p>	<p>1A. PLMD</p> <p>1B. Community</p> <p>1C. PLMD, Community</p>	1A, B, C Center for Land Use Education, Lynn Markham	1 A, B, C PLMD Rep	<p>1.WDNR Lake Protection Grant Up to 50,000 or (75%) with 25% Local Match</p> <p>WDNR Lake Planning Grant \$10,000 (75%with 25% local Match</p>

Issue: In order to develop thresholds for water quality improvement regarding nutrient and sediment loads, continued data collecting in the Park Lake Watershed and in lake is necessary.

Value Statement: We need to invest in the health of our lakes, balanced and sound lake management is what is right for Park Lake.

Goal: Develop water monitoring strategy to develop a model, thus quantifying nutrient and sediment loads.

TIMELINE	STRATEGIES	ACTIONS	LOCAL GOVERNMENT PARTICIPATION	COMMUNITY PARTICIPATION	TECHNICAL EXPERTISE	PLMD INITIATOR	FUNDING
BEFORE DRAW DOWN	<ol style="list-style-type: none"> Continue 2006 Watershed monitoring into 2007 to gather appropriate data needed in future model (SWAT, WILS, TMDL) 1A. Monitor water through 2008 with data for model 1B. Use 2006 and 2007 as catalyst for larger TMDL project(Funding Dependent 2008 Grant Cycle) 2. Use data to develop model (Determining nutrient and sediment load) 3. Use model to develop sediment and nitrification thresholds to gauge level of improvement within Watershed Plan 	<ol style="list-style-type: none"> Work with Nancy Turek, Carol Shawl, & Buzz Sorgi to develop grant proposals with varying scope for monitoring watershed 1A. Contain 2006 project into 2007 with 4 sites sample every 2 weeks. End of 2 years develop SWAT and WILS models 1B. If WDNR 303D grant is obtained use 2006 and 2007 data as beginning of TMDL Monitoring effort 2. Have data placed into SWAT or TMDL model to develop thresholds of expectable Phosphorous Levels 3. Threshold numbers become goals to meet in Watershed plan 	<ol style="list-style-type: none"> 1, 1A, 1B PLMD, Village of Pardeeville 2.PLMD, Village of Pardeeville 3.PLMD 	<ol style="list-style-type: none"> 1, 1A, 1B PLMD District 2.PLMD District 3.PLMD District 	<ol style="list-style-type: none"> 1, 1A, 1B Project Coordinator, LWCD, UW, WDNR, USGS 2.Project Coordinator , UW, USGS, WDNR 3.LWCD 	<ol style="list-style-type: none"> 1, 1A, 1B PLMD Rep 2. PLMD Rep 3.None Needed 	<ol style="list-style-type: none"> 1, 1A, 1B and 2. Lake Planning, 303D, Lake Protection, USGS 3.TRM Grants, Lake Protection Grants
AFTER DRAW DOWN	<ol style="list-style-type: none"> Use watershed monitoring as a gauge to determine success 	<ol style="list-style-type: none"> After modeling is done and watershed work has been underway revisit watershed monitoring to gauge watershed response 	<ol style="list-style-type: none"> 1. PLMD, Village of Pardeeville 	<ol style="list-style-type: none"> 1. PLMD District 	<ol style="list-style-type: none"> 1. Project Coordinator, LWCD, UW, WDNR, USGS 	<ol style="list-style-type: none"> 1. PLMD Rep 	<ol style="list-style-type: none"> 1 Lake Planning, 303D, Lake Protection
LONG TERM	<ol style="list-style-type: none"> Monitoring should be the foundation to gauge progress for work in watershed, as well as, to understand how water chemistry in lake is relative to plant life, fishery and watershed. 	<ol style="list-style-type: none"> At a certain interval develop a monitoring strategy to assess how far you have come 	<ol style="list-style-type: none"> 1. PLMD, Village of Pardeeville 	<ol style="list-style-type: none"> 1. PLMD District 	<ol style="list-style-type: none"> 1. Project Coordinator, LWCD, UW, WDNR, USGS 	<ol style="list-style-type: none"> 1. PLMD Rep 	<ol style="list-style-type: none"> 1 Lake Planning, 303D, Lake Protection

Issue: Develop New Boating Ordinances protecting sensitive areas and the highly valuable plants

Value Statement: We need to invest in the health of our lakes; it is not fair for a few people to get their way when it hurts what the rest of us value; clean water and a healthy fishery.

Goal: Evaluate current boating ordinances in order to develop new boating ordinances to protect newly restored lake

TIMELINE	STRATEGIES	ACTIONS	LOCAL GOVERNMENT PARTICIPATION	COMMUNITY PARTICIPATION	TECHNICAL EXPERTISE	PLMD INITIATOR	FUNDING
BEFORE DRAW DOWN	1. Develop understanding of intent with other local government	1. Work with Pardeeville Village Representative	5. PLMD, Village of Pardeeville, Town of Wyocena	1. Community	1. Columbia County Sheriff's Department, WDNR Game Warden	1. PLMD Rep	1. None needed
AFTER DRAW DOWN	1. Identify aquatic plant buffer 2. Identify focused boating area 3. Identify navigational corridors 4. Identify important spawning ground *See Boating Ordinance Revision Process in Appendix	1. Develop "No-wake" area on exterior 2. Interior of aquatic buffer becomes focused boating 3,4 Develop "No-Wake"	1,2,3,4 PLMD, Village of Pardeeville, Town of Wyocena, WDNR	1. Community 2. Community 3. Community 4. Community	1,2,3,4 Columbia County Sheriff's Department, WDNR Game Warden	1,2,3,4 PLMD Rep	1. WDNR Lake Planning Grant \$10,000 75% with 25% local Match WDNR Lake Protection Grant Up to 200,000 or (75%) with 25% Local Match
LONG TERM	1. Monitor and reevaluate if developed ordinances are protecting aquatic plants and fishery	1. Use in lake monitoring data as guide to understand if new ordinances are working Use WDNR fish monitoring data to see if fish goals are met and if sensitive spawning grounds are being protected	1. PLMD, WDNR	1. PLMD District	1. WDNR Fishery Biologist 2. Individual analyzing Watershed Monitoring	1. PLMD Rep	1. WDNR Lake Planning Grant \$10,000 (75% with 25% local Match) WDNR Lake Protection Grant Up to 200,000 or (75%) with 25% Local Match

Issue: Aquatic Plants

Value Statement: Restoring and protecting high-quality aquatic plants will help maintain the restored clear-water state while providing critical habitat for a self-sustaining fishery.

Goal: Restore and sustain native aquatic vegetation.

TIMELINE	STRATEGIES	ACTIONS	LOCAL GOVERNMENT PARTICIPATION	COMMUNITY PARTICIPATION (Public/Private)	TECHNICAL EXPERTISE	PLMD INITIATOR	FUNDING
BEFORE DRAW DOWN	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
AFTER DRAW DOWN	1. Conduct Aquatic Plant Inventory 2. Develop Aquatic Plant Cutting Plan 3. If/when needed Develop Aquatic Invasive/Nuisance Plant Plan *All three should be done at one time	1. Hire consultant and conduct a plant inventory determining abundance and diversity of aquatic plants 2. Hire consultant to develop aquatic cutting plan 3. Depending on species present also develop Invasive/Nuisance Management Plan *All three should be done at one time	1. PLMD 2. PLMD 3. PLMD	1. PLMD Support 2. PLMD Support 3. PLMD Support	1. Consultant following WDNR guidelines 2. Consultant following WDNR guidelines 3. Consultant following WDNR guidelines	1. PLMD Rep 2. PLMD Rep 3. PLMD Rep	1,2,3 WDNR Lake Planning Grant \$10,000 (75% with 25% local Match) WDNR Lake Protection Grant Up to 200,000 or (75%) with 25% Local Match
LONG TERM	1. Regular Monitoring of Abundance and diversity 2. Adjustments to Management Plans Based on Monitoring of Species Abundance and Diversity	1. Use plant species from WDNR boom shocking information as annual monitoring of aquatics 2. Set an interval period to conduct a formal plant inventory 2A. Use findings on monitoring to allow for adaptive management of aquatic Plants (cutting plan, sensitive area protection, invasive/nuisance management)	1. PLMD, WDNR 2. PLMD, WDNR	1. PLMD Support 2. PLMD Support	1. Project Coordinator 2. PLMD Board 2A. Project Coordinator	1. PLMD Rep 2. PLMD Rep	1,2 WDNR Lake Planning Grant \$10,000 (75% with 25% local Match) WDNR Lake Protection Grant Up to 50,000 or (75%) with 25% Local Match

Issue: Fisheries

Value Statement: Healthy lake ecosystems are vital and valuable natural resources for lake shore property owners. A self-sustaining fishery will be restored, monitored and protected by protecting high quality aquatic plant communities and managing angler harvests.

Goal: Restore and protect a healthy self-sustaining blue gill, northern pike, and bass fishery.

TIMELINE	STRATEGIES	ACTIONS	LOCAL GOVERNMENT PARTICIPATION	COMMUNITY PARTICIPATION (Public/Private)	TECHNICAL EXPERTISE	PLMD INITIATOR	FUNDING
BEFORE DRAW DOWN	1. Remove/Salvage Desirable Fish	1. Develop Salvage Plan to remove desirable fish from the consolidated water after all water has been able to be drawn out of lake	1. PLMD, Village of Pardeeville, WDNR	1. PLMD District	1. Project Coordinator 1A. WDNR Fishery Biologist	1. PLMD Board	1. None Needed
AFTER DRAW DOWN	1. Restore Fishery	1. Restock Bluegills, Northern Pike, Largemouth Bass with numbers provided through Technical Team *See Aqua Cultural Guidelines in Appendix D	1. PLMD, Village of Pardeeville, and Town of Wycena should work with WDNR	1. PLMD District, Community	1. WDNR Fishery Biologist, Project Coordinator	1. PLMD Board	1. WDNR Lake Protection Grant Up to 200,000 or (75%) with 25% Local Match
LONG TERM	1. Protect restored fishery. 2. Maintain Monitoring of Park Lake fish species in effort to hold 3:1 planktivore/piscovore ratio.	1A. Restructure Bag Limits 1B. Restructure Size Limits 1C. Protect sensitive/critical fishery habitat from boating and fishing(Create No-Wake Areas) 2. Continue to work with WDNR Fishery Biologist to use Fisheries Data gathering to determine stocking sizes and monitor progress.	1. PLMD, Village of Pardeeville, and Town of Wycena should work with WDNR 2. PLMD and Village of Pardeeville must work with WDNR to continue monitoring efforts on Park Lake	1. PLMD District, Community	1. A, B, C. WDNR Fishery Biologist, Project Coordinator 2. WDNR Fishery Biologist	1A,1B,1C. PLMD Representative 2. PLMD Board	1. WDNR Lake Protection Grant Up to 50,000 or (75%) with 25% Local Match WDNR Lake Planning Grant \$10,000 (75% with 25% local Match) 2. None Needed

Appendix B

GLOSSARY

- Algae:** One-celled (phytoplankton) or multicellular plants either suspended in Water (plankton) or attached to rocks and other substrates (periphyton). Their abundance, as measured by the amount of chlorophyll *a* (green pigment) in an open water sample, is commonly used to classify the trophic status of a lake. Numerous species occur. Algae are an essential part of the lake ecosystem and provides the food base for most lake organisms, including fish. Phytoplankton populations vary widely from day to day, as life cycles are short.
- Alkalinity:** A measure of the amount of carbonates, bicarbonates, and hydroxide present in water. Low alkalinity is the main indicator of susceptibility to acid rain. Increasing alkalinity is often related to increased algae productivity. Expressed as milligrams per liter (mg/l) of calcium carbonate (CaCO_3), or as microequivalents per liter ($\mu\text{eq/l}$). $20 \mu\text{eq} = 1 \text{ mg/l}$ of CaCO_3 .
- Aquatic Invertebrates:** Aquatic animals without an internal skeletal structure such as insects, mollusks, and crayfish.
- Best Management Practice (BMP):** A practice or combination of practices that is determined to be most effective and practical (including technological, economic, and institutional considerations), means of controlling point and nonpoint pollutant levels compatible with environmental quality goals.
- Bioaccumulation:** see "Food Chain".
- Biomass:** The total quantity of plants and animals in a lake. Measured as organisms or dry matter per cubic meter, biomass indicates the degree of a lake system's eutrophication or productivity.
- Blue-green algae:** Algae that are often associated with problem blooms in lakes. Some produce chemicals toxic to other organisms, including humans. They often form floating scum as they die. Many can fix nitrogen (N_2) from the air to provide their own nutrient.
- Catch Basin:** An inlet to the storm drain system that typically includes a grate or Curb inlet where stormwater enters the catch basin and a sump to Capture sediment, debris and associated pollutants.
- Chlorophyll *a*:** Green pigment present in all plant life and necessary for photosynthesis. The amount present in lake water depends on the amount of algae and is therefore used as a common indicator of water quality.
- Conductivity (specific)** Measures water's ability to conduct an electric current. Conductivity is reported in micromhos per centimeter ($\mu\text{mhos/cm}$) and is directly

conductance):	related to the total dissolved inorganic chemicals in the water. Values are commonly two times the water hardness unless the water is receiving high concentrations of contaminants introduced by humans.
Cost Sharing:	The use of outside financial resources to offset or share the total cost of the installation of best management practices. Typical cost share rates range from 50% to 90%.
Drainage Basin:	A geographic and hydrologic subunit of a watershed.
Drainage Lakes:	Lakes fed primarily by streams and with outlets into streams or rivers. They are more subject to surface runoff problems but generally have shorter residence times than seepage lakes. Watershed protection is usually needed to manage lake water quality.
Dry Detention Ponds:	A structural BMP or retrofit that consists of a large open depression that stores incoming storm water runoff while percolation occurs through the bottom and sides.
Eutrophication:	The process by which lakes are enriched with nutrients, increasing the production of rooted aquatic plants and algae. The extent to which this process has occurred is reflected in a lake's trophic classification: oligotrophic (nutrient poor), mesotrophic (moderately productive), and eutrophic (very productive and fertile).
Filamentous algae:	Algae that forms filaments or mats attached to sediment, weeds, piers, etc.
Food Chain:	The sequence of algae being eaten by small aquatic animals (zooplankton) which in turn are eaten by small fish which are then eaten by larger fish and eventually by people or predators. Certain chemicals, such as PCBs, mercury, and some pesticides, can be concentrated from very low levels in the water to toxic levels in animals through this process.
Groundwater:	Subsurface water occupying the zone of saturation. In a strict sense, the term is applied only to water below the water table.
Groundwater Drainage Lake:	Often referred to as spring-fed lake; has large amounts of groundwater as its source, and a surface outlet. Areas of high groundwater inflow may be visible as springs or sand boils. Groundwater drainage lakes often have intermediate retention times with water quality dependent on groundwater quality.
Impervious Surface:	Hard surface that prevents and retards the entry of water into the soil mantle as natural conditions prior to development and/or a hard surface area that causes water to runoff the surface in greater quantities or at increased flow rates from the flow present under conditions prior to development. Common impervious surfaces include, but are not limited to rooftops, walkways, patios, driveways, parking lots, storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam, or other surfaces that similarly impede the natural infiltration of urban runoff.

Impoundment: Manmade lake or reservoir usually characterized by stream inflow and always a stream outlet. Because of nutrient and soil loss from upstream land use practices, impoundments ordinarily have higher nutrient concentrations and faster sedimentation rates than natural lakes. Their retention times are relatively short.

Infiltration: The penetration of water through the ground surface into subsurface soil or the penetration of water from the soil into sewer or other pipes through defective joints, connections, or manhole walls.

Land Conversion: A change in land use, function or purpose.

Limiting factor: The nutrient or condition in shortest supply relative to plant growth requirements. Plants will grow until stopped by this limitation; for example, phosphorus in summer, temperature or light in fall or winter.

Local Government: Any County, City, or Town having its own incorporated government for local affairs.

Macrophytes: See "Rooted aquatic plants".

Non-point Source Pollution: Pollution whose sources cannot be traced to a single point such as a municipal or industrial wastewater treatment plant discharge pipe.

Overturn: Fall cooling and spring warming of surface water increases density, and gradually makes temperature and density uniform from top to bottom. This allows wind and wave action to mix the entire lake. Mixing allows bottom waters to contact the atmosphere, raising water's oxygen content. However, warming may occur too rapidly in the spring for mixing to be effective, especially in small sheltered kettle lakes.

Phosphorus: Key nutrient influencing plant growth in more than 80% of Wisconsin lakes. Soluble reactive phosphorus is the amount of phosphorus in solution that is available to plants. Total phosphorus includes the amount of phosphorus in solution (reactive) and in particulate form.

Photosynthesis: Process by which green plants convert carbon dioxide (CO₂) dissolved in water to sugar and oxygen using sunlight for energy. Photosynthesis is essential in producing a lake's food base, and is an important source of oxygen for many lakes.

Phytoplankton: See "Algae".

Pollution Prevention:	A management measure to prevent and reduce nonpoint source loadings generated from a variety of everyday activities within urban areas. These can include turf management, public education, ordinances, planning and zoning, pet waste control, and proper disposal of oil.
Respiration:	The process by which aquatic organisms convert organic material to energy. It is the reverse reaction of photosynthesis. Respiration consumes oxygen (O ₂) and releases carbon dioxide (CO ₂). It also takes place as organic matter decays.
Retention Time (turnover rate or flushing rate):	The average length of time water resides in a lake, ranging from several days in small impoundments to many years in large seepage lakes. Retention time is important in determining the impact of nutrient inputs. Long retention times result in recycling and greater nutrient retention by most lakes. Calculate retention time by dividing the volume of water passing through the lake per year by the lake volume.
Retrofit:	The modification of an urban runoff management system in a previously developed area. This may include wet ponds, infiltration systems, wetland plantings, streambank stabilization, and other BMP techniques for improving water quality and creating aquatic habitat. A retrofit can consist of new BMP construction in a developing area, enhancing an older runoff management structure, or combining improvements and new construction.
Rooted Aquatic Plants (macrophytes):	Refers to higher (multi-celled) plants growing in or near water. Macrophytes are beneficial to lakes because they produce oxygen and provide substrate for fish habitat and aquatic insects. Overabundance of such plants, especially problem species, is related to shallow water depth and high nutrient levels.
Runoff:	That part of precipitation, snow melt, or irrigation water that runs off the land into streams or other surface water. Runoff can carry pollutants into receiving waters.
Secchi disc:	An 8-inch diameter plate with alternating quadrants painted black and white that is used to measure water clarity (light penetration). The disc is lowered into water until it disappears from view. It is then raised until just visible. An average of the two depths, taken from the shaded side of the boat, is recorded as the Secchi disc reading. For best results, the readings should be taken on sunny, calm days.
Sedimentation:	Accumulated organic and inorganic matter on the lake bottom. Sediment includes decaying algae and weeds, marl, and soil and organic matter eroded from the lake's watershed.
Sedimentation Basins:	Sediment storage areas that may consist of wet detention basins or dry detention basins. Excavated areas with storage depression below the natural ground surface; creek, stream, channel or drainageway bottoms properly engineered and designed to trap and store sediment for future removal.

Seepage Lakes:	Lakes without a significant inlet or outlet, fed by rainfall or groundwater. Seepage lakes lose water through evaporation and groundwater moving on a down gradient. Lakes with little groundwater inflow tend to be naturally acidic and most susceptible to the effects of acid rain. Seepage lakes often have long residence times and lake levels fluctuate with local groundwater levels. Water quality is affected by groundwater quality and the use of land on the shoreline.
Soluble:	Capable of being dissolved.
Stratification:	The layering of water due to differences in density. Water's greatest density occurs at 39°F (4°C). As water warms during the summer, it remains near the surface while colder water remains near the bottom. Wind mixing determines the thickness of the warm surface water layer (epilimnion), which usually extends to the depth of about 20 feet. The narrow transition zone between the epilimnion and cold bottom water (hypolimnion) is called the metalimnion or thermocline.
Suspended Solids:	A measure of the particulate matter in a water sample, expressed in milligrams per liter. When measured on inflowing streams, it can be used to estimate the sedimentation rate of lakes or impoundments.
Thermocline:	See "Stratification".
TMDL:	Total maximum daily load. A watershed study designed to set thresholds to establish high quality water by determining acceptable nutrient and sediment loads from all sources.
Trophic State:	See "Eutrophication".
Turnover:	See "Overturn".
Watershed:	A drainage area or basin where all land and water areas drain or flow toward a central collector such as a creek, stream, river or lake at a lower elevation.
Wet Detention Ponds:	A structural BMP or retrofit that consists of a single permanent pool of water that stores and treats incoming storm water. Wet detention ponds usually have three to seven feet of standing water, allowing pollutants to settle, with a defined siltation/sedimentation pond and outlet structure.

Appendix C

Sample 2008 Work Plan

1. Watershed Monitoring - Monitor sample sites through 2008
2. Develop understanding of intent with other local governments
3. Care for and maintain the frog pond plug planting
4. Implement Phase 2 of the frog pond buffer project
5. Develop Pardeeville Lakes Terrestrial Shore Land Buffer Cost/Share Program
6. Palio Core Study - Develop an in-depth understanding of history through sediment analysis
7. Dredging Feasibility Study- Determine understanding of components determining practicality of Dredging
8. Public Relations Campaign with Information and Education Sessions designed at identifying the components of the Park Lake Restoration

It should be noted that this is just a sample work plan. In Appendix A, the goal statement sheets identify all of the pre-drawdown objectives which will need to be done by the PLMD. It is recommended that every year in early summer the PLMD review their progress working towards meeting the pre-drawdown issues. This should become the process for evaluating the work done in the previous year, while determining what work should be done for the upcoming year. The annual work plan review should become the first step toward budget development.

Appendix D

Aqua Cultural Producers Questioner

If the WDNR fish Hatcheries are not rearing all the necessary fish species by the time restocking is going to be implemented then it will be necessary to use the services of a Aqua cultural producer. It is strongly advised that when seeking out an Aqua cultural producer use the check list provided below.

Aqua Culture Services Check List

- Does the company sell product raised vs. catch and sell?
- What are the companies in the wild survival rate?
 - The higher the rate of survival the better
- How does the company feed their stock?
 - Live Feeding
 - Fosters hunting skills
 - Artificial Feed
 - Does not foster hunting
- How long has the company been providing aquaculture services?
- Ask for companies list of testing policies.
- Ask for references on companies testing history.
 - Must have excellent track record
- Company must provide health certificate.
- Obtain WDNR stocking permit in advance.
 - Must be done way ahead of time
- If aquaculture service is from out of Wisconsin
 - Must obtain a valid WDNR import permit
- Verify the age of the specimens being purchased/ per species?
- Verify the size of the specimens being purchased/ per species?
- Verify harvest technique used by Aquaculture Company?
 - Stress on fish can be significant
 - 5° change during transport can cause delayed mortality a month later
- Verify stocking technique.
 - No under ice stocking
- Verify time of stocking.
 - Night?
 - Day?

- Verify time specimens will be transported or time on truck.
 - time in transport = >stress = < probability of survival rate
 - 5° change during transport can cause delayed mortality a month later
- Develop Long term relationship with aqua culture company
- Verify Reputation
 - Must research company with their past clients

Aquaculture Contacts

- Dr. Myron J. Kebus
 State Aquaculture Veterinarian
 Division of Health
 Wisconsin Dept. of Ag., Trade and Cons. Protection
 2811 Agriculture Drive
 Madison, WI 53718-6777
 608.224.4876
 608.224.4871 Fax
myron.kebus@datcp.state.wi.us
- Dr. Jeffrey A. Malison
 Director
 UW Aquaculture Program
 University of Wisconsin-Madison
 Department of Animal Sciences
 1675 Observatory Dr.
 Madison, WI 53706
 Primary Phone: (608) 263-1242
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- Sarah Kaatz
 Aquaculture Outreach Specialist-Central
 University of Wisconsin-Stevens Point
 243 Nelson Hall
 Stevens Point, WI 54481
 715.346.3037
SKAATZ@UWSP.EDU
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 Bayfield, WI 54814
 715.779.3189 (NADF)
 715.209.5701 (Cell)
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302 S.MAIN ST.
LAKE MILLS, WI 53551
920.648.2902
JAHELD@WISC.EDU

Boating Ordinance Creation Procedures

First Step:

1. Complete **Waterway Marker Application and Permit** Form 8700-058 (R 11/06)
 - a. Form 8700-058 Located in Appendix with directions
 - b. Attach diagrams and maps showing proposed location of the markers
 - i. Identify exact location of water marker(s) in distance from one or more fixed objects, whose location is known or provide the GPS coordinates of the marker(s) placement.
2. Receive local government approval
 - a. Complete a form for each Local Government
 - i. Village of Pardeeville
 - ii. Town of Wyocena
 - b. Have Local Government Complete **Section 3: Local Government Authorization**
3. Receive county approval
 - a. Bring application to Columbia County Clerk's Office
 - i. Carl Frederick Administration Building, 400 Dewitt Street, Portage, WI 53901
 - ii. Form including lake area in Village of Pardeeville
 1. Attention
 - a. Columbia County Board District 11 Supervisor
 - b. Judiciary Committee Chair
 - iii. Form including lake area in Town of Wyocena
 1. Attention
 - a. Columbia County Board District 11 Supervisor
 - b. Columbia County Board District 17 Supervisor
 - c. Judiciary Committee Chair
4. Receive WDNR Game Warden approval
 - a. Game Warden Office
 - i. MacKenzie Center, W7303 County Highway CS, Poynette, WI 53955
5. Game Warden passes Application onto WDNR Recreational Safety Warden for approval
6. Conformation sent back to local government
 - a. Included will be a recommendation for buoy placement

PLEASE NOTE FOLLOWING TIMELINE WILL TAKE 3-6 MONTHS

Reporting Boating Ordinances

When reporting violations:

1. Place Phone Call to
 - a. 429.2188 Pardeeville Police Office/Columbia County Sheriff's Department
 - b. 1.800.TIP.WDNR Wisconsin Department of Natural Resources
2. Helpful Information
 - a. Boat Identification Number
 - b. Description of Activities
 - c. Photo Documentation (Not necessary but always helpful)

If buoys are not located on the waterscape Wisconsin Department of Natural Resources State Game Wardens and Columbia County Sheriff's Department Deputies cannot enforce "Slow No-Wake" violations. As a result; when reporting "Slow No-Wake" violations in early spring and late fall, please make sure that buoys are on the waterscape.
