

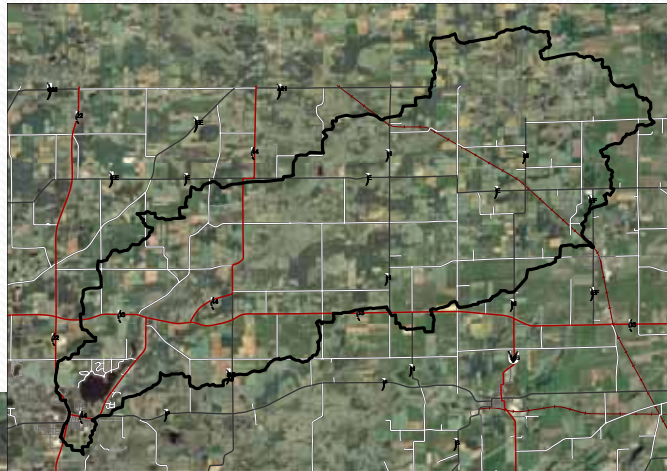
Impaired Water and TMDLs Case Study for Park Lake, Columbia County, Wisconsin



Wisconsin Lakes Convention
April 11, 2013

Christopher Arnold
Land and Water Conservation Dept., Columbia County
Nancy Turyk and Paul McGinley
Center for Watershed Science and Education, UWSP

Lake Characteristics



- Village of Pardeeville, Columbia County
- 312 acres
 - Shallow
 - Warm water
 - Unidirectional
 - Unstratified impoundment of the Fox River
- 53.4 sq. mile watershed



The Beginning

- 2001

- Columbia County LWCD was contacted and asked to attend PLMD meetings and determine how LWCD could be help with **decreases in:**
 - Plant community abundance and diversity
 - Fish community abundance and diversity
 - Water quality



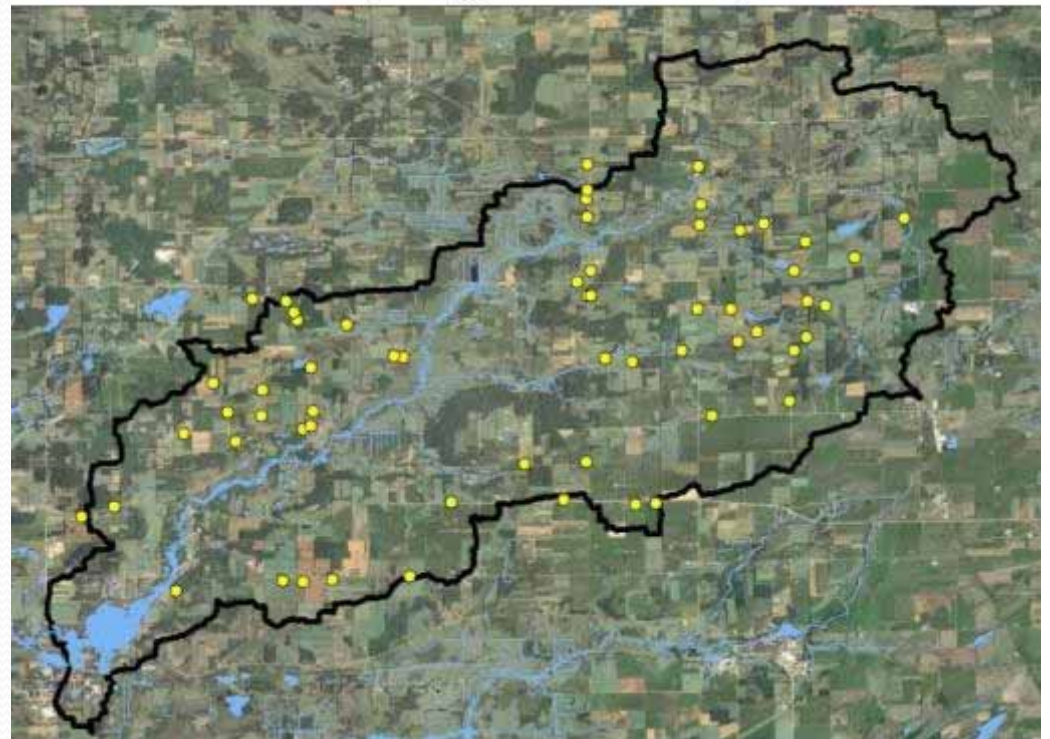
Columbia County LWCD Approach

- NR 151 livestock inventory
- WDNR approved Watershed Management Plan
- Water quality data
 - In lake
 - Watershed/tributary monitoring
- 303(d) list of Impaired Water ???
- Total maximum daily load (TMDL) ???

2005-2006 Livestock Inventory

Park Lake Hydrology and Livestock Operations

- 34,432 acre watershed
- 26,315 tillable acres
- 59 livestock operations
 - 1,920 dairy cattle
 - 1,612 beef cattle
 - 401 hogs
 - 181 sheep
- 5,780,245 gallons of manure annually
 - 219 gallons manure/tillable acre
 - 8-14 lbs. P_2O_5 /gallon
 - 1752-3066 lbs P_2O_5 /acre/yr



2005-2006 Livestock Inventory

- 14 of 59 obvious runoff issues (1,432 dairy/beef cows)



2005-2006 Livestock Inventory

- 9 of 59 unlimited access to waters of the state
 - 6 of 9 not maintaining adequate sod



2005-2006 Livestock Inventory

- 8 of 59 manure storage structures
 - 2 of 8 need abandonment
 - 6 of 8 have potential problems



2005-2006 Livestock Inventory

Number of operations (59 total)	Issue
55	Need nutrient management plans
37	Clean water diversions necessary
31	Unaware if meeting tolerable “T” soil loss
9	Rill or gully erosion
5	Manure stacks draining to surface water



2007 Public Participation Watershed Planning Process

Pardeeville Lakes Management District Technical Team

- **Wisconsin Department of Natural Resources Staff**
 - PAUL CUNNINGHAM, Fisheries Policy Ecologist
 - TIMOTHY "TIM" ASPLUND, Water Resources Management Specialist
 - TIM LARSON, Basin Team Supervisor
 - SUSAN GRAHAM, Water Resources Management Specialist
 - MICHAEL SORGE, Water Resources Management Specialist
 - DONNA F. SEFTON, Lakes and Aquatic Invasive Specialist
- **Center for Watershed Science and Education**
 - NANCY TURYSK, Water Resource Scientist
- **University of Wisconsin-Extension**
 - STANLEY A. NICHOLS, Emeritus Professor of Environmental Sciences
- **Columbia County Land and Water Conservation**
 - KURT CALKINS, Director Columbia County Land and Water Conservation Department
 - CHRIS ARNOLD, Water Resource Specialist

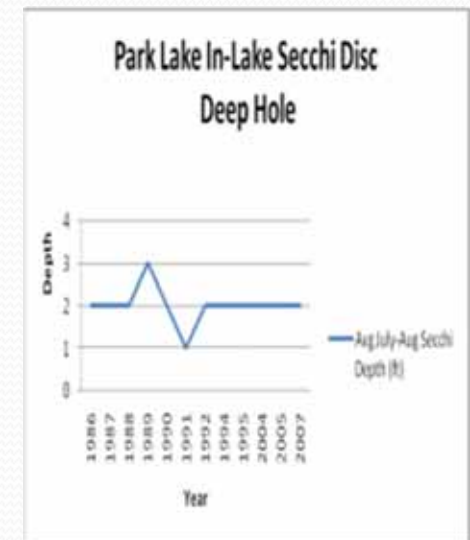
Park Lake Gap Analysis - Water Quality

GAP ANALYSIS

What do we know?

What do we need to learn?

July and August	TP (ug/L)	Chlorophyll <i>a</i> (ppb)	Secchi Disc (ft)
Park Lake	131	99	1.8
Eutrophic	30-50	11-15	5
Highly Eutrophic	150		



Park Lake Gap Analysis

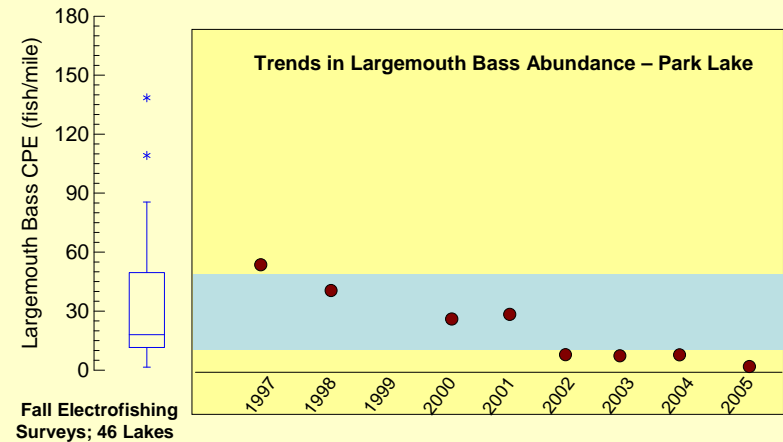
– Biotic Measures

Common Name	1978	1998	2001	2003
Coontail	X	X	X	
Elodea	X	X		
Duckweed	X			
Water milfoil	X			
Eurasian water-milfoil		X	X	X
Slender Naiad	X	X		
American lotus				
Bull head pond-lily	X	X	X	X
Fragrant Water lily	X	X	X	X
Curly pondweed	X	X		
Illinois pondweed		X		
Longleaf pondweed				
Sago pondweed	X	X		X
White stem pondweed	X			
Small pondweed	X			
Flatstern pondweed	X	X		
Arrowleaf	X			
Soft-stem bulrush	X	X	X	X
Broadleaf cattail	X		X	X
Wild Celery				
Water stargrass				

Park Lake

Fish Community: Assessment by Analogy

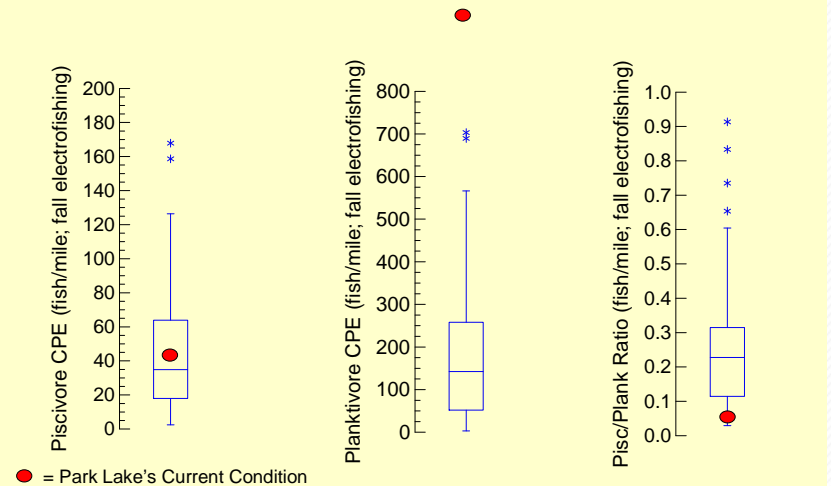
Inter-quartile ranges are benchmarks for quick evaluations of survey data. Catch rates within the inter-quartiles = **normal** for Class 3 lakes. Catch rates outside the inter-quartiles = **unusual**.



Park Lake

Fish Community Structure, Years 2000-2004

Box plots: Shallow lowland drainage lakes in Southern Wisconsin





Park Lake Gap Analysis Outcomes

- **What we knew**

- Eutrophic/hyper-eutrophic
- Excessive algal blooms
- Declining aquatic plant diversity
- Unbalanced fish population
- Increased shad population

- **Gaps**

- Water quality data
 - In-lake
 - Tributaries
- Flow

- Lake/watershed plan
- 303(d) list
- TMDL

2007 Public Participation Watershed Planning Process

- 7 Months
- 11 Meetings
- Over 180 participants
 - Citizens (rural & urban)
 - Park Lake Management District
 - Village of Pardeeville
 - Town boards
 - Columbia County LWCD
 - US Fish & Wildlife
 - UW-Extension
- WDNR approved Lake/Watershed Management Plan





2007 Public Participation Watershed Planning Process

Pardeeville Lakes Management District Mission Statement

*The Pardeeville Lakes Management District (PLMD) 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.*

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.



2007 Public Participation Watershed Planning Process

- Chapter 1 - Introduction
- Chapter 2 - Planning Process
- Chapter 3 - Lake Characteristics
- Chapter 4 - Shallow Lake Management Concepts
- Chapter 5 - Historical Lake & Watershed Management
- Chapter 6 - Lake Management Alternatives
- ***Chapter 7 - Water Monitoring Study Plan***
- ***Chapter 8 - A Watershed Plan***
- ***Chapter 9 - In-Lake Restoration Plan***

<http://www.co.columbia.wi.us/ColumbiaCounty/Portals/16/Park%20Lake%20Comprehensive%20Management%20Plan.pdf>

2007 Public Participation Watershed Planning Process

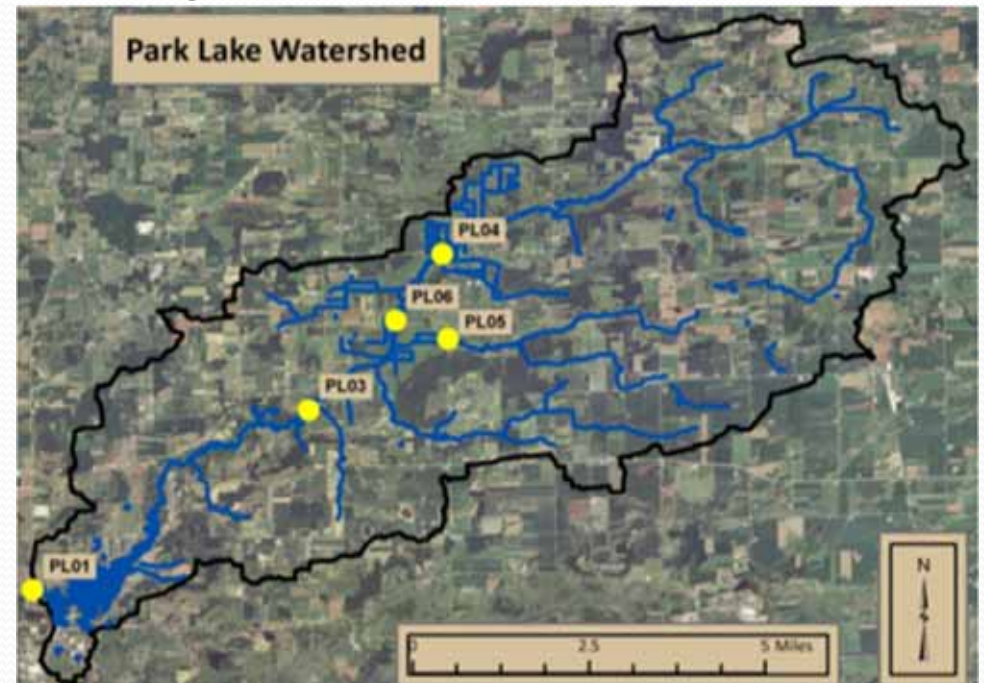
- **Chapter 7 - Water Monitoring Study Plan**

- Phase 1 Data collection
- Phase 2 Data modeling, compilation and recommendations
- Phase 3 TMDL development and lake management plan integration



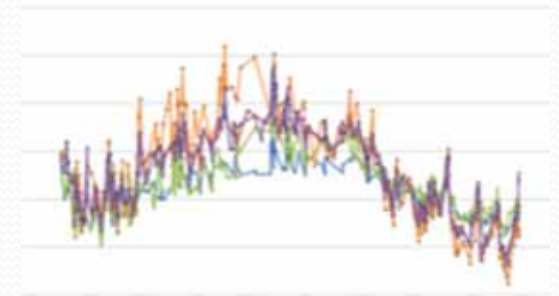
Water Quality Monitoring Study Plan

- Design
 - Phosphorus and Sediment TMDL
- Goal
 - Load reductions for in-lake P (using proposed P criteria)
- Scope
 - In-lake sampling
 - 5 tributary monitoring sites



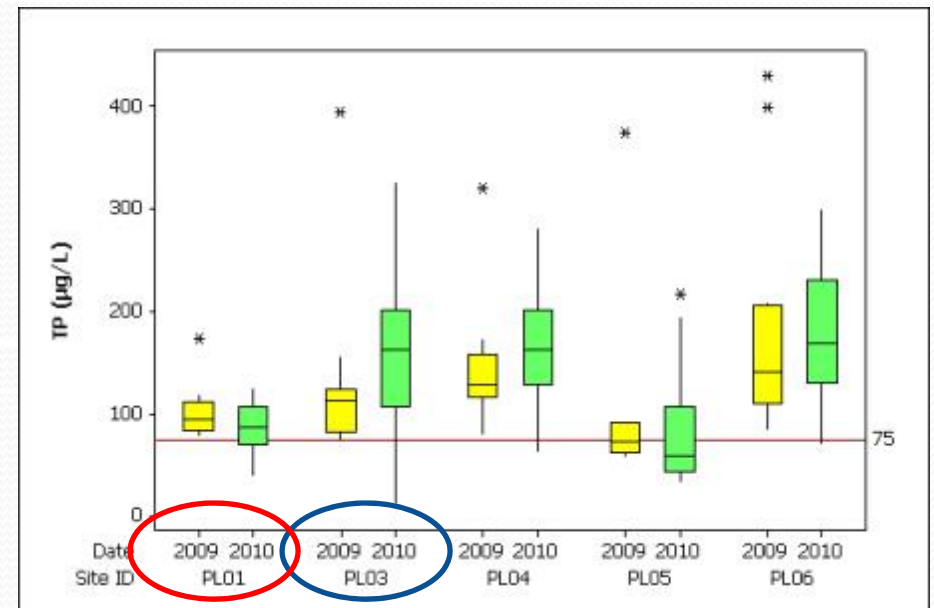
Water Quality Monitoring

- Intensity
 - 14 Day Interval, ice out to ice on
- Measurements
 - Flow
 - Solinst level logger, flow meter
 - Analyses
 - total P, reactive P, nitrogen, suspended solids, chloride
 - In-situ measures
 - pH, specific conductance, temperature, dissolved oxygen
- Duration
 - Varies from 2 to 4 years
 - due to 2008 floods
- Funding
 - WDNR Large Scale Lake Planning Grants
- Field Staff
 - Columbia County LWCD
- Data Storage
 - WDNR SWIMS, Columbia County LWCD, UWSP WEAL



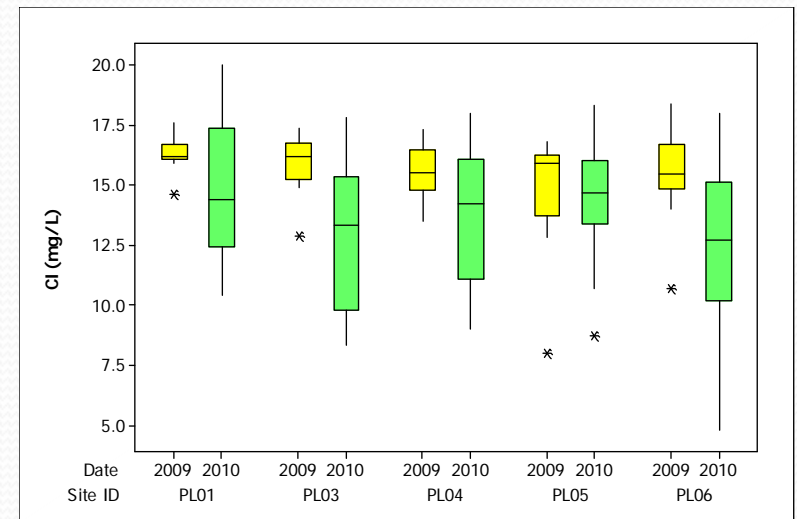
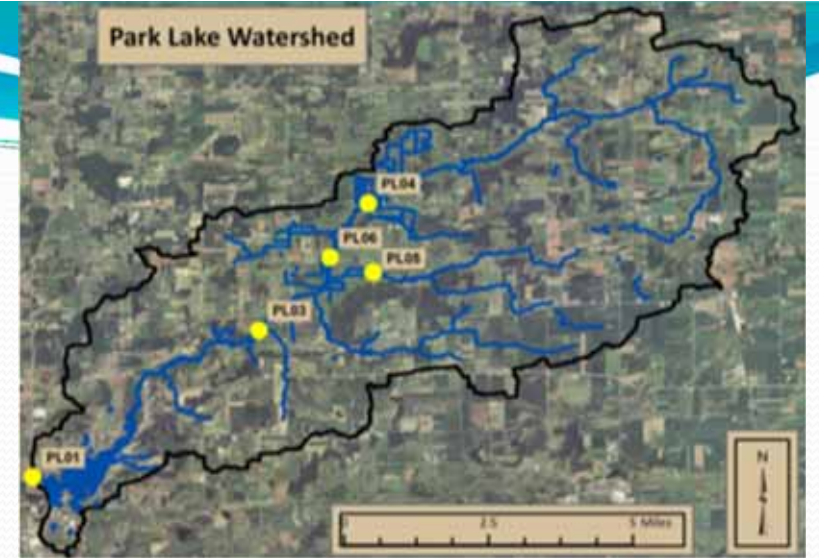
Water Quality Results

- Total Phosphorus Sources
 - Natural and cultural
 - Watershed
 - Wetlands, soil erosion, animal waste, septic systems
 - In-lake/in-stream
 - Sediment release or re-suspension, animal waste, decomposing aquatic biota
- Phosphorus criteria
 - 70 $\mu\text{g/L}$ – Stream
 - 40 $\mu\text{g/L}$ - Impoundment

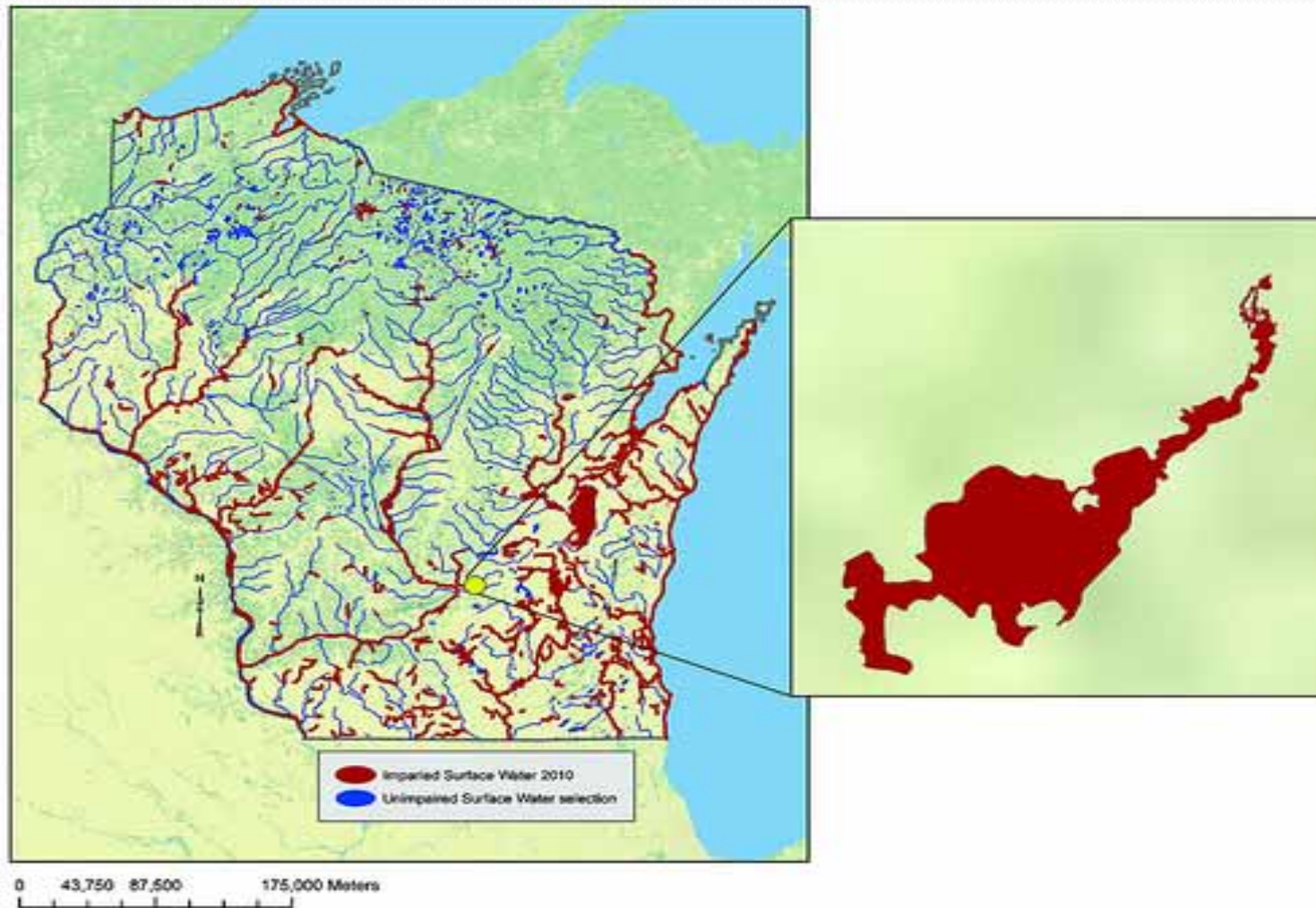


Water Quality Results

- Chloride
 - Not biologically available
 - 3mg/L background concentration
 - High levels: low flow = groundwater sources
 - High levels: events = surface runoff sources
 - Sources
 - Septic systems
 - Animal waste
 - Potash fertilizer
 - Road salts



2006 Park Lake added to 303(d) List of Impaired Surface Water



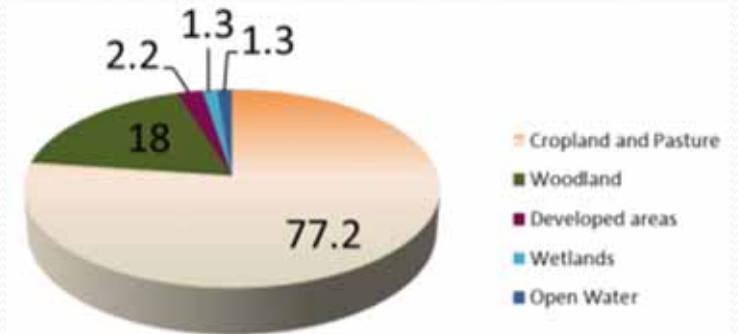
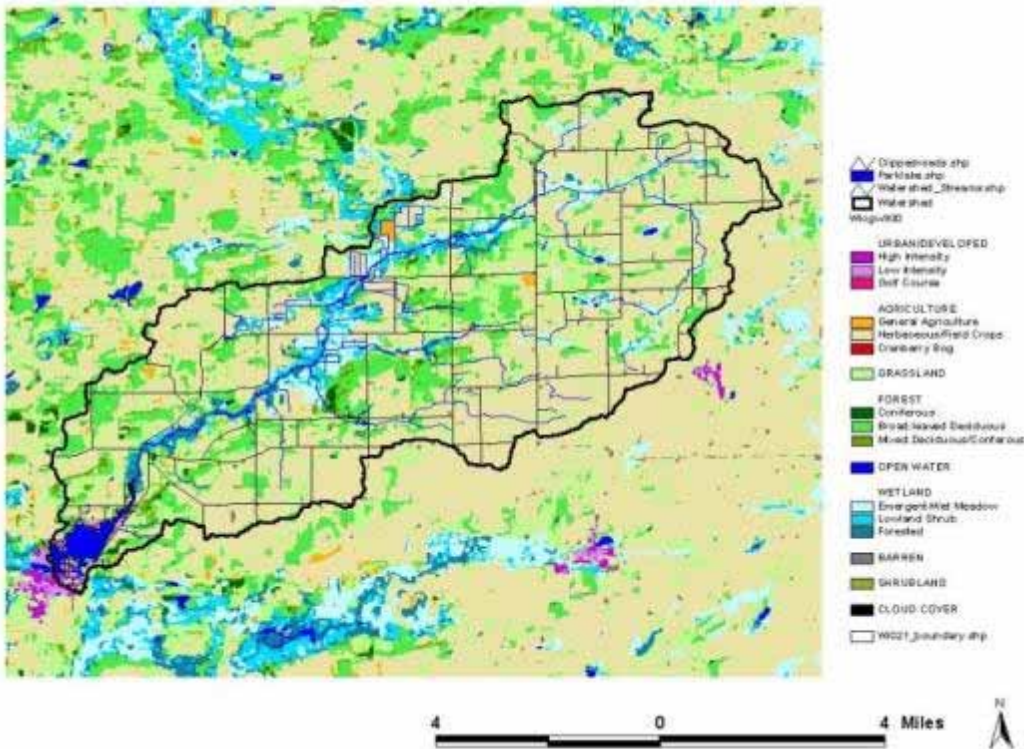
Total Maximum Daily Load

- Maximum amount of P Park Lake and its' tributaries can accept to meet the P criteria
 - derived from changes in biotic communities
 - defined NR 102 administrative code
- Required for impaired 303(d) listed waters
- TMDL Process
 - Collect and analyze data
 - Develop predictive model and TMDL Report
 - Source estimates
 - Reduction goals
 - WDNR submittal
 - EPA approval
 - EPA requires “reasonable assurance” that implementation will happen



Park Lake TMDL

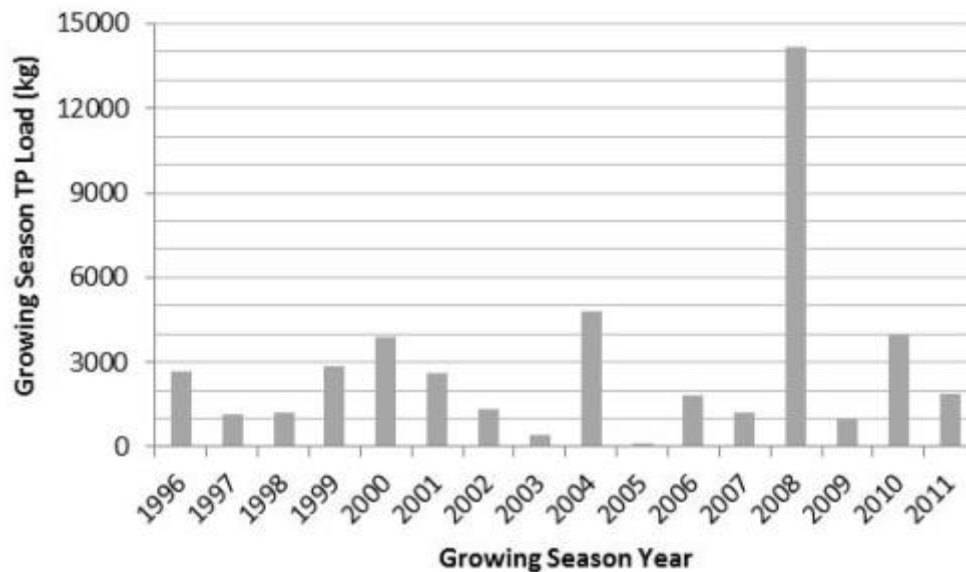
- Land Use in Park Lake Watershed



Park Lake TMDL

Modeling Results – Watershed Loads

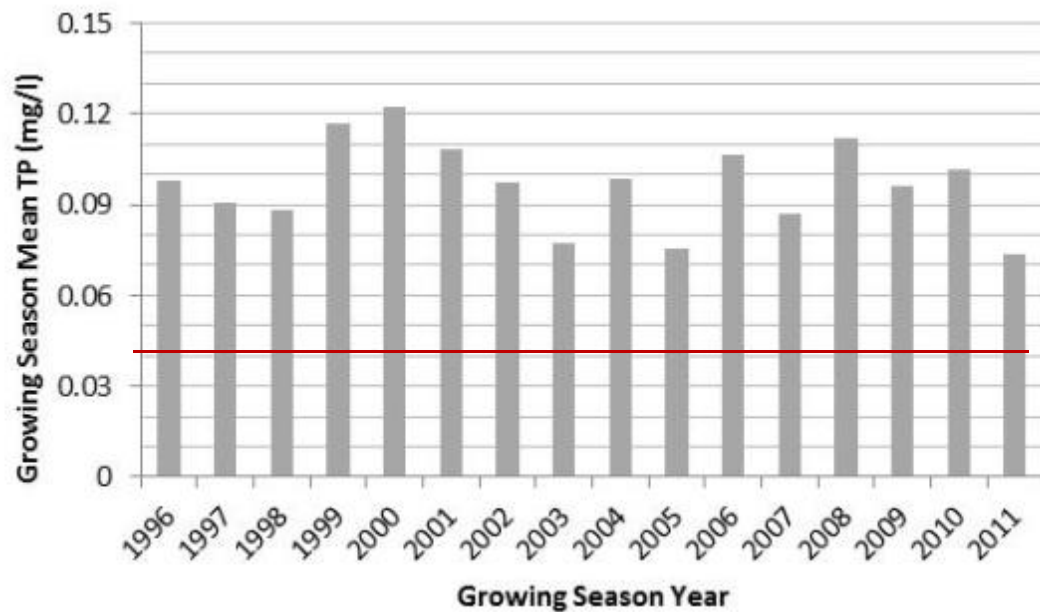
- Growing season (May-Oct) TP load to Park Lake from the daily simulated watershed model.
- SWAT 2005
- Precipitation, TP data, soil, crop rotations, temperature, infiltration rate



Park Lake TMDL

Modeling Results – Park Lake

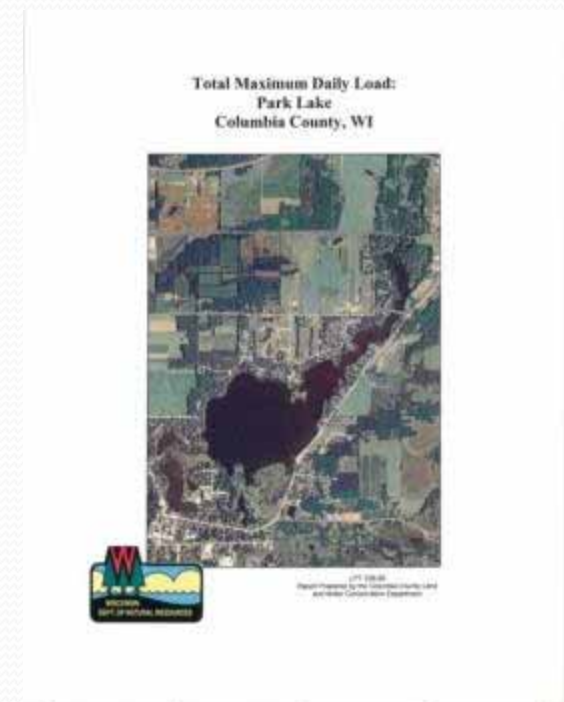
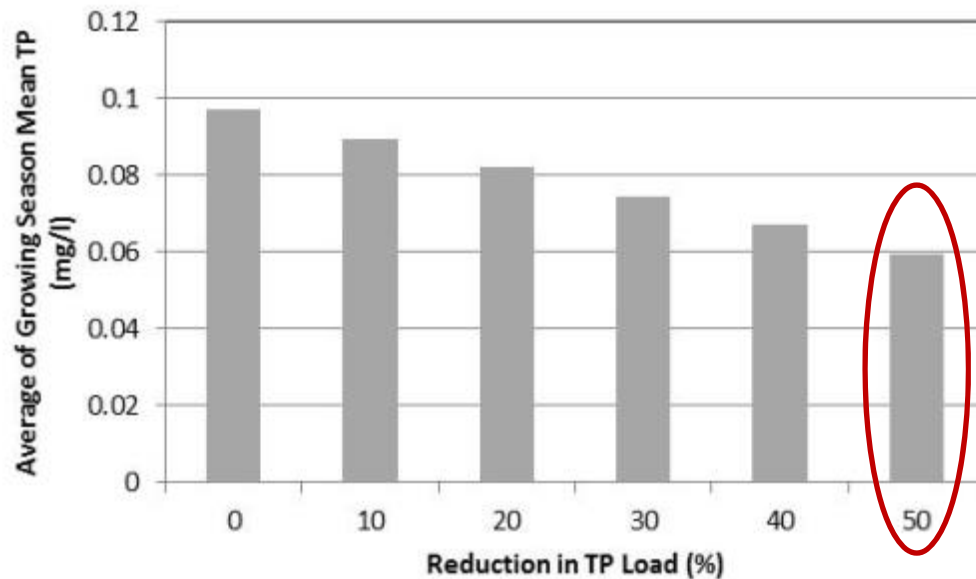
- Lake model derived using
 - Watershed daily flow and TP concentration May through Oct
 - Sediment P release adjusted for season
 - (June-Aug 5 mg/m²/day, 0.5 mg/m²/day rest of year)
 - P. crispus decay rate (35 mg/m²/day)



Park Lake TMDL

Derived from lake and watershed models

TMDL	The average daily TP load over the median growing season is 11 lbs/day
Reduction	50% TP Load reduction to obtain 60 ug/L





Park Lake Restoration Implementation

Park Lake Implementation Team

- Pardeeville Lakes Management District
 - Jack Paulson Team Chairperson
- Village of Pardeeville
 - George Grimsrud, David Tracey
- Town of Wyocena
 - Doug Cole
- Columbia County LWCD
 - Chris Arnold, Kurt Calkins
- Wisconsin DNR
 - Sue Graham, David Rowe, Cathy Bleser



Park Lake Restoration Implementation Plan

- Restoration steps identified in Park Lake Comprehensive Management Plan 2007
- Restore to a clear water state with aquatic vegetation and a healthy fishery
- Inventory July 2012-July 2013
- Restoration Sept. 2012 – Dec. 2013
- Monitoring Dec. 2013 – Dec. 2015



Park Lake Implementation Plan

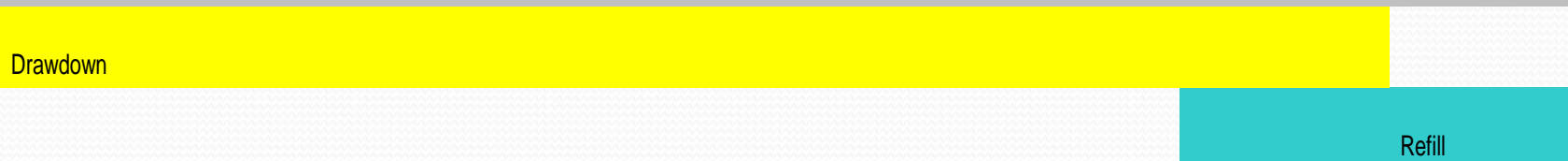
- Drawdown
- Reestablish aquatic plants
- Fish kill
- Fishery restoration
- Recreation
- Other considerations
- Cost summary
- Approvals, permits, and funding



Park Lake Restoration Timeline

July Aug Sept Oct Nov Dec Jan Feb March April May June July Aug Sept Oct Nov Dec Jan Feb March April May

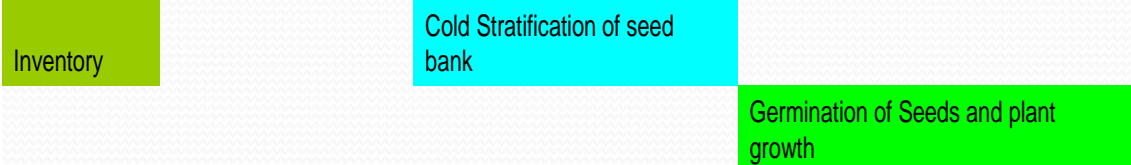
Water Level



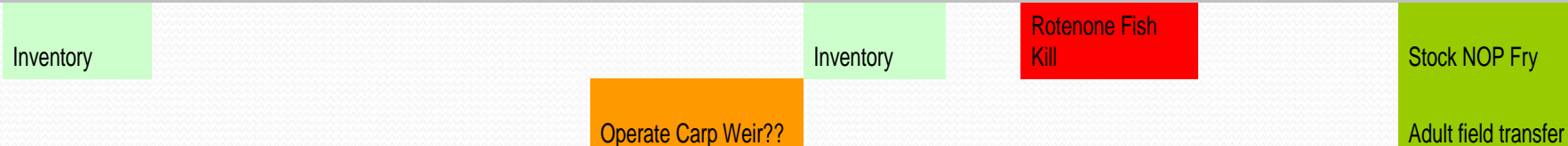
Vegetation



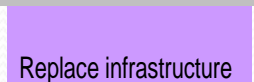
Inventory



Fish



Infrastructure



Overall Costs of Restoration

Practice	Costs	Required Local Match	Available Local Match Credit
Fish Inventory/Flow Test	\$3,148		
Fish Kill	\$50,320		
Fish Restocking	\$11,500		
Fish Habitat	\$7,500		
Water Quality Monitoring	\$7,040		
Aquatic Plant Inventories	\$2,000 Yet to be finalized		
Loss of Power	\$25,000		\$25,000
Total	85,860	\$21,465	
Other Local Match activities			To be determined
Total Cash Needed for Local Match	\$0		

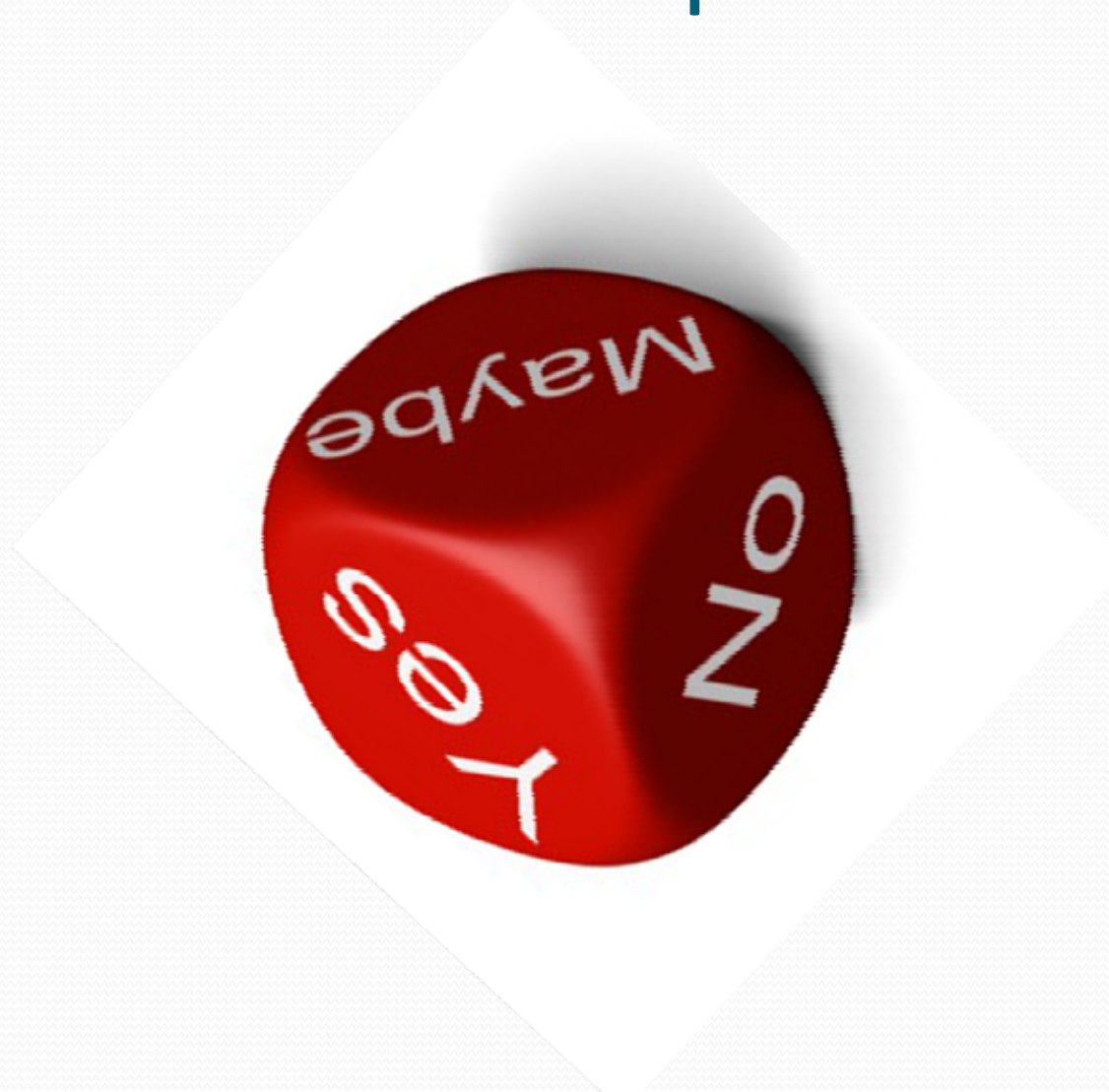
Park Lake Implementation Plan

- February 21, 2012
 - Pardeeville Village Board rejects plan
 - 4-3
- April 8, 2013
 - Conservation Congress votes on fish regulations
 - Majority voted YES (2106-808)



Photo By-Lyn Jerde/Daily Register

Was the Partnership Successful?





Was the Partnership Successful?

- 2001 LWCD was contacted and asked to attend PLMD meetings and determine how LWCD could help
 - Plant community abundance and diversity decreasing
 - Fish community abundance and diversity decreasing
 - Water quality decreasing
- 2005-2006 NR 151 watershed inventory
- 2007 Lake/watershed planning process
- 2007-2010 Water quality assessment
- 2012 TMDL developed (approval pending)
- 2012 Park Lake Implementation Plan
- 2006-Present Focused watershed BMP installation effort

Was the Partnership Successful?

- Watershed Grants
 - 2006 WDNR-Lake Planning Grant
 - NR151 Park Lake Watershed Inventory
 - 2007 WDNR-Lake Planning Grant
 - Park Lake Comprehensive Watershed Plan
 - 2008 WDNR-Lake Protection Grant
 - Park Lake Total Maximum Daily Load Study
 - 2009 WDNR-TRM Grant
 - Park Lake HUC 040302010101

Total Cost	462,010 +
WDNR Grants	412,010
Match	50,000+

Was the Partnership Successful?

Best Management Practices

- Reduce field runoff
 - Nutrient management planning
 - Meeting Tolerable soil loss
- Reduce P with barnyard systems
 - Concrete barnyards
 - Clean water diversions
- Waterways
- Contour strips
- Field buffers





Was the Partnership Successful?

- Lessons Learned



Special thanks..

- Wisconsin Department of Natural Resources for project funding and professional guidance
- Columbia County UW-Extension for facilitation of planning process
- Lake residents and the Village of Pardeeville

Questions ?





Park Lake Study History Leading to TMDL

- **1979 WDNR Pre-Draw down Evaluation Survey (Aquatic Plant Survey, Fish Survey, & Over winter In-Lake Do)**
- **1993 Water Resources Data Wisconsin Water Year 1993, Volume 1. St Lawrence River basin, B.K. Holmstrom, P.A. Kammerer, Jr., and B.R. Ellefson**
- **2002 Improving the Water Quality of Park Lake: Recommendations and Options for the Future, Water Resources Management Workshop 2001, Gaylord Nelson Institute for Environmental Studies University of Wisconsin- Madison**
- **2006 WDNR-Lake Planning Grant LPL- 1072-06, NR151 Park Lake Watershed Inventory**
- **2007 WDNR-Lake Planning Grant LPL-1107-07, Park Lake Comprehensive Watershed Plan**
- **2008 WDNR-Lake Protection Grant LPT-339-09, Park Lake Total Maximum Daily Load Study**

2007 Public Participation Watershed Planning Process

- Chapter 8 - A Watershed Plan
 - Storm Management Water Management & Construction
 - Village of Pardeeville
 - No Ordinance
 - Townships
 - Under county Zoning – No Storm water Ordinance
 - Septic System
 - Village of Pardeeville
 - City sewer
 - Townships
 - Columbia County Planning and Zoning
 - Riparian Property Management
 - Village of Pardeeville
 - City zoning
 - No shoreland zoning ordinance
 - Townships
 - Columbia County shoreland ordinance
 - Citizens
 - Upland Agricultural Source Management
 - Columbia County Land and Water Conservation
 - Agricultural Producers
 - Citizens





Total Phosphorus

Things to Consider

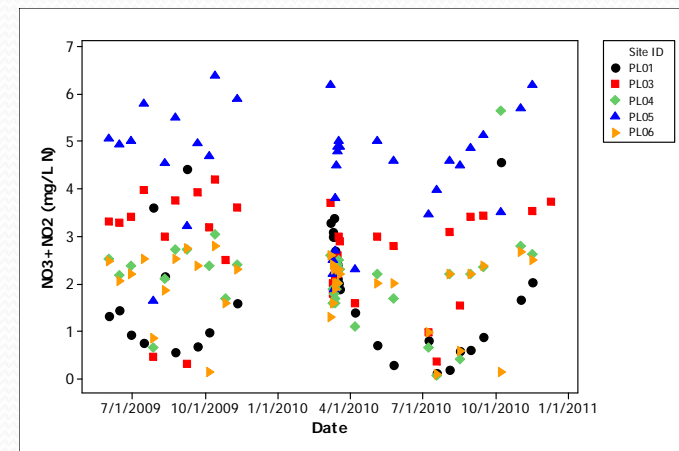
- Levels hit 6* the impoundment standard
- Levels indicate substantial runoff to surface water
- Total P is not all immediately plant available
- Soluble Reactive P is plant available
- Mostly surface water problem

Sources

- Soil (Erosion)
- Plant Material
- Wetlands
- Septic Systems
- Animal Waste

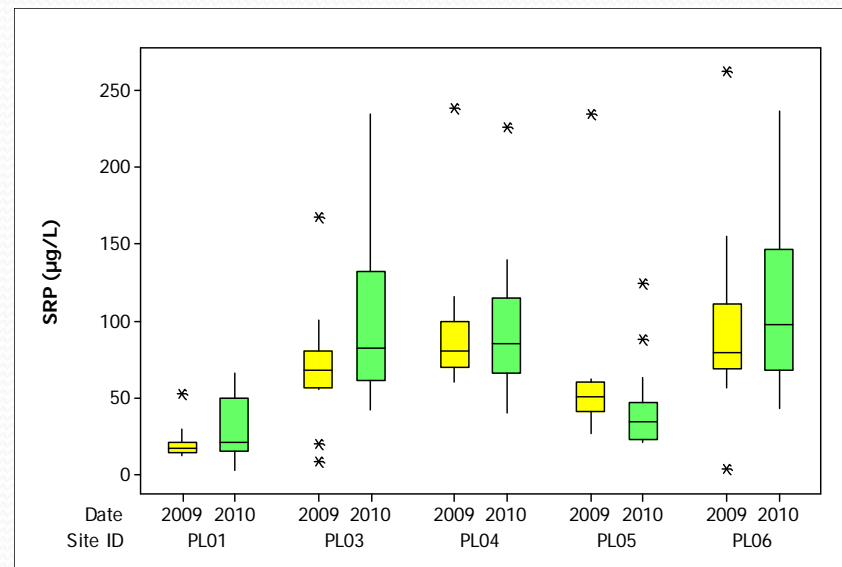
Water Quality Monitoring Results

- Nitrate (NO_3^-)
 - High component of TN
 - Ground water issue
 - Water Soluble
 - 10 mg/l
 - Drinking water standard
 - 3 mg/l – Fuel summer algal blooms
 - Elevated levels in surface water indicate wells should be tested



Water Quality Results

- Soluble Reactive Phosphorus
 - Bio available



Water Quality Monitoring Results

- Total Suspended Solids
 - Similar Patterns to TP and organic nitrogen
 - Runoff Issue
 - BMP
 - Reduce P with Barnyard Systems
 - Concrete Barnyards
 - Clean Water Diversions
 - Reduce field Runoff
 - Nutrient Management Planning
 - Meeting Tolerable Soil Loss
 - Waterways
 - Contour strips
 - Field buffers

