Report

Phase III Lake Study Report

Phosphorus Source Identification and Lake Management Plan

Project I.D.: 05L013

Long Lake Advancement Association
Manitowoc County, Wisconsin

December 2006

Foth & Van Dyke

December 18, 2006

Mary Gansberg
Wisconsin Department of Natural Resources
2984 Shawano Ave.
P.O. Box 10448
Green Bay, Wisconsin 54307-0448

Dear Mary:

RE: Long Lake Phase III Lake Study Report

Enclosed are two copies of the Phase III lake study report for Long Lake – Manitowoc County.

The Phase III report was presented to the Long Lake Association at their annual meeting on June 24, 2006. Based on the feedback at the meeting at a subsequent meeting of the board of directors, the lake management plan was finalized. The lake association is eager to move ahead with the action items.

Sincerely,

Foth & Van Dyke and Associates, Inc.

Philip A. Korth

Philip A. Korth, P.E.
Lead Environmental Engineer

cc: Doug Dedering – Long Lake Association

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Phase III Lake Study Report
Phosphorus Source Identification and Lake Management Plan

Distribution

No. of Copies	Sent To
2	Mary Gansberg Wisconsin Department of Natural Resources 2984 Shawano Ave. Green Bay, WI 54313
10	Doug Dedering Long Lake Association 6223 Glenview Pkwy West Bend, WI 53095

Phase III Lake Study Report
Phosphorus Source Identification and Lake Management Plan

Project ID: 06B018

Prepared for

Long Lake Advancement Association
Manitowoc County, Wisconsin

Prepared by
Foth & Van Dyke and Associates, Inc.

December 2006

2737 S. Ridge Road, P.O. Box 19012, Green Bay, Wisconsin 54307-9012, 920/497-2500, FAX: 920/497-8516

Phase III Lake Study Report

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1 Introduction

Long Lake is located in eastern Manitowoc County approximately 3 miles south of the city of Brillion. The lake covers 119 acres with a maximum depth of 38 feet. A dam on the south end of the lake controls the water level in the lake.

The Long Lake Advancement Association completed a Phase I lake planning study in May 2003. Two key issues were identified; water quality and northern pike spawning concerns. The study showed the lake to be highly eutrophic with a relatively small watershed. Phosphorus concentrations were high and have led to elevated algae levels and excessive weed growth. Chemical treatment for phosphorus removal was identified as a potential lake management strategy. Northern pike spawning was evaluated with a focus on the dam. Controlling water levels and providing increased spawning areas are keys in improving northern pike populations in the lake.

The Long Lake Advancement Association completed a Phase II lake planning study in July 2005. The study evaluated residential and storm water sources of phosphorus. Phosphorus concentrations were tested at the inlet and outlet streams. A hydrologic budget was prepared using data collected in 2004. Most of the water entered the lake from precipitation or the inlet stream. Water that left the lake was from evaporation and the outlet stream. Little groundwater flow was measured. The phosphorus budget identified the inlet stream as the major external source in 2004 with 75% of the phosphorus entering through the inlet stream. Internal phosphorus loading was identified as a larger source of phosphorus than the inlet stream with measurements showing high phosphorus concentrations in the hypolimnion during the summer.

1.1 Authorization

The Long Lake Advancement Association authorized Foth & Van Dyke to complete the Phase III study for Long Lake, and to prepare a report identifying the results. The study was completed through a collaborative effort between Foth & Van Dyke and the Long Lake Advancement Association volunteers.

1.2 Purpose

The purpose of the Phase III lake study was to address the following areas:

- Identify the source of phosphorus to the inlet stream.
- Evaluate alternatives for managing the internal phosphorus load. The alternatives include chemical treatment and summer aeration to prevent anoxic conditions.
- Identify potential northern pike spawning areas and develop costs and implementation details.
- Meet with the Long Lake Advancement Association to develop priorities for implementing lake management activities.
- Complete lake management plan.

The results of this study will be combined with the Phase I and Phase II studies to prepare the lake management plan. This management plan will be used for long term lake management.

2 Inlet Stream Phosphorus Evaluation

2.1 Sample Results

On April 3, 2006, Foth & Van Dyke staff conducted field sampling and land use observations of the Long Lake inlet stream beginning at the Boot Lake Road bridge and proceeding upstream to Long Lake Road. A total of 11 water samples were collected and tested for total phosphorus. The phosphorus sample results are shown below. The sample locations are shown on Figure 2-1.

Table 2-1
Inlet Stream/Wetland Phosphorous Sampling

Sample ID Number	Total Phosphorus – µg/L
1	100
2	93
3	76
4	104
5	52
6	1,020
7	470
8	268
9	376
10	111
11	907

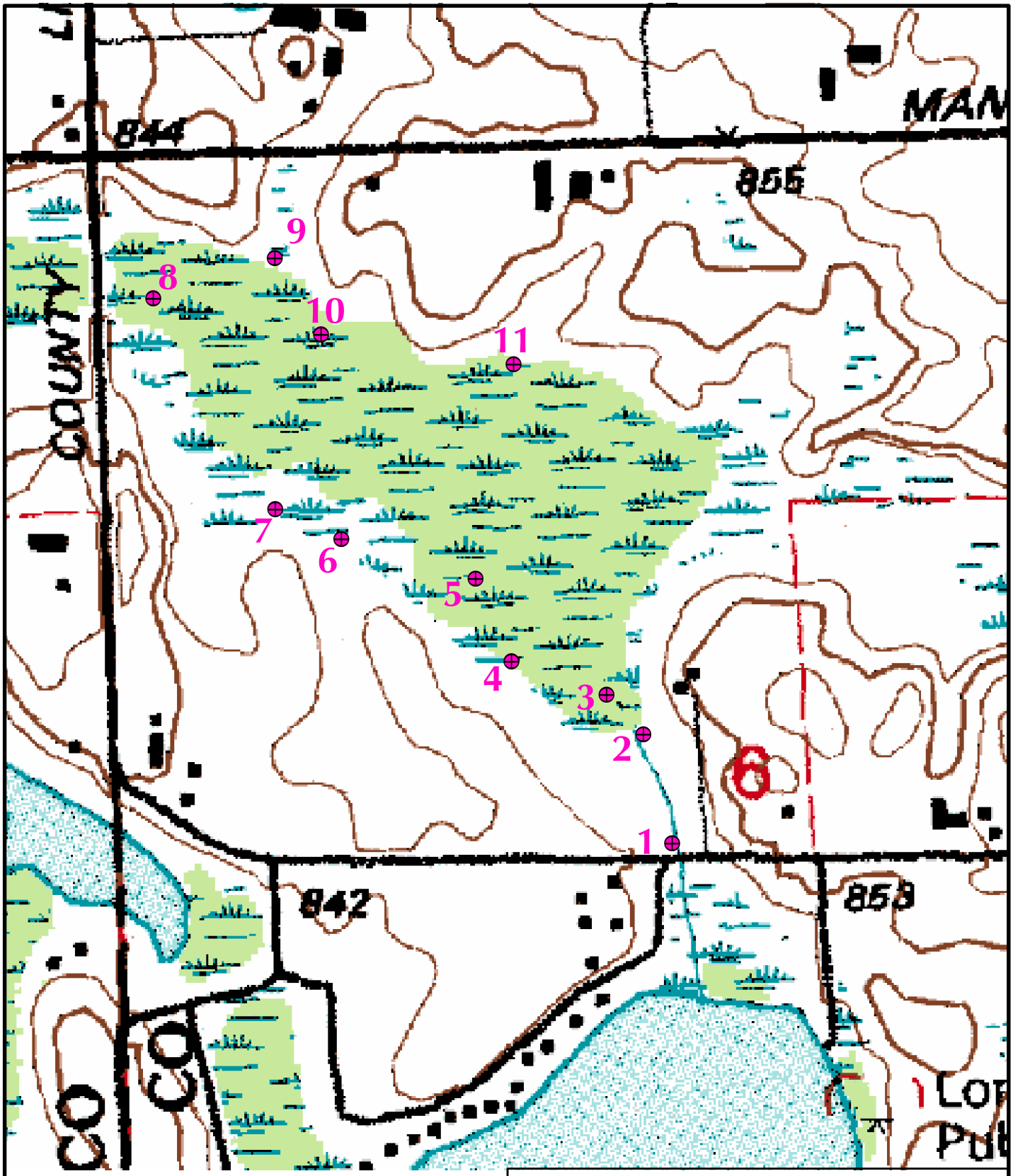
2.2 Land Use Observations

Land use tributary to the wetland and inlet stream to Long Lake was observed during the field sampling. Figure 2-2 shows the land use on April 3, 2006. Some agricultural areas drained into the wetland and could be potential sources of phosphorus. However, these areas are a significant distance from Long Lake and the natural buffering and sedimentation of phosphorus that occurs in the wetland will tend to remove phosphorus from the water before it flows into Long Lake. Appendix A contains photos of the wetland and land use adjacent to the wetlands.

2.3 Data Analysis

Phosphorus is a key nutrient for limiting excessive growth of aquatic vegetation, from algae to macrophytic plants. It is a parameter that is used to define the age or trophic status of a lake. Table 2.2 is a trophic classification of Wisconsin lakes that uses phosphorus as one of the indicator parameters.

Samples 1 through 5 show phosphorus concentrations ranged from 52 µg/L to 104 µg/L. Sample 6 had a much higher concentration of 1,020 µg/L. Samples 7 through 11 had variable phosphorus concentrations although they were all greater than Samples 1 through 5. The samples with high concentrations of phosphorus were related to agricultural drainage areas. This indicates clear impact of agricultural land use on the water quality of the inlet stream/wetland.



Legend

⊕ Sample Location and ID Number

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.
Source: U.S.G.S. 7.5 minute topographic quadrangle - Brillion (1992), Manitowoc County.

N

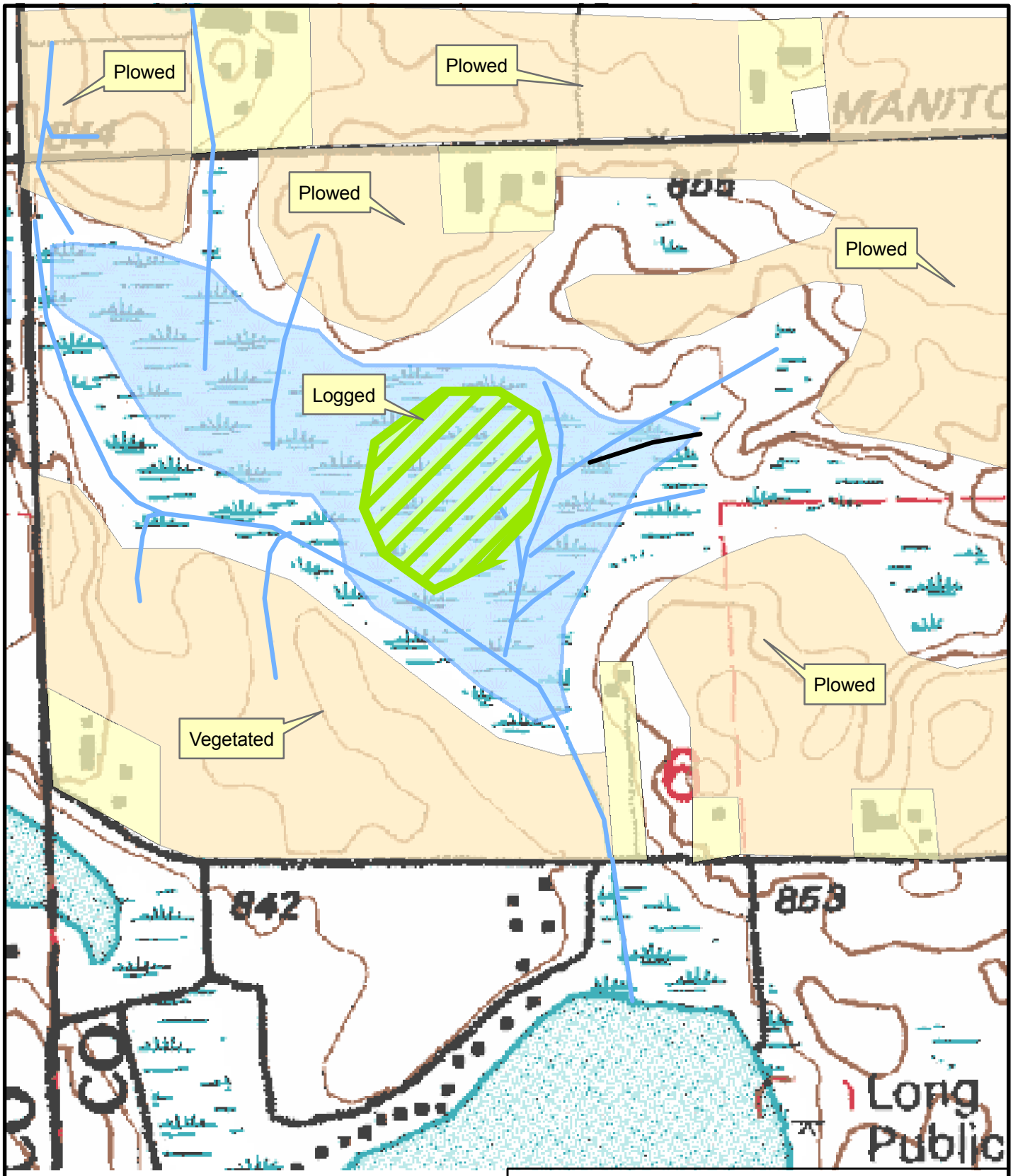
LONG LAKE

FIGURE 2-1

SAMPLE LOCATIONS

Scale: 0 250 500 Feet	Date: June 19, 2006	
Drawn By: DAT	Checked By: PAK	Scope: 05L013

m:/00l008/mxd/longlake.mxd



Legend

- Agricultural
- Residential
- Flooded
- Stream Channel

N

This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

Source: U.S.G.S. 7.5 minute topographic quadrangle - Brillion (1992), Manitowoc County.

LONG LAKE

FIGURE 2-2

LAND USE AND FLOW PATTERNS

Scale: 0 250 500 Feet	Date: June 19, 2006	
Drawn By: DAT	Checked By: PAK	Scope: 05L013

m:/00l008/mxd/longlake1.mxd

Table 2-2
Trophic Class of Lakes and Phosphorus
(Adapted from Lillie and Mason, 19831)

Trophic Class	Total Phosphorus – µg/L
Oligotrophic	3
	10
Mesotrophic	18
	27
Eutrophic	30
	50

Samples collected at the bridge location on the inlet stream in 2004 showed phosphorus concentrations that averaged 342 µg/L. The weather conditions in the spring of 2004 were a result of a higher than average rainfall in April through June. This weather pattern contributed more agricultural runoff and potentially flushed out more phosphorus from the wetland than in other years. A similar sample location taken in 2006 had a phosphorus concentration of 100 µg/L. The weather in March and April of 2006 had lower than average precipitation. From this analysis, it can be concluded that the inlet stream is a major source of phosphorus to the lake during wet weather periods due to a higher volume of flow and a higher phosphorus concentration. During dry weather periods, as a result of reduced flows there is little or no phosphorus entering the lake from the inlet stream. The phosphorus is not being purged from the wetlands during these periods.

2.4 Alternatives to Minimize Inlet Stream Phosphorus Loading

The inlet stream is the largest source of external phosphorus loading. Phosphorus loading to the stream and wetland can be reduced by improving management practices at adjacent agricultural fields. The primary means of these improvements is through the Manitowoc County Soil and Water Conservation Department.

Wetlands can be a natural trap for phosphorus but can also naturally release phosphorus during periods of high water. This can occur in spring or during periods of above normal precipitation. The phosphorus concentration in the inlet stream has been shown to be much higher during periods of high precipitation. Testing done in 2006 showed the inlet stream had a naturally high concentration of phosphorus (100 µg/L) even during a relatively dry spring. Reducing phosphorus from agricultural runoff may have little effect due to the natural phosphorus occurring in the wetland.

[1] Lillie, R. A. and J. W. Mason. 1983. *Limnological Characteristics of Wisconsin Lakes.* Wis. Dept. of Natural Resources Tech. Bull. 138, Madison

An alternative that will significantly reduce inlet stream phosphorus is alum addition. Alum will react with the phosphorus in the stream to form a precipitate. Because the inlet stream flow is highly variable, alum addition to the stream would likely be seasonal in nature. The alum feed system would require a building and chemical feed pump. Alum can be delivered in 400 gallon totes that are stored in the building. Appendix B contains a cost estimate for an alum feed system. The total cost for the building and equipment is estimated at $123,000.

3 Alternatives to Minimize Internal Phosphorus Loading

The Phase 2 study of Long Lake identified internal phosphorus loading as the largest contributor to the annual phosphorus budget. Internal phosphorus loading occurs when phosphorus is released from the sediments under anoxic conditions. Sampling conducted in 2001 and 2004 in Long Lake confirmed a large phosphorus release occurs under anoxic conditions.

Treating internal phosphorus loading is important as lake researchers have found lakes are slow to recover after excessive phosphorus inputs have been eliminated. This is driven by lake sediments becoming phosphorus rich and delivering excessive amounts of phosphorus to the overlying water.

There are two approaches to reducing or eliminating internal phosphorus loading. The first is to prevent the lower lake water from becoming anoxic. This is done with aeration. The second approach is to add a chemical such as aluminum sulfate to form a barrier to react and remove phosphorus as it is released from the sediments.

3.1 Hypolimnion Aeration

A lake forms a hypolimnion when a lake stratifies and cold dense water remains at the bottom of the lake. Warm, lighter water (epilimnion) stays above the hypolimnion in the summer months. In 2001, the thermocline separating the hypolimnion and the epilimnion was at approximately 14 feet. The hypolimnion can become anoxic in summer and phosphorus release occurs. While anoxic conditions favor phosphorus release, aerobic conditions will also allow phosphorus release at a slower rate.

A method of preventing anoxic conditions is to aerate the lower levels of the lake. This goal is different than aerating a lake in winter to prevent a fish kill. Winter aeration focuses on creating a small zone of higher dissolved oxygen where fish can survive. Summer aeration to prevent anoxic conditions must cover a larger area with aeration provided to as much of the lake levels deeper than 15 feet as possible. Approximately 5,000 feet of aeration tubing will be needed to cover the water depths greater than 15 feet.

The cost of a large scale aeration system with 5,000 feet of aeration tubing will be $100,000 to $150,000. This system will prevent anoxic conditions in the lower lake levels but will not prevent some phosphorus release from occurring under aerobic conditions. There is also a question regarding operating the aeration system during winter. Anoxic conditions can occur during winter to cause phosphorus release. Aerating the entire lake will disrupt ice formation and create a hazard for ice fisherman and snowmobiles.

3.2 Alum Treatment

Alum (aluminum sulfate) is a nontoxic material commonly used in water treatment plants to clarify drinking water. In lakes, alum is used to reduce the amount of phosphorus in the water. Alum works in two ways. The first way is when added to the lake water, alum reacts with dissolved phosphorus to form an aluminum phosphate precipitate. This precipitate settles to the lake bottom. With low amounts of phosphorus in the lake water, algae production will decrease and water clarity will improve.

The second way alum works is when aluminum hydroxide settles to the lake bottom and forms a layer that acts as a phosphorus barrier. As phosphorus is released from the sediment, it reacts with the alum at the lake bottom and forms a precipitate.

Alum treatment is not a permanent solution to the phosphorus problem but a single treatment can be effective for 7 years or more. Eventually, new sediment settles on top of the alum barrier that can release phosphorus or all the alum is reacted eliminating the barrier to the phosphorus released from the sediments.

Alum is effective in reducing algae in the water, enhancing water clarity, and improving dissolved oxygen. However, alum does not inhibit aquatic macrophyte growth. With improved water clarity, aquatic macrophytes may increase and expand their habitat to deeper waters where sunlight can now penetrate.

Alum treatment is accomplished with specialized boats that apply the liquid chemical at the proper depth and location in the lake. The project cost for applying approximately 77,000 gallons of liquid alum is $90,000.

4 Northern Pike Spawning Area Enhancement

Long Lake has historically provided natural reproduction of northern pike. In recent years, northern pike natural reproduction has been minimal and the lake association has stocked northern pike on a regular basis. One of the goals of the lake association is to improve natural reproduction of northern pike and increase the natural population.

Northern pike prefer to spawn in shallow water with emergent grass type vegetation. An ideal spawning area will be 1 to 2 feet deep with bulrushes or other native emergent vegetation. That water level will need to be maintained from early April through May to provide protection for the young pike fry to grow until large enough to move into deeper water. Adjacent to the spawning area, an area of deeper water and a connection to the main lake will provide access for adult northern pike to get to the spawning area.

Existing wetland areas around Long Lake are commonly too shallow or are vegetated with shrubs and trees. These areas would need to be excavated and re-vegetated with sedges and bulrushes preferred by northern pike for spawning.

The most feasible location for improved northern pike spawning is an area adjacent to the inlet stream and west of the public access. The estimated cost for a 1 acre spawning area featuring a connection to the main lake, shallow spawning area planted with bulrushes and sedges, and an area of deeper water for adult northern pike cover will cost approximately $55,000. Appendix B contains the project cost estimate for a 1 acre site improvement.

5 Lake Management Plan

The goal of the lake planning grants completed in 2003, 2005, and this project completed in 2006 is a lake management plan. As the lake planning grants have been completed, information collected has been used to develop options for implementation. These options or alternatives have been discussed and presented to the lake association at their annual meeting on June 24, 2006. Lake association members provided input to the board of directors to aid in formulating a lake management plan.

5.1 External Phosphorus Reduction

One of the key goals in managing and improving the water quality of Long Lake is reducing external phosphorus sources. External phosphorus sources were identified in the process of studying Long Lake and its watershed. The recommended action items are listed below:

5.1.1 Reduce Agricultural Runoff at West Shore Retreat

The agricultural community has long been known as a key source of sediment and nutrients entering Wisconsin's waterways. Improvements in land management is an important step in controlling these impacts, however, these practices are often viewed as a cost to be born by the agricultural entities. Steps have been taken by lake associations and districts to help fund such improvements.

Recently the field adjacent to West Shore Retreat has been planted in row crops. During significant rainfall events, the runoff from the field flows to the lake, adding phosphorus to the lake.

Improved management practices should be implemented to reduce runoff from getting into Long Lake. Resources are available to the agricultural community to assist with identifying and implementing these improvements. Tom Ward at the Manitowoc County Soil and Water Conservation Department is a local resource available to the Association and the local farmers. He can be contacted and asked to develop a plan for minimizing runoff into the lake. The property owner should also be contacted to develop a working relationship toward providing cleaner water.

There is a potential cost to the lake association to implement improvements that may include payment to the land owner for loss of crop production. This will need to be evaluated on a case by case basis.

5.1.2 Educate Property Owners to Improve Stormwater Runoff

Residential stormwater adds phosphorus to the lake when it collects phosphorus from the soil and vegetation. There are many methods available to reduce phosphorus loading and route clean water to the lake. Some of the methods were outlined in the Phase II lake study. The University of Wisconsin Extension (UWEX) and WDNR have good information available to property owners as well. Appendix C includes copies of documents that can be purchased from the UWEX for educational purposes with the Association members. It is recommended that education of property owners be an annual activity either in a newsletter or in a presentation at meetings. Consider selecting one property each year and do a demonstration project to improve

stormwater management on the property. Highlight this project at a meeting or in a newsletter to inform people of improvements that can be made in their lake association.

5.1.3 Improve Stormwater Channels in West Shore Retreat

The land included in West Shore Retreat has a significant slope. Stormwater channels flowing to the lake are eroded ditches and sediment from erosion is deposited in the lake. Lining the ditches with rip-rap and/or the use of proper vegetative cover will reduce erosion and stabilize the banks. Transporting the water in pipes is another alternative. The lake association will need to work with the property owners to implement these potential improvements.

5.1.4 Reduce Phosphorus from Inlet Stream

The inlet stream is the largest source of external phosphorus loading. Phosphorus from the stream and wetland can be reduced by improving management practices at adjacent agricultural fields. The primary means of these improvements is through the Manitowoc County Soil and Water Conservation Department. UWEX publications are also available for educating the agricultural community as well.

There is a potential cost to the lake association to implement improvements that may include payment to the land owner for loss of crop production. This will need to be evaluated on a case by case basis.

A more costly but more effective means of reducing phosphorus from the inlet stream is to chemically treat the water from the inlet stream with alum to remove phosphorus. This can be done by installing a chemical feed system. The estimated cost for a building, chemical storage tank, chemical feed equipment, etc. is approximately $100,000.

The phosphorus will be removed chemically from the water but will settle in the lake. Alum would be injected in the inlet stream and will react with the phosphorus as it enters the lake. Approximately 200 pounds of phosphorus could be removed each year resulting in an accumulation of solids totaling 0.04 inches per year over 1 acre. This small amount of solids will not impact the lake in the foreseeable future.

Operation costs for the chemical feed system will include power, labor, and alum. The costs for an average year will be $2,000 mainly for chemical. The feed system would only operate when the inlet stream had a significant flow rate. In the high rainfall year of 2004, the inlet stream had flow from early April until mid July. If the chemical feed system was operational during 2004, it would have operated for about 3.5 months.

5.1.5 Develop a Plan for Yard Waste Disposal

Site inspections during the various studies found evidence of yard waste and aquatic vegetation being removed from residential property and deposited in a wetland adjacent to the lake. This practice can result in the organic waste decomposing and phosphorus released back into the lake.

An alternative to consider is arranging for a yard and aquatic vegetation disposal site near the lake that does not runoff into the lake. Residents could transport the waste there themselves or

the lake association could arrange for waste pick up. The cost for this alternative could be zero if a cooperative landowner can be located.

5.1.6 Improve Septic Tank Systems

Studies showed over 2/3 of the lake's private wastewater treatment systems were holding tanks that do not discharge to the groundwater. There were about 16% total systems that were conventional septic tank systems that could potentially impact the lake. While this is a small impact on the lake compared to other phosphorus sources, the lake association could contact property owners with conventional septic systems to upgrade their systems to holding tanks and reduce the amount of wastewater that enters the lake.

5.2 Internal Phosphorus Reduction

The lake planning studies have shown that internal phosphorus loading (phosphorus release from the bottom sediments) is the most significant source of phosphorus in the lake. Reducing the internal phosphorus loading will be essential in lowering the phosphorus concentration in the lake.

5.2.1 Alum Treatment

Alum treatment is the most effective means of internal phosphorus reduction. The chemical treatment will remove phosphorus from the water column and form a barrier at the lake bottom to prevent phosphorus release from the bottom sediments. Similar chemical treatments have been effective for 7 years or more. The cost of alum treatment is approximately $90,000 for a complete lake treatment.

5.3 Northern Pike Spawning Improvement

Northern pike spawning areas can be constructed in existing wetlands by excavating channels, grading the wetland to the proper depth, and planting their preferred vegetation. The lake association has several locations that could be used for northern pike spawning areas. The area adjacent to the public boat landing is available for use at no charge and should be the first site used for northern pike spawning improvements. The cost for these improvements will be approximately $55,000 for a 1 acre area. It is recommended that one site be constructed and monitored for spawning activity before other sites are constructed.

5.4 Aquatic Vegetation Management

Property owners recently expressed concern over the amount of aquatic vegetation in the lake. Excessive vegetation has restricted boating, swimming, and been a nuisance along shorelines. Aquatic vegetation management was not a focus of the prior lake planning grants. The recommended approach to aquatic vegetation management is to do a vegetation survey in the summer of 2007 followed by an aquatic vegetation management plan. To accomplish this task, the lake association should apply for a lake planning grant to assist in funding the study.

The result of the aquatic vegetation management plan may be chemical treatment, mechanical harvesting or other management techniques. This plan should be incorporated into the overall lake management plan.

5.5 Water Quality Monitoring

Lake association members currently measure water quality with a secchi disk. The data collected with this device measures water clarity. The WDNR can work with the association to expand the water quality monitoring to include total phosphorus and chlorophyll. The program is called the Citizen Lake Monitoring Network. The WDNR will provide instructions, sampling equipment and will pay for the laboratory testing. The lake association will need to provide volunteers to collect the samples. It is recommended that this program be pursued and samples be collected at a midpoint of the lake as well as the inlet stream. Lake management is highly dependent on water quality data and having more data over a greater length of time will improve the lake management planning efforts.

5.6 Education

Lake association members and public users can often damage the lake environment without realizing the impact of their actions. These damaging behaviors can be changed through education. Education efforts are not costly but must be consistent and the lake association must be committed to providing education on a regular basis. It is recommended that an education committee be formed in the lake association and education be incorporated into each newsletter and meeting. Topics can include septic systems, runoff management, shoreline vegetation, invasive species, water quality data reporting, and many other topics. WDNR and the UWEX are excellent sources of information and brochures that can be used for education of lake association members. Lake association leaders should be encouraged to attend and be active in the Wisconsin Association of Lakes annual meeting.

5.7 Funding

Many of the key elements in lake management will required a significant financial commitment by the lake association. While there are potential grants available for up to 75% of eligible project costs through the WDNR Lake Protection Grant program, even the remaining 25% will be significantly more than the annual lake association dues that are currently collected. One of the most important tasks facing the lake association as they look to implement the lake management plan will be financial.

If the Long Lake Advancement Association continues to operate under its current status, fund raising will be a major activity of the association. A lake association will not be able to borrow any significant funds for long term projects because there is no guarantee of being able to collect money to pay a loan back. The lake association will need to raise funds and have cash available to pay for projects. Obtaining WDNR Lake Protection Grants will likely depend on having funds available to pay the non-grant portion of any project before grant funds will be awarded. WDNR will not grant funds for projects that will fail because of lack of matching funds. An alternative to funding projects with cash is to form a Lake Protection District and obtain taxation powers. Under this scenario, the Lake Protection District could borrow money to finance a long term project (purchase a weed harvester or construct northern pike spawning area) and recover the funds through property taxes.

The same comments on capital funds apply to operational funding requirements. Weed harvesting or alum treatment on an annual basis will require a budget to be established and funds obtained to pay for yearly expenses.

6 Lake Management Plan Implementation

6.1 Critical Path Issues

The critical path method identifies project tasks and their interdependence in completing the tasks. This method is applied to Long Lake Management Plan because there are several tasks that must be accomplished before other tasks can begin. WDNR expressed that they would not approve chemical treatment of the lake for phosphorus removal unless external phosphorus sources were controlled. Therefore, on the implementation schedule, external phosphorus reduction measures must be implemented prior to treating for internal phosphorus reduction. Likewise, an aquatic vegetation management plan must be completed before WDNR will approve funding for vegetation management activities (weed cutting for example).

Table 6-1
Project Implementation Schedule

Lake Management Activity	Date
Approve Lake Management Plan	10-06
Fund Raising	10-06 – Ongoing
Education	10-06 – Ongoing
Agricultural runoff reduction – begin meetings with property owners and Manitowoc County Soil and Water Conservation Dept.	10-06 – 6-07
Aquatic Invasive Species Grant Application	2-07
Apply for Citizen Lake Monitoring Network program	2-07
Develop yard waste disposal plan	4-07
Lake Protection Grant Application – Pike Spawning and Inlet stream phosphorus treatment	5-07
Begin Citizen Network Monitoring of water quality	5-07
Develop Plan to Improve storm water channels in West Shore Retreat	6-07
Complete Aquatic Vegetation Management Plan	12-07
Lake Protection Grant Application – Aquatic Vegetation Management	5-08
Implement agricultural runoff reduction measures	6-08
Implement storm water channel improvement plan in West Shore Retreat	
Lake Protection Grant Application – Chemical Phosphorus Removal for Internal Phosphorus Reduction	5-09

Appendix A

Inlet Stream Land Use

Photo 1: Bridge Sampling Location

Photo 2: First Driveway Culvert

Photo 3: Upstream View from Bridge

Photo 4: Second Driveway Culvert

Photo 5: Split in Channel

Photo 6: Ephemeral Split

Photo 7: Flowing through Logging Area

Photo 8: NE Corner Flowing through Ag & Res

Photo 9: Second Northeast Corner Ag

Photo 10: Northeast Waterway and Standing Water

Photo 11: Northeast Ag & Res

Photo 12: NE Ag

Photo 13: North End of Wetland

Photo 14: A Drain from Farm North

Photo 15: Drain from Ag

Photo 16: Farm Drainage Channel North

Photo 17: Spawning Northern

Photo 18: Spawning Northern

Photo 19: Ag Land to the South

Photo 20: Ag Land to the South

Photo 21: Northern Spawning Area

Photo 22: Downstream View of Spawning Area

Photo 23: Upstream View of Spawning Area

Photo 24: Potential Spawning Area

Photo 25: Potential Spawning Area

Photo 26: Upstream View

Photo 27: Downstream View

Photo 28: Grass Waterway Flowing to Creek

Photo 29: Grass Waterway Flowing to Creek

Photo 30: Grass Waterway Upstream

Photo 31: Upstream

Photo 32: Upstream

Photo 33: Field Activity North Sample West

Photo 34: Field Activity North Sample East

Photo 35: Second Area to Flow North Sample

Photo 36: South of North Sample

Photo 37: North Sample Looking North

Photo 38: North Sample North

Photo 39: North Sample South

Appendix B

Project Cost Estimates

Long Lake Advancement Association

Cost Estimate for Chemical Feed System

Item	Quantity	Unit	Unit Price	Cost
Chem Feed Building	300	sq. ft.	$150	$45,000
Chem Feed Pump	1	ea	$2,000	$2,000
Chem Storage Tank	1	ea	$15,000	$15,000
Safety Equipment	1	ea	$1,000	$1,000
Chem piping	300	ft	$10	$3,000
Land	1	ea	$5,000	$5,000
Electrical	1	ea	$10,000	$10,000
Site Work	1	ea	$5,000	$5,000
Landscaping	1	ea	$2,000	$2,000
Subtotal				$88,000
Engineering				$17,600
Contingency				$17,600
Total				$123,200

Note: Cost estimate assumes location near access road. If discharge point is significantly farther away, additional cost for piping will be required.

Long Lake Advancement Association

Cost Estimate for Northern Pike Spawning Enhancement
Assume 1 acre site

Item	Quantity	Unit	Unit Price	Cost
Excavation	3000	cu. yd.	$10	$30,000
Clear and Grub	1	acre	$5,000	$5,000
Wetland Plants	3000	ea	$1.5	$4,500
Subtotal				$39,500
Engineering				$7,900
Contingency				$7,900
Total				$55,300

Note: Cost estimate assumes labor for wetland plants is donated by Lake Association Members

Appendix C

Educational Literature Examples

RUNOFF MANAGEMENT PUBLICATIONS ORDER FORM

Wisconsin Department of Natural Resources • Rev. 5/2006

Instructions:
1. Fill in the quantity of each publication you're ordering on the blank line.
2. Fill in your name, address and phone number on the opposite side of this sheet.
3. Fold and tape so that Runoff Management Publications-WT/2 mailing address faces out.
4. Stamp and mail!

GENERAL RUNOFF PUBLICATIONS

___ Brown Water, Green Weeds, fact sheet, UWEX GWQ003*, DNR WT-459
___ What is a Watershed?, brochure, USDA, DNR WT-174
___ Reining in Polluted Runoff: Wisconsin moves from the law to the land, booklet, DNR CE-4007
___ Wonderful, Wacky Water Critters, UWEX GWQ-023, DNR WT-513
___ Water Action Volunteers activity packet, 1995, DNR WR-388, UWEX GWQ018*
___ Volunteer Monitoring Fact Sheet Packet, UWEX GWQ026*
___ Water Activities to Encourage Responsibility, booklet 46pp. DNR WR-324
___ Wisconsin's Runoff Rules, fact sheet, DNR
___ Priority Watershed Projects in Wisconsin, map, updated yearly.
___ Conservation Easements, DNR WT-549
___ Paying for the Past, Investing for the Future, booklet, DNR WR-259

URBAN RUNOFF

___ Polluted Urban Runoff: A Source of Concern, UWEX GWQ020*, DNR WT-483
___ Cleaning Up Stormwater Runoff, UWEX GWQ016*, DNR WT-532
___ Storm Sewers--The rivers beneath our feet, fact sheet, UWEX GWQ004*, DNR WR-460
___ Storm Drain Stenciling: How you can prevent water pollution, fact sheet, UWEX GWQ015*, DNR WT-531
___ Stormwater Ponds, booklet, UWEX GWQ017*, DNR WT-762
___ Storm Water Basins: Using natural landscaping for water quality & esthetics, UWEX GWQ045*, DNR WT-824
___ Car Care for Cleaner Water, UWEX GWQ019*, DNR WT-533
___ The Green(er) Machine, (topic: cars) booklet, DNR IE-053
___ Where to Go With the Snow, brochure, DNR WR-154
___ Pet Waste and Water Quality, fact sheet, UWEX GWQ006*, DNR WT-534

Yard Care and the Environment Series, fact sheets, UWEX

___ Lawn and Garden Fertilizers, GWQ002*, DNR WT-528
___ Lawn and Garden Pesticides, GWQ011*, DNR WT-529
___ Rethinking Yard Care, GWQ009*, DNR WT-526
___ Lawn Watering, GWQ012*, DNR WT-530
___ Lawn Weed Control, GWQ013*, DNR WT-527
___ Shoreline Plants and Landscaping, UWEX GWQ014*, DNR WT-461
___ Managing Leaves & Yard Trimmings, UWEX GWQ022*, DNR WT-490

___ Wisconsin Native Plant Sources and Restoration Consultants, booklet, UWEX GWQ041*, DNR WT-802
___ Rain Gardens: A household way to improve water quality in your community, brochure, UWEX GWQ034*, DNR WT-731
___ Rain Gardens: A How-To Manual for Homeowners (31 pp, limit one per customer) DNR WT-776, UWEX GWQ037*
** Wisconsin Rain Garden Educator's Kit CD, DNR WT-800, **Cost: $10.00** See sidebar for ordering information.

Technical Stormwater Documents

___ Does Your Construction Site Need a Storm Water Permit? fact sheet, DNR WT-811
___ New State Stormwater Rules: What municipalities need to know about public outreach & education, brochure, DNR WT-839, UWEX GWQ 046*
___ Authorized Local Program for Storm Water Construction Site Permitting, brochure, DNR WT-812
___ Sources of Pollutants in WI Stormwater, 1993, tech. paper, DNR
___ Storage Pile Best Management Practices, tech. binder, DNR WT-468

RURAL RUNOFF

___ Manure Management Choices, UWEX GWQ024*, DNR WT-518
___ Farmland Conservation Choices, UWEX GWQ025*, DNR WT-520
___ Residue Management Choices, UWEX GWQ029*, DNR WT-538
___ Agricultural Spills and How to Handle Them, booklet, DNR RR-687
___ A Guide to Agricultural Conservation Easements, booklet, DNR WM-300
___ Conservation on Rented Land, UWEX*
___ Farm & Residential Petroleum Storage Tanks: An overview of issues and regulations in Wisconsin, booklet, UWEX GWQ030*
___ Permits for Concentrated Animal Feeding Operations (CAFOs): What you need to know, brochure, DNR WT-729
___ Wisconsin's Runoff Rules: What farmers need to know, factsheet, DNR WT-756

SHORELAND/LAKES MANAGEMENT

___ A Fresh Look at Shoreland Restoration, UWEX GWQ027*, DNR FH-429
___ Protecting & Restoring Shorelands, fact sheet, UWEX GWQ038*, DNR WT-748
___ Protecting Our Living Shores, fact sheet, UWEX GWQ039*, DNR WT-764
___ Protecting Your Waterfront Investment: 10 Simple Shoreland Stewardship Practices, booklet, UWEX GWQ044*, DNR WT-821 2005
___ Sensible Shoreland Lighting: Preserving the beauty of the night, booklet, UWEX GWQ031*, DNR FH-431

WI COASTAL NONPOINT POLLUTION CONTROL PROGRAM

___ Down to the Shoreline, booklet, DNR WR-413
___ Shipshape: A guide to reducing pollutants for marinas, boaters, and other coastal customers, booklet, DNR CE-4002

VIDEOS

___ **It All Adds Up** Video Series: (can also be borrowed from most Land Conservation Dept. or DNR Madison or regional offices)
  ___ Taking Action for Cleaner Water--series overview, 22 min.
  ___ Conservation in the '90s, 19 min.
  ___ From Barnyard to Field, 17 min.
  ___ Streamside Protection, 14 min.
  ___ From Curb to Stream, 19 min.

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*UW-Extension Publications
1-877-947-7827 (toll free)

Several UW-Extension publications are also available to download from their Internet sites:
http://clean-water.uwex.edu/pubs/ and
http://www1.uwex.edu/ces/pubs/index.cfm

** For the *WI Rain Garden Educator's Kit*, send $10 check payable to "UW-Extension" to:
Rain Garden Educator's Kit
Milwaukee County UWEX
932 South 60th Street
West Allis, WI 53214-3346
Ph: 414-290-2400

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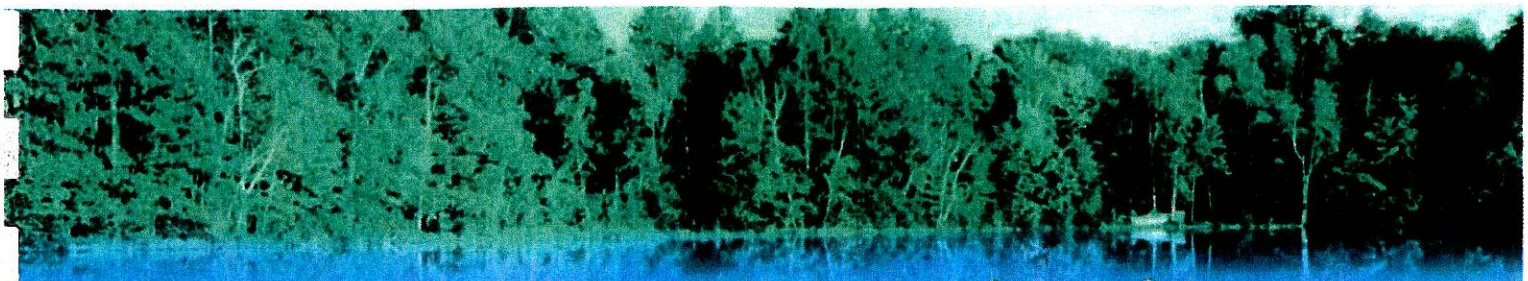
Runoff Management Publications--WT/2
WI Department of Natural Resources
P.O. Box 7921
Madison, WI 53707



The Shoreland Stewardship Series Number 1

Which Tradition?

Owners of shoreland property often bring with them traditional landscaping ideas centered on the conventional residential yard. Sometimes that means a manicured lawn extending to the water's edge. Unfortunately, that carpet of green can cause serious problems for the adjacent lake.

A natural shoreline is a bridge between two worlds. Studies show that there can be as much as 500% more diversity of plant and animal species along a natural shoreline compared to upland areas. When we change a natural shoreline to a lawn, we damage more than that rich mosaic of life. We could also be contributing to water pollution. Building a home and establishing a lawn can cause seven times the amount of phosphorus and 18 times the amount of sediment to enter the water compared to a natural shoreline.

But lakeshore property owners can help prevent these negative effects by rethinking the idea of tradition. Instead of transplanting urban traditions to the natural lakeshore getaway, why not retain the traditional Wisconsin lakeshore? Leave a buffer of natural vegetation along the shore!

Compared to a conventional residential yard, a naturally landscaped yard can be better for the waterway and less work to maintain.

A Fresh Look at Shoreland Restoration

Shoreland landscaping, as its name implies, is the practice of restoring the healthy transition between land and water. Typically, a plan will include a shoreland buffer zone—an area of native vegetation along the water's edge. It can extend both onto the land and into the water. The goal of creating or restoring native vegetation in a buffer zone is to bring back the ecological habitats that are reduced or lost by traditional lawns.

Shoreland restoration differs somewhat from the traditional gardening approach. Rather than modifying the site with fertilizers and continuous, long-term cultivation, as is often necessary when you plant a garden, this approach attempts to re-establish native vegetation that once grew with the existing soil, moisture and sunlight conditions. Once established, native plants are superior to non-native plants for the specific site conditions found along your shoreline.

Vegetative buffers can return or maintain many desirable features to your shoreline. At a minimum, shoreland buffers present a seasonal array of colors, textures, aromas, and wildlife activity. They can maintain or restore the natural qualities that keep us so strongly attracted to our living shores.

A Fresh Look at Shoreland Restoration

What is the best way to restore shoreland to protect water and wildlife? There are a number of ways, depending on the site characteristics and desires of the property owner. To the right are some points to consider:

No-Mow Zone

Creating a buffer zone by simply not mowing along the shoreline is the easiest and least expensive method. Turf grasses will grow 12-24 inches tall before going to seed. Creating a curving edge that separates the buffer from your lawn and any pathways to the water will also give your shoreland a pleasing, natural appearance. Over time, shrubs and trees will naturally fill in and provide a more diverse plant cover.

Keep it in the Family

Native wild flowers, ground covers and trees along the shore add seasonal color and diversity. Native vegetation, once established, will discourage undesirable, exotic species such as purple loosestrife from overtaking your property and can deter Canada geese from loitering on your lawn. Properly placed, native plants will frame views, muffle the noise of lake activities, protect water quality and wildlife, and restore the natural beauty of native shorelands.

Roll Up Your Sleeves!

"Do-it-yourselfers" no longer have to wonder where to start. Many local nurseries and garden centers carry native plant stock and can recommend the best plants for your site. Local University of Wisconsin–Extension or Department of Natural Resources offices, and some county zoning and land conservation offices also have excellent information on how to go about the job.

Hire a Pro

Shoreland restoration is a rapidly growing field among landscape professionals. Combined with the growing availability of native plant stocks, many landscape nurseries are now positioned to provide waterfront property owners with full-service shoreline restorations. Waterfront property owners can expect shoreland restorations to include a detailed site analysis, a resulting site plan developed with the owner, and professionally installed (and even maintained) plantings.

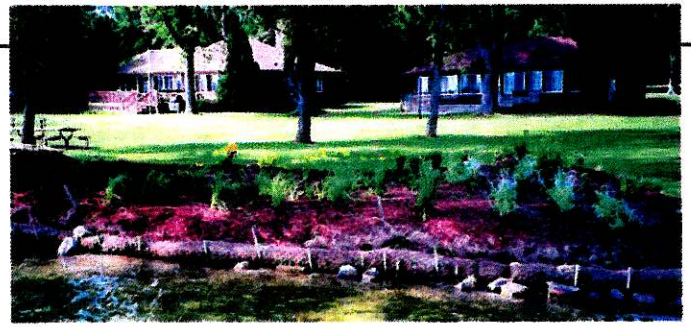
Reviving your shore

Restoring all the functions of natural buffers takes time and effort. By far the best solution is to protect natural shorelands whenever possible. This includes leaving logs and beneficial vegetation in the water as well as protecting upland areas from mowing and other continuous disturbances that compact soil or eliminate ground cover plants, shrubs and trees.

When looking to create a view of the lake, consider only selective removal of branches, trees, shrubs and ground cover. A path with an opening for your dock or swimming area may be all that you need. As times change and your use of the lake evolves, you may consider letting vegetation spread and grow on its own. This option requires less maintenance and provides additional habitat benefits.

In the water, aquatic vegetation can quickly recolonize sites previously cleared or disturbed, once the disturbance is eliminated or reduced. Consider docking or boating activities that allow portions of the shallow water areas to remain relatively undisturbed. If possible, observe what is growing in the shoreland zone at other undeveloped sites around your property. These lush, undeveloped sites provide good examples to follow when restoring your own shoreline.

Much can be done to enhance the natural characteristics of areas that are currently maintained as mowed lawns. However, areas of full sun and well-established lawns often require substantially more effort to restore. In these areas, expect serious turf competition. A technique called accelerated recovery can be used on these sites to jump-start natural vegetation. This approach may include controlling the existing turf and planting plants, rootstock or live stakes. For information on the process of accelerated recovery, refer to *Lakescaping for Wildlife and Water Quality* (listed on the back of this publication).



A well-planned landscape with natural vegetation and fiber logs along the shore can reduce soil erosion, preserve the views and allow access to the water.

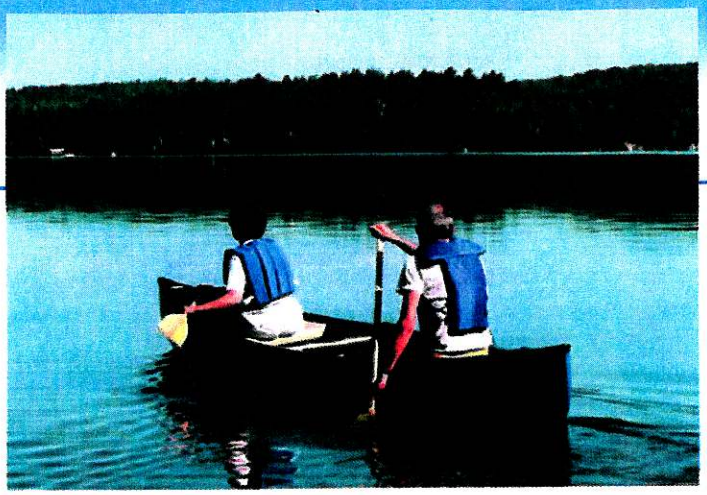
If the area is shaded or very damp, remnants of natural vegetation are likely present and will begin to re-establish if the site is left alone. Eliminating mowing, foot traffic or other disturbance in these areas may be all that is needed to establish the process of natural recovery.

Nature's World Wide Web

Perhaps the most compelling reason for restoring our shorelands to their natural splendor can be found among the living plants and animals. Although shorelands are relatively small parcels of land, they host an incredible number of species which depend on us to protect their habitat.

Quite often, our attention is focused on the larger, more visible members of the lake community, such as deer and eagles. However, a complete view of the lake environment includes the smaller but more numerous members, which provide the foundation for those higher up the food chain. Tiny plants and animals called plankton provide food for insects, which in turn become food for fish, frogs and birds. The living members of our lakeshores exist in an interdependent web. Removal of one will likely affect the lives of others. Indeed, when shorelands are altered or cleared, this whole idyllic scene undergoes subtle changes that are hard to detect at first, yet the effects become devastatingly obvious as time goes by. ■

A Fresh Look at Shoreland Restoration



Our canoe glides over the shallow waters of a bay, passing by dozens of saucer-sized nests excavated in the sandy bottom. Each nest houses bluegills guarding the eggs that hold their unborn young. The distinctive cry of an eagle fills the air and a great blue heron dips its beak into the clear water. A splash along the shore reveals a family of otters bobbing along the lakeshore in search of entertainment and a meal. The canoe continues slicing through the calm waters, past a log crowded with painted turtles competing for space to catch the morning sun. As the sun rises higher, the trilling of American toads gives way to the banjo-like strum of green frogs seeking attention from suitable mates. A gentle popping sound is evidence of fish inhaling a breakfast of insects off the water's surface. Near the shore a cluster of delicate blue flowers emerges on stalks surrounded by the glossy leaves of pickerelweeds. Beyond this splash of color, a stand of bulrushes and cattails marks the meandering shoreline. The breeze softly rustles through the maples that overlook the bay.

Sights and sounds such as these reflect the spectrum of life typically found on a healthy lake or river. Here, ecological systems provide food, clean water and habitat. Fortunately, waterfront property owners can restore or maintain many of the ecological functions of their lakeshore if a shoreland buffer zone is established or maintained. These areas not only protect our lakes, they can actually solve many problems for homeowners. As an added bonus, this rich mosaic of vegetation, water and wildlife creates a highly desired landscape that inspires our affections and increases property values. Our lakes are a place to live or vacation—for us they are a chosen landscape. For the wildlife that live there, however, our lakes are their only home. ■

Additional Resources

Lakescaping for Wildlife and Water Quality—Minnesota Department of Natural Resources, 1-800-657-3757
Life on the Edge: Owning Waterfront Property—Wisconsin Lakes Partnership, (715) 346-2116
Rain Gardens (GWQ034)—UWEX Publications, (877) WIS-PUBS (947-7827) *or* (WT- 731-2002)—Available from local DNR service centers
The Water's Edge: Helping fish and wildlife on your waterfront property (FH-428-00)—Available from local DNR service centers
Through the Looking Glass: A Field Guide to Aquatic Plants (Item No. A12)—North American Lake Management Society, (608) 233-2836

Shoreland Stewardship Series:
This is the first fact sheet in the shoreland stewardship series. The entire series is available from the county UW-Extension offices, Extension Publications (1-877-947-7827), or Wisconsin DNR service centers. It is also available online at http://clean-water.uwex.edu/pubs/shore.

A publication of University of Wisconsin-Extension, Wisconsin Lakes Partnership, Wisconsin Department of Natural Resources, the Wisconsin Association of Lakes, and The River Alliance of Wisconsin. The Wisconsin Department of Natural Resources acknowledges the Great Lakes Protection Fund and the Environmental Protection Agency's Region V (through Section 319 of the Clean Water Act) for their involvement in the partial funding of this publication.

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DNR PUB-FH 429 2003
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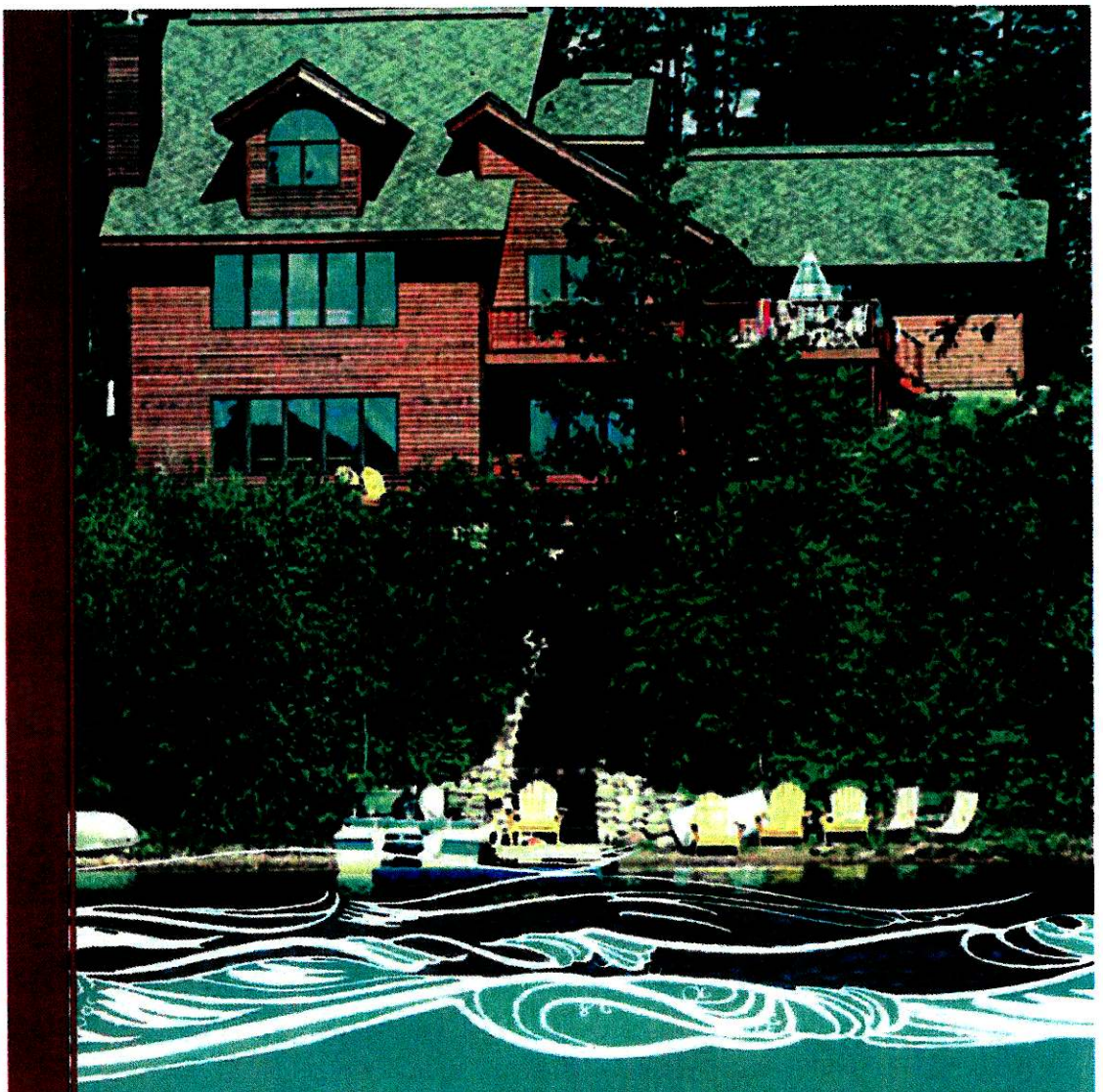
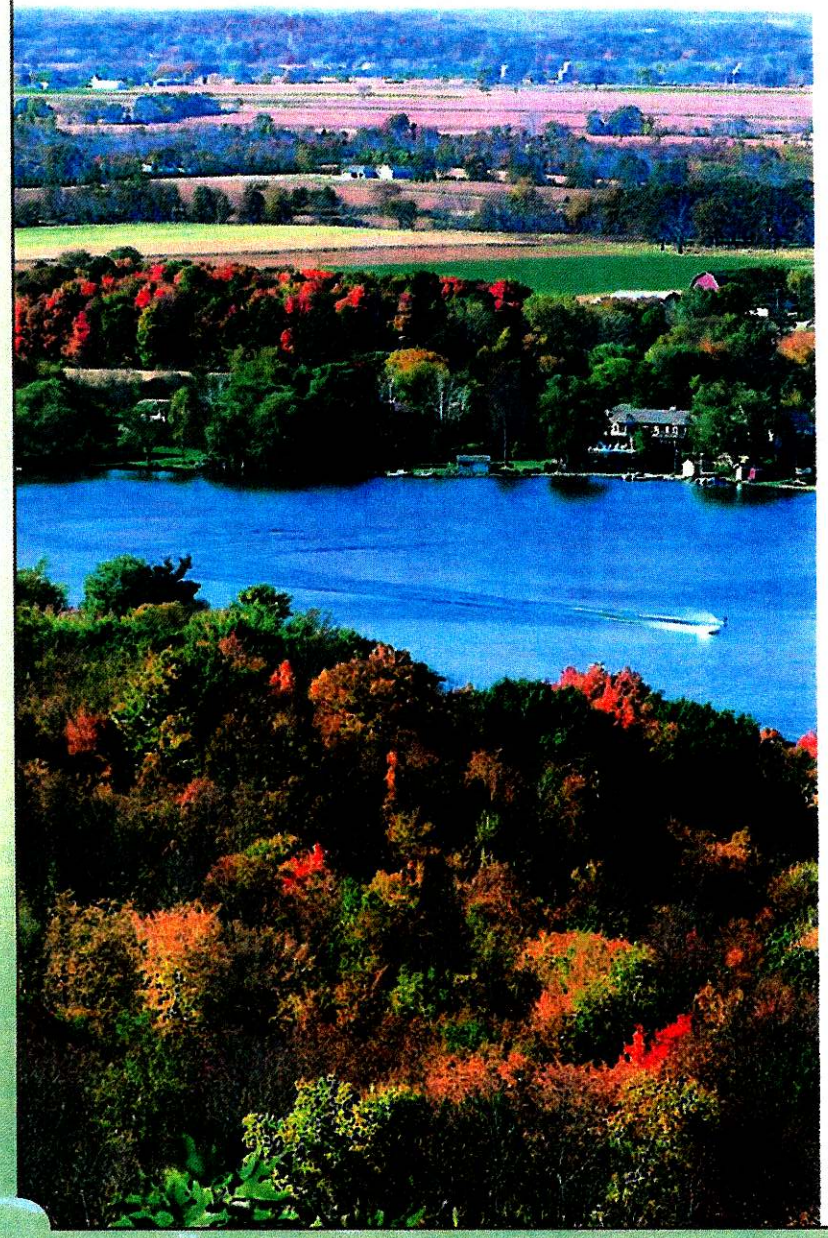
UW Extension

The Wisconsin Lakes Partnership



Protecting Your WATERFRONT Investment

10 Simple Shoreland Stewardship Practices



HEALTHY WATERSHEDS MAKE HEALTHY LAKES AND HIGHER PROPERTY VALUES

The quality of our lakes and streams is ultimately a reflection of how we take care of our land.

A watershed is the land area that drains to a lake or stream. Waterfront property owners, inland residents, recreational users, agricultural producers and other businesses all can play a positive role in maintaining and improving the water quality of our lakes and streams.

How will shoreland stewardship practices affect your pocketbook? A recent study of over 1,000 waterfront properties in Minnesota found that when all other factors were equal, properties on lakes with clearer water commanded significantly higher property prices.[1] In other words, people prefer clean water and will pay more to live on lakes with better water quality. What you and your neighbors do to sustain or improve water quality will improve resale potential. On the other hand, if water quality is degraded, lower property values could result.

This publication was developed for people who live on developed waterfront lots. It describes three types of opportunities to protect your property investment:

Curb Pollutants

Curb pollutants at their source – fertilizers, household toxins, eroding soils, malfunctioning septic systems.

Cut Runoff

Cut the amount of runoff that picks up pollutants and carries them to the waterway by minimizing the hard surfaces that create runoff.

Capture & Cleanse

Capture and cleanse pollutant-carrying runoff before it reaches the waterway – with shoreland buffers, rain barrels or rain gardens.

Simple Step #1:

Choose zero-phosphorus fertilizer

If you must fertilize, avoid fertilizers that contain phosphorus. Remember, it's phosphorus that accelerates algae growth in our lakes and rivers. Most lawns and gardens already contain adequate – and often excessive – amounts of phosphorus. Based on a study of 236 lawns sampled in Dane County, the average available soil phosphorus concentration was approximately four times higher than the amount needed to maintain a healthy lawn.[2] Consider this – one pound of phosphorus in runoff can result in 500 pounds of algae growth![3]

Phosphorus is an essential nutrient for plants. However, when too much phosphorus makes its way into our lakes and streams it promotes the rapid growth of weeds and algae and decreases water clarity, often turning lakes green. Decaying algae also depletes oxygen in the water, so that fish can no longer thrive. Human activities contribute a great deal to the amount of phosphorus that enters a lake or stream.

WHEN YOU'RE FERTILIZING THE LAWN, REMEMBER, YOU'RE NOT JUST FERTILIZING THE LAWN.

If you follow the instructions on a bag of fertilizer containing phosphorus, you may be adding over 50 pounds of phosphorus to a half-acre lot each year.[4]

Some communities have prohibited the use of phosphorus fertilizer around lakes and streams. *Check local ordinances.*

Simple Step #2:

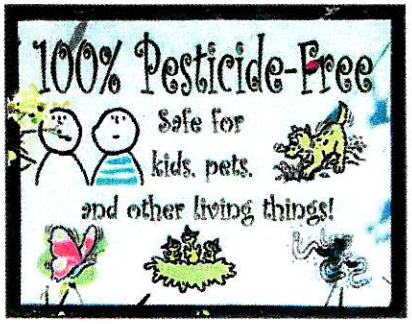
Properly dispose of household hazardous wastes

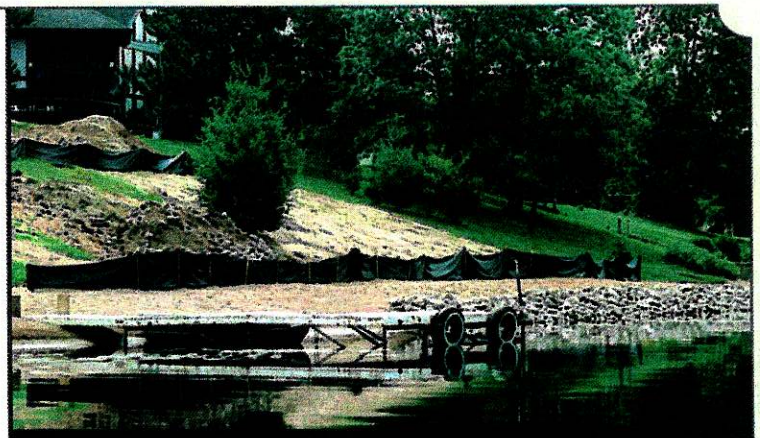
Do not pour old oil or pesticides into the ditch or wash paint brushes at the end of your driveway. Where do these pollutants end up? In our groundwater, lakes and streams![5] Gasoline, oil, solvents, old paints, thinners, fertilizers, pesticides, cleaners and many other products need to be disposed of properly. Some counties offer Clean-Sweep programs where you can take these products for safe disposal. To find out about local options, contact your county Land and Water Conservation Department. You can find their contact information at www.wlwca.org/Pages/LCDWeb.html or in the phonebook.

IF YOU WOULDN'T DRINK IT, DON'T DUMP IT!

EVEN BETTER, MINIMIZE YOUR USE OF TOXIC PRODUCTS.

See your county UW-Extension family living educator for alternatives to toxic household products.





Sediment fences serve as a last resort for preventing construction site erosion, but the best policy is to leave the natural shoreline intact.

Simple Step #3:

Minimize erosion

When you're planning a construction project, follow these steps to protect the lake:

- ***DEVELOP AN EROSION CONTROL PLAN.***
  This publication will help you: **Erosion Control for Home Builders,** (clean-water.uwex.edu/pubs/sheets/erosio.pdf). It describes how to preserve existing vegetation, build an access drive, install a sediment fence, protect soil piles, clean up sediment and replant the area.

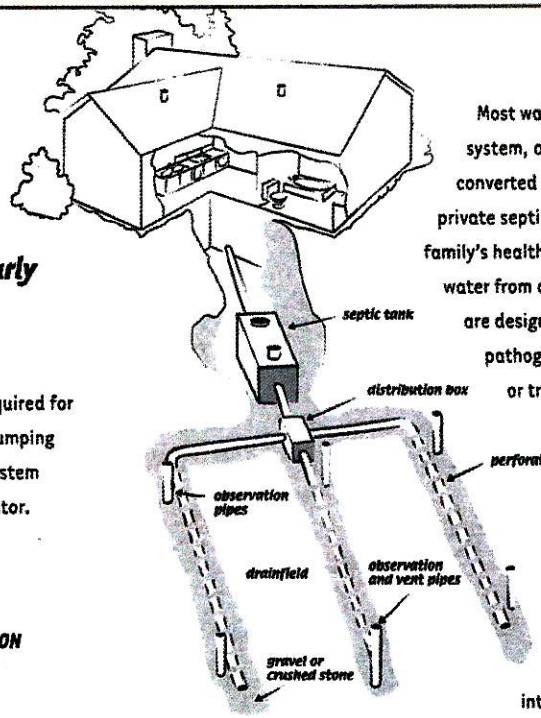
- ***FENCE THE CONSTRUCTION AREA TO LIMIT CONSTRUCTION ACTIVITY TO THE NECESSARY AREA OF THE SITE.***
  This approach reduces erosion and soil compaction. In fact, this approach can reduce the amount of sediment and phosphorus delivered to a lake by 18-fold.[6]

- ***DIVERT RUNOFF AROUND DISTURBED AREAS TO MINIMIZE EROSION.***

- ***AFTER CONSTRUCTION, ESTABLISH VEGETATION RIGHT AWAY.*** The less time bare soil is exposed, the less erosion you will create.

Simple Step #4:

Inspect and maintain your septic system regularly



- ***PUMP OR INSPECT YOUR SEPTIC SYSTEM ONCE EVERY THREE YEARS.***[7] Just like owning a car, there is maintenance, inspection and service required for septic systems in order to prevent premature failure. Inspection and pumping costs ($50-100) are minor compared to the cost for installing a new system ($3,000-$8,500).[8] Hire a licensed pumper, plumber or plumbing inspector.

- ***DIVERT SURFACE WATER AWAY FROM THE DRAIN FIELD.***

- ***AVOID DRIVING OR PARKING ON THE DRAIN FIELD TO PREVENT COMPACTION OF THE SOIL.***

- ***KEEP THE ROOTS OF TREES AND SHRUBS AWAY FROM THE DRAIN FIELD PIPES TO AVOID OBSTRUCTED DRAIN LINES.***

- ***WHEN A REPLACEMENT SYSTEM IS NEEDED, CONSIDER AEROBIC DIGESTERS, RECIRCULATING SAND FILTERS,*** and other effluent filtration systems that may do a better job of treating wastes and may be designed to remove nutrients and other contaminants.

- ***AVOID PUTTING ANY OF THE FOLLOWING MATERIALS DOWN THE DRAIN OR TOILET BECAUSE THEY MAY CLOG THE DRAIN FIELD:*** Cooking grease, oils, coffee grounds, cigarettes, facial tissues, paper towels, sanitary napkins, tampons or disposable diapers.[9]

- ***AVOID USING A GARBAGE DISPOSAL.*** Compost your vegetable scraps instead.

- ***CONSERVE WATER.*** Use low-flow toilets, faucets and showerheads to reduce the volume of water the system must filter and absorb.

Most waterfront homeowners in Wisconsin utilize a septic system, although some densely developed lakes have converted to public sanitary sewer systems. Owners of private septic systems have a responsibility to protect their family's health, as well as to protect the surface and groundwater from contamination. Properly functioning systems are designed to remove most disease-causing human pathogens, but generally are NOT designed to remove or treat water-soluble nutrients or pollutants.[10]

The more water and material that goes into your septic system, the more that comes out into your drain field. Recent research at the University of Wisconsin-Stevens Point on septic systems located in sandy soils has found both phosphorus and nitrates migrated underground over 150 feet from drain fields. If these nutrients seep underground into the lake, aquatic plant growth and algae blooms are likely results.

Malfunctioning systems are especially harmful. Effluent from failed systems can result in direct contamination of well or surface water and could cause serious human health risks. Reasons for septic system failure may include advanced age, overloading, poor site placement and/or poor maintenance.

EVIDENCE OF A MALFUNCTIONING SEPTIC SYSTEM:

- Sewage backing up in the basement or drains.
- Ponded water or wet areas over the drain field.
- Bright green grass over the drain field.
- A dense stand of aquatic plants along only your shoreland.
- Sewage odors.
- Bacteria or nitrate in nearby well water.
- Biodegradable dye flushed through your system is detectable in the lake.

Runoff is excess water that comes from hard surfaces like roof tops, driveways, parking areas, sidewalks, decks and compacted soils. Runoff water washes fertilizer, eroded soil, car fluids and other pollutants into our lakes and streams. To reduce runoff, let water soak into the ground.

Simple Step #5:

Reduce the hard surfaces like rooftops and driveways on your property

When considering additions, decide whether the extra space is really needed. Perhaps you could build up instead of out. Also consider runoff from decks, sidewalks and parking areas. Gravel areas quickly become compacted and are nearly as impervious as paved surfaces. Pervious pavers are an option for areas that do not have heavy traffic.

WHICH LOT WILL CREATE MORE RUNOFF?

Simple Step #6:

Plant trees and shrubs or protect your wooded areas

Wooded areas develop a thick understory of small shrubs and plants and a duff layer. This duff protects soil from rain impact and absorbs water. Root systems keep the duff in place, not in the lake. Lawns absorb little rainfall. A recent Wisconsin study found that lawns created much more runoff than wooded areas. As a consequence, the runoff from lawns carried eight times more phosphorus to the lake than the runoff from similar sized wooded areas.[11]

LAWNS CREATE MORE RUNOFF BECAUSE:

- Grading a lot removes the natural divots where water naturally ponds and has time to soak in.
- Heavy equipment, vehicles, lawn mowers and foot traffic compact the soils during and after construction.
- Removal of trees and shrubs causes more rain to hit the ground and run off rather than landing on leaves and branches.

Allowing water to soak in rather than run off your property filters out pollutants and replenishes our groundwater.

Simple Step #7:

Direct downspouts onto your lawn or landscaping, not onto hard surfaces

Simple Step #8:

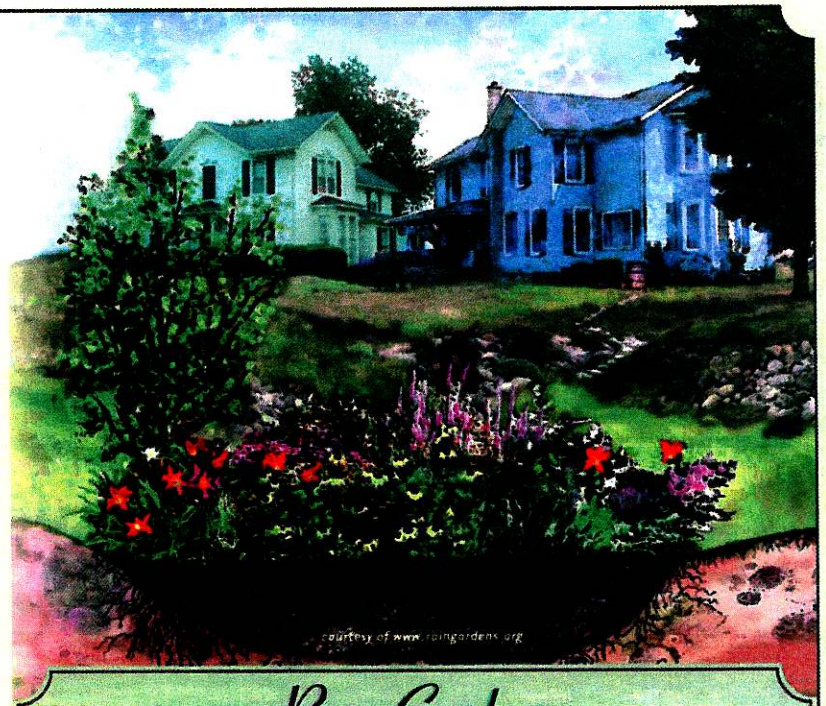
Install a rain barrel Collect water from your rooftop to water your yard during dry periods. The barrel should be covered to keep out silt, leaves and insects.

Simple Step #9: Build a rain garden

Rain Gardens: A How-To Manual for Homeowners provides easy-to-follow instructions to create a rain garden providing guidance on the following questions:

- ***Where is a good spot in my yard for a rain garden?***
- ***How big should it be?***
- ***What plants would work well?***
- ***What do I need to do after it's planted?***

This publication is available through county UW-Extension offices, and at: clean-water.uwex.edu/pubs/raingarden



Rain Gardens - a beautiful solution to water pollution

HOW DOES A RAIN GARDEN WORK?

Rain gardens are just what they sound like – areas that soak up rain water during wet times and serve as a beautiful garden all the time. They are landscaped areas planted to wildflowers and other native vegetation to replace areas of lawn. The gardens fill with a few inches of water and allow the water to slowly filter into the ground.[12] The plants in the rain garden act as filters for the rain water, helping to slow the runoff and allowing it to soak into the ground rather than flowing out into storm sewers, ditches, or drainage ways on the way to lakes and streams. Keeping rain on your property, where it naturally belongs, will help solve some of our water pollution problems.

In addition to the benefits they provide to our water supply, rain gardens also provide wildlife habitat for birds, butterflies and dragonflies and are an aesthetically pleasing addition to any property.

Simple Step #10:

Protect or restore your shoreland buffer

If you have native vegetation along your shoreline, consider yourself and the local wildlife fortunate. A mature native buffer represents many years of nature at work and discourages undesirable, exotic plants and animals while attracting songbirds, butterflies, turtles and frogs.

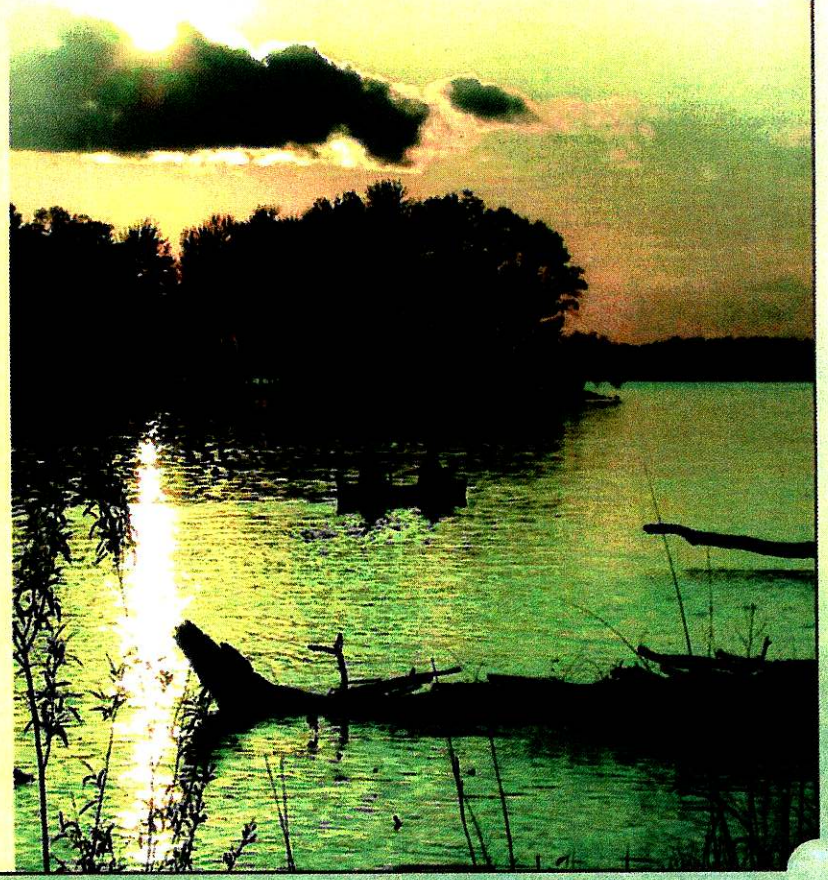
If you have lawn to the water's edge, a simple, no-cost way to get started in restoring your shoreland is to stop mowing next to the water. Seeds in the soil will germinate and valuable native plants will begin to reappear.

If you have lawn to the water's edge and would like to play a more active role in restoring your shoreland, you can replant native trees, shrubs, grasses and wildflowers to attract songbirds and butterflies. The main area where water runs off your property is the best location to start planting to improve water quality. You can create a natural, appealing waterfront landscape while eliminating expensive and time-consuming lawn care. The publication **Protecting and Restoring Shorelands** (clean-water.uwex.edu/pubs/shore/protectrestore.pdf) will help you think about what benefits you want from your buffer and the size needed to achieve these. For help designing and planting a natural shoreland, contact your County Land and Water Conservation Department listed at www.wlwca.org/Pages/LCDWeb.html or a local nursery that specializes in native landscapes. Some counties have cost-share programs to help restore your shoreland.

Natural shorelands contain a lush mixture of native grasses, flowers, shrubs and trees that help to filter polluted runoff and provide important habitat for animals in the water and on the land. The trees, shrubs and plants not only help shelter and create privacy for both the homeowner and the lake user, but may also act as a noise buffer. Larger areas of natural shoreline provide more benefits. However, any amount of natural shoreline is better than none.

Flourishing shorelands provide some of the most effective protection for the lakes and streams of Wisconsin.

When trees and branches fall in the water, they form critical habitat for tiny aquatic organisms that feed bluegills, turtles, crayfish and other critters. Additionally, a fallen tree is like a dock for ducks and turtles, as well as serving as a perch for kingfishers, osprey and songbirds.



Endnotes

1 Krysel, Charles et al. June 2003. Lakeshore property values and water quality: Evidence from property sales in the Mississippi headwaters region. www.mhbriverwatch.dst.mn.us/publications/lakeshore_property.pdf

2 Bennett, E.M. 2003. Soil phosphorus concentrations in Dane county, Wisconsin, USA: An evaluation of the urban-rural gradient paradigm. Environmental Management 32, no. 4: 476-487 and Bennett, E.M. personal communication 4/13/05.

3 Henderson, Carrol L. et al. Lakescaping for Wildlife and Water Quality. Minnesota Department of Natural Resources, p. 27.

4 Calculated by Kate Demorest, UW-Stevens Point.

5 How we are "killing" our local lakes and wetlands with leaves and grass clippings. Ramsey-Washington Metro Watershed District, Maplewood, MN

6 Wisconsin Department of Natural Resources memo from John Panuska 11/6/94. Graphic by Wisconsin Lakes Partnership

7 Department of Commerce, COMM 83

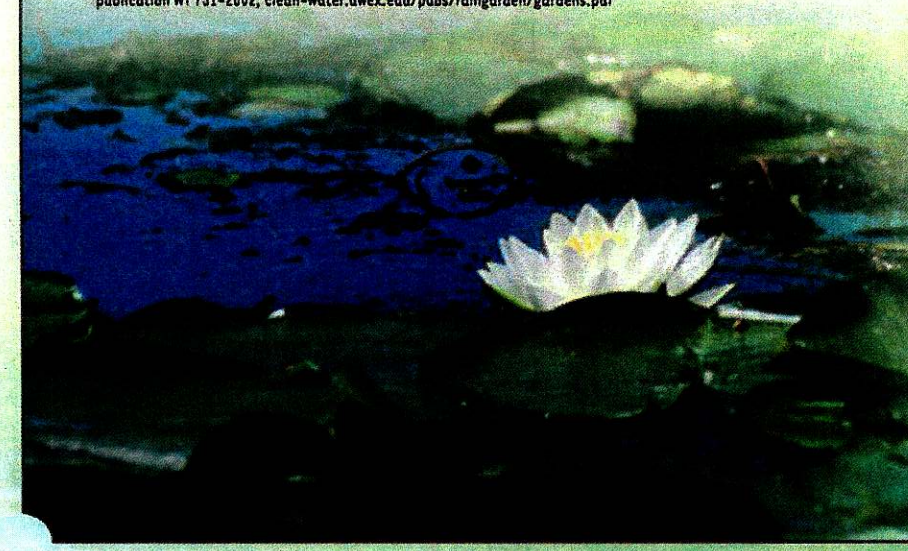
8 Portage County Onsite Waste Specialist, personal communication 8/5/04.

9 Life on the Edge. 7th ed. Dresen, Michael and Robert Korth. 2003. University of Wisconsin-Extension, College of Natural Resources, UW-Stevens Point.

10 Pierce, Bryan; Kraft, George and Paul McGinley. August 2003. Guarding Our Groundwater. UW-Extension. www.uwex.edu/ces/shoreland/modules.htm

11 Graczyk, David J. et al. 2003. Hydrology, Nutrient Concentrations, and Nutrient Yields in Nearshore Areas of Four Lakes in Northern Wisconsin, 1999–2001. p 41, USGS Water Resources Investigation Report 03-4144. water.usgs.gov/pubs/wri/wrir-03-4144/

12 Rain Gardens: A Household Way To Improve Water Quality in Your Community by University of Wisconsin-Extension, publication GWQ034, and Wisconsin Department of Natural Resources publication WT 731-2002, clean-water.uwex.edu/pubs/raingarden/gardens.pdf



In addition to this booklet and the resources below, we encourage you to join your local lake or river association, Wisconsin Association of Lakes, River Alliance of Wisconsin or other conservation groups. Additional resources, training and workshops may also be available through your county UW-Extension or Land and Water Conservation office, or local DNR office.

Additional Information:

GENERAL REFERENCES:

The Living Shore. A 17-minute video showing the importance of leaving a natural 'buffer zone' between the lake and lake owners' dwellings, and providing information about selecting and planting shoreline plants. UW-Extension and University of Minnesota Extension. Phone: 800-542-5253

Life on the Edge... Owning Waterfront Property. UW-Extension Lakes Program. Comprehensive guide for waterfront property owners.112 pages. Phone: 715-346-2116

PHOSPHORUS

Phosphorus in Lawns, Landscapes and Lakes. 2004. Minnesota Department of Agriculture and partners. Phone: 651-296-6121 www.mda.state.mn.us/appd/ace/phosphorusguide.pdf

Understanding Lake Data. 2002. UW-Extension and Wisconsin DNR (G3582) www.dnr.state.wi.us/org/water/fhp/lakes/under/

Brown Water, Green Weeds. 2001. UW-Extension (GWQ003) and Wisconsin DNR (WT-459-92) clean-water.uwex.edu/pubs/sheets/brownwater.pdf

FERTILIZER

Lawn & Garden Fertilizer. 1999. UW-Extension (GWQ002) and Wisconsin DNR (WT-528-99) clean-water.uwex.edu/pubs/yardcare/lgfert.pdf

Rethinking Yard Care. 1999. UW-Extension (GWQ009) and Wisconsin DNR (WT-526-99) clean-water.uwex.edu/pubs/yardcare/rethink.pdf

EROSION CONTROL AND RUNOFF

Erosion Control for Homebuilders. 1996. UW-Extension (GWQ001) and Wisconsin DNR (WT-457-96) clean-water.uwex.edu/pubs/sheets/erosion.pdf

SEPTIC SYSTEMS

Care and Maintenance of Residential Septic Systems. 2002. UW-Extension (B3583) cecommerce.uwex.edu/pdfs/B3583.PDF

Onsite Sewage Treatment Program for Homeowners. University of Minnesota Extension Service. septic.coafes.umn.edu/Homeowner/index.html

STORMWATER RUNOFF

A Storm on the Horizon: An Educational Video on the Effects of Stormwater on Our Rivers. 18 minute video by Trout Unlimited.
Phone: 715-386-7568 or andrewlamberson@hotmail.com

RAIN GARDENS

Rain Gardens ... A Household Way To Improve Water Quality in Your Community. 2002. UW-Extension (GWQ034) and Wisconsin DNR (WT-731-2002) clean-water.uwex.edu/pubs/raingarden/gardens.pdf

Rain Gardens: A How-To Manual for Homeowners. 2003. UW-Extension (GWQ037) and Wisconsin DNR (WT-776 2003) Phone: 608-267-7694 clean-water.uwex.edu/pubs/raingarden/rgmanual.pdf

Wisconsin Native Plants for Rain Gardens.
dnr.wi.gov/org/water/wm/nps/rg/plants/PlantListing.htm

SHORELAND BUFFERS

The Waters Edge: Helping Fish and Wildlife on Your Waterfront Property. 2000. Wisconsin DNR (PUB-FH-428 00).
www.dnr.state.wi.us/org/water/fhp/fish/pubs/thewatersedge.pdf

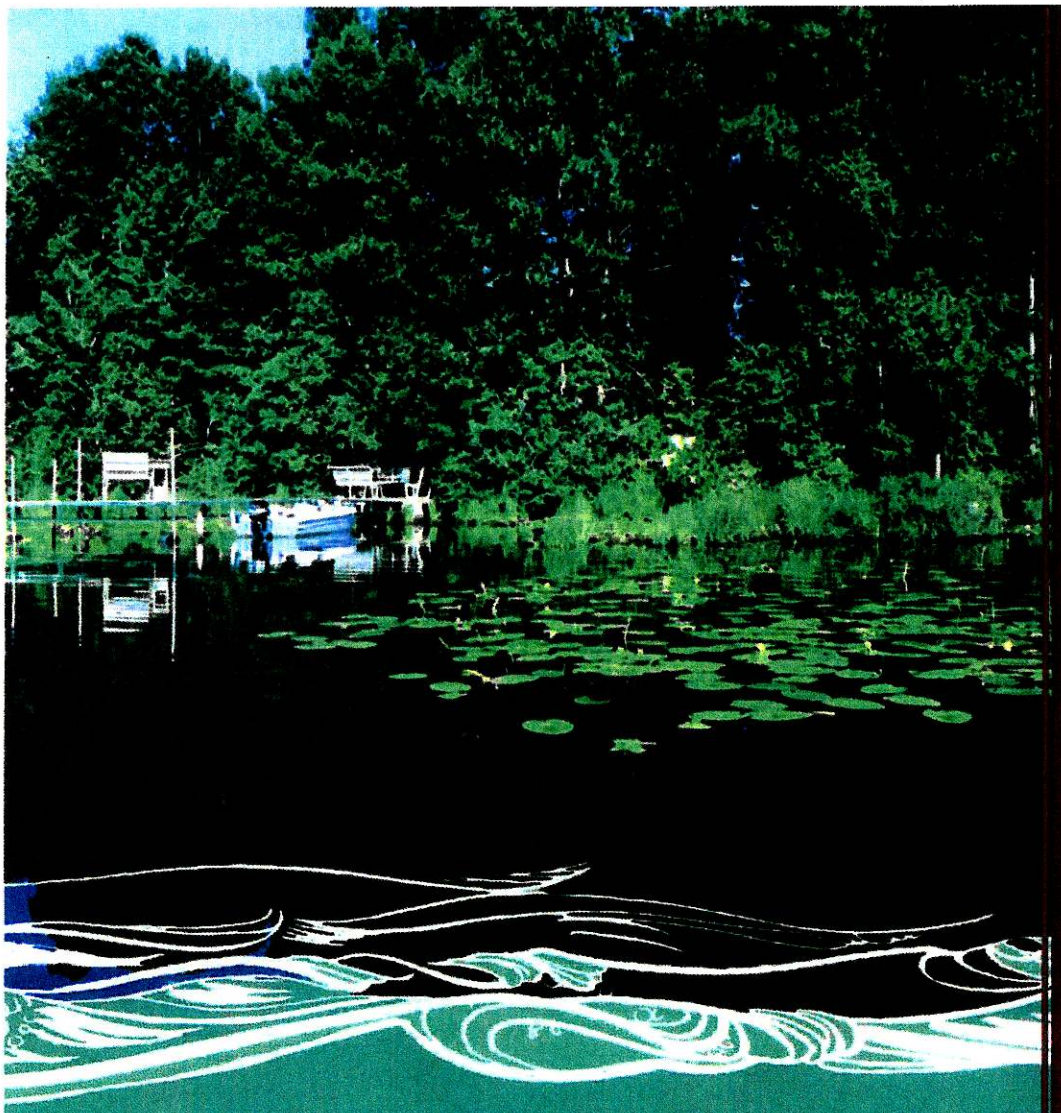
Shoreland Restoration: A Growing Solution. 2001. A 15 minute how-to guide. UW-Extension (GWQ032) Phone: 877-947-7827.

Shoreland Stewardship Series. 2003. UW-Extension and Wisconsin DNR. clean-water.uwex.edu/pubs/shore/index.html

- ***Protecting Our Living Shores*** – UWEX (GWQ039) DNR (WT-764-2003)
- ***Protecting and Restoring Shorelands*** – UWEX (GWQ038) DNR (WT-748-2003)
- ***A Fresh Look at Shoreland Restoration*** – UWEX (GWQ027) DNR (FH-429-2003)

Lakescaping for Wildlife and Water Quality. Minnesota Department of Natural Resources. The best detailed planning guide available for shoreland restoration in Wisconsin.180 pages. Phone: 800-675-3757

Wisconsin Native Plant Sources. 2004. UW-Extension (GWQ041) and Wisconsin DNR (WT-802). clean-water.uwex.edu/pubs/shore/nativeplants.pdf



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