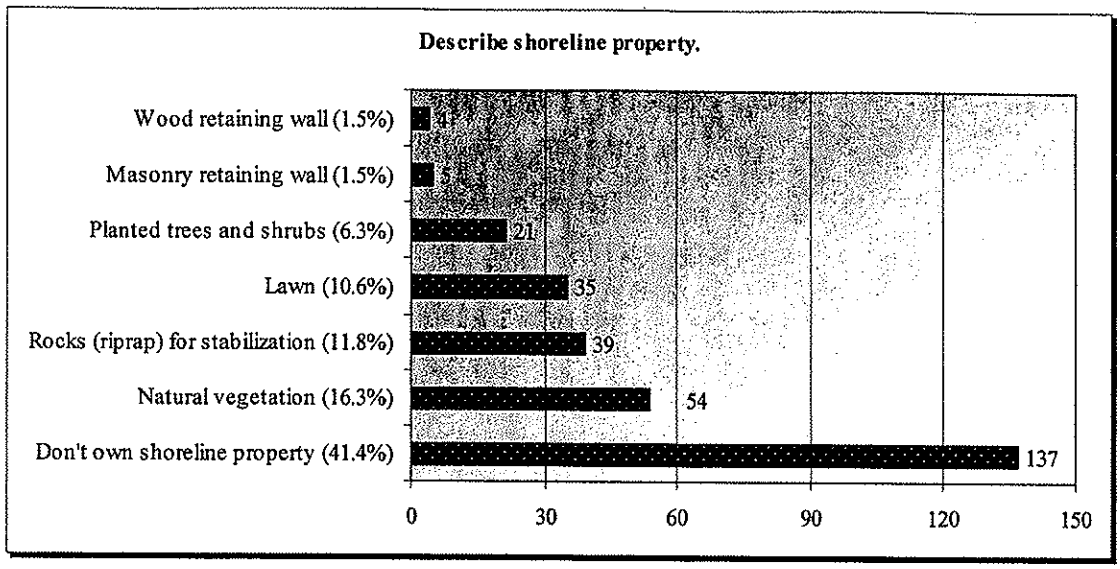
4. In describing their shoreline property, 41.4% of respondents said they don't own shoreline property. However, 16.3% said they have natural vegetation, while 16.9% have lawn or planted trees and shrubs.



5. Canoe/kayak water crafts are used the most (26.9%) on the Amery Lakes.

6. The Amery Lakes water clarity were described by the survey audience as:
   a. Pike Lake is clear to cloudy
   b. South Twin is crystal clear to clear
   c. North Twin is clear to cloudy

7. The Amery Lakes water quality were described by the survey audience as:
   a. Pike Lake is good to fair
   b. South Twin is fair to poor
   c. North Twin is good to fair

8. Lake shore residents and lake users were asked to describe what prompted them to answer the last two questions (6 and 7) and the two most common responses…

   a. …for Pike Lake: the ability to see the lake's bottom and amount of plant growth.
   b. …for South Twin Lake: the presence of swimmer's itch and amount of plant growth.
   c. …for North Twin Lake: the ability to see the lake's bottom and amount of plant growth.

9. Each lake was perceived as being used at different intensities.

   a. Pike Lake: moderate use
   b. South Twin Lake: little to moderate use
   c. North Twin Lake: moderate use

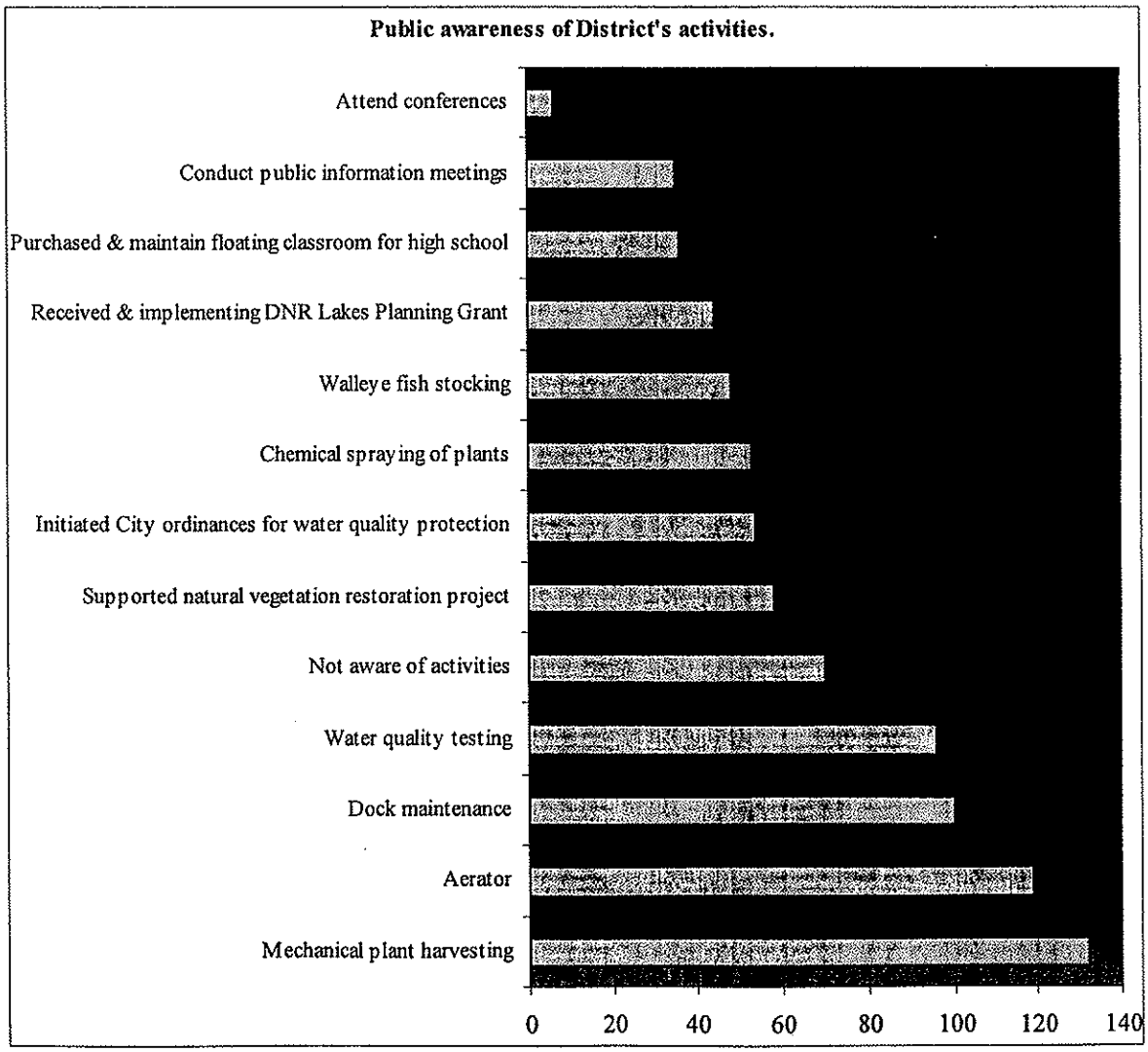
10. The overall rating of natural shoreline vegetation was perceived to be adequate on Pike and South Twin Lake. However, survey responders feel North Twin Lake has lacking to adequate natural shoreline.

11. The ALPRD survey responders feel the Amery Lakes are generally safe.

12. After rating the level of aquatic plant growth in each lake, Pike Lake and North Twin Lake were rated as moderate to heavy growth and South Twin Lake was rated as heavy to dense growth.

13. Many respondents found that the current public access to the Amery Lakes is slightly less than adequate.

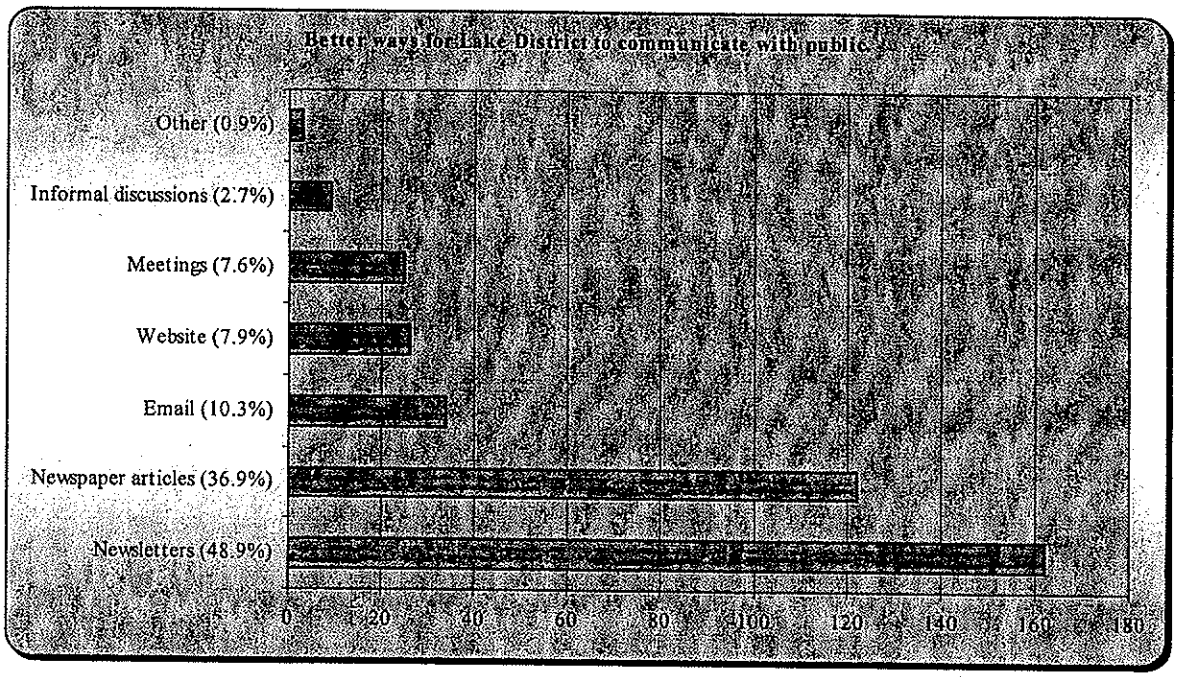
14. The ALPRD members are aware of many activities completed by the District. The top four most recognized ALPRD activities are mechanical plant harvesting, aerator, dock maintenance, and water quality testing.



15. Many think ALPRD Board should take these top three actions on each lake:

    a. Pike Lake: Stock fish, harvest aquatic weeds, boat safety program
    b. South Twin Lake: Harvest aquatic weeds, stock fish, boat safety program
    c. North Twin Lake: Harvest aquatic weeds, stock fish, establish buffers

16. The public wants the District to better communicate with them by means of newsletters and newspaper articles.



17. Most (65.3%) comments suggest that ALPRD members are not available to contribute their skills toward District lake management.

18. Fifty-nine (17.8%) survey responders said they would be willing to volunteer with Lake District projects.

Our thanks to all those who took the time to complete the questionnaires and be part of this phase of the ALPRD Lake Management Planning project. This information will be used by WDNR and Amery Lakes District Board as feedback from the community on their progress and directional changes requested for future plans.

4.3. City of Amery Community Development Survey

In November 2000, the City of Amery conducted a community-wide survey to develop an understanding of public needs and opinions and determine the percent of low and moderate income households in the community. This information was used to update the City's Comprehensive Plan and to apply for state and federal public infrastructure grant programs.

A community-wide mailing of the survey used a list of household addresses compiled by City staff, the Housing Authority, and the City Planning Commission. Press and media releases were also sent to the Amery Free Press, Amery Telecom, and WXCE Radio to inform residents about the community survey.

The tabulated questionnaire results are included as Appendix M. The Low to Moderate Income (LMI) category is determined by the U.S. Department of Housing and Urban Development Section 8 income levels, which are based upon 80% of the county median. The LMI level varies by household size as indicated:

Household Size:	Year 2000 LMI if Annual Earnings are Less Than:
1 person	$26,150
2 persons	$29,900
3 persons	$33,600
4 persons	$37,350
5 persons	$40,350
6 persons	$43,350
7 persons	$46,350
8 or more persons	$49,300

The study results show an increase of 240 dwelling units within the City over the period 1991 to 2000 (from 1171 to 1411 total dwelling units, respectively). A total of 724 surveys were received with a response rate of 51.9%. Of those responding, 372 or 51.38% were categorized as LMI. For a community of this size, a response rate of 40% and a 51% LMI status are required by the Department of Commerce to apply for federal funds.

4.4. City of Amery Comprehensive Land Use Plan

Land use planning is a vital key in protecting the Amery Lakes. The most recent Comprehensive Land Use Plan was completed in 1991 and 1992. The City of Amery Plan Commission's purpose was to develop a Comprehensive Land Use Plan to advise the City Council on such topics as zoning, extraterritorial zoning, and subdivision review.

Desiring public input and participation, the City of Amery conducted a Community Development Survey in July 1991. Topics covered include: City Planning Issues, Income Information, Demographics, Housing, Public Facilities, Shopping Facilities, and Economic Development. The survey had a 39% response rate of 1,171 households surveyed. The results are presented in Appendix A of the 1993 City of Amery Comprehensive Land Use Plan.

This Plan expresses the wants and needs of the Amery community and serves as a decision-making guide. Amery's Comprehensive Lake Use Plan identifies physical and demographic characteristics, factors influencing development, and proposes a land use plan. *The Plan is over 10-years-old and does not address the influence of the City on the Lakes, therefore, we recommend that the City of Amery Comprehensive Land Use Plan be updated, and, in particular, consider the City's environmental impacts on the local watersheds.* At the September 1, 2004, Amery City Council meeting, the City Council approved a motion to join

with a multi-jurisdictional group in Polk County to obtain a grant to update the existing Comprehensive Plan.

4.5. ALPRD Annual Meetings

In 2002, 2003, and 2004, ALPRD Annual Meetings were scheduled at the Amery High School Library, Amery, WI. Attendance totaled seven in 2002, eight in 2003, and seven in 2004. Updates on the progress of development of the Plan were made at each meeting. Presentations of various elements of the Management Plan have been discussed at the annual meeting.

4.6. Wisconsin Association of Lakes (WAL)

Why not w/ partners? including board?

The ALPRD is a member of WAL and have donated to their various causes. WAL is a nonprofit group of citizens, organizations, and businesses working for clean, safe, healthy lakes for everyone. To accomplish their mission, they:

- Assist lake groups and lake users in their efforts to carry out our mission;
- Help local leaders defend, manage, and restore lakes and their watersheds;
- Provide a unified voice for public policy that will protect and preserve lakes; and,
- Advance public knowledge of lakes, their watersheds, and ecosystems.

WAL works to establish policy and obtain state funding for programs such as these:

- The Wisconsin Lake Planning, Protection, and Classification Grants.
- DNR (Dept. of Natural Resources) and UWEX (University of Wisconsin Extension) Lake Specialists to give scientific and educational assistance.
- The Wisconsin Self Help Lake Monitoring Program with over 1500 citizen volunteers.
- The Adopt-A-Lake Program and Project WET for school and youth groups.
- Lake Classification technical and educational assistance.
- Lake Leaders Institute, which Amery Lakes Protection and Rehabilitation District President, Steve Schieffer, was a member of the first class.

WAL has been very effective at advancing legislation that has had a positive impact on Wisconsin Lakes and continues to work on legislative issues, such as the following:

- Defending the 75 foot shoreline setback rule.
- Intervening in the Dockominium case, to uphold Wisconsin's public trust doctrine.
- Strengthening local authority to regulate boating.

WAL works in partnership with the DNR and UWEX lake programs to build a strong, effective support system for local lake organizations and to promote stewardship of ALL Wisconsin lakes.

CHAPTER 5: LAKE CONCEPTS

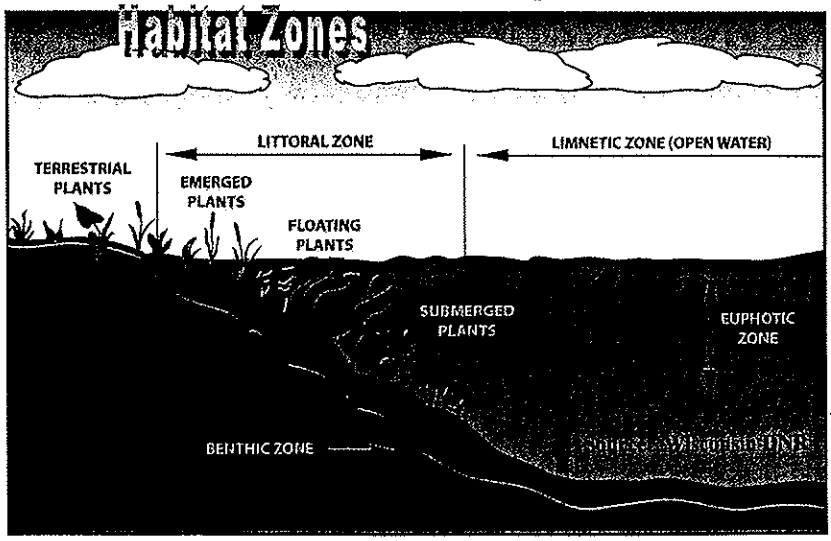
Pike, North Twin, and South Twin Lakes add much diversity to the adjoining landscape of the Amery area. The Amery Lakes Protection and Rehabilitation District wants to protect the Lakes' delicate ecosystems, and fragile water quality. Managing the Amery Lakes will help avoid major problems, including algae blooms, exotic and invasive species, nuisance weeds, siltation, winter fish kills, loss of natural shoreland landscapes, and lake user conflicts. Also, becoming educated in general "healthy" lake concepts will create and build an understanding of how watershed activities directly affect the Amery Lakes.

5.1. Lake Ecosystem

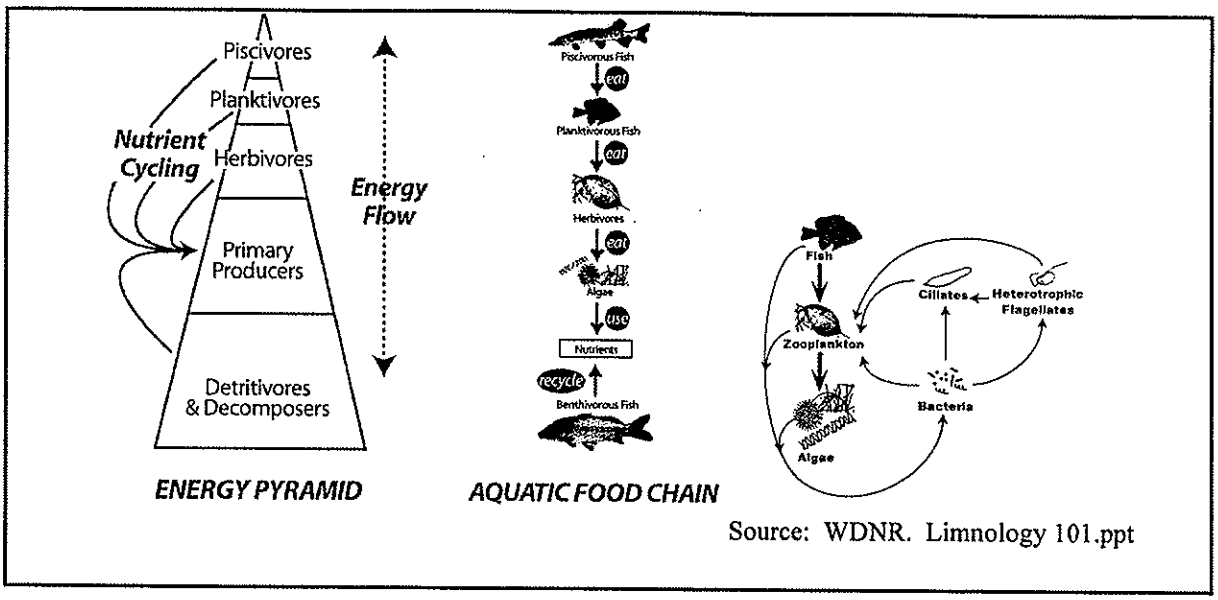
Stable ecosystems have great diversity and habitat. A lake without wetlands, marshes, near shore shallow areas, or deep open water is more unstable than a lake exhibiting this diversity. However, as the years change, season-by-season, the diversity of the ecosystem also changes. A single, short-term algae bloom event does not necessarily identify a long-term problem. However, while land use changes in the watershed, the effects of these changes may not be immediately seen in the lakes. The effects may take years, decades, or more before the negative impacts are realized.

Wisconsin lake shorelines once provided lush vegetation. Private homes were sparse; oars and manpower controlled boats; and a crowded lake may have meant seeing another person on the lake. This scenery and serenity may have been observed when we visited a resort or a friend's vacation home. Continued development and alteration of the uplands in the watershed and the increased desire to acquire lake frontage has resulted in many of the water quality concerns discussed in this Lake Management Plan.

Living organisms in and around lakes require a special balanced habitat that provides food, shelter, oxygen, and other specific needs. "The margin of our water is the place where all life comes together...a bridge between two worlds. It is a place essential for plants and creatures to survive. As many as 90 percent of the living things in our lakes and rivers are found along their shallow margins and shores." (Rideau Canal, Parks Canada). This littoral zone provides a nursery for fish, refuge from predators, and intercepts nutrients and sediments.



The water lilies, fish, and other organisms in the Amery Lakes need to be protected to maintain a healthy habitat and balanced ecosystem so desirable species thrive. By extensively altering one habitat, the balance is altered, and as a result, the entire community will change in some way.



Source: WDNR. Limnology 101.ppt

5.2. Macrophyte Study

In June, 2003, ALPRD contracted with Dragonfly Consulting, Amery, WI, to conduct a study of the macrophytes (vegetation) in Pike and North Twin Lakes. Follows are excerpts from the report, which is included in Appendix N in its entirety. South Twin not completed. It will be . . .

Methods

A grid was generated that spaced the sampling points 100 meters running north/south and 100 meters running east/west. In addition, this would give approximately 60 sampling points, which is recommended by the literature for littoral zones of this size. At each point, the number or amount of a particular species at any one sampling point was recorded. Upon completion, the data was entered into a spreadsheet where the average number of species per point, average native species per point, and frequency of species were calculated. In addition, a floristic quality was determined.

This assessment measures the response the plant community in the lake has had to disturbance. A list of all plant species that are part of the assessment are assigned a coefficient of conservatism ranging from 0 to 10. This number is then averaged and used in the following equation to calculate the floristic quality:

$$I = (\text{average } C) \times \sqrt{N}$$

Where **I** is the floristic quality, **C** is the conservatism and **N** is the number of species. These values are then compared to the lake averages from lakes that were studied in the same ecoregion as North Twin and Pike Lakes.

Percent Coverage

North Twin Lake is approximately **95% plant coverage.** Pike Lake is approximately **86% plant coverage.** Define plant coverage sooner.

Exotics

Only one exotic was sampled. This was curly leaf pondweed or *Potamogeton crispus*. On North Twin Lake this plant was collected at 50% of the sampling sites and on Pike Lake it was collected at 25% of the sites. It should be mentioned that the curly leaf was fairly scattered on North Twin, but on Pike, there was a substantial stand on the north shore in the bay just east of the public boat landing. There were five purple loosestrife plants observed in the southwest shoreline of North Twin Lake in late July, 2003.

Summary

Floristic Quality

North Twin Lake and Pike Lake both show good water quality in relationship to the floristic quality. Both lakes show higher number of species, higher average conservatism and higher floristic quality than the average lake for this ecoregion. Both lakes had a number of intolerant species with Pike Lake showing a longer list and therefore higher floristic quality. In general, both lakes look to be in good health based on the species of plants successfully growing in these lakes, with Pike Lake being the better of the two.

Plant Coverage

North Twin Lake has a tremendous coverage of aquatic plants. Approximately 95% of the lake has emergent or submergent plants present. Even though this is a very high coverage, the lake doesn't appear to have a consistent area of nuisance level.

Pike Lake has a smaller coverage area of 86%. Again, this is very extensive coverage, but lower than North Twin. The bay on the north shore to the east of the boat landing does appear to reach nuisance levels. The nuisance bay in Pike Lake may warrant management of the curly leaf pondweed as it is growing rather dense stands in this bay. If the curly leaf pondweed were eradicated, a follow-up of how the native plants are fairing would be recommended.

Non-Native Species

The only non-native species that was present in both lakes was curly leaf pondwood. On North Twin Lake, there were five plants of Purple Loosestrife observed on the southwest shoreline.

Species Diversity

Twenty species of aquatic plants were found during this survey in Pike Lake, and 16 species in North Twin Lake. In both lakes, a healthy and diverse plant community is present. This compares to a North Central Hardwoods Ecoregion average of 14 species, indicating a healthy ecosystem based on the aquatic plant diversity.

The most prevalent species was coontail in North Twin Lake at 84% of the samples having this plant present. This plant can reach nuisance levels at times and with this frequency, coontail should be monitored for reaching nuisance levels. In Pike Lake, northern milfoil (Myriophyllum sibiricum) was the most common.

In addition to tremendous diversity, some indicator species were sampled. White-stem pondweed was observed in Pike Lake. This aquatic plant is very sensitive to water quality changes. The presence of this plant is an indicator of a healthy water system. In addition, bladderwort was sampled in the narrows between the lakes while wild rice was observed but not sampled. The presence of bladderwort in this portion of the lake provides a rather significant contribution to this special ecosystem. Other species sampled in both lakes that have ecological significance are large leaf pondweed (cabbage weed), flat-stem pondweed, northern milfoil, and celery.

Nuisance Stands Warranting Management Actions

Only one area had significant growth of a plant that is non-desirable. This area is the North Bay to the east of the boat landing on Pike Lake. This bay had extensive growth of curly leaf pondweed, which is non-native. It may be prudent to manage this plant in the spring during the time this coldwater plant is growing. This would allow native, warm water plants to grow without competition from curly leaf.

There have been spotty nuisance stands of elodea or waterweed near the narrows on North Twin Lake. Future monitoring should be conducted in these areas to establish any consistent development. Considering the coverage of plants in North Twin, nuisance stand development is a distinct possibility.

Eurasion Water Milfoil

The spread of Eurasion water milfoil cannot be overlooked. This exotic invasive species is present in several western Wisconsin counties – Polk, St. Croix, Barron, and Dunn. The incidence of the occurrences is quite low – four water bodies in St. Croix County, one in Polk, three to four in Barron, and one in Dunn County. Continued surveillance for the presence of this species is necessary and boat launches need to be posted to advise people of the threat of the species and how to properly deal with it.

Sensitive Areas

A sensitive area survey has not been formally completed by the WDNR, but sensitive areas are present where: emergent native vegetation is present, such as at the outlet of Pike Lake. Polk County has identified and restored six shoreline areas on South Twin Lake where they completed shore land restorations along the north and northeast shorelines of this Lake.

What is represented on this map? Sensitive Areas? Shoreland Restoration?

5.3. Movement of Water

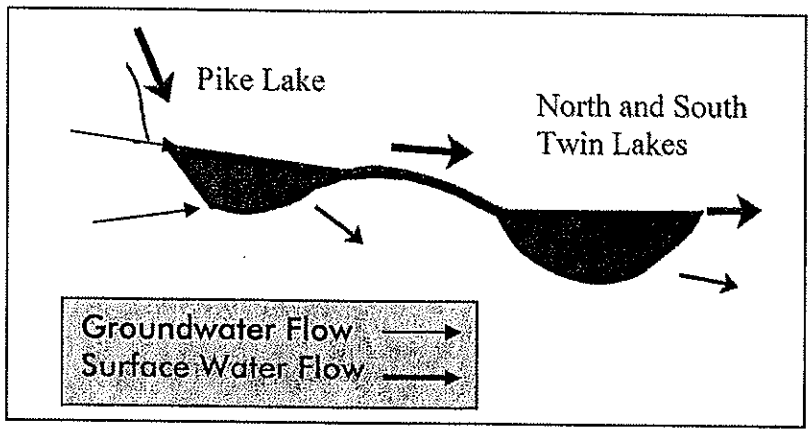
Wisconsin is blessed with the third largest concentration of fresh water glacial lakes on the planet; only Ontario and Alaska have more (WDNR). About 75% of the precipitation that falls to our lakes and land re-enters back into the earth's atmosphere from evaporation and plant transpiration. On flat land or sandy areas, water infiltrates to the ground water and moves toward lakes and rivers. But the excess water runs off the land and enters the lakes and rivers. Lake levels fluctuate season-to-season in response to rainfall events, outside temperature, dams, etc. Such fluctuations are characteristic of normal lake systems.

The classification of lakes is dependant upon water source and types of outflow for the individual water body.

A. A lake fed by precipitation, with limited runoff and ground water, and has no stream outlet is called a seepage lake.

B. A lake fed by ground water, with limited precipitation and runoff, and has a stream outlet is called a ground water drainage lake. Pike Lake is considered a ground water drainage lake.

C. A lake fed by precipitation, ground water, runoff, and is drained by a stream outlet is called a drainage lake. North Twin Lake is classified as a drainage lake.



D. A manmade lake created by damming a stream, which still allows it to drain, is called an impoundment. As the outlet of South Twin Lake is controlled by a weir, South Twin Lake is classified as an impoundment.

Is this true? Was it a wetland before weir?

5.4. Oxygen Supplies in Lakes

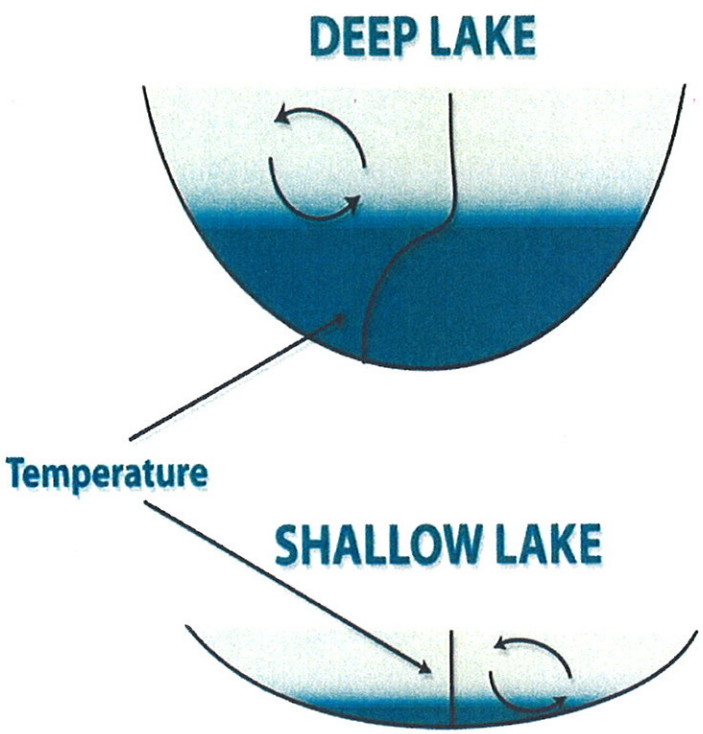
Aquatic plants produce oxygen gas, which is dissolved in lake water, and is released to the atmosphere at the lake surface. In the winter, the ice on the Amery Lakes stops the release of oxygen to the atmosphere and the snow cover prevents sunlight from reaching the aquatic plants. The plants die without the ability to photosynthesize, and decompose, which consumes oxygen. This process can cause winter kill (of oxygen dependent aquatic species) in shallow lakes when the oxygen is depleted and is not replenished. Aquatic plant die-off also results in the release of nutrients (nitrogen and phosphorous) that either is dissolved in the lake water or is stored in lake bottom sediments.

Low Oxygen also releases phosphorus from the sediments

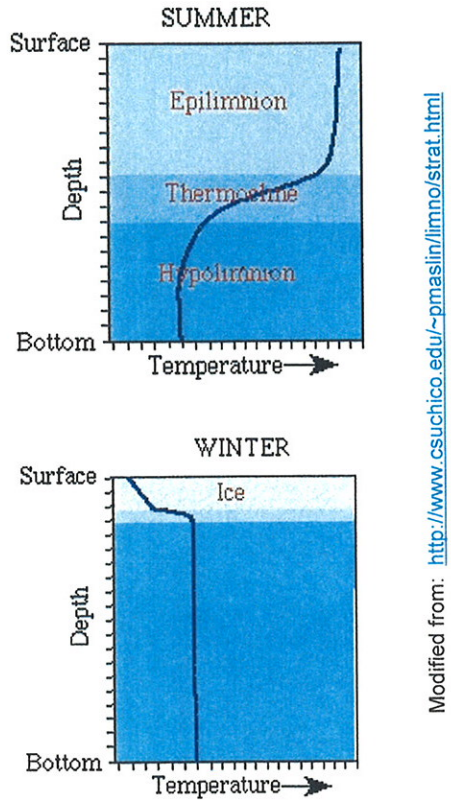
5.4.a. Mixing

Mixing of water in the lakes controls the quantity of dissolved oxygen in the lake, and the depth, size, and shape of the lake controls the ability of water to mix. In the summer, water in shallow lakes easily mix by wind action, if not protected, and the nutrients within the lake also mix. However, deeper lakes stratify, or form separate layers, and only that near surface water mixes and releases oxygen to the atmosphere. Figure 18 provides a visual explanation of the role of mixing, stratification, and dissolved oxygen.

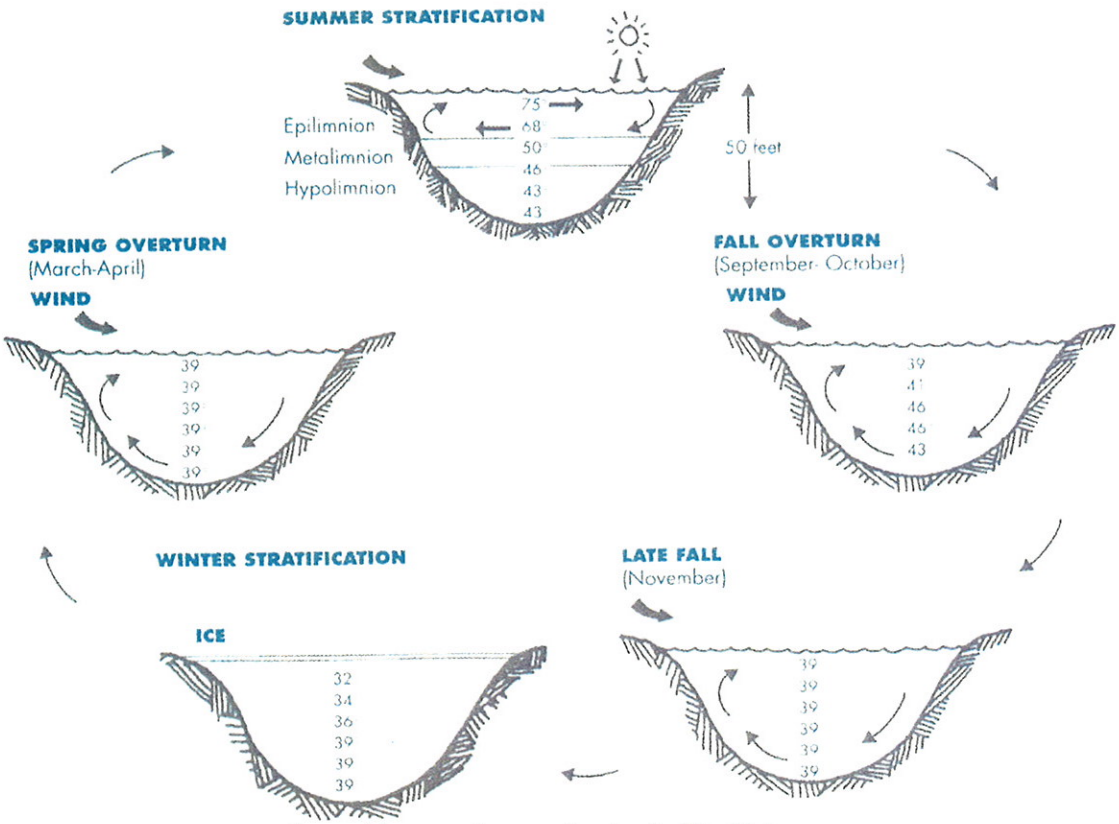
Figure 18: Lake Stratification & Mixing



Source: Wisconsin DNR Limnology 101.ppt



Modified from: http://www.csuchico.edu/~pmaslin/limno/strat.html



Annual temperature cycles in stratified lakes.

Source: http://www.dnr.state.wi.us/org/water/fhp/lakes/under/mixing.htm

5.4.b. Stratification

Summer stratification in deeper lakes usually forms three layers, as shown in Figure 18. The warm surface layer is called the epilimnion; here oxygen is mixed from the atmosphere in this layer. The transition zone between warm surface water and cold, deeper water is called the thermocline, or metalimnion. The cold bottom water is called the hypolimnion. Stratified lakes that do not mix experience low oxygen levels in the hypolimnion and this layer usually traps nutrients that are released from the lake bed sediments. From the information collected, stratification in the shallow Amery Lakes was present in Pike Lake at about 16 feet (June 2003), and in North Twin Lake (July 2003) at 10-11 feet (Tables 6 and 9). The upper layers of Pike and North Twin Lake, and all of South Twin Lake, are well mixed. Stratification depths vary with annual weather patterns. Hence, we can assume that as stratification occurred in summer 2003, some degree of stratification would be present under similar climatic conditions.

At the 2004 Annual Meeting, Steve Schieffer reported that he had observed well developed stratification in Pike Lake as early as May some years.

5.4.c. Retention Time

A lake's size, water source, and watershed size determine the average length of time water remains in a lake, or the retention time. Another way to look at this would be to see how long it would take to fill a drained lake. From BATHTUB modeling completed in 2004, retention time was calculated for Pike Lake as 8.65 years, North Twin Lake as 3.43 years, and South Twin Lake as 0.55 years.

5.4.d. Drainage Area/Lake Area Ratio

The area of a lake and that of the adjoining watershed determine the amount of surface water inflow. The watershed size (drainage basin) relative to lake area calculates a ratio important in assessing the quantity of nutrients present in a lake. Table 3 presents this ratio and the characteristics of retention time and other parameters.

Table 3: Drainage Basin / Lake Relationships

Lake	Pike	N. Twin	S. Twin
Retention Time (years)*	8.65	3.43	0.55
Lake Area (ac)*	159	135	74
Mean Depth (ft)*	15	10.5	5
Max Depth (ft)*	33	27	9
Drainage Basin (ac)*	320.8	525	675.8
DB:LA ratio**	2	3.89	9.13

* 2004 BATHTUB modeling results

** Drainage Basin / Lake Area

? Is this right? See map 42/43 Figure 21

5.5. Lake Water Quality Data

Polk County Land and Water Resources Department provided two flow monitoring and water quality sampling devices for installation in Amery at select locations. ISCO flow samples were installed at two storm water outfalls in an effort to record flow data and collect samples.

Lake water quality sampling was completed at several locations in the three lakes to document current conditions with respect to historic trends. These locations are presented on Figure 19.

ALPRD has conducted lake water sampling at five locations each in Pike and North Twin Lakes and two locations in South Twin Lakes. Water quality parameters analyzed include: ammonia, nitrate-nitrite, total Kjeldahl nitrogen, total phosphorous, dissolved orthophosphorous, total suspended solids, and chlorophyll-a. Samples were collected through in lake sampling from May 2002 to June 2003 (Pike and North Twin Lakes) and on South Twin lake from May 2003 to May 2004. All samples were analyzed at the Wisconsin State Laboratory of Hygiene. The reports are included as Appendix O. These data have been compiled into Table 4.

The analytical data has been incorporated into the water quality modeling reported in later sections of this chapter.

Reviewing the analytical data, inlet samples for Pike and North Twin lakes show high concentrations of nitrogen, phosphorous, and sediment.

5.5.a. Water Clarity

Two components determine water quality: materials dissolved in water and materials suspended in water (turbidity). Water quality is regularly measured as clarity with a Secchi disc. It is an immediate and easy to conduct indicator or measure of water quality that can be used for comparison with other lakes and is combined with other chemical and physical properties of the lake to characterize water quality.

Table 5: Water Clarity Index

Water Clarity	Secchi Depth (ft)
Excellent	32
Very good	20
Good	10
Fair	7
Poor	5
Very Poor	3

Modified from: Understanding Lake Data, Table 2, WDNR

A Secchi disc is a round, 8-inch, weighted, flat disc with alternating black and white quadrants that can be lowered into a lake to visually measure water clarity. The depth at which the Secchi disc disappears is relative to the quantity of nutrients and type of algae present in the water column; i.e., the higher the readings, the clearer the lake. Cloud cover, sun's angle, and waves, affect this reading, thus, Wisconsin DNR recommends these measures be completed on calm, sunny days between 10:00 a.m. and 2:00 p.m. Table 5 presents the Wisconsin DNR water clarity index.

For the Amery Lakes, Secchi disc measurements have been recorded for five years on Pike and North Twin Lakes and two years on South Twin Lake (Figure 20). The average of the observed Secchi disc readings on Pike Lake is 11.08 feet, North Twin 10.44 feet, and South Twin 8.9 feet (max. depth 9 feet). Thus, all three lakes can be considered as having "good" water clarity.

Figure 19: Lake Water Quality Sampling Locations

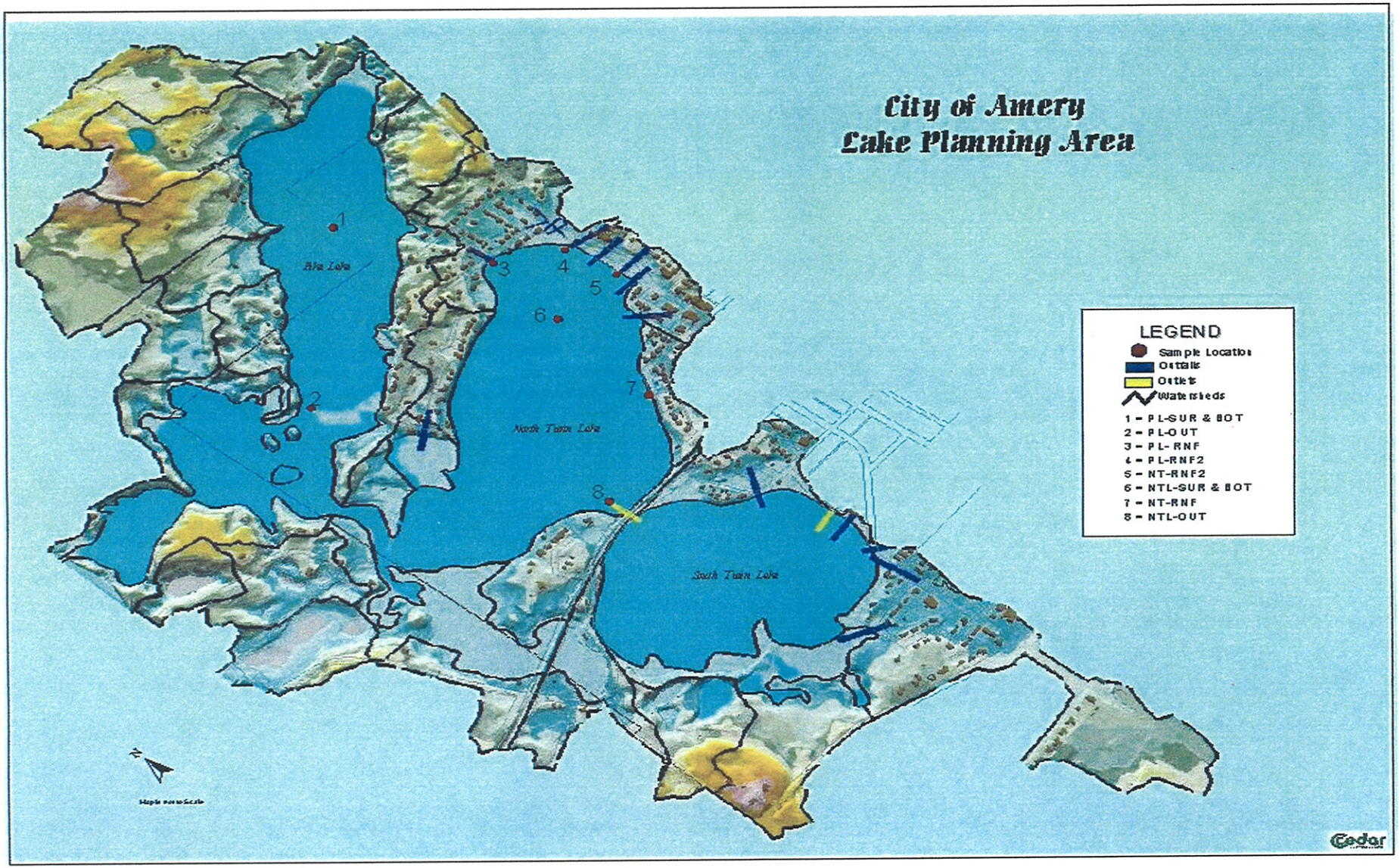
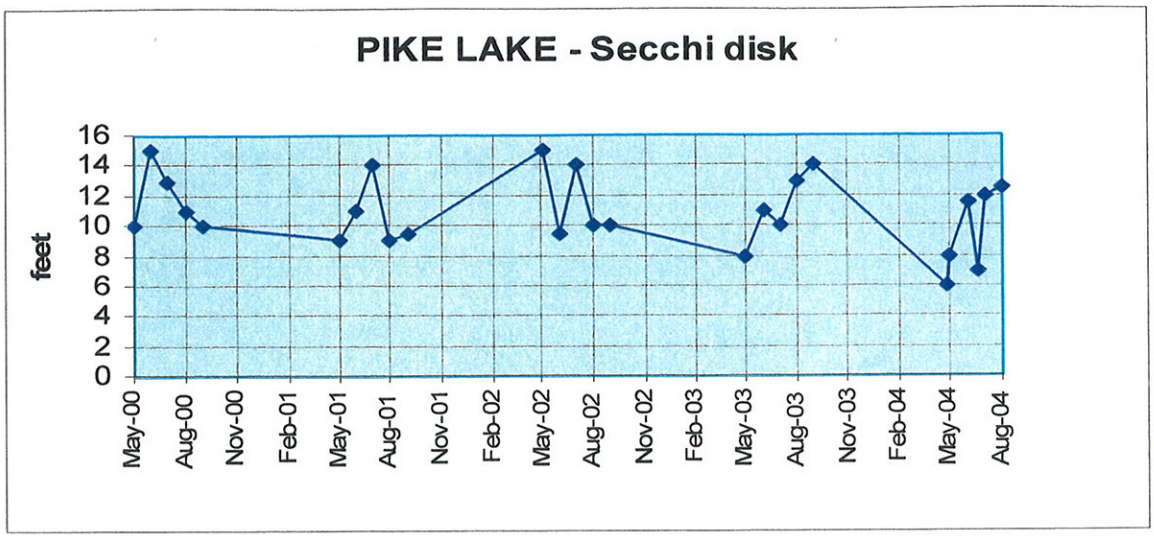
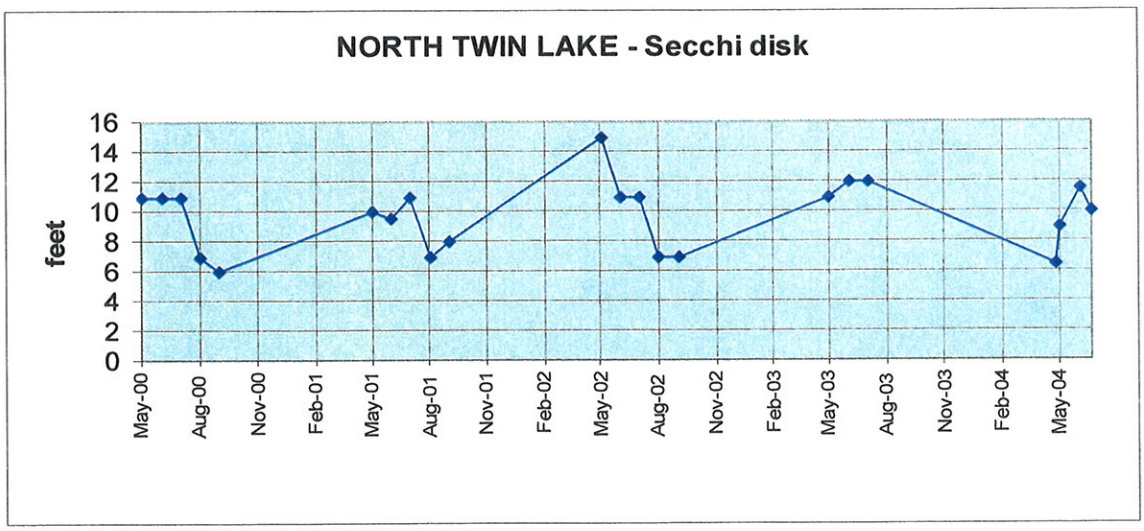
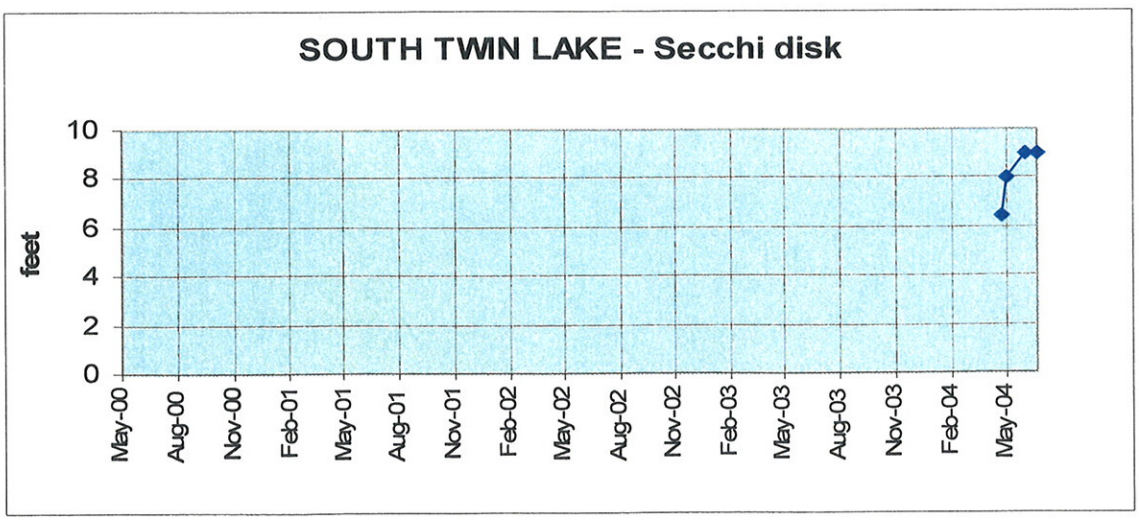


Figure 20: Secchi Disk Measurements







5.5.b. Nutrients

Runoff that contains high concentrations of phosphorus and nitrogen (basic biological nutrients) contribute to an increase in the frequency of algae blooms and an acceleration of the eutrophication of impounded receiving waters. River impoundments are an example of a receiving water that has the greatest risk of increased rates of eutrophication. In this region, phosphorus is typically the main nutrient controlling algae blooms in water systems. Lakes that are phosphorus limiting, as are the Amery Lakes, are those where sufficient nitrogen is present to support plant growth but require phosphorous to stimulate plant growth. Thus, a little phosphorus added to the Amery Lakes system can result in increased algae growth.

5.5.c. Trophic State

Section 305b of the Clean Water Act requires each state to establish "fishable" and "swimmable" goals. Federal requirements in Section 314 of the Clean Water Act require all lakes of the nation be classified to their "trophic" state.

Scientists have established general criteria to evaluate the nutrient state of the lakes, since they are unique and at different levels of eutrophication. The first scientist to develop the trophic state concept was Einar Naumann, a Swedish limnologist from the University of Lund, Sweden (Naumann, 1919). The terms describing trophic classification are adopted from C.A. Weber, who classified bog nutrient content (Hutchinson, 1969).

Trophic State Index

Dr. Carlson's index uses a log transformation of Secchi disk values as a measure of algal biomass on a scale from 0 - 110.

Each increase of ten units on the scale represents a doubling of algal biomass. Because chlorophyll a and total phosphorus are usually closely correlated to Secchi disk measurements, these parameters can also be assigned trophic state index values. The Carlson trophic state index is useful for comparing lakes within a region and for assessing changes in trophic status over time. Thus it is often valuable to include an analysis of trophic state index values in summary reports of a volunteer monitoring program. The program manager must be aware, however, that the Carlson trophic state index was developed for use with lakes that have few rooted aquatic plants and little non-algal turbidity. Use of the index with lakes that do not have these characteristics is not appropriate.

$$TSI = 60 - 14.41 \ln \text{Secchi disk (meters)}$$
$$TSI = 9.81 \ln \text{Chlorophyll a (ug/L)} + 30.6$$
$$TSI = 14.42 \ln \text{Total phosphorus (ug/L)} + 4.15$$

where:

TSI = Carlson trophic state index
ln = natural logarithm

above

The formulas for calculating the Carlson trophic state index values for Secchi disk, chlorophyll *a*, and total phosphorus are presented below. Also presented is a table that lists the trophic state values and the corresponding measurements of the three parameters. Ranges of trophic state index values are often grouped into trophic state classifications. The range between 40 and 50 is usually associated with mesotrophy (moderate productivity). Index values greater than 50 are associated with eutrophy (high productivity). Values less than 40 are associated with oligotrophy (low productivity).

Eutrophication is referred to as the process by which lakes are enriched with nutrients, accumulated sediments, productive aquatic plants, and algae. Table 6 describes four trophic status designations for lakes, and corresponding Trophic State Index value/ranges and characteristics.

Table 6: Trophic State Index (TSI)

TSI Value	Water Quality Attributes	Fisheries, Recreation or Example Lakes
<30	**Oligotrophy:** Clear water, oxygen through the year in the hypolimnion. Water supply may be suitable unfiltered.	Salmonid fisheries dominate.
30-40	Hypolimnia of shallower lakes may become anoxic during the summer.	Salmonid fisheries in deep lakes only. Example: Lake Superior (WDNR)
40-50	**Mesotrophy:** Water moderately clear but increasing probability of anoxia in hypolimnion during summer. Possible iron, manganese, taste and odor problems may worsen in water supply. Water turbidity requires filtration.	Walleye may predominate and hypolimnetic anoxia results in loss of salmonids.
50-60	**Eutrophy:** Lower boundary of classic eutrophy. Decreased transparency, anoxic hypolimnion during the summer, macrophyte problems evident, warm water fisheries dominant.	Bass may dominate.
60-70	Dominance of blue-green algae, algal scums probable, extensive macrophyte problems. Possible episodes of severe taste and odor from water supply. Anoxic hypolimnion, warm water fisheries.	Nuisance macrophytes, algal scums and low transparency may discourage swimming and boating.
70-80	**Hypereutrophy:** Light limited productivity, dense algal blooms and macrophyte beds.	Lake Menomonie and Tainter Lake, Menomonie, WI (WDNR)
>80	Algal scums, few macrophytes, summer fishery kills.	Dominant rough fish.

Source: Carlson, R.E., 1977

Laboratory analyzed water samples for total phosphorus and chlorophyll-a identify the Amery Lakes as mesotrophic water quality systems. The visual clarity (Secchi disc) measurements also indicate the Lakes can be classified as mesotrophic.

A lake becomes fertile (or eutrophic) through the slow, natural process of nature that can result in the lake becoming filled in over time. Lake fertility can be accelerated by human influences as a result of nonpoint source runoff, industrial effluent, fertilizers, pesticides, sediment, and excess nutrients from agriculture, lawn fertilizers, streets, septic systems, storm drains, etc. The analytical data suggest the Amery Lakes are in good shape, now—but are on the edge and over time the water quality will continue to degrade. As the water quality of the Amery Lakes has been determined to be mesotrophic, with the tendency for the system to become eutrophic, it is very important to act now to protect existing water quality. Water quality improvement and protection measures need to be implemented as soon as possible to preserve this fragile ecosystem.

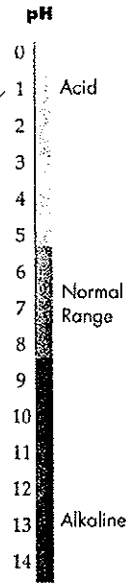
5.6. Carbonate System

Biological productivity, lake acid buffering capacity, and solubility of toxic chemicals are affected by a lake's carbonate system. Many natural occurring chemicals of this system constantly change with sunlight, temperature, each wave, and different biological activity.

5.6.a. Lake pH

An important aspect of the carbonate system is the acidity or pH of the lake. The pH indicates the amount of available hydrogen ions (H^+) in water. The more acidic (pH less than 7) the water, the more hydrogen ions are present. Basic water has less hydrogen ions (pH greater than 7). Neutral water has a pH of 7.

The pH in Wisconsin lakes ranges from 4.5 in reducing lakes to 8.4 in hard water lakes. Rainfall also varies in pH from 4.4 in southeast Wisconsin to 5.0 in northern Wisconsin (WDNR). These ranges are deceiving, ~~but~~ because acid levels change 10 times for every pH unit. Therefore, a lake with a pH of 7 is 10 times more acidic than a lake with a pH of 8 because there are 10 times as many H^+ ions.



Most fish live between 5 pH to 9 pH values. Moderately low pH doesn't usually harm fish. However, with lower pH concentrations, metals (aluminum, iron, mercury and zinc) become soluble and are released from the lake bottom sediments. Lakes that contain more acidic waters usually have tainted fish due to high levels of mercury or aluminum. When eagles, loons, osprey, or humans eat tainted fish, the metals accumulate in their bodies and can threaten their health. Table 7 shows the relative affects of lake water acidity on fish species. Note the sensitivity of the walleye fishery to a pH of 6.5 or less.

Table 7: Effects of Water Acidity on Fish Species

Water pH	Resulting Effect
3.0	Toxic to all fish
3.5	Perch disappear
4.5	Perch spawning inhibited
4.7	Brown bullhead, northern pike, pumpkinseed, rock bass, sunfish, & white sucker disappear
5.0	Spawning inhibited in many fish
5.2	Burbot, lake trout, & walleye disappear
5.5	Smallmouth bass disappear
5.8	Lake trout spawning inhibited
6.5	Walleye spawning inhibited

Source: Olszyk 1980.

ALPRD collected and reported pH data during the summer months. These data are presented below:

Pike Lake	Surface	Bottom
May	7.6	6.4
June	8.2	7.01
North Twin		
May	7.8	6.2
June	8.8	7.2
South Twin		
June 25, 2004	8.26	

These data indicate that the lake water acidity is near normal (5.5 to 8.5). The near surface higher pH values are a likely function of the photosynthesis process. (The pH method is a determination of free H^+ ions in solution.) just stated

In hypereutrophic lakes, the EPA established surface water quality indice for pH of 9, that can be exceeded by the overproduction of carbon dioxide and bicarbonate, which reduces the number of available hydrogen ions, resulting in highly alkaline near surface water.

5.6.b. Alkalinity and Hardness

Do you have this data for Amery Lakes?

Alkalinity (CO_3 or carbonate) and hardness (Mg + Ca (magnesium and calcium)) of lake water (Table 8) are affected by the quantities of impurities that dissolve or come in contact with lake water, soil minerals, and bedrock. Bicarbonate and carbonate are two alkaline compounds that act as acid buffers and are usually found combined with calcium (calcium carbonate: calcite or limestone) and magnesium (calcium magnesium carbonate: dolomite).

Much of northern Wisconsin glacial deposits (Chapter 3) contain little limestone (Ca CO_3). Therefore, these soils tend to have higher quartz content and the lakes have lower alkalinity and hardness. This is increased when the major source of lake water is direct rainfall. However, if a lake receives groundwater through limestone bedrock, the water will have a higher alkalinity and hardness. More fish and aquatic plants are produced in hard water lakes than soft water lakes.

Table 8: Water Hardness Categorization

Total Hardness (mg/L $CaCO_3$)	Hardness Level
0-60	Soft
60-120	Moderately Hard
120-180	Hard
> 180	Very Hard

5.7. Lake Sediments

5.7.a. Lake Sediments

ALPRD collected samples of lake sediments at various locations throughout the Lakes. These sediments were analyzed at the WSLOH. Analytical reports are included as Appendix R and the data complied in Table 9. These data indicate that the Total Nitrogen and Phosphorous levels in the sediments are very high. Also present in the sediments are concentrations of aluminum, calcium, iron, and manganese at levels of 0.1 to 6 percent. Iron, calcium and aluminum are the primary metals in the sediments. This is understandable given that the soils in the area are glacially derived unconsolidated sediments and/or wind blown silt.

Iron and manganese may be precipitated from the ground water, which is known to have locally high concentrations. There are variations from lake to lake in concentrations of the specific compounds detected, but given the uncertainty of input influences from the storm water inlets, it is not possible nor realistic to characterize sediment content based on intra lake flow.

Table 9: Water Quality Summary

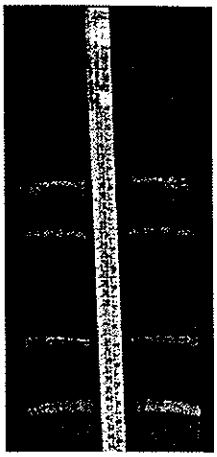
Type	Pike Lake	North Twin Lake	South Twin Lake
	Secchi Depth		
Average (feet)	11.08	10.44	8.9
Range (feet)	6-14	6.5-13.5	6.5-9
Carlson Secchi Depth TSI *	42.45	43.47	46.8
	Lake Water Phosphorous		
Average (ug/L)**	17	17	19
Range (ug/L)	14-20	11-23	14-26
Carlson Phosphorous TSI *	45	45	46.61
	Lake Sediment Phosphorous		
Total P conc. (ug/L)	7980	4370	676
	Nitrogen:Phosphorous Ratio		
	26.7:1	30.1:1	30.3:1
Limiting Nutrient	Phosphorous	Phosphorous	Phosphorous
	Chlorophyll-a		
Average (ug/L)	4296	1433	2954
Range (ug/L)	1530-7480	500-4460	1350-5640
Carlson Chlorophyll-a TSI *	44.91	33.9	41.38

* From BATHTUB Modeling

** For Years 2002-2003

5.7.b. Paleolimnology

Since the Amery Lakes' formation about 10,000 years ago, fine grained sediments have and continued to accumulate on the lake bottom. Sediment runoff has been transported by water from upstream tributaries or non-point source runoff, and as the water current slows in the lakes, so does sediment/particulate carried by the water; and then, these sediments settle out to the lake bottom. These sediment deposits provide a history of the lake, and paleolimnology is the study of lake sediments with an attempt to understand the history of a lake.



An example sediment core halved vertically.

Bottom sediment coring devices are used to collect the long, vertical sediment columns (or cores) from the lake bottom sediment. The sediment is separated into its respective layers and each layer is evaluated to understand historic physical, chemical, and biological conditions at the time the layers were deposited. Special paleolimnological techniques and methodologies are used to analyze historic algae production, water clarity, lake pH, how watersheds responded to human impacts, and other patterns in global climatic changes.

The results from this type of study vary. One example is the comparison of sediment accumulation data with time. Another example is water clarity data with respect to time. Currently, water clarity is measured through the lake aging process and is typically interpreted by current in-lake water clarity conditions and other factors. As lakes age, the water clarity decreases and the lake fertility increases. Lake aging processes suggest that a lake may eventually "die." However, paleolimnologic results have contradicted this process in some studies and are useful in identifying the background or natural fertility levels of the lakes, where the history can be compared with current data.

The paleolimnologic data results could then be used to set a lake's biological/ecological resource goal. Nutrient and sediment contributions are first analyzed at different depths and associated time periods (i.e. pre-1850, 1940, 2004, 2024, etc.) to identify the amount accumulated. For example, if sediment and nutrient accumulation (with respect to time) began to increase after the 1930s and continued to 2004, one could infer that the accumulation prior to 1930 could be background or the "natural levels" of the lake. The 2024 data cannot be analyzed from a sediment core, so the accumulation rates are often predicted with respect to population growth.

Following the data gathering period, the ALPRD Board and consultant may then set management goal scenarios with respect to:

a) Algae composition, concentration, and bloom frequency;

b) Nutrient (Total Phosphorus) summer concentration and annual loads;

c) Water Clarity with reference to mean summer Secchi depth; and,

d) Sediment accumulation rate annual load and volume per century.

These goals should then be assessed every three to five years and set again. Historic water quality evaluation, or paleolimnology, has not been completed on the Amery Lakes. This research technique is recommended in Chapter 6.

5.8. Watershed Modeling

5.8.a. Water Quantities

The primary watershed and internal sub-watersheds of the Amery Lakes were delineated (Figure 21) and compiled using the HydroCAD program to model the storm water quantity and erosion effects on the Amery Lakes. A summary of the model results is included as Appendix P.

The three lakes are described in the model as A, B, and C, from north to south. Pike Lake has 14 delineated sub-watersheds; North Twin Lake has 12 sub-watersheds; and, South Twin Lake has 8 sub-watersheds. Each sub-watershed has been evaluated for area, land form, land use, and soil type. These factors were incorporated in the HydroCAD mathematical model to produce water runoff at different storm event levels.

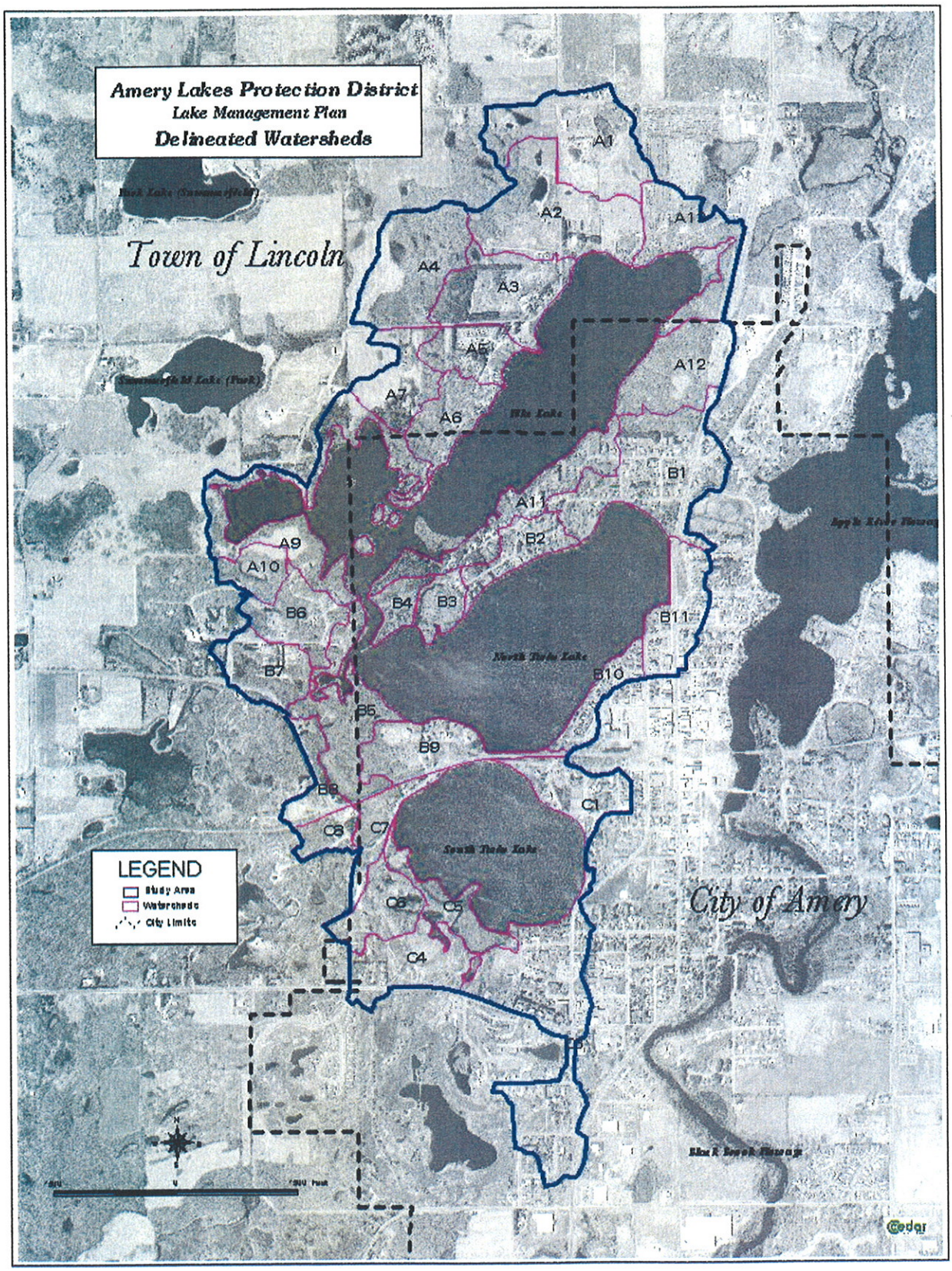
Storm water runoff is typically calculated for a moderate rainfall event. In this case, a 24-hour storm event that has a frequency of occurring every two years was employed. Storm water contribution to the lakes from this size storm event for Pike Lake is 15.65 acre feet, North Twin Lake is 18.28 acre feet, and South Twin Lake is 9.86 acre feet. The HydroCAD model predicts a storm water volume (including that falling on the Lakes) entering the Amery Lakes from this size storm event of 130.223 acre feet in this watershed. As one acre foot is the equivalent of 325,830 gallons, each of these storm events contributes over 42 million gallons of water to the Lakes system. Of this volume, 43.79 acre feet or 14.27 million gallons is storm water with associated runoff contaminants. Thus, small concentrations of contaminants in large water volumes readily become large quantities that increase the need for intervention in managing the lake ecosystem.

5.8.b. Water Quality

5.8.b.1. Phosphorous Modeling Methods

Complex mathematical models have been developed to estimate nutrient and water budgets for lakes. These models can be used to relate the flow of water and nutrients from the watershed surrounding a lake to observed water quality conditions in the lake. Alternatively, the models may be used to estimate changes in the quality of the lake as a result of changing land uses in the watershed. To analyze the in-lake water quality of the Amery Lakes, the models **WILMS** (Panuska and Kreider, 2003) and **BATHTUB** (Walker, 1996) were used.

Figure 21: Watersheds and Sub-Watersheds



The "Lake Eutrophication Analysis Procedures" (LEAP), which forms a part of the Wisconsin Lake Modeling Suite or **WILMS**, was originally developed from the MNLEAP (Wilson and Walker,1989) model. This model was developed on an analysis of data collected from the ecoregion reference lakes in Minnesota and then adapted for Wisconsin by Department of Natural Resources researchers. The model is intended to be used as a screening tool to estimate lake conditions with minimal input data and is described in greater detail in Wilson and Walker (1989). Default Polk County values coupled with Northern Lakes and Forests ecoregion generalized concentrations of nutrient and sediment loads were used in the LEAP assessments for WILMS calculations due to:

- the small watershed to lake ratio for Pike Lake coupled with in-lake measured values ;
- lakes in a chain have sequential sedimentation that is not adequately represented in the LEAP nutrient model development or use; and
- the measured summer total phosphorus concentration for Pike and North Twin Lake is less than 20 µg/L, which is substantially less than typical values for the North Central Hardwood Forests ecoregion lakes.

BATHTUB was developed to model reservoir water quality and is based on empirical data obtained from the U.S. Army Corps of Engineers' reservoirs. BATHTUB is several linked eutrophication models presented in an interactive format that estimates in-lake eutrophication responses based upon general or specific watershed runoff quantities and quality. Natural lake models for phosphorus, chlorophyll-a and Secchi disk were chosen for estimation purposes. In-lake observed concentrations from 2002 were utilized in this assessment for comparative purposes. The lakes were segmented as separate basins with very minimal cross-basin mixing. A flow-weighted mean (FWM) using 20 µg/L (micrograms per liter) of phosphorous and also 150 µg/L phosphorous from general watershed runoff and urban area runoff, respectively, were used for calculation purposes. Monitored storm water phosphorous concentrations from on-site data collection ranged from 120 to 212 µg/L in the Watershed; hence, the estimated urban runoff concentration of 150 µg/L is quite consistent with the input parameter.

No adjustments to the models were used (e.g. no calibrations of model coefficients). All model inputs and segmentation morphometric characteristics are included in the electronic copy (Appendix Q).

5.8.b.2. Modeling Results

i) LEAP Model Summary

The first model, LEAP, generally predicted lower average growing season in-lake Total Phosphorous concentrations of 11, 13 and 16 (± 4) than the observed concentrations of 17, 17 and 19 µg/L for Pike, North and South Twin Lakes, respectively. Subsequently the predicted chlorophyll-a and Secchi are not significantly different as compared to the observed values. The P-loading rate from all sources estimated by ecoregion runoff in LEAP is very low (e.g. less than 50 kg or 110 pounds P/year). These estimates are based on the respective watershed areas, regional estimates of precipitation, evaporation, and runoff, and a stream flow-weighted mean (FWM) total phosphorous concentration of 20 µg/L. Back-calculating the net, FWM inflow concentration (from

all sources, including potential internal loading sources) is on the order of 60 to 125 µg/L phosphorous, or less than 140 pounds phosphorous per year from all sources. As such, these lakes are likely very sensitive to Phosphorous loading sources including runoff from urban and fertilizer sources as well as internal sources.

The model estimates the hydraulic residence time (time it takes to refill the lake if it was completely empty) at about 8.6 years, 3.5 years , and 0.6 years respectively for Pike, North and South Twin Lakes. The relatively small watershed to lake ratio for Pike Lake means that the lake has a long memory or water residence time for deposition of nutrients and sediments, etc. This means the nutrients entering Pike Lake will be retained and deposited within this lake basin.

Pike

Variable	*Observed*	*Predicted*	*Std Error*
Total Phosphorus (ug/L)	17	11	4
Chlorophyll-a (ug/L)	4.3	2.2	1.4
Secchi (m)	3.4	4.2	2.0

North Twin

Variable	*Observed*	*Predicted*	*Std Error*
Total Phosphorus (ug/L)	17	13	4
Chlorophyll-a (ug/L)	1.4	2.8	1.6
Secchi (m)	3.2	4.2	1.6

South Twin

Variable	*Observed*	*Predicted*	*Std Error*
Total Phosphorus (ug/L)	19	16	4
Chlorophyll-a (ug/L)	3	3.8	1.9
Secchi (m)	2.5	3.5	1.2

LEAP model default runoff average TP (total phosphorus) concentrations (annual flow-weighted mean values, or FWM's) of 20 µg/L suggest a very low TP load of less than 20 kg/year phosphorous reaching these lakes. In contrast, the typical urban runoff phosphorous concentration for Amery is likely in the 100 to 300 µg/L range.

ii) BATHTUB Model Summary

BATHTUB simulations of water quality of the Amery Lakes reasonably approximated observed conditions for 2002, likely due to the more accurate incorporation of upgradient lake-basin sedimentation, a feature the BATHTUB Model can incorporate as opposed to LEAP (WILMS). For example, the long water residence time of Pike Lake provides an estimated retention of about 80% of the phosphorus prior to reaching North Twin Lake. South Twin Lake receives the combined sedimentation of both Pike and North Twin Lakes. In general, the observed in-lake conditions, indicate that these lakes

are very sensitive to nutrient quantities reaching them from watershed sources. Furthermore, the relatively low sediment metal content indicates that these lakes may have limited phosphorus binding capacities and hence, be prone to showing rapid increases in algal blooms in response to very low increases in watershed or internal P loading.

iii) Amery Lakes Sensitive to P Sources

Using modest increases of about 50 kg P to 100 kg P per year to the lakes, the model indicates that average summer total phosphorus concentrations could exceed 30 µg P/L in both North and South Twin Lakes, for example. In response, algal blooms are predicted to increase to "some scums" (percent of the summer exceeding 10 µg/L chl-a (chlorophyll-a)) occurring about 5% to up to 40 % of the summer, "nuisance conditions" (percent of the summer exceeding 20 ug/L chl-a) occurring about 0% to 8 % of the summer. Severe nuisance conditions as estimated by percent of the summer with chlorophyll-a exceeding 30 ug/L are predicted to increase to about 2%. As the growing season is generally considered to be 100 days, the model results can be expressed as the number of days where some scums or nuisance conditions would be anticipated.

The BATHTUB results indicate that some scums would be currently present in Pike Lake about 5 days/year (based on sample data) while the model estimates about 9 days/year. With the increased internal loading, the model estimate jumps to over 20 days/year with some scums and also shows over 2 days/year with nuisance conditions. For North Twin Lake, the current observed conditions would have less than 1 day/year with some scums, with the model predicting over 12 days/year with some scums and 1 day/year with nuisance conditions. With increased loading, the model predicts over 33 days/year with some scums and 6 days/year with nuisance conditions. For South Twin Lake the current observed conditions and model predictions are similar to North Twin, however, with increased internal loading the model predicts some scums at over 40/year days and nuisance conditions at almost 9 days/year. The BATHTUB output summaries are listed in Appendix Q. ***Based on the model results, aggressive phosphorus management strategies within the Watershed are likely to have very observable benefits to lake residents in helping to maintain the current conditions of the Amery Lakes.***

The effects of phosphorus-load reductions immediately after a load reduction are not expected to be as large as those simulated by the models because of phosphorus release from the sediments. Empirical models, such as those in BATHTUB and WILMS, assume a typical internal phosphorus release for a lake with the specified external loading. Therefore, it is assumed in model simulations that the lake is in equilibrium with its external loading. However, if external phosphorus loading is reduced, internal loading would be expected to remain relatively high for several years. Therefore, phosphorus release from sediments of the Amery Lakes could become relatively more important and possibly delay the anticipated effects of external phosphorus-load reductions.

Although a decrease in phosphorus loading from areas immediately adjacent to the Amery Lakes by itself would only slightly improve the water quality of the Lakes, increases in phosphorus loading from areas adjacent to the Amery Lakes could appreciably degrade the water quality of the Lakes. Suspended sediment in the storm water inlets was found to have a high particulate phosphorus content; therefore, any increase in erosion from the Watershed could result in unusually high phosphorus loading to the Lakes. Therefore, although the water quality of the Amery Lakes has not changed appreciably in recent years, continuing efforts to protect the Lakes and its susceptible watershed are necessary to maintain the current water quality.

CHAPTER 6: RECOMMENDATIONS FOR IMPLEMENTATION

This chapter presents recommendations for various actions to slow, stop, or reverse the degradation of water quality in the Amery Lakes. A significant task is the development and continuation of an information and education program to promote and foster among residents and non-residents of the region, an individual responsibility to protect water quality. Chapter 7 is dedicated to a description of the public education program to accomplish this objective.

Individuals, local government, and area businesses should assume an increasing responsibility for protecting water quality of the Amery Lakes. This report documents that a variety of factors affect the water quality of the lakes, including point and nonpoint source pollutants -- primarily sediments and nutrients (phosphorous and nitrogen) in groundwater, storm water runoff, precipitation, and background or natural sources. The previous chapter discusses mathematical models that document that the water quality of the Amery Lakes is good, but fragile. Clearly, the water quality of the Lakes as a whole should be considered as on the edge of slipping into a eutrophic state. Especially as some indicators are already identifying the presence of a eutrophic state in certain areas of the watershed. Thus, the District and its members, the surrounding City of Amery populace, and the Lakes visitors all need to be sensitive to the existing water quality and be encouraged, and where possible, to adopt those necessary measures to be protective of the water quality of the Amery Lakes.

Any plan is only as good as it is used and maintained. To rate the progress on the lake improvement measures and to document achieved goals, it is encouraged to schedule annual updates of lake water quality and share these with local governmental units. Continuing the on-going lake water quality monitoring program will assist in rating the progress. And, as the ol' saying goes:

"An ounce of prevention is worth a pound of cure."

The recommendations can be categorized as two elements of implementation – basic and specific. Basic elements include those that can be considered ongoing and continued into the future. These actions include education and community outreach, water quality monitoring, exotic invasive species programs, fisheries surveys, etc. These elements have already been successfully introduced in the Amery Lakes area and need to be continued and expanded as they mature. Specific elements are those that require additional studies, including the development and implementation of strategies and projects to control source pollutants, development of area wide storm water management plans, erosion control management, and resource improvements, among others.

An effective Lake Management Plan must present both an Implementation Strategy as well as Recommendations to improve water quality. In evaluating the available information, and to assist the District in future planning, we recommend the adoption of a strategy to address both basic and specific elements.

6.1. Implementation Strategy

Recognizing that the progression of development around the Lakes has limitations due to current land use, devising a strategy to thwart future degradation of the water quality is key to long-term planning. An approach to meet the overall goal of water quality protection and improvement can be identified on a subwatershed basis. Of course, finding funding to implement the goal is of utmost importance, thus developing an implementation strategy that incorporates funding opportunities prepares an achievable Action Plan.

This Plan has identified that the current development in the direct draining subwatersheds around the perimeter of the Lakes have the most impact on lake water quality. However, the implementation strategy in the watersheds has to respect the values and various needs of the community, must be protective of the water quality, and be financially achievable. The projects can overlap each other as the individual funding, design, and construction schedules for the various projects could occur in a continuous process. Projects have to be developed from both existing data sets collected during the Lake Management Planning process as well as more detailed information obtained in the subwatersheds in order to finalize treatment goals and project designs.

6.2. Recommendations

6.2.a. Specific Projects

Project selection should consider the following considerations:

1) Sub-watershed(s) that have the greatest impact on the Lakes.
2) Least costly implementation projects that have significant capability to reduce runoff.
3) Project designs that are readily implemented (least hindered by cost, access, land availability, permit acquisition).
4) Significance of the City of Amery city-wide storm water management plan.
5) Overall funding capability of potential projects.

Project phases may include:

a) Water quality/quantity assessments on a subwatershed scale.
b) Projections of future development and development of future water quality and quantity parameters.
c) Identify water quality treatment goals that will protect and preserve lake water quality.
d) Design of treatment Best Management Practices (BMPs) specific to the watershed.
e) Project location – land easements or acquisitions.
f) Permitting and bidding for project construction.
g) Construction of desired BMP.
h) Water Quality Monitoring – Pre- and Post-Implementation.

Dependent upon the available resources and the desires of the ALPRD, we would recommend the following projects. The dates referenced identify when grant submittals are due (typically considered to be the first of the month). There is no requirement to follow this specific project list, but any projects should follow in a logical manner.

Sub-watershed Storm Water Quality Improvements:

These projects are typically storm water drainage pipes that drain into the Lakes and Require BMPs.

- Select sub-watershed(s) for water quality improvement project.
- Engineering review and cost estimate.
- Grant application – Lake Management Protection (typically May 1st of each year).
- Design, prepare plans, specifications, and construct (fall or after grant award date); construction may lapse to following year dependent on accessibility, land availability, permitting, etc.

Storm Water Management Master Plan:

A significant portion (and over 90% of the downtown area) of the City are at relatively shallow elevations above the Amery Lakes and Apple River flowage. Minor flooding during storm events; storm water quality entering the Lakes and the flowage, impacts of future developments, and, the fragile state of the water quality observed in the Amery Lakes are all concerns that can benefit from a city-wide evaluation of the storm water systems, capacities, flows, loading, etc. This evaluation would provide the City with common direction for storm water planning, possible treatment, and provide a basis to understand the impacts of future growth. This is a grant eligible project (Lake Management Planning – February 1st and August 1 each year, or Targeted Runoff Management) and it is recommended this project be recommended to the City to act as the sponsor and project manager.

Water Quality Monitoring:

On-going monitoring of water quality parameters – nutrients, sediment (total solids), temperature and dissolved oxygen profiles, water clarity, etc., should be completed for each lake in the traditional monitoring locations to establish seasonal and annual variation. These data should be recorded with comments of seasonal climatic conditions (warm summer, cool summer, dry year, etc.) that the factors can also be considered when evaluating the data (Lake Management Planning Grants, February 1st and August 1st).

Other Projects:

The District has control over project timing and project selection and should work with the City of Amery and surrounding townships to gain their input and support. Dependent upon site specifics within the watersheds, there may be nonpoint source water quality improvements projects that can utilize the Wisconsin DNR Runoff Management TRM (Targeted Runoff Management) grant monies. These projects can be developed and defined as the sub-watersheds are more thoroughly evaluated. The proposed project is only a proposal and should be considered as a guideline for the District in its goal of implementing water quality improvements in the Amery Lakes Watershed.

6.2.b. Basic and Specific Controls for Resource Protection

Pollutant source controls can be achieved through different levels of approach to achieve local and regional water quality improvements and preserve the highly desirable water quality experienced in the Amery Lakes.

a) "Basic" and "Specific" Controls for Resource Protection
b) Sensitive Area Concerns
c) Community Survey Recommendations
d) Education and community Outreach (Chapter 7)

Exotics Management:

- Pike Lake was identified as an area for the growth of purple loosestrife.
- Assist Wisconsin DNR with Eurasian Milfoil inspections on the Amery Lakes and at boat landings.
- Curly leaf pondweed is an invasive species that has been identified in the Lakes. Control strategies include chemical spraying and harvesting. This must occur in May or June before the weed sinks to the bottom of the Lakes.

Runoff Management:

- For those properties with slopes that allow runoff to directly enter the Lakes; the grounds keeping activities at these facilities should:

  a. Conduct soil tests to determine the most appropriate fertilizer.

  b. Do not use phosphorus based products for fertilizer or cleaning.

  c. Restore shorelines to native vegetative state and leave at least 35 foot wide shoreline buffer.

  d. Implement proper storm water management on the property by diverting impervious surface runoff to infiltration basins or other approved devices for treatment before being discharged to area receiving waters.

e. Ensure 80% total suspended solids reduction from storm water runoff before it is discharged. These designs should meet DNR guidelines and review procedures.

- Stabilize eroding shorelines to preserve aquatic habitat and visual aesthetics. Encourage shoreline owners not to remove submerged dead wood from shoreline areas. This eliminates habitat and encourages erosion. Consider shoreline stabilization projects where erosion has increased sedimentation in the Lakes.

- Restore shore land with native vegetation by incorporating a 35 foot wide shoreline buffer. ALPRD is encouraged to pursue a cooperative venture with private, public, and town land owners to restore various shore land plots. Begin first by looking early in the spring for lake shore properties with large lawns and offer shoreland restoration pilot projects with owners. Assistance from local County Conservationists, UW-Extension, WDNR, and other representatives is encouraged. As an example, select a park area for a demonstration project of water quality improvements. Improvement efforts are encouraged including general park improvements, developing handicapped accessibility areas, restoring shore land vegetation, and constructing a passive park.

- Avoid lake shore burning of leaves as the ash is rich in phosphorus and can wash easily into lakes. The ash should be recovered when cool and set aside for disposal as a solid waste.

- Effective soil erosion control from all construction sites is key to improving water quality throughout the watershed. A rigorous and strict enforcement of the recently updated and adopted soil erosion control regulations administered by the Wisconsin DNR and Department of Commerce is necessary to minimize construction runoff into the lake. City officials and community residents should insist on the best possible erosion control methods, update or adopt their own ordinances, and enforce these recommendations. Construction projects and related site erosion control plans should be reviewed by experienced professionals, consultants, and/or planners before implementation.

- In Denser Rural Residential and Urban Areas:

  a. Divert storm sewers to water quality pre-treatment ponds or devices before water enters the Amery Lakes.

  b. Divert sewage effluent away from the Lakes.

  c. Sweep leaves and dirt from streets; do not sweep them into the Lakes.

  d. Parking lot runoff should be diverted to water quality pre-treatment ponds before water runs into the Lakes.

  e. Erosion control and/or storm water management ordinances should be created and adopted by local government. This will allow for more strict regulations and engineer review of developments' erosion control practices are meeting reduction capacity before the effluent enters into the Amery Lakes' Watershed.

Infiltration Management:

- Infiltrate roof water by redirecting roof downspout outlets from an impervious surface to a grassed area. If the grassed area does not allow for much infiltration, create a Rain Garden to maximize infiltration. Dry wells or French drains can also be used to handle roof water infiltrations. Large volumes of roof water runoff from large buildings should be handled through a properly engineered device. Large infiltration systems require zoning permits and DNR review.

- Grass swales are wide grassed lined ditches and are an alternative to standard curb and gutter, and reduce runoff impacts to receiving waters by increased infiltration of runoff. The vegetation in the swale acts as both a sediment filter and a runoff velocity reduction device.

- Filter storm water with other devices including infiltration trenches, alternative surfaces, oil and grit separators, water quality pre-treatment ponds, and detention ponds. These and other techniques may require feasibility studies to determine the point of origin and proper BMP to improve the site condition.

Reduce Fertilizer Usage:

- Soil test lawns and add only the necessary fertilizers. The City of Amery has an ordinance that no or low phosphorous fertilizers can be used in the Amery Lakes watershed. This ordinance should be extended to the Town of Lincoln. Local business owners who offer fertilizer for sale should be reminded annually of the need to provide low phosphorous fertilizers. Other communities have instituted such an ordinance and local stores only supply this type of fertilizer. For example, Minnesota currently has a 0% phosphorus regulation for the Twin Cities metro area and 3% phosphorus for all greater Minnesota.

Monitoring Programs:

- Continue an annual water quality monitoring program.

- The data analysis is based on an assumption of the potential contribution from groundwater as no ground water data was collected. A groundwater study should be completed to determine if groundwater contributes phosphorus to the Amery Lakes. This could be significant in that broader controls will have to be considered to control dissolved phosphorous in the groundwater.

- Historic water quality evaluation, or paleolimnology, has not been completed. An evaluation of historic trends in-lake sediment can be gained through this research. Section 7, in Chapter 5, discusses paleolimnology.

Forest Land Management:

Although there is not a large amount of forest land in the Amery Lakes area, the conservation area northeast of Pike Lake could benefit from the following practices:

- Reforestation.
- Follow Wisconsin DNR Forestry Best Management Practices.
- Leave timber on steep slopes.
- When crossing streams and gully areas, build bridges per Wisconsin DNR Forestry Best Management Practices and uphold NR 151 Runoff Management rules.
- If timber is taken from steep slopes or lowland areas, perform this work between January and March to ensure frozen ground.

Agriculture:

Agricultural areas in the Town of Lincoln have the potential to generate large volumes of runoff. The following practices greatly reduce runoff volume, and sediment and nutrient loads.

- Minimum tillage.
- Contour farming.
- Diversion around barnyard.
- Limit soil loss and leave winter cover crops.
- Add only needed fertilizer per soil test results.
- Increase forage acreage and decrease corn crops.
- Do not apply manure to frozen ground or on steel slopes.
- Improve manure storage tanks.
- Fence pastured stream banks.
- Polk County Soil and Water Conservation Department recommends the following practices be used when growing row crops: conservation tillage (no-till is the preferred practice), grass waterways, and nutrient management. Contour faming is a practical tool; however, it is a site specific application depending on the topography. More site specific recommendations should be generated from County Conservation Departments or other professionals within the sub-watersheds. Promoting the use of conservation tillage, grass waterways, and nutrient management farming practices on row crop farmed land is recommended to help attain the goals listed above.

If the ALPRD wants to assist no-till practices in the farmed sub-watersheds, they could:

a. Support the cost of a no-till planter for area farmers to use and have it borrowed from the County Conservation Department.

b. Offer farmers incentives by providing funding at a flat per acre fee. Contracts between the farmer and Association could be made so no-till practices are ensured. This is a current practice in Upper Turtle Lake, near Cumberland, Wisconsin, and usually is set up as follows:

   i. Farmer agrees with the cost-share.
   ii. Contract signed between Association and Farmer. A contract copy is sent to the Township, County, or Consultant.
   iii. Farmer introduces no-till practice on acres agreed upon.
   iv. Town, County, or Consultant inspects the land to ensure proper acres are in no-till practice.
   v. Payment from Association to Farmer is made according to the actual amount that is in the no-till practice.

Government Partnership and Policies:

- As State, County, Town, and City transportation departments minimize the use of road salt, an increase in sand content is common. Alternative de-icing compounds should be recommended for those areas that directly impact the Amery Lakes, and related tributaries, swales, etc., boat landings, culverts or storm water outfalls, and other areas of high salt-use. Snow disposal areas should be located so as to not drain into lakes or streams. As State Highway 46 transects the Towns of Lincoln, Black Brook, and the City of Amery, the Wisconsin Department of Transportation should work with these units of government to explore the best method for ensuring safe roads with minimal salt usage, and minimum impact to the Amery Lakes.

- Utility and Highway Corridors:

  a. Proper route selection.

  b. Encourage runoff from roads to be directed to sedimentation traps or water-quality pre-treatment ponds before runoff reaches the lakes.

  c. Require Wisconsin DOT construction contractors to follow Wisconsin DNR NR 151 runoff management ordinances. Encourage the use of BMPs to trap road runoff for pretreatment before entering the Lakes.

  d. Don't dump sand on the waterfront.

  e. Make docks and boat houses as unobtrusive as possible. Permits are required for these structures. Avoiding permanent structures will reduce shoreline alterations, tree cutting, and filling.

f. Keep dock lighting to a minimum safe level.

- Local emergency officials should be prepared either as first responders or have readily available information to protect ground and surface water resources from spill contamination (i.e. gasoline, etc.). Spill preparedness should include adequate training and equipment, such as containment booms and spill absorbents. Emergency response consultants can assist fire fighters and emergency crews in spill contingency planning.

- As the City of Amery updates its Comprehensive Plan, it is recommended that the local officials adopt the Amery Lakes Management Plan, and its updates or amendments, into the Natural Resources section of the City Comprehensive Plan.

- As the City of Amery contains many impervious surface areas with commercial, residential, and industrial development; it is recommended the community complete a Storm Water Runoff Management Master Plan to reduce sedimentation and nutrient loading of the Amery Lakes. This Plan should include, but not be limited to:

  a. an investigation of the quantity and quality of water running off the impervious areas;

  b. inventory and inspect any storm sewer outfalls;

  c. inspect private septic systems;

  d. inspect storm sewer catch basins;

  f. investigate the need for a street sweeping program; and,

  g. identify Best Management Practices (BMPs) to be used to decrease sediment transport to the down stream waters (i.e. Amery Lakes) and encourage infiltration of storm water runoff.

- Ensure the ordinance that no or low phosphorous fertilizers is used in the Amery Lakes watershed is enforced.

- Develop local ordinances to further reduce the degradation of the Amery Lakes from non-point source pollution. Ordinances provide the legal frame work for requiring suitable management practices to control non-point source pollution. Adopting erosion control and storm water management ordinances can specify performance standards, specific BMP, or limit peak runoff flow. In future years, as more land is developed, managing runoff to protect water quality will become increasingly important and the ability to control runoff will be limited if the proper ordinances are not in effect.

- Various Wisconsin communities are using erosion control and storm water management ordinances to regulate pollution prevention for both water quality and water quantity objectives. A comprehensive storm water management ordinance can provide assurance that future growth will not be significantly detrimental to water resources in the Amery Lakes area. To assist in ordinance creation, the Wisconsin DNR has developed model ordinances that can be adopted or used as a starting point in creation of a Town's own ordinance. Ordinances will consider runoff volumes, property size, pollutant loads, etc.

- Financing ordinance administration to avoid over burdening taxpayers is recognized as a major concern in ordinance adoption. Developing financing alternatives and administrative strategies may reveal acceptable costs for enacting an erosion control and/or storm water management ordinance. The City should consider retaining the services of an engineer or other professional experienced in storm water management and design, to review new development proposals for compliance with the City's ordinance(s).

6.2.c. Sensitive Area Recommendations

As stated in ch. NR 107.05 (3)(i)(1.), "sensitive areas are areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat, including seasonal or life stage requirements, or offering water quality or erosion control benefits to the body of water." Protecting the Amery Lakes' sensitive areas is vitally important to the habitats in and around the lakes. Table 13 shows a list of important functions of plants in and around lakes.

The following recommendations are based on Wisconsin DNR's general guidelines for sensitive areas:

- Aquatic plant communities provide fish and wildlife habitat, thus vegetation removal should be limited to no greater than 20 feet wide in navigation channels, and only where necessary. If removal is necessary, mechanical harvesting is preferred to chemical treatment. (Be sure to follow the new Wisconsin DNR Aquatic Plant regulations if this action is pursued.)

- Alterations to the littoral zones where coarse rock rubble provides walleye spawning habitat should be prohibited, as these areas are protected under Chapter 30, Wisconsin Administrative Code. These alterations can only be made if evidence supports the changes would benefit the Lakes' ecosystem and only with necessary permits and approvals from WDNR and others.

- Prevent sedimentation of walleye spawning beds, by strictly controlling erosion in adjacent areas. Identify these areas as high priority for runoff controls.

- Provide habitat and refuge from predators for fish and other organisms by leaving logs, trees, and stumps in the littoral zone.

- Protect existing buffer and aquatic plant communities at the shoreline.

- Eliminate sources of nutrient inputs to the lake often caused by fertilizers, herbicides, failing septic systems, etc.
- Promote the use of no-phosphorus-containing fertilizer for commercial and residential use.
- Encourage local officials to strictly enforce zoning ordinances.
- Do not remove aquatic plants from sensitive areas.
- Protect water quality, plant communities and walleye habitat by controlling erosion.
- Steep lakeshore slopes should be protected from further erosion using a vegetated buffer strip.
- Develop an aggressive educational program to promote the above recommendations.
- Eliminate purple loosestrife by removing the plant's flowers, removing the plant seed heads, disposing of the plant in garbage bags, treating the plant with Rodeo™ herbicide, or raising beetles and releasing them to the wild as a biological control method.
- Shoreland Protection: If you own shore property, the state mandates that you keep a 35-foot strip of vegetation intact for the use of wildlife, and to reduce the pollutants than run off your property into our water resources (including wetlands). If you own shoreline property there is a responsibility to maintain that wildlife habitat and reduce pollutants. It's important to remember that 80% of all endangered species spend at least part of their life near the shore in the littoral or shoreland zone.
- Shoreline buffers are important on steep slopes. The littoral zone should not be altered unless erosion prevention requires the use of rip-rap.
- Preserve lightly developed and high quality environmental areas through a conservation easement or through acquisition.
- Implement land acquisition or easements to protect unspecified critical areas from possible future development.

6.2.d. Community Survey Recommendations

In 2003, ALPRD conducted a community survey to evaluate the perceptions of the lakes' residents and users of the Amery Lakes. A total of 1,085 surveys were mailed to various recipients – 335 (30.9%) responded. Survey results have been discussed in Chapter 4 and the survey data is presented in Appendix L.

The Amery Lakes are most appreciated by the community for their peace and tranquility, wildlife observation, fishing, entertainment, and boating (motorized and non-motorized).

Survey respondents appear to be concerned about simmer's itch and a perceived increase in lake vegetation. Respondents feel that the ALPRD should conduct fish stocking, aquatic weed harvesting, a boat safety program, and establish buffers (shoreline). They note that more community through newsletters or newspaper articles would be appreciated (ALPRD recently issued their newsletter, Appendix S).

Although many indicated an inability to participate in District lake management, 59 survey responders indicated a willingness to volunteer with Lake District projects. As these surveys are anonymous, we would recommend that the ALPRD mail a letter requesting interested individuals to sign up as Amery Lakes District Volunteers.

6.3. Roles and Responsibilities

The following activities are the roles and responsibilities for the ALPRD as part of the "basic program." Summarized below are some Lake District responsibilities:

- Work in cooperation with a consultant or local City, Town or County in order to gain certain types of grant funding (see Chapter 8: Funding Options).
- Identify in writing a person to represent the District during project implementation.
- Get in writing any commitment from other local units of government to implement the basic program.
- Prepare and submit work plans for staff and activities necessary to implement the project to The District Board for review and approval.
- If a consultant is involved, be sure team-work is achieved, a contract is drawn up (if necessary), and documents written by the consultant are reviewed.
- If a grant is involved, be sure to prepare and submit annual reports on the project's progress.
- Present an update at the District Board project review meetings.

The following activities are the roles and responsibilities for the Amery Lakes Protection and Rehabilitation District (ALPRD) as part of the "specific program," where applicable.

- Adopt and enforce a comprehensive storm water management and erosion control ordinance for undeveloped areas that is consistent with State "model" ordinances.

- Complete "specific" sub-watershed studies to determine the best means to implement site specific nonpoint source control measures for existing development in high priority areas of a project area. Structural best management practices will be guided by detailed feasibility reports. Projects may require grant assistance; specific permits (Local, State, and/or Federal); and, land easements or acquisitions for implementation and future maintenance. A commitment between client and engineer is often made to ensure the engineer is implementing recommendations of the feasibility report(s).

- Enter into cost share agreements with owners/developers for funding, designing, and installing best management practices within the existing development areas, include complete detailed engineering studies.

- Best Management Practices are those that have been determined effective in reducing nonpoint source pollution to meet water quality objectives. The application of these practices will be guiding the feasibility report and assistance provided by the DNR.

- The BMP is only good if it is in operation and being properly maintained. Keep records of the BMP design, operation, installation, and maintenance requirements.

- Following Wisconsin DNR ch. NR 155 Runoff Management construction site erosion control practices is required by any contractor. Engineers, who may have performed the feasibility study and designed the project BMP, can assist in acquiring necessary permits; the Association in developing land agreements, easement, or acquisition; ensure that State and Federally recognized contracts are drawn up between client and subcontractor; and inspect the site inspected to ensure proper BMP installation.

- Private land owners may install BMPs on their property within critical areas. They are usually the most important participant for the project's success. Eligible land owners can participate in the project by signing cost share agreements with ALPRD. Any BMP installation in a critical area needs evaluation, design, and construction oversight by an experienced professional.

6.4. Progress Assessments

Projects undertaken by ALPRD, or by local governments on behalf of ALPRD, that receive grant assistance, should be evaluated for the effectiveness in attaining project objectives. The evaluation is centered on tracking project progress in implementing the basic and specific programs. A nonpoint source load reduction tracking system should also be maintained.

- Pollutant Load Evaluation: If a grant is awarded, requirements to analyze the designed BMP for water quantity and water quality reductions are common. The engineer can provide that information upon design completion. The local project manager will provide that information with the grant application.

  Pollutant source reduction activities should be reported by ALPRD to memberships and local governments. If source reductions are not quantifiable, accomplishments should be recognized as having a positive impact on efforts to reduce nonpoint source pollution.

- Administrative Evaluation: The local project manager will provide an annual report to the DNR and the ALPRD Board on the progress in implementing the basic program accomplishments and when applicable, specific program activities. This report should include:

  a. Scheduled information and education activities.

  b. Any recommended changed in community "housekeeping" activities.

  c. Actual improvements in community nonpoint source "housekeeping."

CHAPTER 7: EDUCATION AND INFORMATION

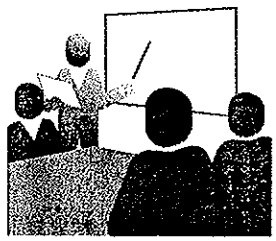
7.1. Importance of Public Involvement

Public involvement is the most important aspect of this plan. If the public does not understand the goals and reasoning behind these recommendations, the chance of sustained action on lake management and protection is reduced dramatically. Simply put, the success of the implementation of the plan recommendations relies on the effort to educate and involve the public on the issues of lake management and protection. The key to improving water quality is for everyone to do their share. Also, a collective voice is more often heard than a single individual.

7.2. Target Audiences

Many different groups need to be targeted in the Education and Information Program for it to be effective. Examples of groups that should be included are:

- Public Officials/Policy Making Bodies
- Local Organizations and Environmental Groups
- Elementary, Middle, High School Students
- Adult Residents
- Business and Industry
- Homebuilders and Developers



Each group has a different view and knowledge level of lake management and protection. Some may be initially against recommendations identified in this plan, as it may result in increased project costs. The goal of this section of the plan is to incorporate all of the different approaches needed to properly address each group and educate them in the importance of lake management and protection and implementation of water quality improvement recommendations.

7.2.a. Public Officials/Policy Making Bodies

The Amery Lakes Protection and Rehabilitation District has held a number of presentations regarding the Lake Management Plan during the ALPRD Annual Meetings. Continued presentations should be made to the public at City, County, and Town Board meetings. These public meetings are publicly noticed, open to the public, and will educate more residents and public officials in understanding the intent and benefits of the Plan. It may be appropriate to present the basis for the conclusions and recommendations to fully involve all affected parties.

These policy making bodies are encouraged to plan for the future and to adopt control erosion and runoff ordinances. Land owners should be offered the opportunity to attend various water quality information meetings. These meetings would offer a more thorough understanding of the topics, such as:

- The benefits of a lake association or district
- Options for aquatic plant management
- Septic and runoff management
- Lawn care and composting
- Nutrient loading
- The sensitivity of the lake ecosystem to influx of nutrients and sediments
- Involvement of more than just the local government in water quality improvement planning.

7.2.b. Local Organizations and Environmental Groups

Invite or involve other organizations and environmental groups within or adjacent to the Amery Lakes Watershed to get involved in lake management and protection. Participation in associated watershed activities increases the success of planned water quality improvement projects. It opens the door of opportunity that allows the other watershed stakeholders to learn from ALPRD's experience, take these experiences back to their organizations, and possibly duplicate or encourage improvement efforts throughout the watershed.

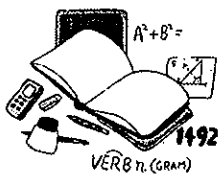
Other groups that have contributed support in the past include:

- Wisconsin Department of Natural Resources
- Polk County Land Conservation Department
- University of Wisconsin-Extension

The groups have established lines of communication with various constituencies, for example:

- These groups can assist the ALPRD in writing joint grants for funding of implementation projects.

7.2.c. Elementary, Middle and High School Students



Perhaps the most important audience for promoting an education program is through the Amery Elementary, Middle, and High School students. These groups can be the most willing to learn about lake management and protection and experience shows that educated students will attempt to educate their parents and develop into education leaders. Amery Lake District educators have brought these principles into the curriculum. The educational efforts should continue to be supported and expanded.

Involving youth in water quality education can have long-term benefits to the community and the water resources (surface and groundwater). Local teachers and administrators should be asked how the local project staff can assist them with environmental education.

Teachers could:

- Include lake management and protection practices into their lesson plans (examples are located in Appendix T).
- Plan a visit from a City, County, or Town official or other professional to discuss lake management and protection.
- Coordinate a stream or lake monitoring program with ALPRD.
- Utilize available educational programs on water quality to emphasize the need to sustain high quality surface and groundwater.

Students could:

- Participate in a stenciling programs in which "Drains to Lake/River" is painted on storm water inlets in their communities (information located in Appendix T).
- Create flyers or posters to be used in a community education campaign.
- Survey their parents and neighbors about their knowledge of lake management and compile the information with their classmates.
- Write articles or letters to the editor highlighting lake management and protection.
- Assist the ALPRD with long-term lake testing and monitoring and with shore land restoration programs.

Of course, there are countless options available to include students in the education and information phase of the plan implementation recommendations.

We recommend that the ALPRD focus on Elementary, Middle and High School students not only as an audience but also a resource for the education and information program, and their continued participation through the Ecology curriculum.

7.2.d. Adult Residents

The primary concern of most adult residents will be the costs for implementation. Therefore, the primary information and educational campaign for this group should focus on the benefits of implementation of the recommended improvements, the costs of improvements, and the creative funding sources available. Public service announcements could target messages on various local water quality topics and where to receive assistance.

Methods of informing adult residents would be:

- Letters or Flyers
- Newspaper articles
- Surveys
- Public Meetings
- Seminars
- Demonstration Projects
- Public Service Announcements

7.2.e. Business and Industry

Businesses and industry are excellent locations to post information that will reach a large number of people. It would be incredibly beneficial to post information regarding lake management and protection in a public location with high pedestrian traffic, such as at the lunch room or at the entrance or lobby of any retail or service business. This would expose the information to a large number of individuals without incurring high printing and postage costs.

Some communities have requested sellers of phosphorus-based fertilizer to post a "kind reminder" next to such products informing them of the non-phosphorus-based choices. In the same vein, lawn care professionals can be a good means to distribute information about non-phosphorus-based fertilizers to their customers.

7.2.f. Homebuilders and Developers

Professionals in the business of land development and disturbance are another main group that should be targeted for information purposes. Enforcement of the Wisconsin DNR ch. NR 151 Runoff Management rules is vitally important to the success of the proposed proper construction and implementation of Best Management Practices. For instance, a subdivision designed and constructed in strict accordance with the provisions therein can still be a major source of flooding and sedimentation downstream if erosion control and Best Management Practices are not properly designed and installed. Homebuilders need to know that silt fence, aggregate tracking pads, and other single site erosion control methods and properly designed and sited Best Management Practices can be relatively inexpensive to install and maintain.

An understanding of the water quality impacts from construction and development sediment and various erosion control methods should be a focus for a "Construction Erosion Control Workshop." Building contractors, landscapers, developers, consultants, zoning officers, and others interested in erosion control should be invited. The Wisconsin DNR and UW-Extension has organized these programs in the past and provide regulatory information. Manufacturer representatives of various erosion control products could be asked to display their products.

Methods of disseminating information to this group of individuals may include:

- Letters/Flyers
- Fact Sheets
- Newspaper articles
- Public Meetings
- Seminars
- Ordinances

We recommend that the ALPRD gives this group the highest priority in the education and information program. Because this group is responsible for a majority of both the problems and solutions to lake management and protection, it is vital to have their cooperation.

7.3. Summary

The Amery Lakes Protection and Rehabilitation District has a vested interest in ensuring the increased understanding and acceptance of lake management and protection by membership support. In targeting various and diverse groups of public officials, staff, residents, business, and developers, it is hoped that all segments of the community are exposed to at least a portion of the educational material regarding lake management and protection benefits. With education comes problem recognition and understanding. It is important that all segments of the population understand that they are part of the "problem" and must be part of the solution. If the "problem" continues to be ignored, the result will be a loss of not only a high water quality water resource BUT also a reduction of the financial gains and benefits of all who reside in this region.

CHAPTER 8: FUNDING OPTIONS

A variety of funding resources are available to those seeking financial and technical assistance for watershed-wide projects related to water quality. With the broad scope of available financial options, it is very important to ask "Which method(s) best suit the ALPRD?" The complexity of the funding (grants vs. loans, grants combined with loans, specific project type eligibility, jurisdictional issues of eligibility from the grant/loan offerors, etc.) is such that the District may wish to retain the insight and the assistance of a consultant team suitably knowledgeable and experienced in this field.

Major categories of funding sources are:

- Local financing
- Private, nonprofit funding
- State grants
- Federal grants

Appendix U presents information on the many available grants and other funding options. However, one should be realistic in selecting which funding options to pursue as a great deal of time and effort can be expended for the potential of very little return. Therefore, we recommend that the Lake Association concentrate on the known offerings that have successfully provided monies in the past. It is also important to recognize that as certain government programs are phased out (such as the Priority Watershed Program) there are others that are being developed to take their place (Storm Water Runoff Management Program funds). The funds that are recommended to ALPRD to consider include local financing, State Grants and Federal Grants.

State grants are available to assist in surface water management and abate nonpoint source pollution. However, it is generally not a good financial practice to rely totally on grants for a service program. This source of revenue is not dependable and requires constant speculation as to its availability. Grants are useful but should only be used to supplement a planned local revenue source.

8.1. Local Financing

- Lake Property Owners

  Lake property owners can prevent or solve some lake problems by individual actions. However, most problems require an organized approach. At the local level, lake associations, community service clubs, town sanitary districts, and lake districts are

involved. Table 10 lists some of the differences between the various types of Lake Associations and Lake District.

- Permanent Conservation Easements

As a protection mechanism, some lake property owners purchase large acres of land to limit area development. To ensure that conservation values are protected and that the land is not broken into smaller parcels and sold for development, land owners can work with a nonprofit organization to place restrictions, such as limit building, logging, etc., on the present and future land uses. Conservation easements still allow land to be lived on, sold, or passed onto heirs, and permanent conservation easements donated to a nonprofit organization may entitle land owners federal and state tax deductions equal to the easement value. More information on this protection mechanism is yet to come from the Wisconsin DNR (*WAL Lake Connection*).

Table 10: Principal Differences among Incorporated Lake Associations, Qualified Lake Associations, and Public Inland Lake Protection and Rehabilitation Districts

	Incorporated Lake Association	Qualified (incorp.) Lake Association	Public Inland Lake Protection and Rehabilitation District
Statutory Authority	Ch. 181, Wis Stats	Ch. 281,181 Wis Stats.	Ch. 33 Wis Stats.
Formation	1. File Articles of Incorporation. 2. Draft bylaws	1. File Articles of Incorporation. 2. Draft bylaws with specific statutory criteria set forth.	1. Landowner petition to county or town board. 2. Resolution of city council or village board. 3. Conversion of a town sanitary district.
Principal Means of Funding Activities	-membership dues	-membership dues *-state grants/other grants*	*-property tax levy* -state grants/other grants
Boundaries	Assoc. should designate one or more lakes. Specific boundaries are not required.	Assoc. should designate one or more lakes. Specific boundaries are not required	Boundaries may include part of lake, entire lake, more than one lake. Boundaries are strictly defined.
Powers			
General Management Powers (pursuant to statutory guidelines) **Not an exhaustive list of powers** *** with permit from DNR**	An incorporated lake association has power to: acquire property, borrow money, invest money, contract for aquatic plant removal, purchase sensitive areas, improve fish habitat*, stock fish*, and maintain lake access. Powers are same as qualified lake assoc. (s. 181.04 Stats.)	A qualified lake assoc. has power to: acquire property, borrow money, invest money, apply for and receive grants, contract for aquatic plant removal, purchase sensitive areas, improve fish habitat*, stock fish*, and maintain lake access. Powers are same as incorporated lake assoc.(s. 181.04 Stats.)	A lake district has power to: sue and be sued, make contracts, take out loans, levy taxes, special charges, accept grants, state aid, monitor water quality, survey lake users, harvest or treat aquatic plants and dredge, adopt boating ordinances (s. 30.22 Stats.)
Additional Powers Public inland lake districts have authority to assume powers of sanitary districts. *District may not exercise these powers within territory of existing sanitary district (s. 33.22(2m), s. 60.77 Stats.)			-authority to require the inspection of private sewage systems, fix and collect charges for solid waste collection, disposal, sewage service and water service. -authority to enact ordinances to implement powers. -authority to provide chemical or mechanical treatment of waters to treat swimmers' itch, algae.
Governance	Board of directors and association membership	Board of directors and association membership	Board of commissioners and electors at annual meeting.

Modified from: http://www.uwsp.edu/cnr/uwexlakes/faq/differences.htm

- Lake Associations

In 1898, Wisconsin's first lake association was established on Lake Geneva. More organizations concerned with the health of lakes incorporated under Chapter 181 of the Wisconsin Statutes. Some have achieved federal tax-exempt status under Section 501(c)(3) of the Internal Revenue Code in 1998.

Under the State and Federal regulations, associations can pursue some of the following general management powers:

- collect membership dues
- borrow/invest money
- apply/receive state and other grants
- acquire property
- contract for aquatic plan removal
- purchase sensitive areas
- improve fish habitat (with DNR permit)
- stock fish (with DNR permit)
- maintain lake areas (s.181.04 Wis. Statutes)

- Town Sanitary District

The State of Wisconsin did not have local public institutions designed to help manage lakes before 1974. Publicly administered lake management was first attempted in the early 1930s. Many lake communities around Wisconsin formed "town sanitary districts" to focus on lake problems, but later found complex problems involved with lake management. The purpose of a town sanitary district is to allow property owners in developed but as yet, unincorporated, areas to form a unit of government to provide basic services such as:

- garbage removal
- public sewer/water
- storm water drainage
- treatment of aquatic nuisances
- septic tank inspection

In the past, lake associations often worked with the sanitary districts to improve the lakes and raise funds through taxation. In recent years, the town sanitary districts have not been formed to solely manage lakes because other mechanisms are available – lake associations and lake districts. Some town sanitary districts have merged or converted to lake districts.

- Lake Districts

After six years of public demonstration, the Wisconsin legislature adopted Wisconsin Lake Management law in 1974. Under Chapter 33 of the Wisconsin Statutes, lake districts were authorized to undertake protection, rehabilitation, and recreational improvement on public inland lakes. As result, in Wisconsin, lake associations/ districts are replacing sanitary districts to provide lake management duties. Lake Districts are in a better financial position to complete lake management activities with their ability to tax property owners within their specifically designated boundaries. Some examples of a lake district's powers are:

- levy taxes
- apply/receive State or other grants
- take out loans
- receive State aide
- make contracts
- sue or be sued
- monitor water quality
- survey lake users
- harvest or treat aquatic plants and dredge
- adopt and enforce boating ordinances (s.30.22 Wis. Statutes)

The organization to a lake district may be appropriate when the lake management organization is active in lake protection, when legal certainty is desired, and when long-term lake planning is anticipated. The disadvantages of a lake district are that it's complexity, requirement for a higher degree of maintenance, and its ability to tax all district property owners. The latter is an advantage once formed but result in the most vocal opposition to the formation of the entity.

The ALPRD is a Lake District and levies a tax on watershed residents to meet its financial obligations.

8.2. State Grants

A. Wisconsin Department of Natural Resources (WDNR)

(1) NR 153 Targeted Runoff Management (TRM) Grant Program

TRM grants are competitive financial awards to support small-scale, short-term projects that are completed by local governmental units within 24 months of the start of the grant period. Both urban and rural projects can be funded through a TRM Grant.

TRM grants *may not* be used to fund the following:

- Projects to control pollution regulated under Wisconsin Law as a point source.

- Staffing and/or planning activities.
- Construction site erosion control and post-construction structural BMPs for new development.
- Projects that are not water quality based (such as projects to solve drainage or flooding problems) or for dredging projects.
- Rural projects within Priority Watershed project areas, unless a showing is made that a Priority Watershed funding is inadequate to cover the entire TRM project.

County Land Conservation Departments (LCD) and municipalities (towns, villages, and cities) are the most common applicants. Applicants include, cities, villages, towns, counties, regional planning commissions, tribal governments, and special purpose districts, such as, lake districts and sewerage and sanitary districts.

(2) Wisconsin DNR Lake Grants

The Wisconsin DNR Lake Grants are influenced by the Wisconsin gas tax revenue. Despite the budgetary changes and cutbacks, the lake grant funding increased from $2.6 to $3.1 million dollars annually.

With a larger budget, the DNR have been directed to create an Aquatic Invasive Species grant program with the new available money. The DNR is also directed by an amendment to write rules for these grants to control these aquatic invasive species. It is proposed that the grants would require 50% match and only local government (i.e. lake and sanitary districts) are eligible, and not lake associations or nonprofit organizations. Eligible planning project activities *may* include:

- Aquatic invasive species monitoring/surveys,
- Development or prevention, control, and restoration plans,
- Educational and training materials, and activities,
- Watercraft inspections,
- Investigation of control methods or prevention techniques.

Final rules for this new grant are expected to be in place the spring 2005. The lake planning and protection grants are available and described below.

a. Lake Planning Grants

Lake planning grants provide funding for the lake management planning process. Qualified applicants are Wisconsin counties, towns, villages, cities, qualified lake associations, town sanitary districts, lake districts, other governmental units as defined in Ch. 66.299, Wisconsin Statutes, tribal units of government, qualified nonprofit conservation organizations. These grants are offered twice annually (February 1 and August 1) for extensive studies and technical planning and there are large and small scale grants.

- Small scale lake planning grants of up to $3,000 are available for obtaining and disseminating basic lake information, conducting education projects, and developing management goals. These grants are ideal for applicants who are just beginning the planning process, education processes, or for activities that supplement an existing plan.

- Large scale lake planning grants up to $10,000 per project (maximum 2 projects per application cycle) are available for larger projects. The intent of a large-scale program is to conduct technical studies to help develop elements of or complete comprehensive management plans. The WDNR typically pays for 75% through grant cost share payments not to exceed $10,000 per project and the applicant may pay 25% (up to $3,000 to $5,000) in local dollars. Diagnostic evaluations of water quality analysis are typically funded activities.

b. Lake Protection and Classification Grants

Lake protection grants provide funding for implementing the recommendations of a management plan. As one progresses from planning to implementation, the costs and the time involved increases. Because implementation is more expensive, protection grants are available for up to $200,000 per project, except that grants for regulation or ordinance development projects are limited to $50,000.

Grants are based on 75% of the total eligible project costs and capped at the maximum grant amount mentioned earlier. Grants will be awarded annually and a priority project list will be prepared each year on a state-wide basis. The grant deadline is annually on May 1.

Activities that are acceptable for funding include purchasing property or easements which contribute to the protection or improvement of the natural ecosystem and water quality of a lake; restoring wetlands or lands draining to wetlands; and developing regulations and ordinances to protect lakes and the educational activities necessary for these regulations to be implemented.

(3) Wisconsin River Protection Grants

The Wisconsin River Protection grants are referenced under Chapter 281.70 State Statutes and under ch. NR 195 Wisconsin Administrative Code. Approximately $300,000 was available for annual appropriation in 2003 and is generated from the Wisconsin gas tax. Communities and nonprofit groups can receive state financial help to protect rivers under a project that aims to prevent water quality, fisheries habitat, and natural beauty from deteriorating as homes, recreation, industry, and other land uses increase along rivers. Ineligible projects include: dam repair and operations, purchase of property on which a dam is located unless for the purpose of dam removal, dredging, design, installation, operation or maintenance of sanitary sewers, treatment plants, or onsite sewerage systems, and others listed in application.

a. River Planning Grants

A maximum of $10,000 is available for eligible river planning grant projects. Up to 75% of the project may be reimbursed by the State. The following are eligible activities under the river planning grant program:

- River Organization Development
- Information and Education
- Assessment of Water Quality, Habitat, Use, Watersheds, and Shorelands
- Data Collecting
- Ordinance Development
- Plans and Strategies

b. River Management Grants

A maximum of $50,000 is available for eligible river management grant projects. Up to 75% of the project may be reimbursed as State Share.

The following are eligible activities under the river management grant program:

- Acquisition and Easements
- Habitat Restoration
- Pollution control practices
- Ordinance Development
- Activities in Approved Plans

(4) Recreational Boating Facilities Grant Program

The Wisconsin DNR Recreational Boating Facilities Program is a 50/50 grant program. Grant funds can be used for boat landings/docks, sanitary facilities, parking lots, basic landscaping, and security lighting. Repairing an existing ramp is eligible, however, not very competitive with other grant applications. A major scoring criteria this program is introducing handicap accessibility. A boat landing (new or repaired) would require a handicap accessible dock and paced access to the dock from the parking lot. Applications are due quarterly.

(5) Stewardship Grant Program

The Wisconsin DNR provides funding for stewardship projects such as the following:

- Land acquisition
- Trails
- Restrooms
- Parking lots
- Picnic areas
- Handicap accessibility modifications

Application deadline is May 1 each year. Grants are extremely competitive. The Wisconsin DNR uses a detailed point system to fund the project and land acquisition project score the highest. Land acquisitions involve the following:

- An acquisition brochure must be given out at the first contact with the land owner.
- An appraisal is required by WDNR.

- If the grant is awarded, WDNR will pay on-half of the appraisal value.

(6) Aquatic Invasive Species Grant Program

Described in proposed NR 198 (yet to be promulgated), the proposed rule describes the eligibility, project requirements for receiving applications and awarding grants for the control of aquatic invasive species (AIS). Any unit of local government, including tribes and inland lake protection and rehabilitation districts, are eligible sponsors. Grants are available to conduct projects on all waters of the state, including lakes, rivers, streams, wetlands and the Great Lakes. Grants operate on a reimbursement basis, meaning sponsors must incur costs and seek reimbursement from the state. Volunteer labor and donated services, equipment and other "in-kind" items can be used to meet the sponsor's required 50% match. Priorities emphasize prevention and control new infestations of AIS.

Projects emphasizing educational programs, develop prevention and control plans and monitor water bodies for the presence of AIS, watercraft inspection and education grants are eligible programs. Recognizing that towns or counties will propose projects encompassing multiple water bodies, the maximum grant amount of is proposed to be $75,000. Sponsors can apply twice a year, February and August, for these grants. Though a reimbursement program, a 25% cash advance is allowed for these activities.

Grants specifically for controlling new or pioneer infestations of AIS are available. Under these projects sponsors can report a new infestation to the Department who will confirm the species, determine the appropriate method of control and authorize the sponsor to conduct the project. A grant application is completed at this time so that the sponsor can be reimbursed for 50% up to $10,000 for the actual costs of the project once it is satisfactorily completed and reported to the Department.

Grants are available for up to $75,000 to sponsors to conduct control projects that are included in a plan approved by the Department. The rule requires mapping of the species to be controlled, and a management plan to be in place, and describes the process for submitting the plan to the Department for approval. These projects are intended to provide for the eradication or substantial reduction and long term control of AIS with the goal to restore native aquatic life communities. Since control techniques for many AIS are less than perfected and new AIS are likely to expand into Wisconsin, experimental or demonstration projects are eligible to allow opportunity to learn and refine methods of lasting control. Sponsors can apply twice a year, February and August, for these grants.

B. State Land Trusts and Stewardship Programs

This voluntary program includes a stream bank component and an urban river component. Funds are available to public entities and provide non-profit organizations for property purchases from willing sellers, fencing, easements and public fishing areas. To date, Wisconsin's land trusts have been awarded $25 million in matching funds through the Warren Knowles-Gaylord Nelson Stewardship Fund. These funds have been matched dollar-for-dollar in federal and private funds and land donations from landowners. In addition, land trusts take on the permanent management responsibility of these lands and each project has clear public support in the community.

C. Wisconsin Environmental Education Board (WEEB)

The Wisconsin Environmental Education Board (WEEB) was created by 1989 Act 299, becoming law in 1990. One of the Board's responsibilities is to award grants for the development, dissemination, and implementation of environmental education programs. Funded projects have included state-wide initiatives as well as small localized efforts. Audiences served include K-12 public and private school children, members of various youth organizations, classroom teachers and other educators, landowners, park patrons, tourists, and of course the public.
During the 2004-2005 grant cycle the WEEB anticipates allocating funds in five categories:

- WEEB identified initiatives
- General environmental education grants
- Forestry education grants
- School forest grants
- Mini-grants

8.3. Federal Grants

A. U.S. Army Corps of Engineers (ACOE)

(1) Section 22 Planning Assistance to States Programs

Funds are a 50/50 cost share. The program is administered through state planning (WDNR-Madison). Eligible projects are given to the COE to prepare a cost estimate which is negotiated with the "customer." The "customer" provides 50% cost share in the form of cash. The COE then completes the preliminary design or study.

B. U.S. Environmental Protection Agency (EPA)

(1) Environmental Education Grant

EPA's Office of Environmental Education supports environmental education projects that enhance the public's awareness, knowledge, and skills to make informed decisions that affect environmental quality. Since 1992, EPA has received between $2 and $3 million in grant funding per year and has awarded over 2,500 grants. Grants of $25,000 or less in federal funds are awarded in EPA's ten regional offices, and grants over $25,000 are awarded at EPA Headquarters in Washington, D.C. Grantees must provide non-Federal matching funds of at least 25% of the total cost of the grant project. This may be cash or in-kind contributions. Colleges, universities, local and tribal education agencies, state education, environmental agencies, not-for-profit organizations, and non-commercial educational broadcasting entities are eligible to apply.

(2) Clean Lakes Grant

The federal Clean Lakes Grant is the next step in lake restoration following the State Lake Planning Grant Program. The program includes significantly more funding than the state program and can be used for development and implementation of lake restoration plans and activities.

C. U.S. Geological Survey (USGS)

The USGS provides funding for research, water resources data collection, data management, and information transfer activities.

D. U.S. Department of Agriculture (USDA)

(1) Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) was established to provide a single, voluntary conservation program for farmers and ranchers to address significant natural resource needs and objectives. Nationally, it provides technical, financial, and educational assistance, half of it targeted to livestock-related natural resource concerns and the other half to more general conservation priorities. EQIP is available primarily in priority areas where there are significant natural resource concerns and objectives.

(2) Water and Waste Disposal Systems for Rural Communities

This program provides monies to provide basic human amenities, alleviate health hazards, and promote the orderly growth of the rural areas of the nation by meeting the need for new and improved rural water and waste disposal facilities. Funds may be used for the installation, repair, improvement, or

expansion of a rural water facility, including costs of distribution lines and well pumping facilities. Funds also support the installation, repair, improvement, or expansion of a rural waste disposal facility, including the collection and treatment of sanitary waste stream, storm water, and solid wastes.

Eligibility: Municipalities, counties, and other political subdivisions of a state (such as districts), and authorities, associations, cooperatives, non-profit corporations, and federally recognized Indian tribes.

Assistance Provided: Project grants (617 grants awarded in FY98, ranging from $3,000 to $4.1 million).

E. National Park Service, Department of Interior

The objectives of this program are to provide Federal grants to local governments for the rehabilitation of recreation areas and facilities, demonstration of innovative approaches to improve park system management and recreation opportunities, and development of improved recreation planning.

F. U.S. Department of Fish and Wildlife

County, local, and tribal governments; private landowners; nonprofit conservation organizations are eligible to apply for this federal grant that has the purposes to:

- Restore wetlands, stream and river corridors, and other fish and wildlife habitats important for Federal trust species (threatened and endangered species, anadromous fish, and some marine mammals).
- Develop partnerships to implement these habitat restoration projects.
- Demonstrate applied technology for habitat restoration projects to help the public understand and participate in fish and wildlife resource conservation.

The financial and technical assistance typically is $10,000 or less per project. However, sometimes larger projects funded. Depending on the available funds and type of project the cost share varies. The following are example projects:

- Restoration of degraded wetlands,
- Stream restoration,
- Restoration of endangered or threatened species habitat,
- Dam removal.

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