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2003 Lake Delton Aquatic Plant Survey Technical Report

Prepared by:

Aquatic Engineering

Post Office Box 3634

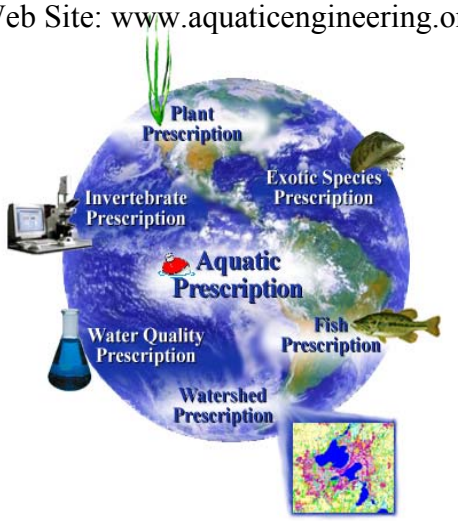
La Crosse, WI 54602-3634

Phone: 866-781-8770

Fax: 608-781-8771

E-mail: info@aquaticengineering.org

Web Site: www.aquaticengineering.org



2003 Lake Delton Aquatic Plant Survey Technical Report

By J. E. Britton[1], and N. D. Strasser[2]

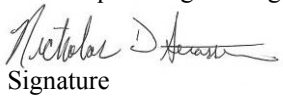
February 2007

In cooperation with the Wisconsin Department of Natural Resources

1 Aquatic Engineering, Inc.; jbritton@aquaticengineering.org
PO Box 3634, La Crosse, WI 54602-3634
Phone: 866-781-8770
www.aquaticengineering.org


Signature 02/21/07
Date

2 Aquatic Engineering, Inc.; nstrasser@aquaticengineering.org
PO Box 3634, La Crosse, WI 54602-3634
Phone: 866-781-8770
www.aquaticengineering.org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Village of Lake Delton

Frank J. Kaminski	Village President
Kay C. Mackesey	Village Treasurer
Leslie Bremer	Village Trustee
Gordon Priegel	Village Trustee
David Shanks	Village Trustee
Thomas Webb	Village Trustee
Todd Nelson	Village Trustee
Jim Rodwell	Village Trustee
Richard Cross	Village Attorney

Wisconsin Department of Natural Resources

Susan Graham	Lake Coordinator
Pat Sheahan	Environmental Grants Specialist
Tim Larson	Fish Biologist

Executive Summary

Lake Delton is a drainage lake located in Sauk County, Wisconsin near the Wisconsin Dells. It is a 76 year-old eutrophic impoundment on Dell Creek with a surface area of 267 acres. The dam sustaining Lake Delton is just upstream of the Wisconsin River and within the Village of Lake Delton.

Lake Delton is one of the most intensively used recreation lakes in the state of Wisconsin. There are a number of resorts and businesses on Lake Delton that depend on the lake's navigability and water quality. It is becoming widely noticed that the economic value of lakes is directly related to water quality and a healthy aquatic plant community (Krysel *et al* 2003).

An aquatic plant survey was conducted on Lake Delton in August, 2003 at the locations shown in Figure 1. Plants within Lake Delton were confined to the areas of the littoral zone where no wake and boating restrictions are in place, as shown in Figure 2.The aquatic plant survey revealed that plants within Lake Delton are confined to the areas of the littoral zone where no wake and boating restrictions are in place. Only one-third of the littoral zone contained aquatic plants. The cause of the lack of plants in the rest of the lake is most likely intensive boat recreation occurring during the growing season. Key diversity indices show that the aquatic plant community has a statistically low diversity.

The most common taxa found during the survey were "desirable native plants". Figure 2 shows that native vegetation is rare and it is valuable biological asset to be preserved.

- Wild celery (*Vallisneria americana*) occurred in 24 % of the sample sites
- Slender naiad (*Najas flexilis*) occurred in 15 % of the sample sites
- Common waterweed (*Elodea canadensis*) occurred in 10 % of the sample sites

Based on the findings of the whole-lake survey, it is recommended that the Village of Lake Delton protect their aquatic plant community by monitoring for non-native species distribution and density, water quality, and enforcing no-wake zones.

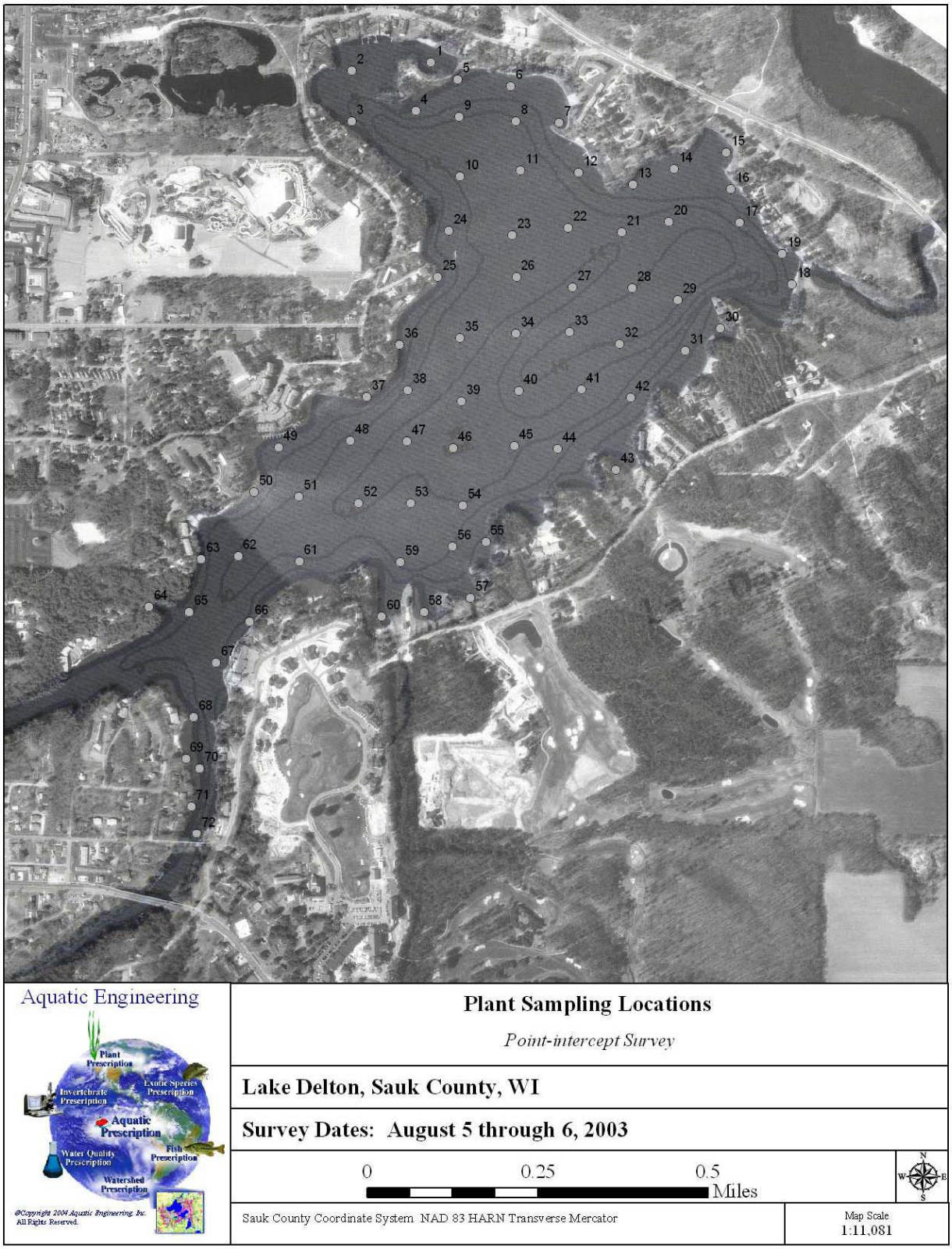

Figure 1. Pre-selected aquatic plant sampling locations within Lake Delton (Sauk County, Wisconsin) in 2003.

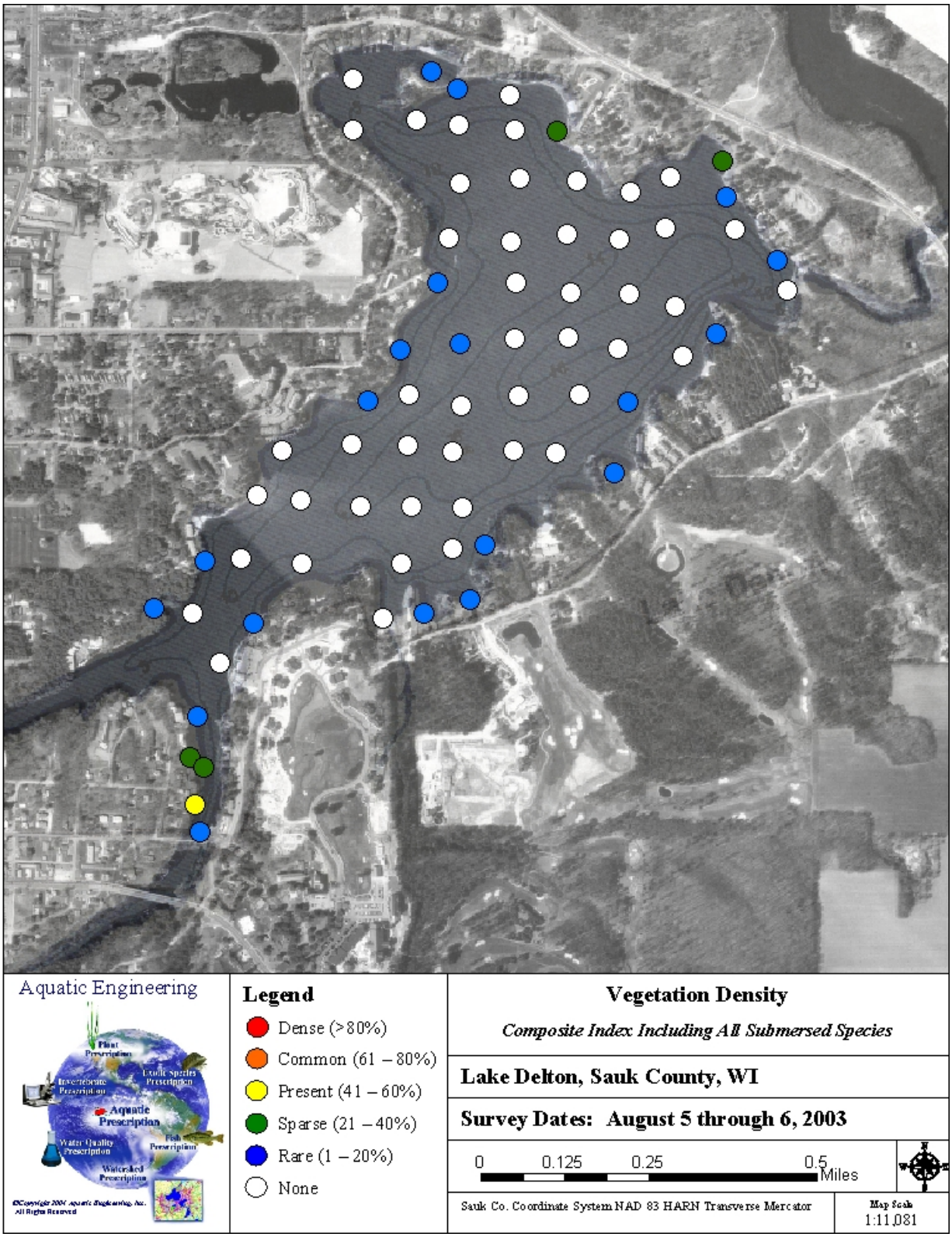

Figure 2. Total plant distribution and density ratings for all submersed aquatic plant species within Lake Delton (Sauk County, Wisconsin) in 2003.

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1.0 Introduction

Lake Delton is a drainage lake located in Sauk County, Wisconsin, near Wisconsin Dells (T13N, R6E, S15; WBIC 1295400). It is a 76-year-old mesotrophic impoundment on Dell Creek with a surface area of 267 acres, a maximum depth of 16 feet and an average depth of approximately 8 feet (Figure 2). The dam sustaining Lake Delton is just upstream of the Wisconsin River and within the village of Lake Delton.

Lake Delton is one of the most intensively used recreation lakes in the state of Wisconsin. There are a number of resorts and businesses on Lake Delton that depend on the lake's navigability and water quality. It is becoming widely noticed that the economic value of lakes is directly related to water quality and a healthy aquatic plant community (Krysel *et al* 2003).

This report addresses aquatic plant monitoring activities occurring on Lake Delton during the summer of 2003. Aquatic Engineering personnel performed an aquatic plant survey to evaluate the current status of the plant community of Lake Delton. Water quality data was collected at each plant sample site to determine whether local impacts of water chemistry changes could be attributed to aquatic plant growth. The goals of the survey were to:

- evaluate the status of the aquatic plant community
- determine a course of action that will improve the aquatic plant community and that is compatible with the recreation-based economy of the Village of Lake Delton
- review the fishery community data and make management recommendations to improve the status of the fishery through habitat improvement.

This report summarizes the 2003 aquatic plant survey on Lake Delton and provides a comprehensive aquatic plant and algae management strategy to guide future management activities.

Purpose Statement

The purpose of this aquatic plant management plan is to collect plant inventory data, analyze the data, make recommendations, organize resources, and facilitate plan implementation.

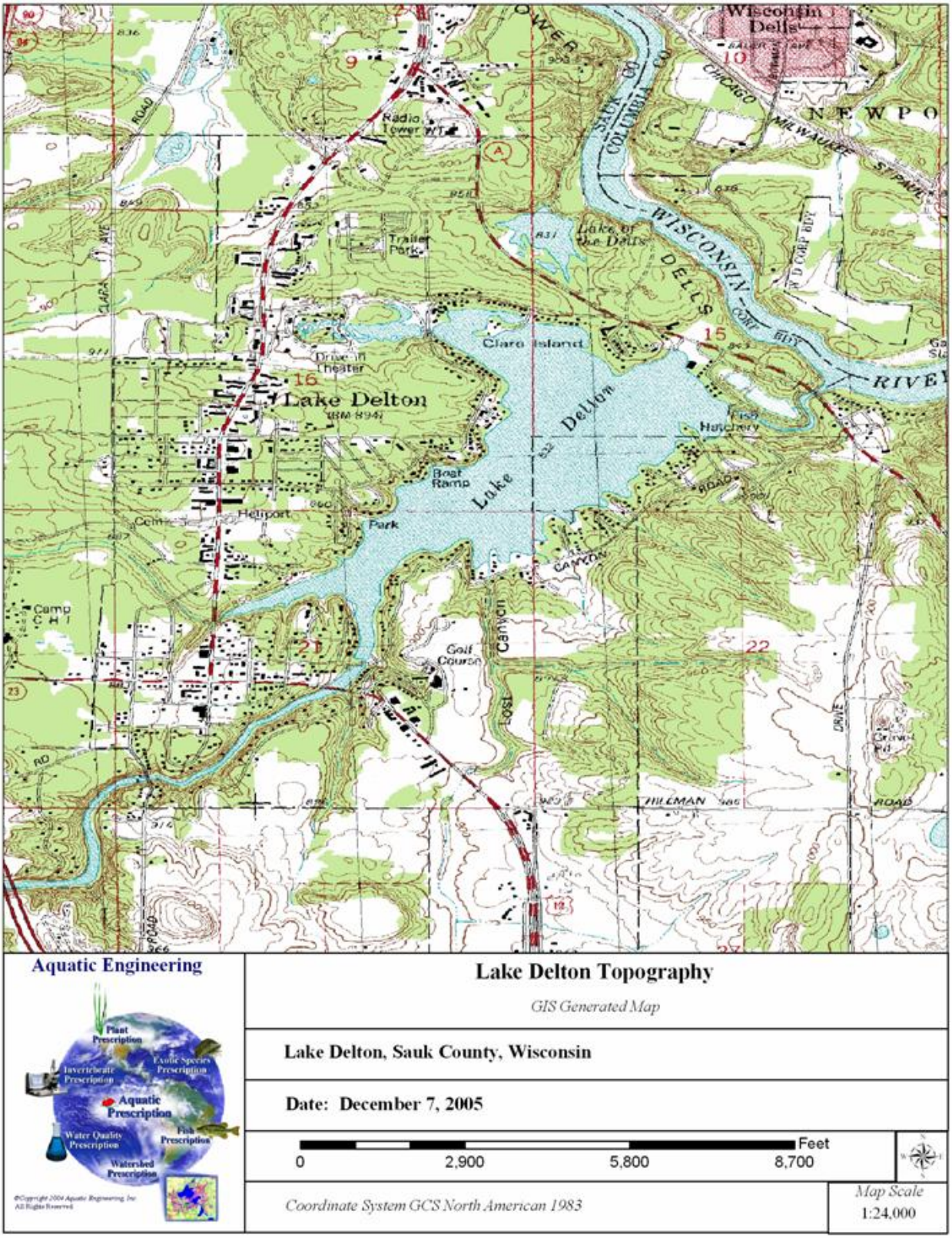

Figure 3. Topography of the region surrounding Lake Delton (Sauk County, Wisconsin)

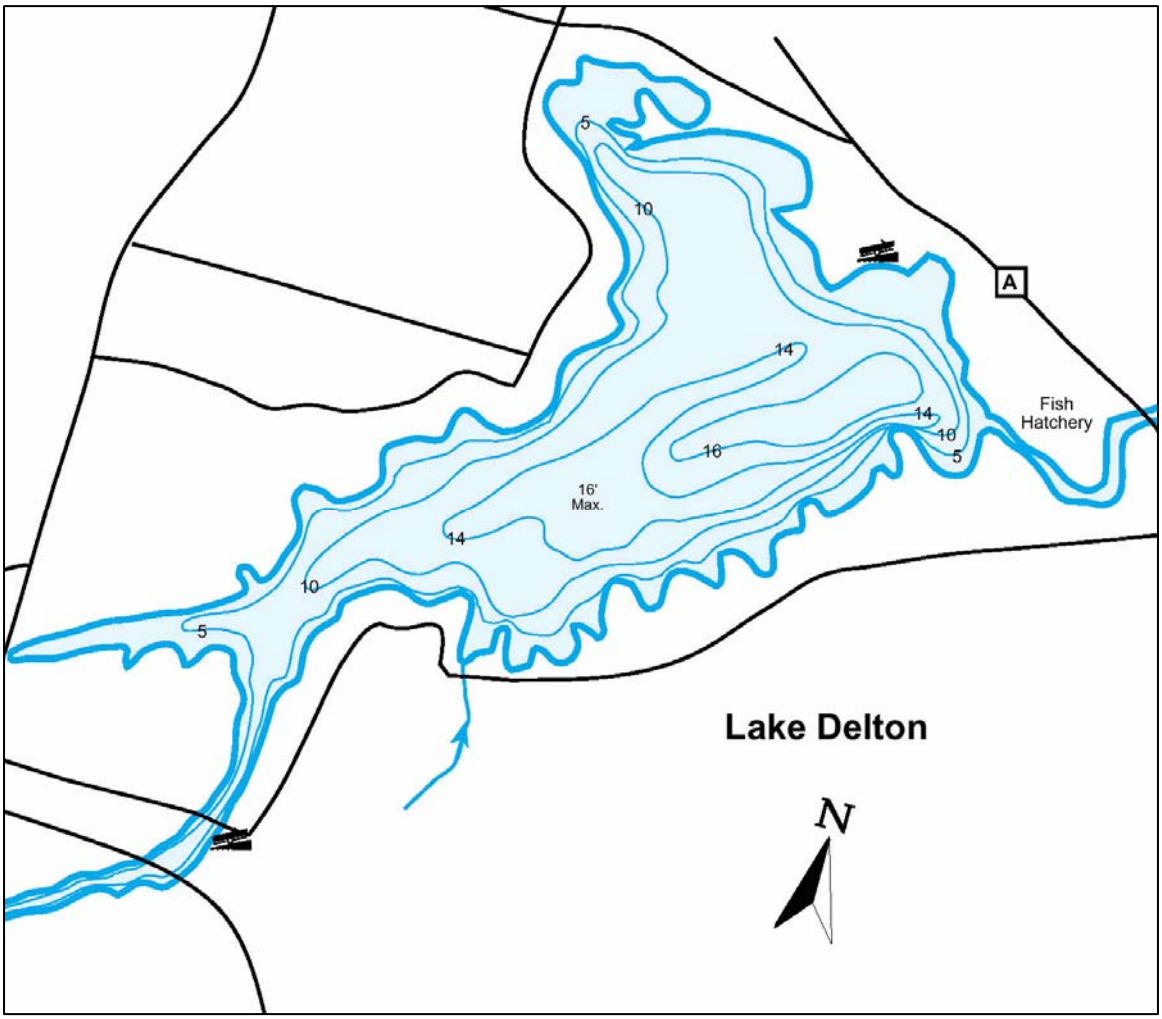

Figure 4. Bathymetric map of Lake Delton (Sauk County, Wisconsin).

2.0 Overview of Aquatic Plants

2.1 Aquatic Plant Distribution within Lakes

Aquatic plants grow in areas of lakes, ponds, and other impoundments called the littoral zone, which is the area between dry land and open water. The area of the littoral zone can vary greatly from lake to lake but is generally considered the area where the water depth is less than 15 feet and rooted aquatic plants can be found. This definition is a general guideline, and the 15-foot depth can increase with clear, calm water or decrease with cloudy, disturbed water. Open water is considered any area greater than 15 feet or where rooted aquatic vegetation does not grow.

The littoral zone is the area where most of the lake's "productivity" takes place (Figure 3). Abundant light and suitable sediment provide prime habitat for plants and algae, and photosynthesis from these provides the energy source for all other life forms in the lake.

Because of this, the littoral zone is the most biologically active area of a lake. Open water areas are also biologically productive in lakes where littoral habitat is available. Planktonic algae and zooplankton migrate to open water where photosynthetically-active radiation (PAR) penetrates the water.

2.2 Types of Aquatic Plants

There are four major categories of aquatic plants.

Algae can be found in all areas of a lake where sunlight penetrates. They have no true roots or leaves and can be single- or multi-celled. Planktonic algae are free-floating microscopic organisms that can be found anywhere light penetrates the water. Blooms of planktonic algae give a lake the "pea soup" look. Filamentous algae are only found in the littoral zone because it first forms at or near the bottom of the lake. As these organisms reproduce, they form tangled mats that eventually trap gasses released during photosynthesis and float to the water surface, where they create an unpleasant odor while they decay.

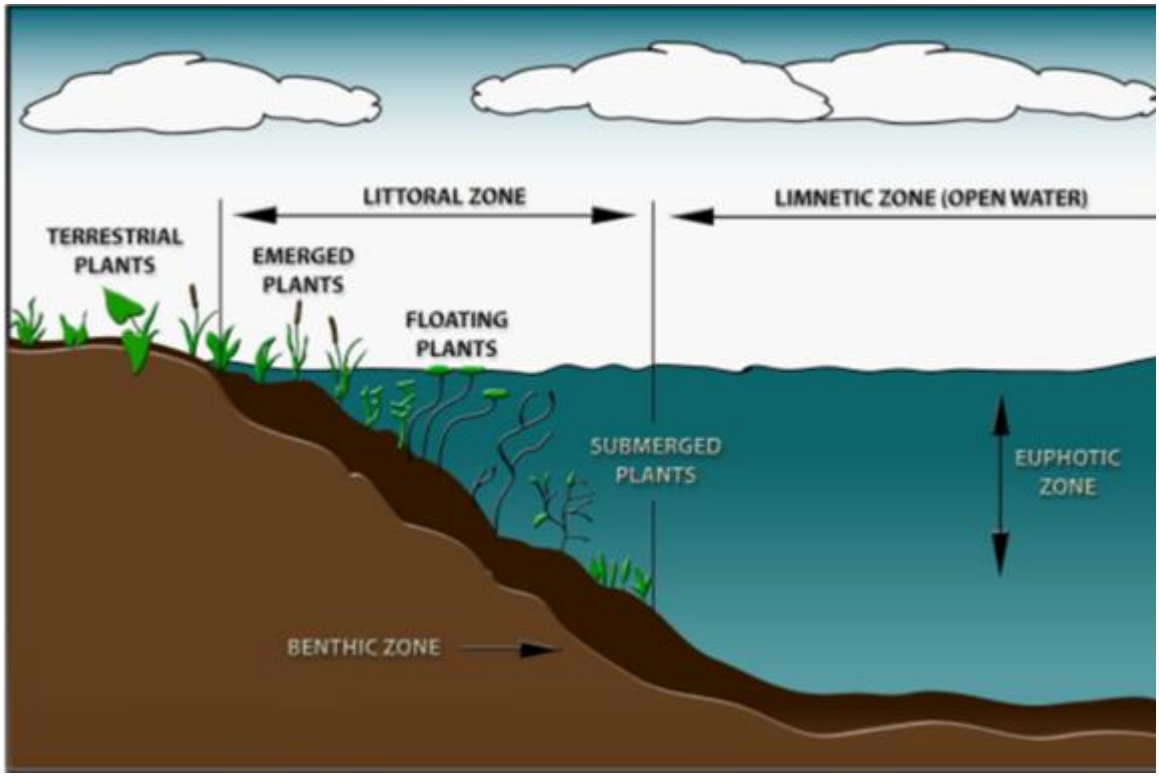

Figure 5. Diagram of a typical littorial zone within a lake.

Submersed macrophytes are true plants, having true stems and leaves that grow entirely underwater. These plants have a wide range of morphologies and are able to grow in all areas of the littoral zone. Although they grow entirely underwater, some produce flowers or seed heads that can stick out of the water completely. These plants can form dense beds or be scattered intermittently throughout the lake. They can grow close to the bottom or form long arrangements of stems that create surface mats.

Floating-leaved plants are often found rooted in the littoral zone where the lake surface is relatively protected from wave action caused by wind or boats. The leaves and flowers of these plants are found floating at the water surface. Water lilies are good examples of floating-leaved plants.

Emergent plants, such as cattails, have roots that are submersed, but their stems and leaves grow above the water surface. These plants are found in the shallow areas of the littoral zone and in wetlands and are the link between land and water. Emergent plants provide cover and food for wildlife and help protect shorelines from wave action. Emergent plants also act as a nutrient buffer by removing nutrients as they wash from the watershed to the lake.

2.3 Value of Aquatic Plants

Serve as a food source – Aquatic plants provide a source of food for insects, snails, and freshwater shrimp. Some fish also eat aquatic plants directly. Some plants produce seeds and roots that are high in simple sugars and are eaten by a variety of wildlife.

Provide shelter/habitat –Plants provide a place for fish to escape from sunlight and predators. They also provide an attachment point for certain insect larvae, and many fish species use vegetated areas of the lake for spawning.

Stabilize shoreline and sediment – Plant roots secure the sediments of a lake and keep them from being stirred by wave action. Plants also protect the shoreline from wave action created by wind and boats and from the erosion caused by those waves.

Improve water quality – Some plants absorb and break down harmful pollutants in the water. Plants also bind nutrients and make them unavailable to algae. The physical structure of plants filters surface runoff from shorelines, keeping pollutants out of the water.

Improve aesthetics – Many plants produce beautiful flowers, leaves, and seeds that enhance the natural beauty of the lake. Shoreline vegetation also reduces noise pollution and offers privacy.

Increase economic value – Because aquatic plants fuel the aquatic ecosystem, they are responsible for the tourism value of the resource. Lakes with healthy plant communities generally have healthy fish and wildlife populations, which draw recreationalists interested in fishing, boating, camping, and hunting. Improved water quality and shoreline aesthetics also raises the value of lakeshore property. The Wisconsin DNR deems aquatic plants an asset to a lake and regulates their protection under NR 107 and NR 109.

3.0 Review of Existing Data

3.1 Previous Plans and Studies

Several plans and studies have been developed for or on behalf of the Village of Lake Delton, Lake Delton Association, Sauk County, and surrounding villages and counties. Many recommendations are contained within each study, but there is no indication that the Village has maintained a "master list" of projects, objectives, goals, implementation and success. The following subsections outline several projects, their goals and recommendations/conclusions.

3.1.1 Lake Delton Proper

Lake Delton Lake Management Plan (Woodward and Clyde, 1992)

This study was conducted to gather background data regarding the Lake Delton watershed and outlined subwatershed analyses. The high points of the findings are: the Lake Delton residence time was approximately 22 days, phosphorus loading mainly originated from cropland runoff (43%) and animal lot runoff (42%), and the Dell Creek subwatershed contributed approximately 83% of the total phosphorus load to Lake Delton.

The recommendation within this study included rural watershed improvements, which were estimated to cost between $750,000 and $1.0M, and an urban public education campaign designed to inform residents, land owners, farmers, and business operators of the importance of protecting the water quality within the watershed through implementing BMPs.

It is not clear weather the recommendations listed within this report were ever implemented, when implementation took place, and when implementation was discontinued.

Fishery Assessment (WDNR summary, November 1995 through May 1997)

Fishery management activities conducted by the WDNR during this period included information regarding the sport and non-sport fishery of Lake Delton. More specifically, the document focused on the walleye stocking effort in Lake Delton. In general, the findings indicated the walleye population within the lake was good and that there were several northern pike, bass and crappie captured. The reports indicated the bait fish population within the lake was excellent.

A review of stocking information determined that walleye fingerling stocking from 1992 contributed to the large population of year class III walleye. Studies from 1997 indicated that fingerling stocking in 1994 was not successful. The possible reasons included the presence of piscivorous fish and a low concentration of large zooplankton. Walleye fingerlings eat large zooplankton until they reach a size where they can graze on larger biological organisms. A possible reason for low zooplankton concentrations could be the large amount of bait fish, which also eat the large zooplankton and therefore directly compete with the walleye fingerlings for food.

3.1.2 Lost Canyon

Lost Canyon Creek is an intermittent stream that contributes a relatively large amount of sandy sediment to Lake Delton. The surrounding land and canyon are sand or sandstone based, and flashy conditions within the creek cause elevated erosion and sediment transport. The Village has looked at several options for controlling water transport conditions throughout the Lost Canyon watershed and within the creek itself. The following reports/investigations have been created in the past decade to assess the problems associated with the Lost Canyon Creek watershed:

- *Possible Sources of Sediment in Lost Canyon Bay (Mid-State Associates, Inc., July 1995)*
- *Storm Water Management Plan Lost Canyon Regional Detention Facility (MSA Professional Services, Inc., January 2004)*

Another issue facing Lost Canyon Creek is the presence of elevated bacterial counts in the water entering Lake Delton from the creek. The watershed surrounding the creek contains a golf course, many impervious substrates, horse stables, and water parks. The watershed also contains wildlife areas rich with biological activity. The following report was written to summarize a 1995 investigation of such bacteria levels:

- *Bacteria Levels in Lake Delton (Pete Jopke, July 1995)*

This report investigated the source of the bacterial load entering Lake Delton and had the following conclusions and recommendations:
1) Recommended 10 rounds of sampling (5 rounds after rain events and 5 rounds during "dry periods") to assess the load rates during various events
2) Concluded the horse stables listed in the previous report were not likely causing the elevated fecal coliform levels experienced (see report for reasons why this was determined)
3) Concluded that abundant wildlife within the canyon and immediate watershed contributed the majority of the fecal matter within the canyon (human feces was also documented)

3.1.3 Dell Creek

The Dell Creek watershed is the largest subwatershed of Lake Delton. Because of this, the nutrient and sediment inputs from this tributary have the greatest potential to affect Lake Delton proper. This subwatershed has also had more investigative and management activities than the other subwatersheds. The Dell Creek watershed became a "Priority Watershed" in the 1990's. The Dell Creek Priority Watershed program is currently underway and is scheduled for completion in 2009.

The major focus of work completed on that project thus far was on public education and sediment reduction. Several publications have been issued as part of this project and summarize monitoring activities and recommendations for watershed improvements. The following two documents regarding the Dell Creek Priority Watershed project were reviewed:

- *Nonpoint Source Control Plan for the Dell Creek Priority Watershed Project (WDNR, WDATCP, Sauk and Juneau County Land and Water Conservation Departments, January 1998)*
- *Dell Creek Watershed (LW 26) (Unknown author, post-January 2000)*

3.1.4 Spring Brook

We found no existing monitoring information or management plans related to the Spring Brook subwatershed.

3.2 Aquatic Plant Surveys

A qualitative aquatic plant survey on July 1, 1994 by C. Molter, M. Sorge, and J. Schure found the following aquatic plants in Lake Delton: *Ceratophyllum dermersum* (coontail), *Elodea canadensis* (common waterweed), *Heteranthera dubia* (water stargrass), *Myriophyllum spicatum* (Eurasian watermilfoil), *Potamogeton amplifolius* (large-leaf pondweed), *Potamogeton crispus* (curly-leaf pondweed), *Potamogeton nodosus* (long-leaf pondweed), *Potamogeton (Stuckenia) pectinatus* (sago pondweed), *Potamogeton zosteriformis* (flatstem pondweed), and *Vallisneria americana* (wild celery). Sago pondweed was found throughout the lake and was the most dominant macrophyte found within 5 feet of the shoreline at depths of 2 to 3 feet. Coontail, largeleaf pondweed, and Eurasian watermilfoil were found throughout the lake up to a depth of approximately 10 feet. Most macrophytes were found in the shallow bays, and, for the most part, all grew in association with one other. Algae were observed, with a large bloom occurring at the time the survey was taken There is also no record of official WDNR "Sensitive Area Designations" within Lake Delton.

3.3 Substrate and Sedimentation

Many sedimentation studies have been completed for the tributaries entering Lake Delton. Not much has been done historically to assess the sediment composition of the "mid-lake." The surrounding soil type is primarily glacial wash sand, sandstone, and other sand-based soil. Because of this, sand deposits are common where tributaries enter the lake. Of the major tributaries, Dell Creek and Lost Canyon have been studied the

most. Sediment control devices have been proposed for Dell Creek and dredging for Lost Canyon. Lost Canyon Creek is an intermittent stream that cuts through Lost Canyon. A major part of controlling the sediment deposition through Lost Canyon is to enforce erosion control ordinances at construction sites within the Lost Canyon subwatershed.

3.4 Watershed Analysis and Phosphorus Budget

The 1992 Lake Management Plan written by Woodward and Clyde documented that the majority of the nutrient load entering Lake Delton originated within the Dell Creek Watershed. This is not surprising since the watershed is the largest of the Lake Delton subwatersheds. The report also concluded that crop land runoff and animal lot runoff contributed the majority of phosphorus (84 percent of phosphorus load combined).

4.0 Methods

4.1 Aquatic Plant Surveys

Two methods were used during the aquatic plant survey on Lake Delton. The first was a qualitative survey to collect all plant species present in the lake. The second protocol was a quantitative point intercept sampling strategy to document plant density and frequencies of occurrence and calculate diversity index values.

4.1.1 Qualitative Survey

Biologists toured Lake Delton prior to the point intercept survey to collect a voucher specimen of each plant species present in Lake Delton. This was a qualitative survey since presence/absence was noted lake-wide. Biologists toured the lake collecting rake toss samples in areas of high plant diversity. This survey focused on shallow to intermediate depths in areas free of exotic plant growth, but exotic plants were collected as encountered. Each new plant species(including fruits if present) encountered during the qualitative survey were immediately pressed on buffered herbarium mounting board, labeled, and placed in a cooler for storage pending further processing.

4.1.2 Quantitative Survey

The quantitative point intercept survey occurred after the initial qualitative survey. A total of 72 points were sampled for aquatic plants. The approximate interval between sample points was 420 ft. All sample points were pre-selected with GIS software. Points were located in the field with a Global Positioning System (GPS) and desktop mapping software. Each sample point was recorded on a Panasonic Toughbook Laptop computer with integrated GPS/GIS software. The horizontal positioning accuracy of the real-time differentially corrected Starlink GPS unit is capable of horizontal accuracy of 5 m or less.

According to Madsen and Bloomfield (1993), “an aquatic plant management survey and subsequent collection and analysis of quantitative data are important for the following four reasons:

- Quantitative data are an objective measure of plant distribution and abundance.
- Quantification allows rigorous statistical analysis (both spatial and temporal) of plant community trends, thereby supporting assessments of management technique effectiveness.
- Quantification of vegetation, as part of an evaluation program, may eliminate the use of ineffective techniques or unneeded control in a given management approach.
- Quantification allows individuals other than the observer to evaluate the data."

The principle of the point intercept method has been widely used in terrestrial plant and animal ecology survey techniques (Madsen 1999). Point observations were made at 72 points (Figure A-1). This technique allows for statistical comparisons to be made between the 2003 survey and future surveys.

The rake coverage technique (Deppe and Lathrop 1992) was used to determine relative abundance of macrophytes. Each sample point consisted of a circle around the boat six to eight feet in diameter and divided into quadrants. A two-headed, weighted rake was extended from a boat to the furthest extent of each quadrant and then dragged along the bottom while being retrieved to collect plants. A general plant density rating was given on a scale from 0-5, depending on how much material is captured on the rake tines (see below). The density value for a site was the average of the four rake tosses.

A second density rating was then given for the different plant species found in each sample quadrant on a scale from 0-5 in the same manner as overall plant density.

Whole plants were collected, including flowers and seeds if available. Herbarium vouchers samples were bagged and stored on ice until they were returned to the lab, where they were cleaned, mounted, labeled and laminated. A set of plant vouchers will be given to the Village of Lake Delton.

Table 1. Percent Rake Coverage

Rake Coverage (% of rake head covered by a species)	Density Rating
81-100%	5
61-80%	4
41-60%	3
21-40%	2
1-20%	1
No Plants Recovered	0
Present but not Collected	P

4.2 Water Quality at APS sites

Water quality parameters were measured at each aquatic plant sampling site with a HACH Sension156 electronic probe. The pH, conductivity, dissolved oxygen, and temperature were recorded on the survey sheet. The Hach Sension156 was calibrated each morning and mid-way through the day to assure accurate data collection.

4.3 Substrate at APS sites

Substrate type was categorized at each plant sample location. After plant samples were collected, an Eckman dredge was lowered through the water column until it reached the sediment. Sediment samples were brought to the surface and designated as mud, organic, sand, or rock.

5.0 Results

5.1 Aquatic Plant Surveys

The aquatic plant community of Lake Delton was assessed with a qualitative plant survey and a quantitative survey on August 5 and 6, 2003.

5.1.1 Qualitative Surveys

The aquatic plant community in Lake Delton is showing signs of stress due to long-term eutrophication and intense recreational use (Asplund 2000). A key indicator of long-term eutrophication is the disappearance of macrophytes from deeper portions of their habitat and a shift to an algal-dominated community (Kalff 2002). This symptom is evident in Lake Delton by the maximum rooting depth. The greatest depth supporting plant growth was recorded at 3.6 m (11.8 feet), but relatively few sites (12.2 %) supported plants at depths greater than 1.5 m (4.9 feet). In addition, only 33% of the littoral zone (<5.0 m) supports aquatic plants.

A total of 12 aquatic plant species were collected from August 5 to August 6, 2003 in the qualitative and quantitative surveys (Table 2, Figure 4). Two exotic plants were identified in both surveys: Eurasian water-milfoil and curly-leaf pondweed. There were no rare or endangered plants encountered. Of the species collected there were 11 submergent species, no emergent species, one free-floating species, and no floating-leaf species.

Wild celery (*Vallisneria americana*) was the most common plant found during the survey. Wild celery has ribbon-like leaves all rising from a single "rosette" which is rooted to the sediment. Wild celery grows best in sandy substrates and rarely creates nuisance conditions. Wild celery germinates in the spring and grows throughout the summer. In the late summer, the plant produces over-wintering seeds.

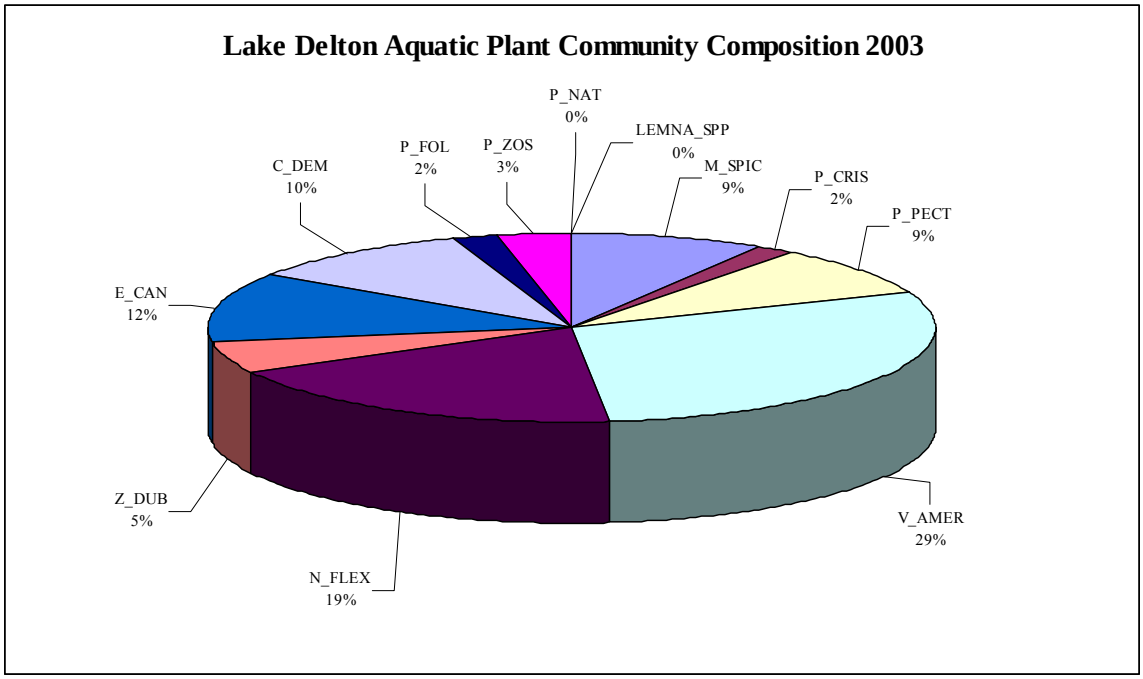

Figure 6. Aquatic plant community composition for the aquatic plant survey conducted on August 5 and 6, 2003, Lake Delton (Sauk County, Wisconsin).

Table 2. Plant taxa, freuquency, and density for Lake Delton aquatic plant survey August 5 and 6, 2003, Lake Delton (Sauk County), WI.

Plant Taxon	Common Name	Frequency of Occurrence (% sites)	Average Density (out of 5)
Overall Plants	NA	33	0.30
Ceratophyllum demersum	Coontail	8	0.04
Elodea canadensis	Common waterweed	10	0.08
Lemna spp	Common duckweed	NA*	NA
Myriophyllum spicatum	Eurasian water-milfoil	7	0.02
Najas flexilis	Slender naiad	15	0.08
Potamogeton crispus	Curly-leaf pondweed	1	0.00
Potamogeton foliosus	Leafy pondweed	1	0.00
Potamogeton natans	Floating-leaf pondweed	NA*	0.00
Potamogeton pectinatus	Sago pondweed	7	0.04
Potamogeton zosteriformis	Flat-stemmed pondweed	3	0.02
Vallisneria americana	Wild celery	24	0.18
Zosterella dubia	Water stargrass	4	0.01

*denotes plant taxa documented during qualitative plant survey

5.1.2 Quantitative Surveys

Biological indices are a common method used to evaluate community structures. Lake Delton's aquatic plant community was analyzed for a number of diversity and quality indices that allow it to be compared objectively to other lakes statewide and in the South Central region. The indices used in this analysis evaluate the diversity, dominance, and biological quality of aquatic plant communities and include the Shannon Diversity Index, maximum Shannon Diversity, Simpson's Index, Floristic Quality Index, and Aquatic Macrophyte Community Index (Table 3).

Table 3. Biological and diversity index values for Lake Delton aquatic plant survey August 5 and 6, 2003, Lake Delton (Sauk County), WI.

Index	Score	Interpretation
Simpson's	83.35	average
Shannon	2.88	low
Floristic Quality Index	15.18	very low
Aquatic Macrophyte Community Index	33	low

Simpson's index (S) is a measure of community dominance. The value is an approximation of the probability that two randomly chosen individuals from a community will belong to different taxa (Simpson 1949). The calculation for Simpson's index is:

$$S = [1 - \sum (\text{species relative frequencies}^2)] * 100$$

where a species' relative frequency equals the percent frequency of an individual species divided by the sum of all species' frequency. The frequency of a species is calculated by dividing the number of sites a particular species is found in by the total number of sites sampled that were less than or equal to the maximum rooting depth. Diverse communities will have high Simpson value. A low value indicates that a small number of taxa dominate the community structure.

The Simpson's Index value of 83.4 for Lake Delton is average compared to all Wisconsin lakes but low for lakes in the same region (Nichols, Weber, and Shaw 1995). This value reflects average or below average species distribution.

The Shannon index (H) measures the uncertainty that the taxon of a randomly chosen individual can be predicted (Shannon and Weaver 1949). Diverse communities will have a high value for the Shannon index. This index is sensitive to the presence of rare species and widely used to analyze biological communities. The calculation for the Shannon index is:

$$H = \sum -p_i \log_2 p_i$$

where p_i is the relativized proportion of taxon i. The H value can be compared to the H_{max} value, which is a measure of the maximum diversity possible given the taxa pool of the community. It is calculated as:

$$H_{max} = \log_2 P$$

where P is the total number of taxa present. The ratio of H/H_{max} provides an estimate of how closely a community approaches its maximum diversity. Ideally, a climax plant community will approach H_{max}.

The Shannon Diversity Index value for Lake Delton is 2.9 out of a possible 3.6. This indicates that the aquatic plant community in Lake Delton is diverse among the species present, but the maximum possible diversity is low compared to Wisconsin lakes.

The FQI is based on the presence and absence of plant taxa. It is a rapid assessment technique that does not require quantitative data (Nichols 1999). Plant taxa are given a score called the coefficient of conservatism (C) based on their tolerance/intolerance to disturbance. Higher values indicate a plant community is intolerant to disturbance and probably near its "natural" state while lower values indicate a plant community impacted

due to human disturbance. In general an intolerant plant community indicates excellent water quality and overall lake health. The FQI (I) is calculated as:

$$I = ((\sum C_i) \div N) \sqrt{N}$$

where C_i is the tolerance if the i^{th} taxon and N is the total number of taxa.

The Floristic Quality Index value of 15 is below average for the region (20.9) and the state (22.2). Lake Delton's FQI value places it in the lower quartile range for both the region (17.0) and the state (16.9). This is not a good indication for Lake Delton. In terms of its aquatic plant community, Lake Delton is most similar to the most degraded lakes in the state. The total number of native species in Lake Delton (10) is below average for both the region (14) and state (13).

The Aquatic Macrophyte Community Index (AMCI) is based on seven characteristics of aquatic plant communities called metrics. The scoring system for metrics is based on characteristics of reference or undisturbed plant communities. A lake can score from 7 – 70, where 70 reflects an ideal plant community (Nichols, Weber, and Shaw1995). The metrics used in the AMCI are maximum rooting depth, percent littoral zone vegetated, Simpson's index, total taxa, relative frequency of submersed taxa, relative frequency of exotic species, and relative frequency of sensitive species. A score for each metric is assigned and the individual scores are summed for the overall score.

The Aquatic Macrophyte Community Index value for Lake Delton (33) is low compared to the Wisconsin state-wide average (51 ± 6) for lakes (Nichols, Weber, and Shaw 1995). Data is lacking to determine whether this value is low for drainage lakes. In general, the data indicates that the aquatic plant community in Lake Delton is lacking in both diversity and abundance.

The species with the highest frequency of occurrence and density in the point intercept survey were wild celery, slender naiad, and common waterweed (Table 2). An average

of 0.81 taxa were found at each sample site and the mean plant density was 0.30 out of a possible 5.0. At sites where plants were present, the average density was 0.90 out of 5.0 and there were 2.4 taxa per site.

5.2 Water Quality at APS Sites

There is no evidence that aquatic plants are causing local declines in water quality in Lake Delton. Temperature, pH, dissolved oxygen, and conductivity were consistent across all sampling points.

5.3 Substrate at APS Sites

Lake Delton's sediment is composed of mud and sand. Since mud and sand are suitable substrate for many aquatic plant species (Nichols and Vennie 1991), a much larger percentage of the lake bottom would be expected to contain aquatic plants. There are virtually no plants in Lake Delton outside of the "no wake" areas and emphasizes the need to protect the native plants that are present.

6.0 Discussion

6.1 Aquatic Macrophytes

In general, the key diversity indices for Lake Delton show that the lake is in a disturbed state and that the plant community is below average for the state and region. The Simpson's index, Shannon index, AMCI, and FQI all indicate the plant community within Lake Delton is below average for lakes in the region, and all but the Simpson's index determined the plant community is below average for lakes in Wisconsin.

Part of the reason the diversity indices show low values is because very few plants were found at the majority of the sites in the middle of the lake. Because the lake experiences heavy recreational use, only near-shore and no-wake zones contained aquatic vegetation. Another reason is that the number of species of plants within the lake is low; only 10 native plant species were found during the survey. Improving the range and number of native species present would increase the diversity values.

Without taking recreational use impacts and water quality into consideration, the entire littoral zone of Lake Delton should support plant growth. Intense recreational use can augment the symptoms of eutrophication due to added nutrients and turbidity in the water column due to sediment resuspension. The positive indication of the 2003 aquatic plant survey is that Lake Delton does not experience problems due to excessive growth by exotic plants. Unless the water quality and/or intensity of recreational boating changes, exotic plants should not present a nuisance.

The current major use of the lake is public recreation. The needs of the lake patrons are met by the current plant community composition. The only management practices needed at present are monitoring and evaluation. This means the Village should continue to have the aquatic plant community monitored on a regular basis and update their management recommendations based on current needs and the condition of the lake resource. The Village does have the obligation to intervene if public use endangers the lake and its natural inhabitants.

The fishery on Lake Delton is related to the aquatic vegetation within the lake with largemouth bass (*Micropterus Salmoides*) and bluegill (*Lepomis macrochirus*) populations being directly dependent on the abundance of aquatic vegetation. Areas of aquatic vegetation, no matter how small, are important as nursery areas for smaller sized fish. In addition, aquatic vegetation harbors aquatic invertebrates that are important food sources for many species of fish within Lake Delton. However, due to water staining and steep sides within Lake Delton, the aquatic vegetation is limited. Yet in the northern bay, this is not the case since the depth is shallower allowing for more aquatic vegetative growth. [1]

6.2 Water Quality

The dissolved oxygen, pH, conductivity and temperature profiles are common for freshwater lakes in Wisconsin. Dense aquatic vegetation had no apparent localized effect on the parameters measured.

6.3 Substrate

The most common substrate in the lake was mud. Fine organic matter is stirred by boat traffic, becomes suspended in the water column, and settles out when wave action subsides. Sand was a common substrate along shorelines, particularly where tributaries entered the lake and where natural sandstone rock was exposed to the lake. Since the watershed is located in the driftless zone, sandstone and sand marl are common bedrock and soil types. As long as soils within the watershed erode and are carried down the tributaries to Lake Delton, sand will be a common substrate type.

There are several options for managing erosion and sedimentation within the lake. Sediment traps have been installed on Dell Creek upstream from Lake Delton proper. Agricultural practices such as row and strip cropping can reduce soil erosion and decrease the sedimentation rate. Urban practices such as construction site erosion control, street sweeping programs, and storm water retention ponds all help reduce the amount of sediment entering Lake Delton.

[1] Adapted with permission from Wisconsin Department of Natural Resources Fishery Manager Tim Larson

6.4 Riparian Land Use

The immediate land use around Lake Delton is primarily commercial, impervious, and manicured. Extreme urbanization has occurred as the tourism industry has flourished around the Lake. Lake Delton is a valuable resource for wildlife and for the local and state tourism industry. Recent development has removed the natural buffering capacity of shoreline vegetation and has jeopardized the health of the aquatic ecosystem within Lake Delton.

6.5 Fishery

The fishery of Lake Delton was last assessed in 1997. Stocking efforts were analyzed and it was found that walleye fingerling stocking was not successful. The reasons stocking efforts were not successful range from a lack of food (low zooplankton populations) to high amounts of competition (large baitfish populations compete for food and shelter) to increased predation (a healthy sport fish community was documented). In addition, small walleyes need vegetation for survival and cover. The small walleyes use the cover to hide from larger predators and other stressors. In addition, cover reduces the stress that fish can encounter in open areas, therefore increasing the fish's health. Future stocking should be done under guidance of WDNR fisheries managers. If the baitfish community is atypically large, top-down management may be considered. Stocking larger predator fish, increasing size limits and decreasing bag limits may help balance the fishery.

6.6 Watershed Management and Phosphorus Budget

Lake Delton resides in a large watershed known as the Dell Creek Watershed. There are two other tributaries that enter Lake Delton separate from the Dell Creek Watershed (Spring Brook and Lost Canyon Creek). Performing a watershed analysis over the entire Lake Delton watershed and interpreting how the various land uses within the watershed affect water quality in Lake Delton would not only be difficult, it would be impractical. The current modeling program used to predict nutrient loading in lakes (WiLMS) operates with several assumptions and generalizations. As watersheds become larger and more complex, the error associated with the assumptions and generalizations becomes

cumulative. The best way to perform future monitoring and modeling is to collect flow and water quality data from each tributary flowing directly into Lake Delton and assess only the immediate watershed of Lake Delton (land that drains directly into Lake Delton without first entering a tributary).

Flow measurements can be collected at upstream gauges (if available) or immediately upstream from the stream/lake confluence and should be collected daily. Total phosphorus is the only water quality parameter necessary for WiLMS modeling and should be collected semi-weekly during the monitoring period. The tributaries should be monitored for an entire year. At the end of monitoring, the nutrient and flow data are used to calculate "flow weighted" nutrient inputs and total nutrient load from each tributary. Land use data from the immediate watershed is used to predict the amount of nutrients entering the lake directly. Together, the tributary and immediate watershed contributions make up the nutrient load originating from the watershed.

Because this method directly measures the nutrient load entering the lake from the tributaries, there is no need to assess each lake upstream from Lake Delton to determine what part of the watershed drains to those lakes, what each lakes' retention is, and what the total nutrient release from those lakes is. The down side to this method is that if a particular tributary contributes an unexpectedly large amount of nutrients to the lake, further investigation is necessary to determine the actual source of nutrients.

6.7 Primary Use Patterns

Lake Delton is a heavily used recreational lake. There is plenty of boat traffic, from local fishermen and recreationists to commercial "Wisconsin Ducks" and power boat rentals. There are several resorts/hotels surrounding the lake and each has a vested interest in the lake. Some resorts offer powerboat rentals, while others use resort boats as a shuttle service to transport their guests from one side of the lake to the other.

The most widely used boat launch is the one located at the Dell Creek/Lake Delton confluence. This launch is located in a no-wake zone and contains plenty of aquatic

macrophytes. A recreational motor-boat rental company also operates just upstream from this landing and contributes a majority of the traffic through this area. The entire lake is used primarily for power boat sports between Memorial Day and Labor Day. Lake use is much lower during the spring, fall and winter.

Use is restricted in the "Tommy Bartlett Thrill Show" area. During shows, this area is completely off limits to the public. During off-show times, the area houses some floating structures used during the show. The only restriction during off-show times is that recreationists must navigate around those structures.

7.0 Aquatic Plant Management Overview

A complete aquatic macrophyte management plan follows a series of events. A plan should organize labor and resources for a clearly defined mission and outline a way to measure success. The WDNR is currently in the process of creating a manual for aquatic plant management in Wisconsin. The manual outlines a seven step process to managing aquatic plants. The steps to completing a plant management plan are:

- Setting Goals. . .Why are We Doing This
- Inventory. . .Gather Information
- Analysis. . .Synthesis of the Information
- Alternatives. . .Providing Choices
- Recommendations. . .Completing the Plan for a Formal Decision
- Implementation. . .Taking Action
- Monitor and Modify. . .So How are We Doing?

7.1 Setting Goals

In order to set goals for Lake Delton aquatic plant management, the village must identify the problems facing lake users and what endpoint is desired through management efforts While identifying problems associated with the lake, the value of correcting the problems should be estimated. In addition, there should be a variety of options to correct the problem with the most viable option being promoted. The first step is to set goals. Setting goals involve the following three steps: 1) Develop a goal statement; 2) Create a plan of work; 3) Create a communication and education strategy.

Lake Delton does not experience nuisance levels of aquatic macrophytes. High turbidity and low light penetration caused by increased recreational activity and fine, silty sediments limit plant growth in most of the lake. Designated no-wake zones host the majority of the plant life within the lake. It stands to reason that, without recreational activity, it is likely most of the lake would be occupied by aquatic vegetation.

The tourism dominated industry surrounding Lake Delton requires a water resource with limited or no navigational impacts due to aquatic plants. The health of the resource, on the other hand, requires aquatic vegetation. The goal of the Village is to maintain a balance between the needs of the tourism industry and the health of the resource.

The Village has already taken the initiative for creating a plan of work in consulting with The Limnological Institute from 2003 to present. The Village has held regular meetings throughout the planning process. The Village needs to create a communication and education strategy including goals, methods, and specific details on how management activities will be carried out. The plan should focus on informing the public of issues regarding the plant community and water quality within Lake Delton and soliciting public input on how best to correct any problems.

Goal Statement[2]

The goals of the APM plan are to:

1. Educate residents about APM activities and planning processes.
2. Monitor for and prevent aquatic invasive/non-native species.
3. Limit the growth and spread of aquatic and semi-aquatic invasive/non-native plants.
4. Promote the growth and spread of high value native plants.
5. Protect the current water quality so that further degradation of the plant community and recreational impairment is prevented.

7.2 Inventory

In this step of the plan, information regarding several aspects of the lake and surrounding area need to be collected and analyzed. Examples of information that should be gathered include:

- ✓ Existing plans and studies
- ✓ Data regarding plants, fish, wildlife, and water quality within the lake
- ✓ Maps and historical documentation that describes past conditions of the lake
- ✓ Aerial photographs of the lake
- ✓ State and local regulations and ordinances
- ✓ Technical information or research on the topics of concern to the Village

[2] Approved by the Village of Lake Delton.

- ✓ Examples of other lake APM plans

Additional inventory information may have to be reviewed depending on the goals of the Village. The WDNR, UW-Extension and regional resources such as county zoning, town clerk, and planning offices are great places to gather most of this information. Past consulting firms may also be able to provide some information specific to their findings.

As part of this study, The Limnological Institute has gathered all the information listed above regarding the aquatic plant community of Lake Delton and included it in section 3.0 of this report.

7.3 Analysis

The analysis step is the most critical step in the management process. It is in this step that the information gathered in the previous step is thoroughly analyzed and compared to the initial issues voiced. The information should provide an objective view of the perceived problems. Individuals dedicated to completing this step need to approach the analysis with open and objective minds so that decisions are based on fact and not emotion or public pressure. To arrive at an objective endpoint, consider these three variables: 1) What is the nature of people's concerns; 2) Where do conflicts occur; 3) Has the problem changed over time? These three variables are discussed in the following paragraphs.

(1) Considering the nature of people's concerns involves dissecting public input to decide if opinions genuinely have the health of the resource in mind. People must understand that a certain amount of vegetation is necessary to sustain fish and wildlife and also helps improve water quality and general aesthetics. Based on conversations during regular Village meetings, the Village has genuine concern that non-native species are becoming more prevalent throughout the lake and that protecting water quality is an important priority. The Village is educated about the value of aquatic plants, is open-minded regarding management methods and is proactive in seeking help to reach their goals.

(2) Identifying areas where conflicts regarding lake use and proposed management may occur will help create a more detailed management plan. Areas that will have restricted use based on management activities need to be identified and management activities timed according to expected lake use. For example, one would not propose to perform a large scale herbicide treatment prior to the 4th of July when use restrictions may prevent activities such as swimming or fishing over the holiday weekend.

The Village has discussed areas where management will occur and appropriate timing of management activities. There do not seem to be any use conflicts with the proposed management plan. At this time, the Village is not concerned about the location of irrigation intakes and public water supply as they pertain to proposed management activities.

(3) There is currently not a need for manipulating the aquatic macrophytes within Lake Delton. The Village should monitor for aquatic and semi-aquatic invasive/non-native species such as EWM, CLP, and purple loosestrife. If Village members determine that non-native species management is necessary to meet the goals of the lake management plan, they will make recommendations for management based on objective findings of plant surveys and public input.

The three variables have now been addressed, and the Village can draft an analysis report. The report will characterize the lake's condition, its natural features, recreational uses, community values, and problems based on objective information. Opportunities to resolve any use conflicts will be evident once this report is written. The report should also include a list of conclusions and findings according to the need for management intervention. The intervention should be based on public input and consultation with the DNR and county officials and should basically keep in mind what is best for the resource. The report would give the Village direction and ensure that future decisions are based on objective findings and keep the vision of the Village in mind.

7.4 Alternatives

Since no manipulation activities are desired and there are no alternatives to monitoring the aquatic plant community, no alternatives are evaluated within this report. If the Village determines that manipulations are needed in the future, a list of alternatives adopted from "Managing Lakes and Reservoirs" is provided on the following page. Benefits and drawbacks are provided so that the Village members can make an informed decision.

The following subsections provide an overview of management strategies that are commonly used to manage eutrophic effects on lakes. The purpose of this section is to provide a general introduction to popular management strategies for future reference and consideration. Methods described are derived from the *Managing Lakes and Reservoirs* manual prepared by the North American Lake Management Society. Practices that are relevant to Lake Delton are described in more detail in the following sections.

Mechanical weed harvesting can be used to remove the upper portion of rooted vegetation. Weed harvesters are low-draft barges that cut and remove vegetation growing at or near the water surface. A harvester can generally operate at a rate of approximately 0.2 to 0.6 acres per hour, depending on the equipment. Once cut, the plants are moved via conveyer to a holding area on the barge itself until they can be unloaded, via a second conveyer, at the shore. Plants are usually transported away from the lake to a compost site or a landfill. The physical removal of plant material means that the nutrients trapped in the plants are also removed from the lake ecosystem.

Harvesting is most effective to remove plants in three to six feet of water growing in dense beds. Harvesting can be used to open navigational channels, remove weedy obstructions from highly used recreational areas, or to produce relief for fish in weed-choked areas of a lake. Harvesting is non-specific and will remove all plants within the harvested area. Sometimes fish become trapped in harvested plants and end up being removed from the lake as well. Harvesting equipment is usually expensive, and operational costs vary depending on the harvesting effort required. Effects of harvesting

are immediate, and there is no use restriction during operations. WDNR permits are required for mechanical harvesting. Contact the local APM coordinator for more information regarding permitting requirements.

Manual weed harvesting is a scaled-down method of mechanical harvesting. In manual weed harvesting, weeds can be uprooted completely or simply cut close to the sediment using a variety of equipment from drag lines and garden rakes to specially designed weed cutters. This method is the most species-specific mechanical method of plant removal since an individual can physically see which plants are going to be removed and which will be missed. This method, however, is also the most labor-intensive means of controlling plants, and its feasibility is directly affected by the available labor force. This method is most applicable to individual property owners who wish to maintain clear areas for swimming, fishing, and for boat access to their dock. And since many times plants are not removed from the root, repeated efforts are needed to maintain the benefits. WDNR permits may be required for manual harvesting. Contact the local APM coordinator for more information regarding permitting requirements.

Sediment screens range from fiberglass or plastic mesh screens to simply sand or gravel and are placed on the existing sediment and plants to block light and suppress growth. While the synthetic barriers make better screens, they are the most difficult to install and maintain. The screens must be installed early in the year and securely anchored to the sediment to prevent them from being disturbed. The screens must be removed and cleaned periodically to prevent sediment from building up on top of them. Synthetic harriers are rarely permitted due to poor record of maintenance by most people and bubble formation under the barrier.

Sand and gravel are more natural means of suppressing aquatic vegetation and are less expensive, but they also require maintenance on an annual basis and are less effective. However, they do not work well and therefore are rarely permitted. WDNR permits are required for sediment screening. Contact the local APM coordinator for more information regarding permitting requirements.

Water level manipulation, commonly referred to as "draw-down," is a useful way to control nuisance vegetation that occurs in the shallow regions of a lake. This method is typically applied in the fall and over winter. Cold, dry conditions are best for a draw-down event, because frozen sediments will kill most of the seed bank and compress soft sediments. Both of these conditions prevent plant growth in the following spring when the water level is brought back up to normal conditions. This method severely impacts recreational uses while the water level is lowered and has the potential to trap fish and other wildlife in shallow areas that may not become completely dry but do freeze from top to bottom over the winter.

Drawing the water level down in the summer has the opposite effect on plant growth. Lowering the water level generally increases the wetland area, and the littoral zone of a lake becomes larger. This provides more habitat for plants to become established. This is a low-labor option but can become expensive if power is generated at the dam. The power company may be entitled to compensation for loss of power generated during the draw-down.

Raising the water level in the summer can also suppress aquatic vegetation by limiting the amount of light penetrating to the bottom thereby making the littoral zone smaller.

Wisconsin DNR permits are required for water-level manipulations. Contact the local APM coordinator for more information regarding permitting requirements.

Dredging sediments and plants is usually only performed when an increase in depth is a required part of the management outcome. If the depth is increased sufficiently, light penetration is limited in the dredged area and plant growth is suppressed. Dredging an entire lake bed is very rarely performed. Dredging small areas for boat access and other recreational uses is a cheaper and more applicable compromise. Wisconsin DNR permits are required for dredging. Contact the local APM coordinator for more information regarding permitting requirements.

Chemical control of aquatic plants and algae is often used in areas where vegetation has created nuisance conditions. Herbicides and algaecides are used to control a wide variety of plant and algae species. Some herbicides and application methods are very specific for which plants they will control. Others control a wide variety of vegetation. In some cases, the precision and concentration of herbicide applied will also determine which species are controlled.

Chemical applications are designed to control vegetation which is already present and rarely address the underlying nutrient problem associated with nuisance plants and algae. They are sometimes the only economically feasible method for creating recreational relief. Recent advances in technologies have made chemical control a more favorable tool for managing exotic species selectively while restoring native habitats. WDNR permits are required for aquatic herbicide applications. Contact the local APM coordinator for more information regarding permitting requirements.

Biomanipulation refers to altering a food web in order to obtain a desired end result. In the case of controlling algae, a "top-down" approach is taken. Promoting top-level predator fish like muskellunge, walleye, largemouth bass, and northern pike naturally reduces the panfish population. Panfish typically graze on zooplankton *(algae eaters)*. When zooplankton reach higher numbers, more algae is consumed and the water clarity is increased. This is generally used only to improve water clarity, however improved water clarity has a significant impact on plant distribution within the lake. WDNR permits are required for biomanipulation. Contact the local APM coordinator for more information regarding permitting requirements.

Biological Control Agents is a term used to describe organisms capable of controlling other organisms within their ecosystem by various methods. For example, loosestrife weevils have been used to control the exotic plant purple loosestrife. The weevils are tiny insects that use the plants for food, shelter, and to reproduce. The weevil larvae consume plant material and make growth and reproduction difficult, if not impossible, for the plant. A similar situation is suggested to occur for Eurasian water-milfoil, an aquatic

exotic plant. There are no known biological control agents that would improve conditions within Lake Delton with respect to CLP and nuisance natives.

There are a variety of methods to manage water quality. Below is a brief overview of the three most common methods.

Land acquisition refers to the setting aside of land within the watershed that will be allowed to develop naturally. Land can be purchased, donated, or signed into easement. The WDNR has purchased thousands of acres of lake shoreline over the past several years.

Public education and participation can change the way people view their aquatic ecosystems and ultimately change their behaviors. Many lake villages begin their public education campaigns at boat launches where various signs inform the public about current topics ranging from fish and plants to water quality. The WDNR solicits public involvement through programs like "Self-help Monitoring" and "Clean Boats, Clean Waters" programs, which promote individual and group efforts for monitoring various aspects of the lake.

Watershed restoration involves returning disturbed land to a pre-disturbance condition. Examples of this would be restoring a grazed grassland to a prairie or woodland. In general, current land use is discontinued in favor of historical conditions. Activities that incorporate best management practices (BMPs) into the landscape can also be considered restorative activities. On a smaller scale, individual riparian property owners can allow their property immediately adjacent to the lake to grow naturally, creating what is commonly referred to as shoreline buffers.

7.5 Recommendations

In this step of the plan, preferred management tools are selected. This requires reviewing the goals and objectives set in step one, reviewing existing conditions from step two, reviewing the level of management decided in step three, and reviewing management

alternatives from step four. The next step in the recommendations is to evaluate the action plan, organize resources such as volunteer time and Village budget, and identify and meet legal obligations prior to implementing the plan. Such legal obligations may be obtaining state permits for managing plants or informing the public of herbicide applications. Many of the requirements are listed in Wisconsin state statutes NR107 and NR109.

Based on the goals of the Village and the objective information gathered by TLI in 2004, Level II is the appropriate level of management necessary for the Village of Lake Delton to achieve their APM goals. Level II management is defined by the DNR as "primarily protection-oriented plans where slight to moderate plant concerns exist and some management is proposed. Invasive and non-native species may be present". All Level I and II management requirements must be met in order to perform Level II management. A checklist of necessary items is included in Section 9.1 of this report. Any items not currently satisfied are recommended for completion prior to plan implementation. Many Level III management requirements have also been met. Level III requirements are not necessary to implement this plan but will be useful if the Village later determines a higher level of manipulation is necessary to meet its goals.

Primary Management Tool Selected[3]

The Village of Lake Delton has chosen to monitor the aquatic and semi-aquatic plant community for non-native species and to monitor water quality for various physical, chemical and biological properties. The Village has also chosen to monitor the lake for all plant species on a regular basis. The Village is also committed to investigating issues regarding the plant community and water quality as they come up.

7.6 Implementation

Implementation can be broken down into three steps. The first step is to adopt the plan. The Village has arranged to have the plan available online on TLI's website for vested parties to view. Revisions to the plan will be made based on the relevance of comments

[3] Approved by the Village of Lake Delton.

received from those parties. The plan should then be adopted by the Village. Once the Village has adopted the plan, it will present it to local units of government (County and DNR) for additional support. In the case of creating and enforcing ordinances as part of the plan, government bodies will be essential in creating and enforcing laws.

The second step to implementation is to prioritize and schedule actions. Actions can be immediate, short-range, medium-range, and long-range. The following three subsections outline an implementation plan suitable for Lake Delton.

Immediate Educational campaigns designed to inform property owners about the value of native plants and what they can do to help improve the water quality should start immediately. Information on how property owners and lake patrons can help protect water quality should also be included in the campaign. The Village should have a member responsible for carrying out the educational campaign. Information and resources can be gathered from the DNR, Sauk County, USGS, USDA, and local UW-Extension office. Educational materials may be typed and distributed, posted in a public place or presented as part of regular Village meetings. The reason for the campaign is to raise awareness, solicit involvement, and promote action.

Short-term One short-term action is to monitor the population of non-native plant species within and around the lake. The Village wishes to begin implementing their plan in 2004. Detailed plans for AIS prevention and monitoring occur in sections 8.2 and 8.3 of this report. The Village may also wish to apply for an Aquatic Invasive Species (AIS) grant which would cost share a portion of the monitoring expenses and must complete the DNR AIS grant application as well (Appendix C).

A second short term action is to monitor the water quality within Lake Delton. Past studies have indicated that sedimentation and biological contamination are the major problems impacting water quality. The Village will continue to enforce erosion control ordinances and investigate alternatives to reduce the sedimentation within the lake. The

Village will also have the water quality monitored on an annual basis and is committed to investigating any sources of biological contamination.

Long-term A long-range plan may include improving water quality (gauged by annual average Secchi depth) by implementing certain BMPs throughout the watershed, enforcing ordinances and expanding no-wake zones. Long-range goals would protect valuable aquatic habitat by promoting the growth of high value native plant species and minimize impacts from management practices and recreationists.

Another key step of implementation is to assign roles and responsibilities for the various agencies involved in the management activities. The roles need to be assigned as early in the implementation process as possible. In addition, the responsibilities need to be clearly defined and recognized by the individuals and organizations responsible for carrying them out. Formal resolutions and contracts are usually adequate in covering these responsibilities. The following is an example checklist of roles and responsibilities for Lake Delton aquatic plant and water quality monitoring:

- ☐ Who will perform the monitoring?
- ☐ Will a consultant be hired for technical expertise?
- ☐ Who will be responsible for coordinating monitoring with public use?
- ☐ Who tracks the monitoring effort; specifically who maps exotic plant species distribution?
- ☐ How are monitoring costs paid for?
- ☐ Who is responsible for submitting grant applications if grants are desired?
- ☐ Who is responsible for implementing a public education campaign?
- ☐ Who will organize volunteer help for implementing self-help monitoring and Clean Boats, Clean Waters programs?
- ☐ Who is responsible for enforcing ordinances?
- ☐ How will areas of the lake not suitable for recreation be marked?

This list simply touches on some of the responsibilities related to the major monitoring recommendations for Lake Delton (public education and non-native species monitoring). The Village will have to create its own comprehensive list in its effort to organize. The list will change periodically as membership, participation, and management activities change. However, the purpose or goal of the list will remain the same – to organize responsibilities and aid implementation.

Funding Sources and Village Budget[4]

The Village has voted to appropriate the necessary funds for implementing their plan and plans to apply for all cost-share grants when applicable. The expenditures to date have been for aquatic plant and water quality monitoring, both of which were funded in part by grant money awarded by the WDNR.

7.7 Monitor and Modify

Monitoring the plant community and water quality with methods outlined by the WDNR and USEPA ensures that objective values are obtained and that management activities are evaluated without bias. Future decisions concerning the plant community and water quality will be based on objective data gathered annually throughout implementation of the plan. It is important for the Village to realize that effective monitoring will be the result of clearly defined performance objectives.

The WDNR APM guidelines outline the necessary monitoring and background information needed to perform Level II aquatic plant management activities in Wisconsin lakes. Method for tracking management progress occur annually prior to and after performing management activities. The DNR also recommends basic baseline monitoring regardless of selected management activities. Baseline activities are those defined as level one management. A few examples of level one management are to periodically monitor aquatic plant community, develop educational and informational programs, and to implement watercraft boat launch inspection programs.

The WDNR recommends performing an annual whole-lake qualitative survey and calculating the FQI for each whole-lake survey. The FQI should increase if the frequency of exotic species decreases and/or the frequency of native species, especially those designated as "sensitive species," increases. Calculating the FQI is explained in Section 5.1.2 of this report and in the WDNR's Aquatic Plant Management in Wisconsin manual. Employing mathematical indices such as the FQI will allow the Village to see

[4] Approved by the Village of Lake Delton.

objective information regarding the plant community and will identify whether the current plant management activities are meeting their goals.

For this APM Plan, “monitor and modify” means the Village will have to reassess their management needs on a regular basis. What the Village needs to evaluate is the current status of non-native species, the desired status, and how to reach the desired endpoint once management is deemed necessary.

8.0 Lake Delton Aquatic Plant Management Plan

8.1 Specific Elements of the Lake Delton APM Plan

This section lists recommendations for Level I management. The recommendations have either been satisfied based on information gathered during previous lake studies and the 2003 Aquatic Engineering, Inc. study (black items) or still need to be fulfilled (red items).

Goals

- ✓ Purpose Statement (Section 1.0)
- ✓ Goal Statement (Section 8.1)

Management History

- ✓ Summary of past management activities (Section 3.0)

Plant Community

- ✓ Comprehensive species list and review growth cycles of dominant species *(*Section 5.1.1)
- ✓ Total surface area covered by aquatic vegetation (Appendix A)
- ✓ Highlight rare, threatened or endangered species and species of concern (Section 5.1.1)
- ✓ Highlight and map invasive and non-native species and compare to native community (Appendix A)
- ✓ Describe beneficial use of plants as well as nuisance or use conflicts associated with plant community (Section 2.3)
- ✓ Describe vegetative characteristics of near shore or shoreland areas (Section 6.4)
- ✓ Collect quantitative data of the lake's aquatic plant community (Appendix B)
- ✓ Determine the percent frequency of each species present (Section 5.1.1)
- ✓ Determine the lake's FQI (Section 5.1.2)
- ✓ Collect 3 samples of each species for herbarium specimens (AEI 2004)
- ✓ Label sites where rare, threatened, endangered, special concern, invasive, and non-native plants were found (Appendix A)
- ✓ Map areas to show dominant species type and aquatic invasive species (AIS)(Appendix A)

Lake Map

- ✓ Obtain map with accurate scale (Section 1.0)
- ✓ Determine township, range and section of lake (Section 1.0)
- ✓ Tabulate lake surface area, maximum and mean depths (Section 1.0)
- ✓ Find Water Body Identification Code (WBIC) assigned by DNR (Section 1.0)
- ✓ Obtain aerial photos of lake (Appendix A)

- ✓ Obtain bathymetric map of lake (Section 1.0)
- ✓ Identify sediment characteristics (Section 5.3)

Fishery & Wildlife

- ✓ Prepare a narrative describing the fish and wildlife community and their relationship to the plant community (Section 2.3)
- ✓ Identify any areas designated as "Sensitive Areas" by the WDNR (Section 3.2)
- ✓ Identify areas where rare, threatened, or endangered species or species of special concern exist (Appendix A)

Water Quality

- ✓ Obtain one year of current water quality, including Secchi disk readings
- ✓ Prepare summary of historical data (Section 3.0)
- ✓ Measure the temperature and dissolved oxygen at 1 meter intervals at the deepest point of the lake during the summer (Lake Delton Water Quality Monitoring Technical Report, 2005)

Water Use

- ✓ Note primary human use patterns in the lake and on shore (Section 6.8)
- ✓ Note areas where use is restricted for any reason (Section 6.8)
- ✓ Note water intakes for public water supply or irrigation (N/A)

Watershed Description

- ✓ Provide topographical map showing watershed boundaries, inflows and outflows (Woodward and Clyde, 1992)
- ✓ Determine watershed area (Woodward and Clyde, 1992)
- ✓ Quantify land use areas within watershed (Woodward and Clyde, 1992)
- ✓ Calculate nutrient loading by area (Woodward and Clyde, 1992)
- ✓ Locate all inputs into lake including streams, drainage ditches, drain tile, etc. (Lake Delton Water Quality Monitoring Technical Report, 2003)

Analysis

- ✓ Identify management objectives needed to maintain and restore beneficial uses of the lake (Section 7.1)
- ✓ Create maps and overlays of the information from the inventory and interpret the results (Section 6.0 and Appendix A)
- ✓ Identify target levels or intensity of manipulations (Section 7.5)
- ✓ Map areas proposed for management (N/A)
- ✓ Record mapping coordinates on a GIS map (Appendix A)

Alternatives

- ✓ Plans should include measures to protect the valuable elements of the aquatic plant community as well as measures to control nonnative and invasive plants,

plants that interfere with beneficial lake uses, and plants that enhance habitat for fish and aquatic life (Sections 8.2 and 8.3)
- ✓ Discuss most common plant control techniques, benefits, drawbacks with vested parties (Section 7.4)
- ✓ Provide sufficient information regarding the feasibility, costs, and duration of control expected of each alternative (Section 7.4)
- ✓ Discuss the potential adverse impacts of each alternative (Section 8.4)

Recommendations
- ✓ Develop an invasive species prevention program including education and monitoring (Sections 8.2 and 8.3)
- ✓ Implement "Clean Boats, Clean Waters" program (Section 8.3)
- ✓ Involve the public in keeping the lake healthy by finding ways to decrease harmful watershed inputs (Section 8.3)
- ✓ List proposed control actions beyond those strictly necessary for aquatic plant management that will be implemented to achieve desired level of control (Section 8.3)
- ✓ Identify specific areas for control on a map and list the level of proposed management (N/A)

Implementation
- ✓ A description of education or prevention strategies needed to maintain and protect the plant community (Section 8.3)
- ✓ A description of how all the management recommendations will be implemented, the methods and schedules applicable to the operation, including, timing, capital, operational cost estimates, and maintenance schedules if applicable. A description of the roles and responsibilities of the persons and/or organizations involved in the management process (Section 8.2)
- ✓ A description of how the public will be involved (Section 8.3)
- ✓ A budget and identification of funding sources, including plans for grant application (Available upon request)
- ✓ A description of how the process by which the plan will be adopted, revised, and coordinated, with DNR approval (Section 7.6)

Monitoring and Evaluation *(Lakes with Known Invasive Populations and Following Management Actions)*
- ✓ Monitor for invasive aquatic plants in early spring and twice in the summer (Section 8.2)
- ✓ Perform quantitative plant survey at least once every five years. Track diversity indices such as FQI for early warning signs of decreasing diversity or water quality (Section 8.2)
- ✓ Contract for a professional survey every three to five years for the presence of exotic species and for updating the native plant list (Section 8.2)
- ✓ For lakes with known exotics, sample more often, use the rake method, and sample areas of know infestation, major inlets, and boat launches (Section 8.2)

- ✓ Following management activities collect basic water chemistry and physical parameters such as TP, TKN, temperature, pH, dissolved and dissolved oxygen at a mid lake site and within each management zone (N/A)

8.2 Annual Aquatic Plant Monitoring Activities

The adoption of a particular management strategy will require monitoring due to project specific needs. For the purposes of general lake monitoring, the following recommendations will meet the needs of the lake, the Village of Lake Delton, and local residents. Future monitoring activities for Lake Delton include scheduled formal plant surveys every three to five years, annual visual plant surveys and FQI assessment, summer water quality monitoring (including algae species), and periodic lake-wide fish surveys.

The proposed method for monitoring macrophytes within Lake Delton includes the following key steps that will be repeated annually:

- Getting organized
- Visual spring (April-May) CLP and EWM monitoring lake wide. However, if water clarity prohibits a visual assessment, a rake survey will have to be performed
- Sub-sampling before and after EWM treatments within treatment zones
- Summer (June and August) EWM monitoring lake wide
- Plant bed and treatment sites located via GPS
- Whole-lake quantitative survey every three to five years
- Review monitoring results and create a status report
- Decide on management activities for the next season

The first step in the process is to get organized for the upcoming season. This will occur annually prior to initiating monitoring activities. Getting organized will include assessing the upcoming budget and needs of the Village. Getting organized will also include selecting an environmental consulting firm (Village Consultant) and outlining the roles and responsibilities of all parties involved. The Village will be organized and ready to implement activities by the middle of March each year.

The next step is to begin monitoring the plant community. Annual visual plant surveys will include exotic plant/nuisance condition inspections and will occur in April for CLP

and May for EWM. Visual surveys will consist of touring the lake and inspecting the littoral zone for new stands of exotic/nuisance plants. Limited rake toss sampling will occur in areas previously known to contain exotics, and major inflows and public boat access will be sampled more intensively. Monotypic beds of EWM and CLP will also be mapped and recorded with GPS coordinates.

Beginning in mid-June, EWM will be managed, if necessary. A sample protocol for EWM will be similar to CLP in that areas previously mapped; major inflows, and public boat launch sites will be sampled more intensively than the rest of the lake. If management is necessary, the Village Consultant will implement an herbicide management strategy using granular 2,4-D.

Purple loosestrife will be noted during June EWM management. Sampling for Purple loosestrife should be conducted from a boat along the entire shoreline of the lake. Additional sampling may be required from land if the conditions found during the initial survey warrant an upland survey. Management will likely occur in July or August each year as loosestrife comes into bloom. The plants will be managed using a cut-stump herbicide application. Harvested plants will be disposed of by the Village Consultant.

Every three to five years the littoral zone will be sampled using a point-intercept and a rake method for all aquatic vegetation. This monitoring will serve to update the plant species list and to determine if their distribution within the lake is spreading. The FQI will be calculated for each whole-lake survey to provide valuable tracking data to objectively assess the plant community in years to come.

8.3 Additional Recommendations

Clean Boats, Clean Waters

The Village will initiate a Clean Boats, Clean Waters (CBCW) program for the lake. The program will be geared toward monitoring boat launches and inspecting watercraft and trailers entering and leaving the lake for the presence of non-native species. The Village will solicit volunteers or may hire professionals to perform the monitoring. The UW-

Extension information regarding CBCW program will be used while developing this program. Official training will be provided to each volunteer at the expense of the Village. Formal training will assist monitors in identifying plants and improving public education at the launches. Hired professionals are expected to have completed similar training at their expense.

Boating Regulations

The Village will investigate the feasibility of expanding no-wake zones and enforcing existing State of Wisconsin boating regulations near piers and docks (100'). This will benefit the aquatic plant community, improve water quality, and will reduce erosion in natural shoreline areas. Lessening the re-suspension of sediment particles (and algal density) will improve water clarity and light penetration into the water column. As a result, aquatic plants will colonize deeper portions of the littoral zone and further stabilize bottom sediment. This effect will increase until Lake Delton's plant community reaches equilibrium relative to sediment nutrient content, water clarity, and competition with algal species.

Emergent and Floating-leaf Plant Rehabilitation

The Village will encourage growth of emergent and floating-leaf plants in shallow littoral areas by placing signage and enforcing boating regulations in near-shore and no-wake areas. This will reduce shoreline erosion, decrease wave action across the lake, locally reduce sediment resuspension, and provide competition for benthic algae in shallow areas. Emergent plants include cattails, bulrushes, and arrowhead while lilies are common floating-leaf plants. These plants absorb wave action and reduce the impact of recreational boat use on shoreline areas. Emergent plants also provide excellent habitat for a variety of waterfowl and wildlife. Floating-leaf plants provide beneficial cover and shading for fish and invertebrates. Shading has the added benefit of limiting light penetration to the lake bottom and should reduce the amount of benthic (filamentous) algae.

Self-Help Monitoring

Lake Delton will re-initiate their Self Help monitoring program through the WDNR. The Village will have a consultant monitor basic water chemistry (chlorophyll *a*, TP, TKN, and alkalinity) from April through November. Other water quality monitoring will be performed by Village Volunteers. This monitoring will include various parameters for the four major tributaries of Lake Delton and Secchi depths for the lake proper. This monitoring will be performed by volunteers three or four times per month beginning in May and continue through September.

Public Education

Designing and implementing a public education campaign for Lake Delton is going to be tricky. Since the lake is mostly used by tourists during the summer months, traditional education methods may not change public involvement; most vacationers are not likely to become active participants. Instead, the Village will design a campaign to recruit local interest in the lake resource. Increased signage regarding refuse disposal, no-wake zones, watercraft regulation, and enforcement will help protect and rehabilitate the lake and surrounding land.

Watershed Protection and Education

Improving water quality within Lake Delton can be accomplished through watershed management practices and public education. The Dell Creek watershed has had several studies regarding land use, BMPs and sedimentation. The Village will appoint a public education coordinator or enlist the help of County or UW-Extension offices to create a public education campaign. Protecting the lake from agricultural and urban runoff will be the major focus of the campaign.

Purple loosestrife

Purple loosestrife can be managed with a variety of techniques. Herbicides, manual removal, and biological control agents (weevils) have all been proven as control agents. For now, the Village will continue to hire a consultant to manage the Purple loosestrife population around the lake. Cut-stump herbicide applications and plant removal should

reduce the population over several years. Public education will also help by enlisting the help of property owners. The Purple loosestrife management practices will be evaluated every three years for effectiveness. Total distribution and plant density will be the criteria used to evaluate the activity's success.

Tracking Work

One of the most important things the Village can do to improve implementation results is to track their work. The Village should have a single method for tracking every project currently in progress. The following is a list of steps necessary for proper tracking:

- Assign tracking responsibilities to a person/committee
- Select a single method for storing tracking information (electronic, paper, etc.)
- When reports/studies are provided to the Village, it should select which recommendations will be implemented
- Provide a timeline for each activity selected for implementation
- Outline the steps necessary to complete the project and "reverse-schedule" each step, keeping the deadline in mind
- Track project progress by recording the completion date of each step
- When the project is completed or discontinued, create a short summary of the project, what the major obstacles were, how to overcome them, and the final status of the project

Currently, the Village has several studies that were conducted from 1995 to 2003. There is no indication that the project recommendations within those reports were implemented or tracked. The Village can access data TLI has accumulated through TLI's website at www.thelimnologicalinstitute.org. The information that already exists regarding the watershed, nutrients, bacterial loading, sedimentation, water quality and now aquatic plants can be used to make future management activities more comprehensive.

8.4 Implementation Plan Timeline

Activity	Timing		Who	Budget
	Start	Stop		(Annual $)
Quantitative Macrophyte Surveys (every three to five years)	May	July	Village Consultant	12,000*
Qualitative Macrophyte Surveys (every year)	May	July	Village Consultant	3,000
AIS CLP Monitoring (every year)	May	May	Village Consultant	2,500
AIS EWM Monitoring and Treatments (every year)	June	August	Village Consultant	8,850
AIS Purple Loosestrife Management (every year)	July	August	Village Consultant	10,250
Clean Boats, Clean Water Monitoring	June	August	Village Volunteers	0
Improve Regulations/Enforcement	2007		Village Rep.	24,000
Self-help Secchi and water quality (3 to 4 times per month, annually)	May	September	Village Volunteers	4,000
Water Quality analysis (every year)	April	September	Village Consultant	18,848
Public Education**	2007		Village Rep.	0
Annual Reporting	December	Village Consultant	4,500	

* denotes an expense incurred every three to five years

** denotes grant currently being applied for

9.0 References

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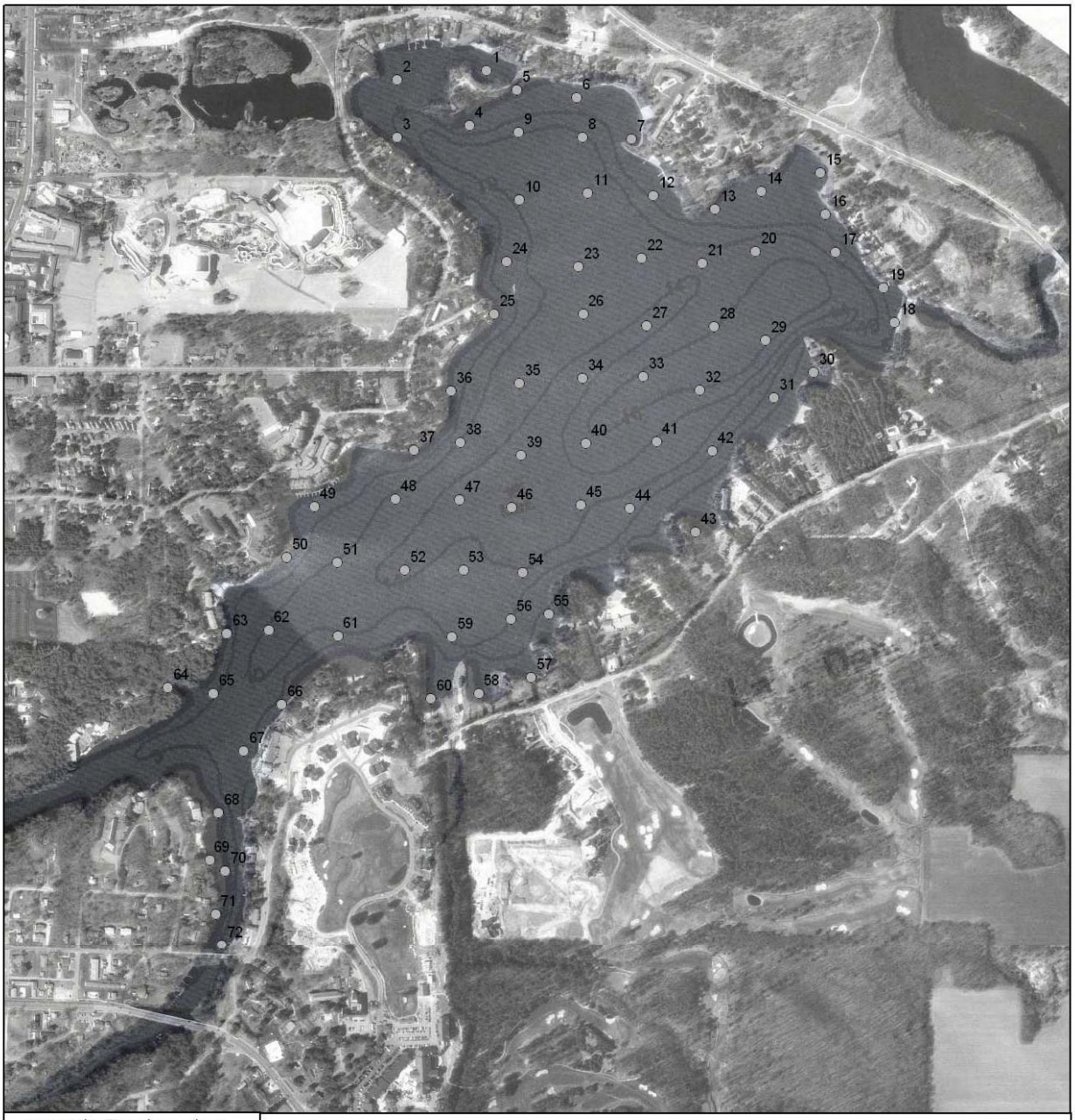
Appendix A:
August Plant Survey Maps



Aquatic Engineering

Plant Sampling Locations

Point-intercept Survey

Lake Delton, Sauk County, WI

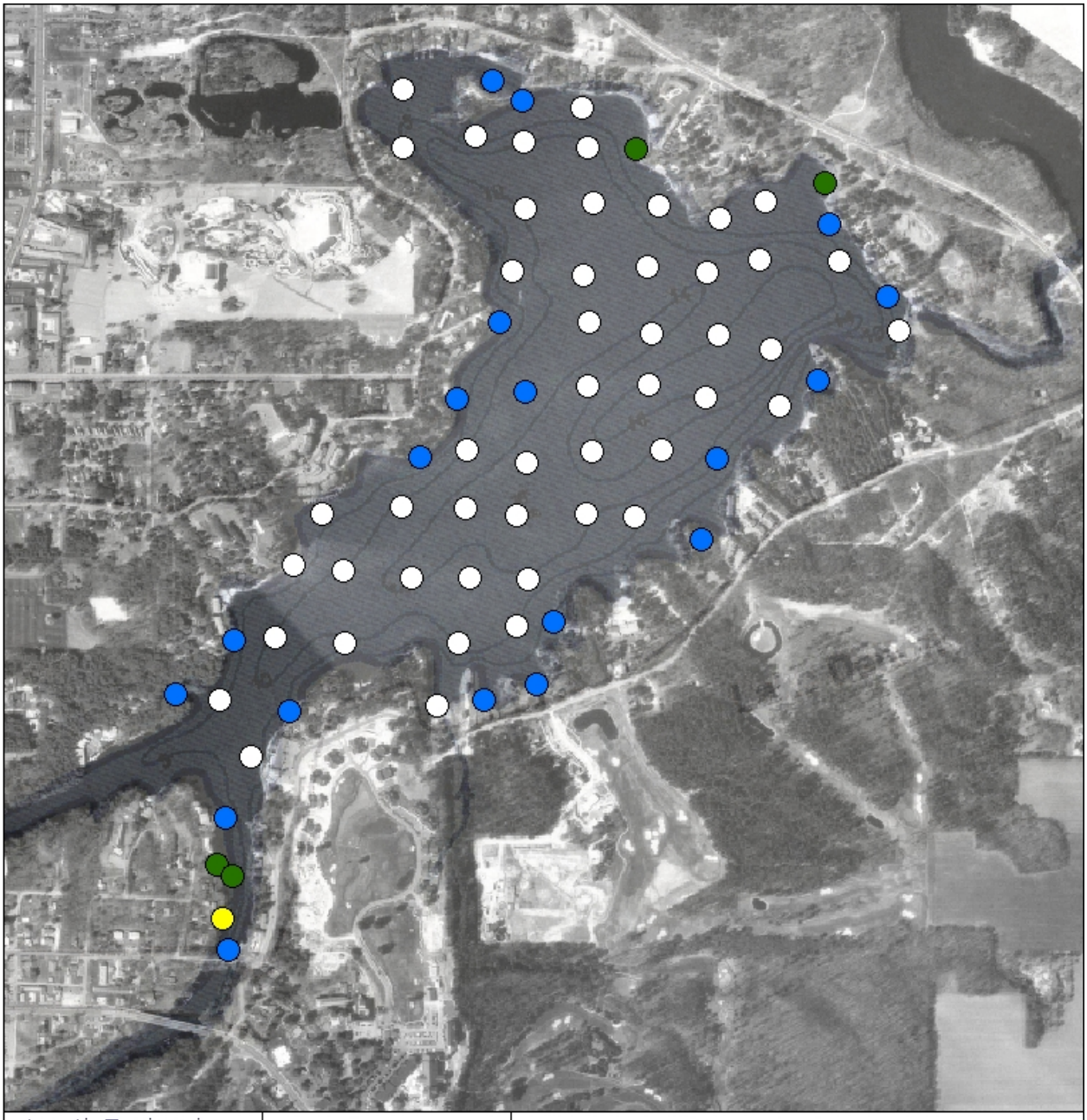
Survey Dates: August 5 through 6, 2003

0 0.25 0.5 Miles

N W E S

Sauk County Coordinate System NAD 83 HARN Transverse Mercator

Map Scale
1:11,081



Aquatic Engineering

Legend

- Dense (>80%)
- Common (61 – 80%)
- Present (41 – 60%)
- Sparse (21 – 40%)
- Rare (1 – 20%)
- None

Vegetation Density

Composite Index Including All Submersed Species

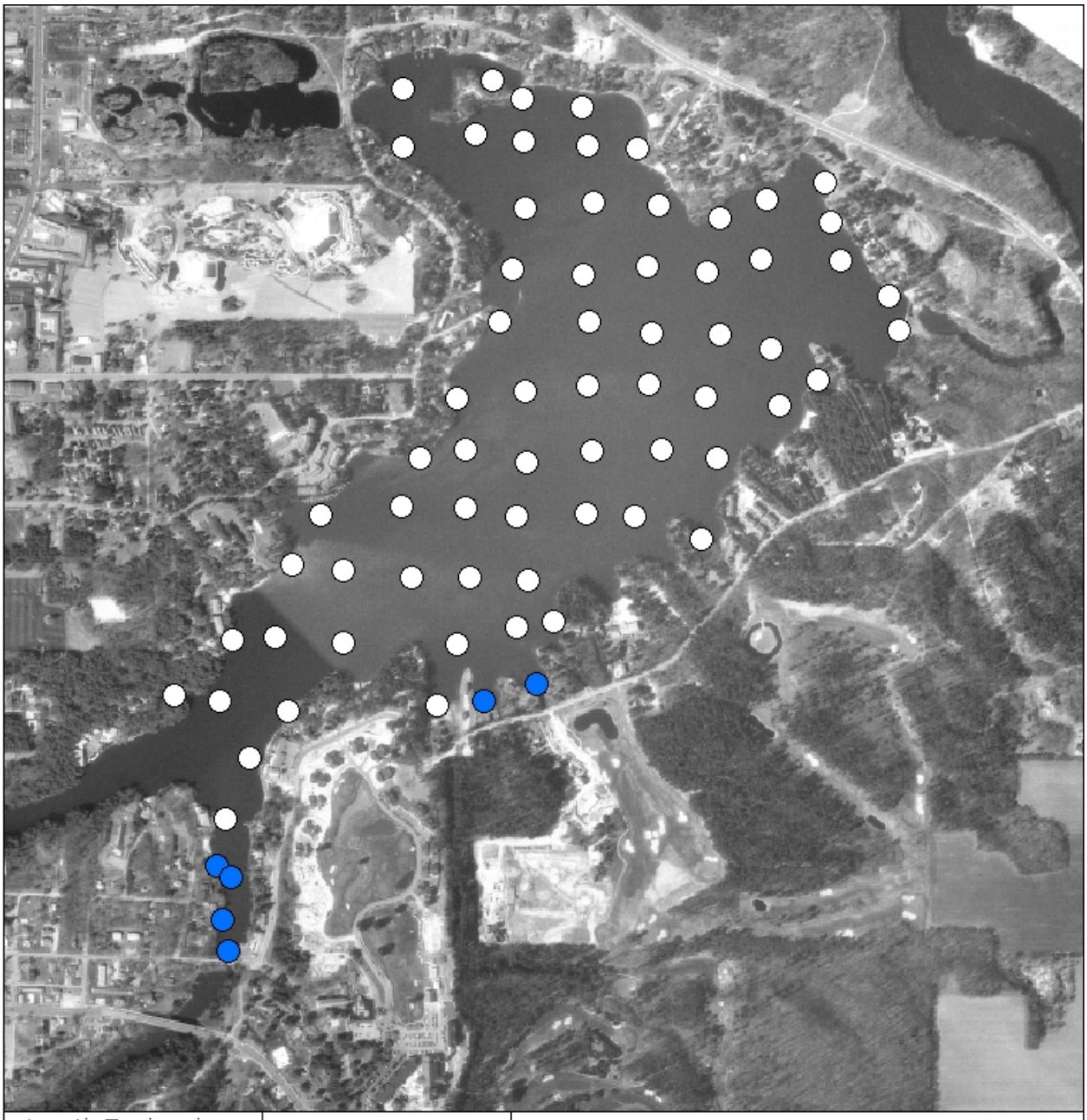
Lake Delton, Sauk County, WI

Survey Dates: August 5 through 6, 2003

0 0.125 0.25 0.5 Miles

Sauk Co. Coordinate System NAD 83 HARN Transverse Mercator

Map Scale 1:11,081



Aquatic Engineering

Legend

- Dense (>80%)
- Common (61 – 80%)
- Present (41 – 60%)
- Sparse (21 – 40%)
- Rare (1 – 20%)
- None

Coontail (*Ceratophyllum demersum*)

Distribution and Abundance

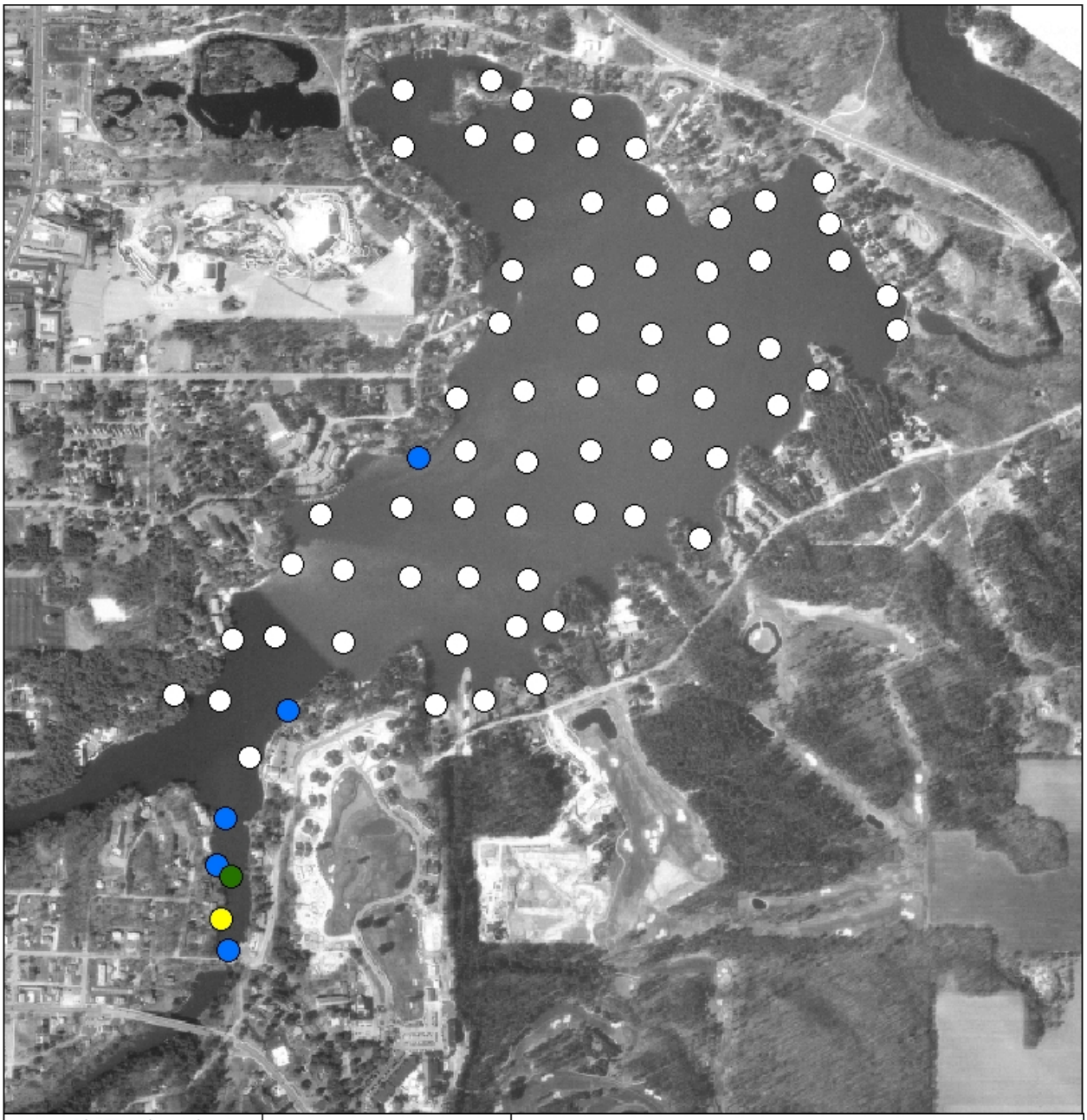
Lake Delton, Sauk County, WI

Survey Dates: August 5 through 6, 2003

0 0.25 0.5 Miles

Sauk Co. Coordinate System NAD 83 HARN Transverse Mercator

Map Scale 1:11,081



Aquatic Engineering

Legend

- Dense (>80%)
- Common (61 – 80%)
- Present (41 – 60%)
- Sparse (21 – 40%)
- Rare (1 – 20%)
- None

Common water weed (*Elodea canadensis*)

Distribution and Abundance

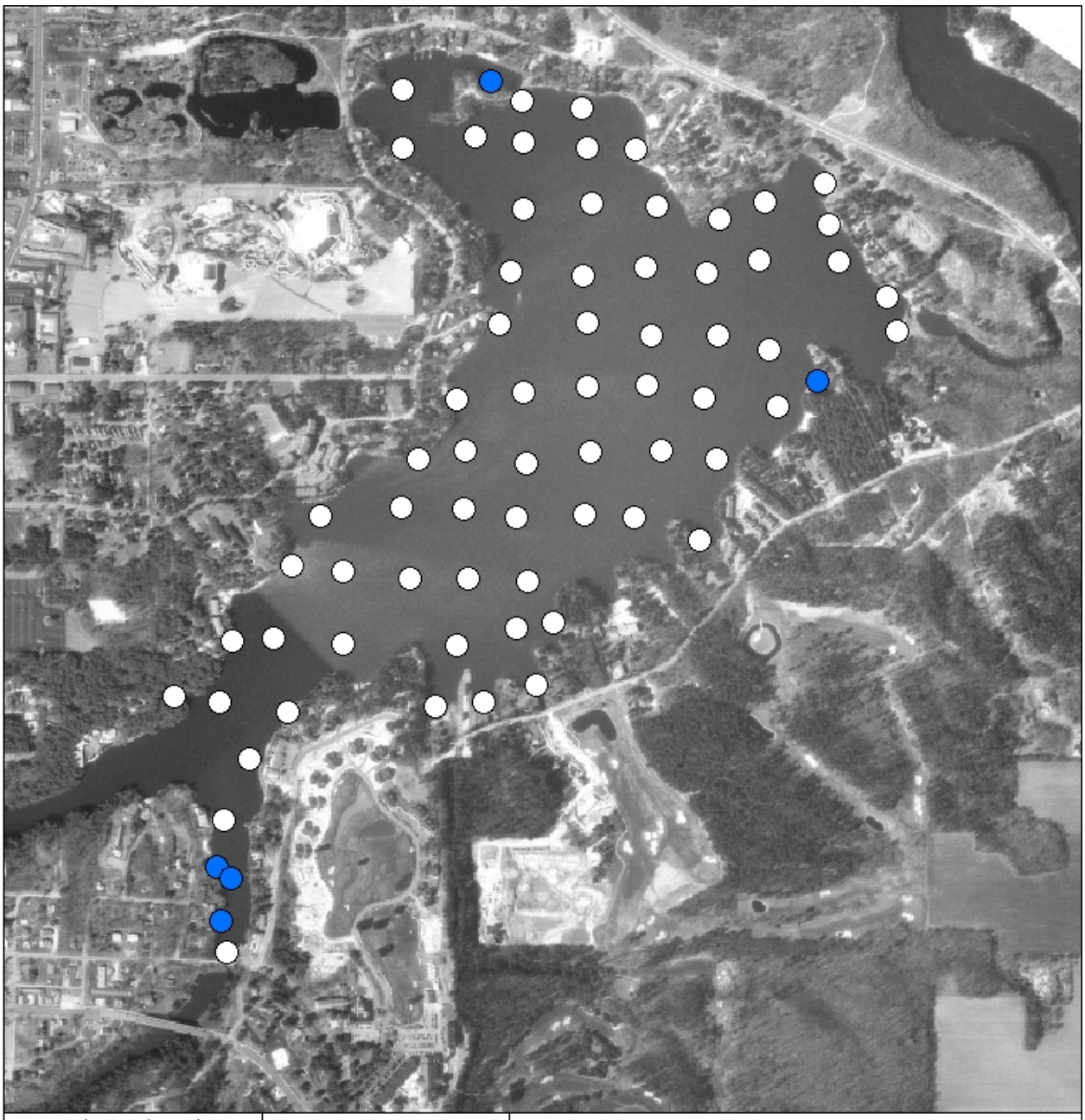
Lake Delton, Sauk County, WI

Survey Dates: August 5 through 6, 2003

0 0.25 0.5 Miles

Sauk Co. Coordinate System:NAD 83 HARN Transverse Mercator

Map Scale 1:11,081



Aquatic Engineering

Legend

- Dense (>80%)
- Common (61 – 80%)
- Present (41 – 60%)
- Sparse (21 – 40%)
- Rare (1 – 20%)
- None

Eurasian water milfoil (*Myriophyllum spicatum*)

Distribution and Abundance

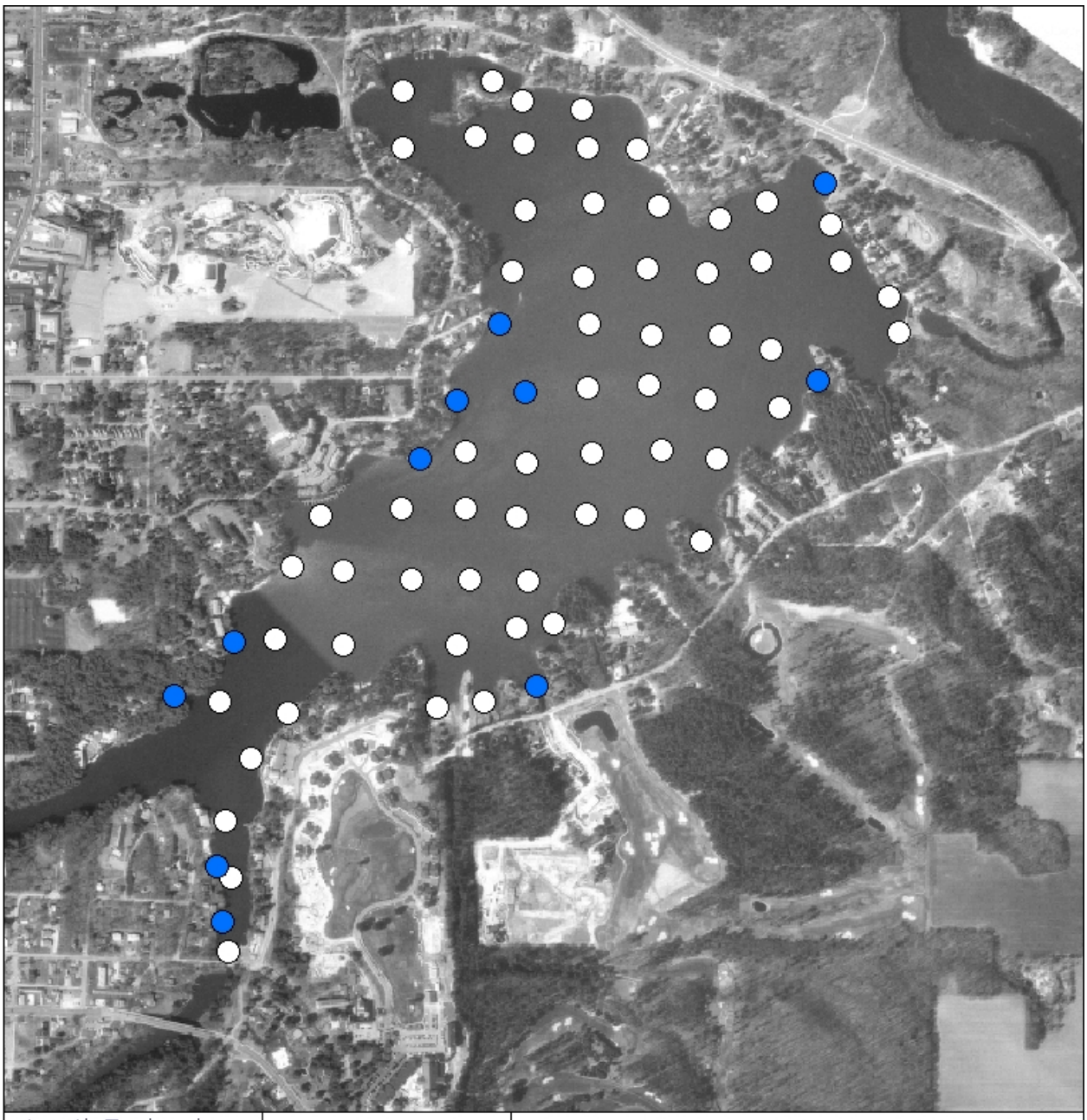
Lake Delton, Sauk County, WI

Survey Dates: August 5 through 6, 2003

0 0.25 0.5 Miles

Sauk Co. Coordinate System:NAD 83 HARN Transverse Mercator

Map Scale 1:11,081



Aquatic Engineering

Legend

- Dense (>80%)
- Common (61 – 80%)
- Present (41 – 60%)
- Sparse (21 – 40%)
- Rare (1 – 20%)
- None

Slendar Niad (*Najas flexilis*)

Distribution and Abundance

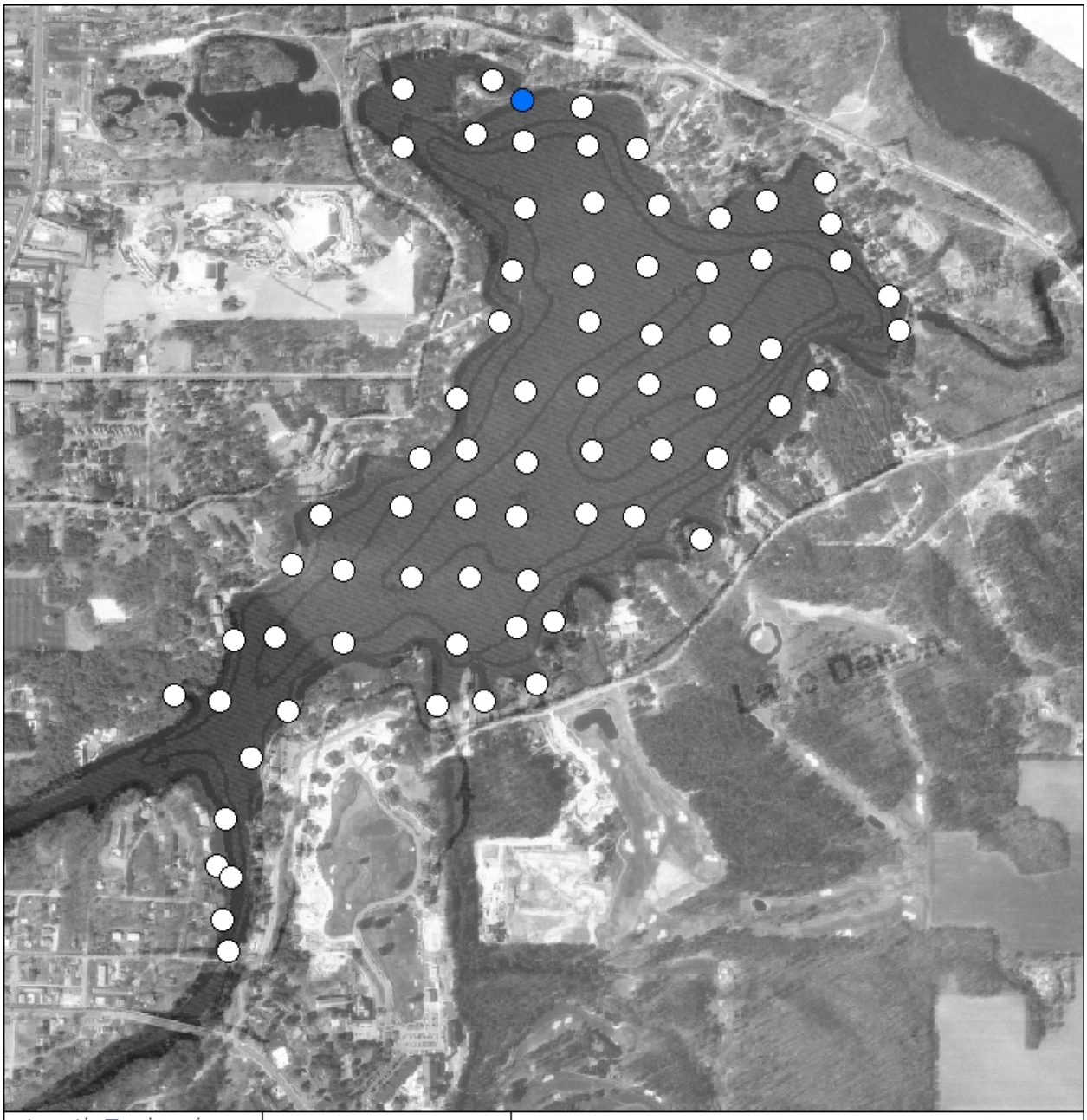
Lake Delton, Sauk County, WI

Survey Dates: August 5 through 6, 2003

0 0.25 0.5 Miles

Sauk Co. Coordinate System NAD 83 HARN Transverse Mercator

Map Scale 1:11,081



Aquatic Engineering

Legend

- Dense (>80%)
- Common (61 – 80%)
- Present (41 – 60%)
- Sparse (21 – 40%)
- Rare (1 – 20%)
- None

Curly-leaf pondweed (*Potamogeton crispus*)

Distribution and Abundance

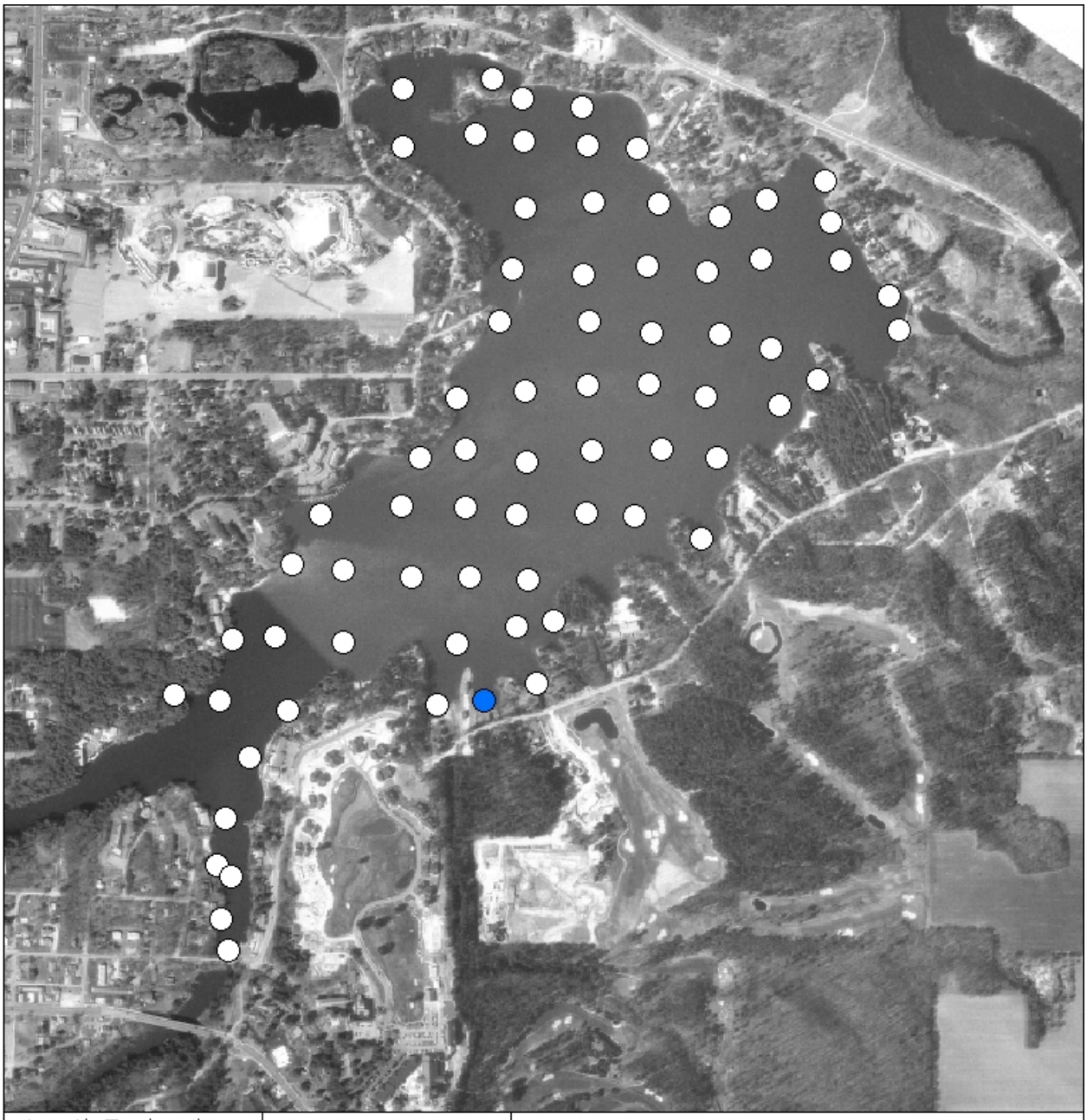
Lake Delton, Sauk County, WI

Survey Dates: August 5 through 6, 2003

0 0.25 0.5 Miles

Sauk Co. Coordinate System NAD 83 HARN Transverse Mercator

Map Scale 1:11,081



Aquatic Engineering

Legend

- Dense (>80%)
- Common (61 – 80%)
- Present (41 – 60%)
- Sparse (21 – 40%)
- Rare (1 – 20%)
- None

Leafy pondweed (*Potamogeton foliosus*)

Distribution and Abundance

Lake Delton, Sauk County, WI

Survey Dates: August 5 through 6, 2003

0 0.25 0.5 Miles

Sauk Co. Coordinate System:NAD 83 HARN Transverse Mercator

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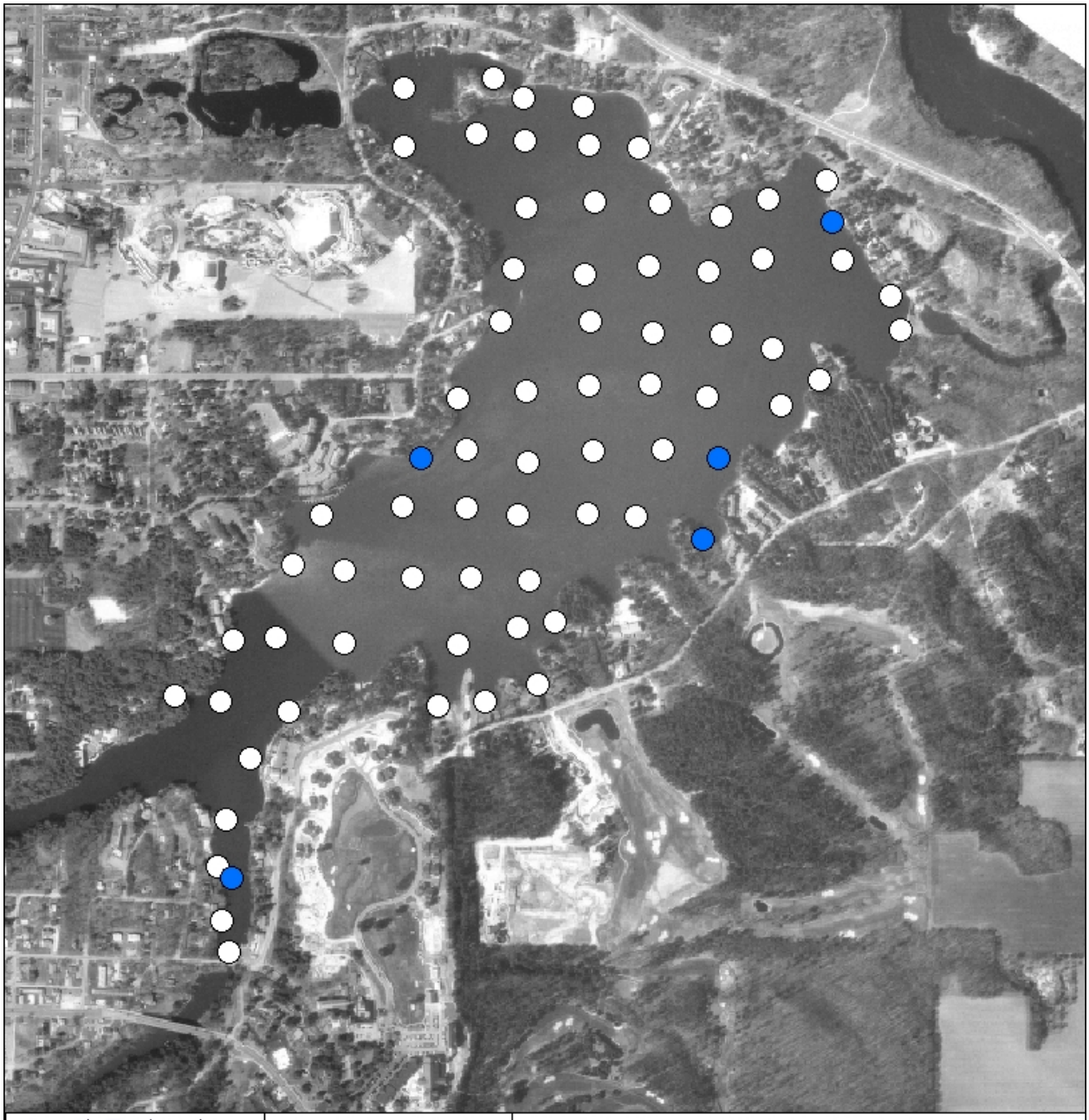
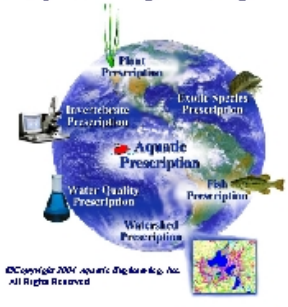


Aquatic Engineering



Legend

- Dense (>80%)
- Common (61 – 80%)
- Present (41 – 60%)
- Sparse (21 – 40%)
- Rare (1 – 20%)
- None

Sago pondweed (*Potamogeton pectinatus*)

Distribution and Abundance

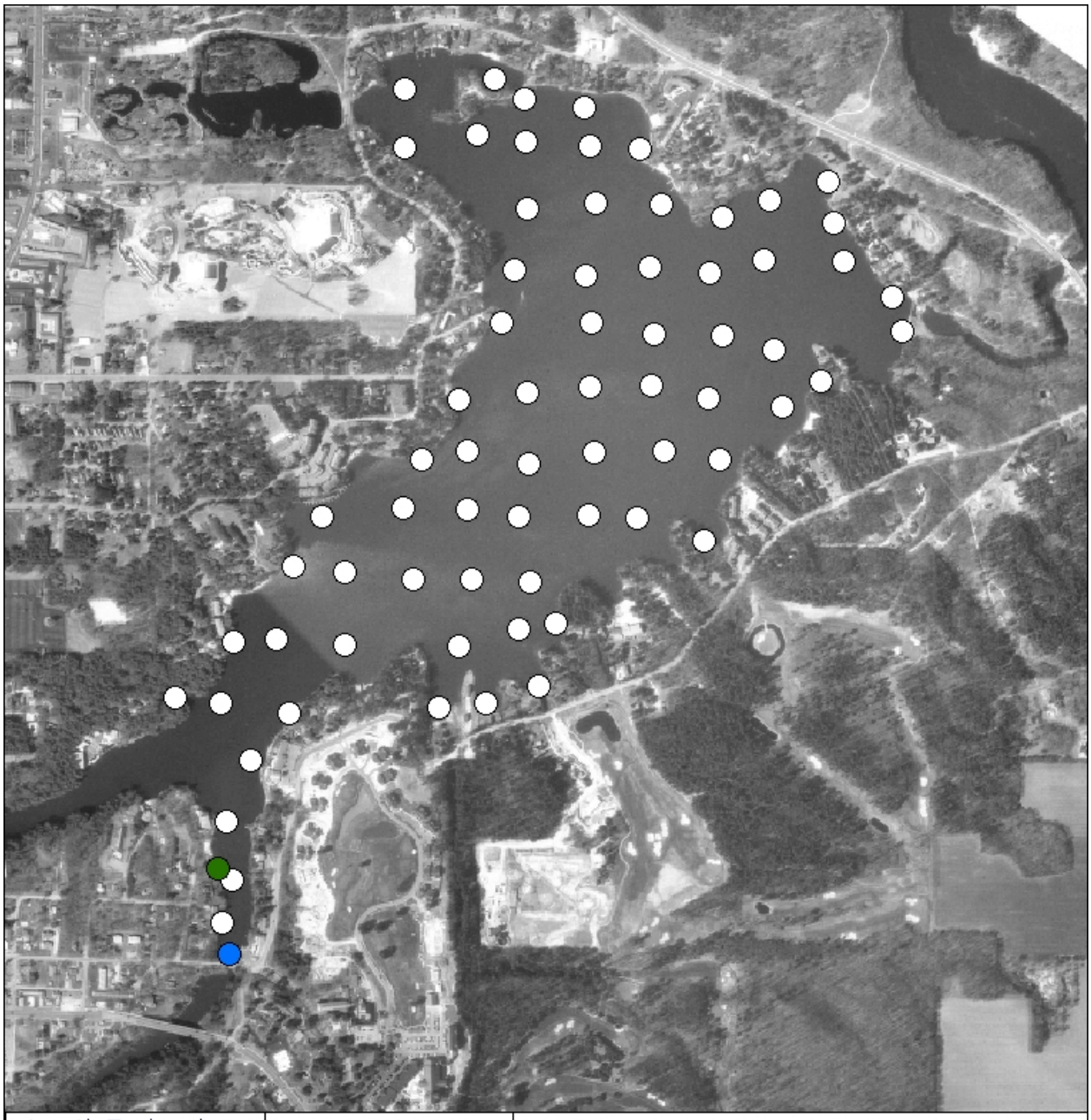
Lake Delton, Sauk County, WI

Survey Dates: August 5 through 6, 2003

0 0.25 0.5 Miles

Sauk Co. Coordinate System NAD 83 HARN Transverse Mercator

Map Scale 1:11,081



Aquatic Engineering

Legend

- Dense (>80%)
- Common (61 – 80%)
- Present (41 – 60%)
- Sparse (21 – 40%)
- Rare (1 – 20%)
- None

Flat-steam pondweed (*Potamogeton zosteriformis*)

Distribution and Abundance

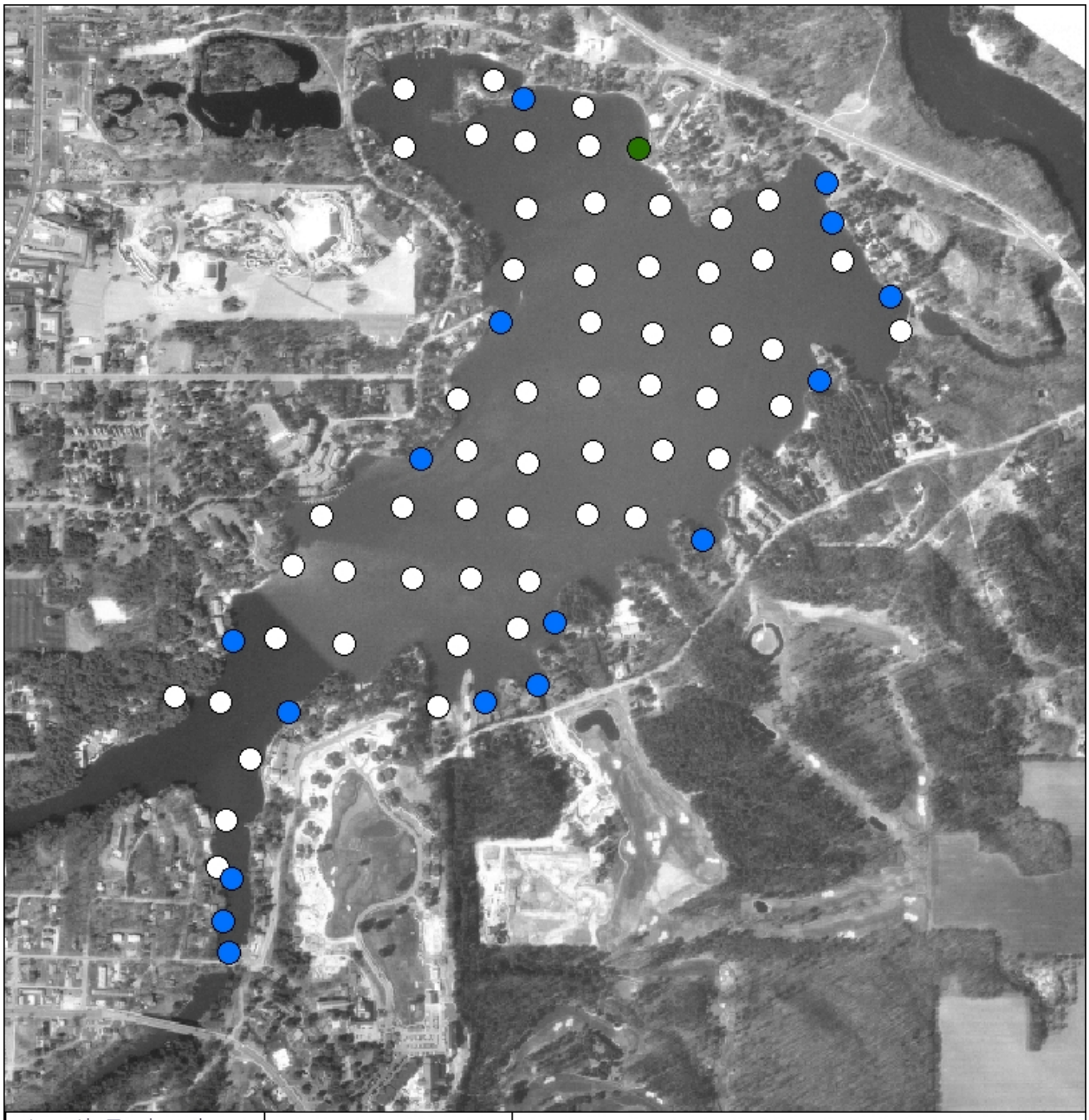
Lake Delton, Sauk County, WI

Survey Dates: August 5 through 6, 2003

0 0.25 0.5 Miles

Sauk Co. Coordinate System NAD 83 HARN Transverse Mercator

Map Scale 1:11,081



Aquatic Engineering

Legend

- Dense (>80%)
- Common (61 – 80%)
- Present (41 – 60%)
- Sparse (21 – 40%)
- Rare (1 – 20%)
- None

Wild Celery (*Vallisneria americana*)

Distribution and Abundance

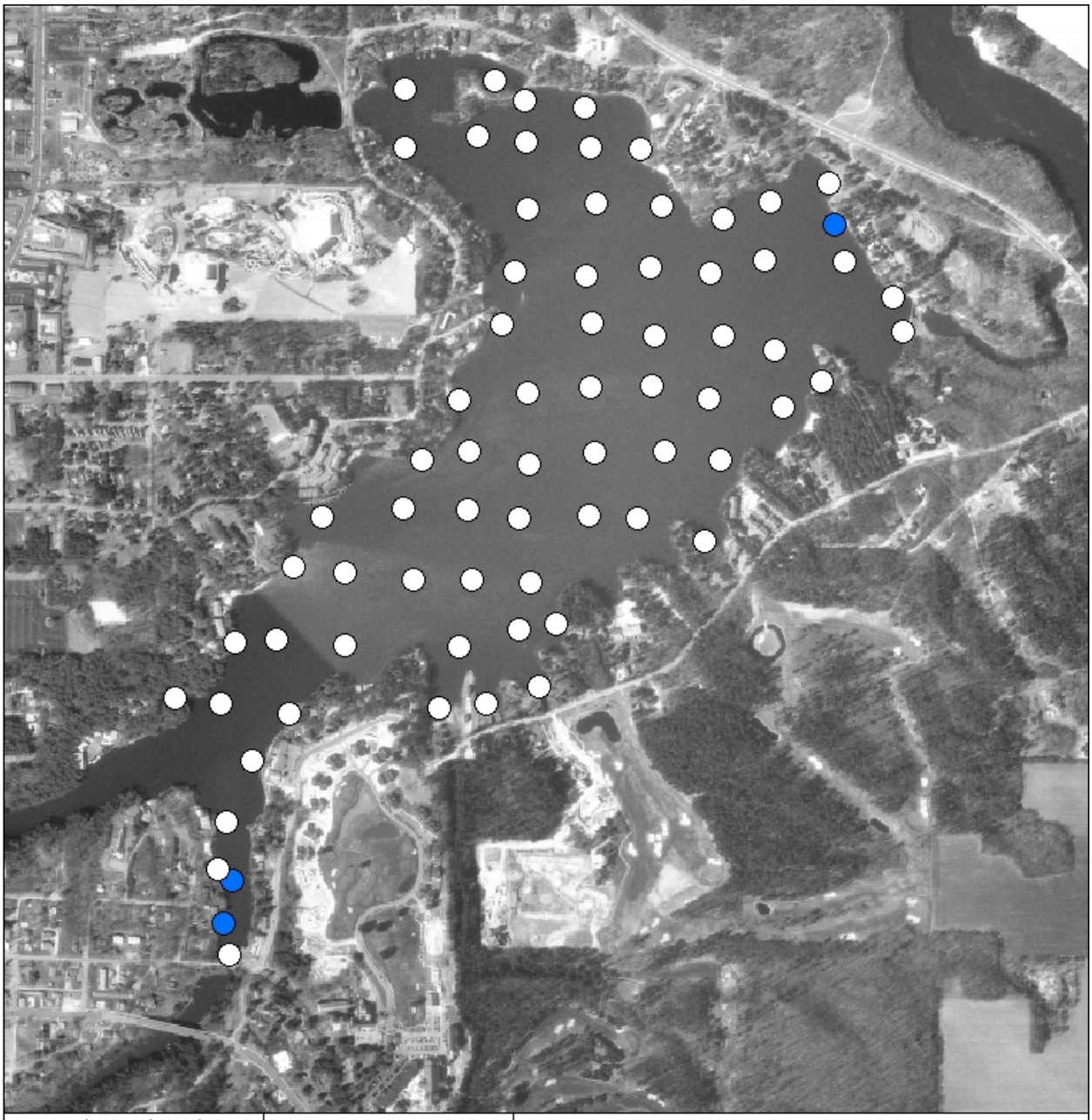
Lake Delton, Sauk County, WI

Survey Dates: August 5 through 6, 2003

0 0.25 0.5 Miles

Sauk Co. Coordinate System NAD 83 HARN Transverse Mercator

Map Scale 1:11,081



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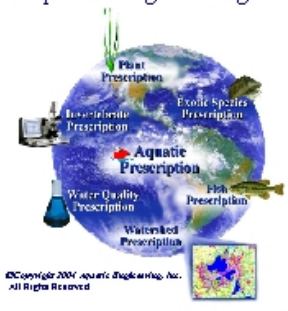

Legend

- Dense (>80%)
- Common (61 – 80%)
- Present (41 – 60%)
- Sparse (21 – 40%)
- Rare (1 – 20%)
- None

Water stargrass (*Zosterella dubia*)

Distribution and Abundance

Lake Delton, Sauk County, WI

Survey Dates: August 5 through 6, 2003

0 0.25 0.5 Miles

Sauk Co. Coordinate System NAD 83 HARN Transverse Mercator

Map Scale 1:11,081

Appendix B:
August Plant Survey Raw Data

Site	Sample	Date	DENSITY	M_SPIC	P_CRIS	P_PECT	V_AMER	N_FLEX	H_DUB	E_CAN	C_DEM	P_FOL	P_ZOS	P_NAT
1	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
1	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
1	C	8/5/2003	1	1	0	0	0	0	0	0	0	0	0	0
1	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
2	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
2	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
2	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
2	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
3	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
3	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
3	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
3	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
4	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
4	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
4	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
4	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
5	A	8/5/2003	1	0	0	0	1	0	0	0	0	0	0	0
5	B	8/5/2003	1	0	0	0	1	0	0	0	0	0	0	0
5	C	8/5/2003	1	0	0	0	1	0	0	0	0	0	0	0
5	D	8/5/2003	1	0	1	0	1	0	0	0	0	0	0	0
6	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
6	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
6	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
6	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
7	A	8/5/2003	1	0	0	0	1	0	0	0	0	0	0	0
7	B	8/5/2003	2	0	0	0	2	0	0	0	0	0	0	0
7	C	8/5/2003	2	0	0	0	2	0	0	0	0	0	0	0
7	D	8/5/2003	1	0	0	0	1	0	0	0	0	0	0	0
8	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
8	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
8	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
8	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
9	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
9	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
9	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
9	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
10	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
10	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
10	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
10	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
11	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
11	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
11	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
11	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
12	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
12	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
12	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
12	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
13	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
13	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
13	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
13	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
14	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
14	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
14	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
14	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
15	A	8/5/2003	1	0	0	0	1	1	0	0	0	0	0	0
15	B	8/5/2003	1	0	0	0	1	1	0	0	0	0	0	0
15	C	8/5/2003	1	0	0	0	1	1	0	0	0	0	0	0
15	D	8/5/2003	2	0	0	0	1	1	0	0	0	0	0	0
16	A	8/5/2003	1	0	0	1	1	0	1	0	0	0	0	0
16	B	8/5/2003	1	0	0	1	1	0	0	0	0	0	0	0
16	C	8/5/2003	1	0	0	1	1	0	0	0	0	0	0	0
16	D	8/5/2003	1	0	0	1	1	0	0	0	0	0	0	0
17	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
17	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
17	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
17	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
18	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
18	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
18	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
18	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
19	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
19	B	8/5/2003	1	0	0	0	1	0	0	0	0	0	0	0
19	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
19	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
20	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
20	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
20	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
20	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0

Site	Sample	Date	DENSITY	M_SPIC	P_CRIS	P_PECT	V_AMER	N_FLEX	H_DUB	E_CAN	C_DEM	P_FOL	P_ZOS	P_NAT
21	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
21	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
21	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
21	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
22	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
22	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
22	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
22	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
23	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
23	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
23	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
23	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
24	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
24	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
24	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
24	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
25	A	8/5/2003	1	0	0	0	1	1	0	0	0	0	0	0
25	B	8/5/2003	1	0	0	0	1	1	0	0	0	0	0	0
25	C	8/5/2003	1	0	0	0	1	1	0	0	0	0	0	0
25	D	8/5/2003	1	0	0	0	1	1	0	0	0	0	0	0
26	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
26	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
26	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
26	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
27	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
27	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
27	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
27	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
28	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
28	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
28	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
28	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
29	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
29	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
29	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
29	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
30	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
30	B	8/5/2003	1	0	0	0	1	0	0	0	0	0	0	0
30	C	8/5/2003	1	1	0	0	0	1	0	0	0	0	0	0
30	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
31	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
31	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
31	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
31	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
32	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
32	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
32	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
32	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
33	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
33	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
33	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
33	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
34	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
34	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
34	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
34	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
35	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
35	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
35	C	8/5/2003	1	0	0	0	0	1	0	0	0	0	0	0
35	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
36	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
36	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
36	C	8/5/2003	1	0	0	0	0	1	0	0	0	0	0	0
36	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
37	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
37	B	8/5/2003	1	0	0	1	1	1	0	0	0	0	0	0
37	C	8/5/2003	1	0	0	1	1	0	0	0	0	0	0	0
37	D	8/5/2003	2	0	0	1	1	0	0	1	0	0	0	0
38	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
38	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
38	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
38	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
39	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
39	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
39	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
39	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
40	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
40	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
40	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
40	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0

Site	Sample	Date	DENSITY	M_SPIC	P_CRIS	P_PECT	V_AMER	N_FLEX	H_DUB	E_CAN	C_DEM	P_FOL	P_ZOS	P_NAT
41	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
41	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
41	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
41	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
42	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
42	B	8/5/2003	1	0	0	1	0	0	0	0	0	0	0	0
42	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
42	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
43	A	8/5/2003	1	0	0	1	0	0	0	0	0	0	0	0
43	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
43	C	8/5/2003	1	0	0	1	1	0	0	0	0	0	0	0
43	D	8/5/2003	1	0	0	0	1	0	0	0	0	0	0	0
44	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
44	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
44	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
44	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
45	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
45	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
45	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
45	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
46	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
46	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
46	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
46	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
47	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
47	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
47	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
47	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
48	A	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
48	B	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
48	C	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
48	D	8/5/2003	0	0	0	0	0	0	0	0	0	0	0	0
49	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
49	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
49	C	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
49	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
50	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
50	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
50	C	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
50	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
51	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
51	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
51	C	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
51	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
52	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
52	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
52	C	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
52	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
53	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
53	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
53	C	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
53	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
54	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
54	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
54	C	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
54	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
55	A	8/6/2003	1	0	0	0	1	0	0	0	0	0	0	0
55	B	8/6/2003	1	0	0	0	1	0	0	0	0	0	0	0
55	C	8/6/2003	1	0	0	0	1	0	0	0	0	0	0	0
55	D	8/6/2003	1	0	0	0	1	0	0	0	0	0	0	0
56	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
56	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
56	C	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
56	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
57	A	8/6/2003	1	0	0	0	0	1	0	0	0	0	0	0
57	B	8/6/2003	1	0	0	0	1	1	0	0	0	0	0	0
57	C	8/6/2003	1	0	0	0	0	1	0	0	0	0	0	0
57	D	8/6/2003	1	0	0	0	1	1	0	0	1	0	0	0
58	A	8/6/2003	1	0	0	0	0	0	0	0	0	0	0	0
58	B	8/6/2003	1	0	0	0	1	0	0	0	1	0	0	0
58	C	8/6/2003	1	0	0	0	1	0	0	0	1	0	0	0
58	D	8/6/2003	1	0	0	0	1	0	0	0	1	1	0	0
59	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
59	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
59	C	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
59	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
60	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
60	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
60	C	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
60	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0

Site	Sample	Date	DENSITY	M_SPIC	P_CRIS	P_PECT	V_AMER	N_FLEX	H_DUB	E_CAN	C_DEM	P_FOL	P_ZOS	P_NAT
61	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
61	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
61	C	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
61	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
62	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
62	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
62	C	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
62	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
63	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
63	B	8/6/2003	1	0	0	0	1	1	0	0	0	0	0	0
63	C	8/6/2003	1	0	0	0	1	1	0	0	0	0	0	0
63	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
64	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
64	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
64	C	8/6/2003	1	0	0	0	0	1	0	0	0	0	0	0
64	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
65	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
65	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
65	C	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
65	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
66	A	8/6/2003	1	0	0	0	1	0	0	1	0	0	0	0
66	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
66	C	8/6/2003	1	0	0	0	1	0	0	0	0	0	0	0
66	D	8/6/2003	1	0	0	0	1	0	0	0	0	0	0	0
67	A	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
67	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
67	C	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
67	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
68	A	8/6/2003	1	0	0	0	0	0	0	1	0	0	0	0
68	B	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
68	C	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
68	D	8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0
69	A	8/6/2003	2	0	0	0	0	0	0	1	0	0	2	0
69	B	8/6/2003	2	0	0	0	0	0	0	0	1	0	2	0
69	C	8/6/2003	1	1	0	0	0	1	0	0	0	0	1	0
69	D	8/6/2003	1	1	0	0	0	1	0	0	0	0	1	0
70	A	8/6/2003	2	0	0	0	1	0	0	2	0	0	0	0
70	B	8/6/2003	2	1	0	0	0	0	1	1	1	0	0	0
70	C	8/6/2003	3	0	0	1	1	0	0	3	0	0	0	0
70	D	8/6/2003	1	1	0	0	1	0	0	0	0	0	0	0
71	A	8/6/2003	1	1	0	0	1	0	0	1	0	0	0	0
71	B	8/6/2003	1	0	0	0	1	1	1	1	0	0	0	0
71	C	8/6/2003	5	0	0	0	1	0	0	4	0	0	0	0
71	D	8/6/2003	5	0	0	0	1	0	0	4	1	0	0	0
72	A	8/6/2003	1	0	0	0	1	0	0	1	1	0	0	0
72	B	8/6/2003	1	0	0	0	0	0	0	1	1	0	0	0
72	C	8/6/2003	1	0	0	0	0	0	0	1	1	0	1	0
72	D	8/6/2003	1	0	0	0	0	0	0	1	1	0	0	0

Appendix C:

Aquatic Invasive Species Grant Application

Aquatic Invasive Species (AIS) Control Grants

For the in-depth version, go to
http://www.uwsp.edu/cnr/uwexlakes/grants/AIS_long.pdf

Aquatic invasive species (AIS) or aquatic nuisance species (ANS) have been hitchhiking their way into Wisconsin for decades. By water, boat and by land - from around the planet - non-native organisms have been moving into inland waters. Aquatic invasive species can threaten the diversity and abundance of native species, alter ecosystems and affect our economy and recreational activities. In today's world, invasives can move at "the speed of flight." In response to the increasing threat to our priceless lakes and rivers, Wisconsin has increased its support of local efforts to prevent the spread of introduced aquatic invasives by creating the Aquatic Invasive Species Prevention and Control Grants.

About the grants

Aquatic Invasive Species (AIS) Control Grants are designed to assist in a state/local partnership to control aquatic invasive species. The Department of Natural Resources (DNR) was directed to establish procedures to award cost-sharing grants to public and private entities for up to 50% of the costs of projects to control invasive species. These funds are available to units of local government and others for grants to control aquatic invasive species. The grant projects are broken down into three major categories:

1) Education, Prevention and Planning
2) Early Detection and Rapid Response
3) Controlling Established Infestations

Grants are available to conduct projects on all waters of the state, including lakes, rivers, streams, wetlands and the Great Lakes.

Eligible Sponsors

Any entity that is eligible for a Wisconsin Lake or River Planning or Protection grant is also eligible for an AIS control grant. This includes units of local government, tribes, lake protection and rehabilitation districts, qualified lake associations, qualified river management organizations, nonprofit conservation organizations and qualified school districts. However, first priority will go to units of local government.

About the money

The budget for this grant program is $1,500,000 per year.
The state will pay up to 50% of the cost of a project, with caps of:

$75,000 for Education, Prevention and Planning
$10,000 for Early Detection and Rapid Response
$75,000 for Controlling Established Infestations

The remaining 50% must be provided by the local organization in the form of cash, time, services, or "in-kind" items. Grants operate on a reimbursement basis. For Education, Prevention and Planning Projects, sponsors may request an advance payment of 25%.

Permit fees are considered an eligible cost, as well as the expenses required to obtain permits (retroactive up to 12 months prior to application). Watercraft inspection projects are limited to $2,500 per public boat launch facility, but can be a component of a larger project.

Eligible Projects may include:

Education, Prevention and Planning

- Educational programs and distributing information about aquatic invasive species (*Note: Projects will be reviewed for consistency with the DNR statewide education strategy and the use of existing publications and outreach materials).*
- Monitoring, mapping and reporting of data about the presence or absence of AIS to provide baseline information and monitor trends in a water body or water bodies.
- Development of plans for the prevention and control of AIS.
- Studies or assessments that will aid in the prevention and control of AIS.
- Watercraft inspection and education projects following DNR guidelines of the departments Clean Boats, Clean Waters (PUB-WT-780-2004) program. Specifically, projects involving watercraft inspectors are required to attend a Clean Boats Clean Waters training workshop conduct inspections, collect and report data, and be present at boat launch facilities a minimum of 200 hours between May 1 and October 30)

Early Detection and Rapid Response

- Identification and removal, by approved methods, of small pioneer populations of aquatic invasive species in the early stages of colonization or re-colonization. (For rooted aquatic plants like Eurasian Watermilfoil, a pioneer infestation is defined as a localized bed that has been present less than 5 years, and is less than 5 acres in size or less than 5% of lake area, whichever is greater.)
- Control of a re-colonization following the completion of an established infestation control project.

Controlling Established Infestations

- Department approved control activities recommended in a management plan adopted by the sponsor for the control of aquatic invasive species.
- Experimental or demonstration projects following a DNR approved plan.
- Purple Loosestrife bio-control projects (no plan approval required).

Applications

Applications for Education, Prevention and Planning Projects and Established Infestation Control Projects are **due by February 1 and August 1 of each year**. Early Detection and Rapid Response grants are offered continuously on a first come, first serve basis and funded in order of approval.

The DNR can provide help with applications and technical guidance. Private consultants can also assist you. A list of consultants, without endorsements, can be obtained from the University of Wisconsin-Extension (UWEX) Lakes Program at http://www.uwsp.edu/cnr/uwexlakes/lakelist/, or your DNR Region Lakes Coordinator.

For more information

Contact your regional DNR Lake Coordinator or Environmental Grant Specialist at:

Northern Region – West Spooner 715-635- 2101

Northern Region – East Rhinelander 715-365-8900

Northeastern Region Green Bay 920-492-5800

West Central Region Eau Claire 715-839-3700

South Central Region Fitchburg 608-275-3366

Southeastern Region Milwaukee 414-263-8500

Or contact any of the following: UWEX-Lakes Program at 715/346-2116 or uwexlakes@uwsp.edu; Wisconsin Association of Lakes at 608/662-0923 or wal@wisconsinlakes.org; DNR Central Office at 608/261-6423.

AIS Grant Rules: http://www.uwsp.edu/cnr/uwexlakes/grants/ChapterNR_198.pdf

General Grant information: http://www.dnr.wi.gov/org/caer/cfa/grants/Forms/LakeGuidelines2006.pdf

Online application form: http://dnr.wi.gov/org/caer/cfa/grants/Forms/8700307.pdf

Application instructions: http://dnr.wi.gov/org/caer/cfa/grants/Forms/AISApplicationInstructions.pdf