

P O R T A G E C O U N T Y

EURASIAN WATER MILFOIL ASSESSMENT

Summary: 2003 - 2005



*Eurasian Water Milfoil stem with one healthy branch (right) and one weevil-damaged branch (left)*

Prepared for:  
Land Conservation Division of Portage County Planning & Zoning Department

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*See Appendices for  
how YOU can help  
stop the spread of  
invasives or help  
your milfoil weevils!*

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**Portage County  
Eurasian Water Milfoil Assessment**

## I. INTRODUCTION

Eurasian water milfoil (EWM) (*Myriophyllum spicatum*) is an exotic aquatic plant that has been gaining notoriety across the United States for its extremely aggressive invasive nature. Native to the Eurasian continent, it has been inadvertently introduced to water bodies across the U.S. by boaters, recreationalists and various aquatic industries. Once introduced, EWM, a champion of reproductive ingenuity, spreads rapidly via stolons or fragmentation. The submersed aquatic plant goes through two flowering periods each summer, after which, it fragments into many pieces. Each fragment may sprout roots and can remain afloat and stay viable for several weeks until it drifts to a suitable site, where it can become another plant. A perennial, the plant may wait out the winter under the ice, intact, and will be growing and well established by April or May, much sooner than native aquatics. It will grow rapidly, reach the water surface and then spread into a dense, tangled mat, shading out the sunlight the other plants need. This dense mat also increases the dissolved oxygen fluxuations, carbon dioxide fluxuations, pH fluxuations and the temperature stratification of the water, and it inhibits water circulation. The EWM aggressively out-competes the native aquatic plants, which results in a rapid decrease in the diversity of the lake's plant community. This in turn decreases the diversity of the insect and fish populations. Dense growth of EWM can impede predator-prey relationships between fish, stunting the growth of the larger fishes as it reduces their ability to see prey. The tangled mats at the water surface can become dense enough to strand boaters, become a safety hazard for swimmers, and create a stagnant breeding ground for mosquitoes. (Jester 1998)



The cumulative effect of EWM impacts creates a chain reaction of changes in to the lake's ecology, decreasing the recreational value, sporting value and aesthetic value of the water body, which may in turn result in decreased property values (Jester 1998). A study in Minnesota found water clarity directly affects lakefront property values, and a study in Maine found that a noticeable gain in water quality could bring about \$25 million in additional spending into the state. (Meersman 2003 and "The Economics")

Therefore, there is a strategic, monetary benefit to understanding a lake or pond's ecosystem and preventing and/or controlling an EWM infestation. Various types of treatments are available, depending on the extent and density of the infestation, including trained manual removal, bottom barriers, mechanical removal/harvesting, winter water level drawdowns, herbicides and biological controls. Choosing the best treatment option is also dependant on the individual qualities of the particular water body, economic feasibility and the restrictions/allowances of local and state ordinances.

**EWM Reports in  
Portage Co.**

**Confirmed - Present:**

1. Lake Emily
2. Lake Jonas
3. McDill Pond
4. Lake Pacawa
5. Springville Pond
6. Thomas Lake

**Confirmed - Not Present:**

(should be watched)

1. Bear Lake
2. Jordan Pond

***Making the connection...*** When new cases of EWM are reported, there is currently no well-defined response program. Sometimes the Wisconsin Department of Natural Resources (WDNR) has the personnel and budget to conduct an assessment, sometimes not. Sometimes there is an active lake association to implement a control plan, sometimes not. Some connection between the local level and state level is needed.

In the summer of 2003, EWM was recorded at 8 of the 29 Portage County lakes that were part of a study being conducted by Portage County and the University of Wisconsin-Stevens Point. It was determined that additional information and management plans for EWM were needed for those lakes. The Portage County EWM Study was initiated by the Portage County Land Conservation Division (LCD) of the Planning and Zoning Department to collect that information.

**The Portage County EWM Studies did not seek to take on the task of EWM control** at the county level, but rather to investigate the problem, devise well-informed recommendations tailored to each lake, and then to **provide the information to the appropriate lake management units** and collaborate with them on implementation details. This approach of information gathering, dissemination and networking seems to be the best role the county can play in EWM control.

***What's been done...*** In October of 2003, field mapping of EWM was completed for four lakes using GPS equipment. In 2004, the remaining two lakes with known EWM infestations were mapped, and milfoil weevil (*Euhrychiopsis lecontei*) population surveys were conducted on four lakes who were candidates for biological control. In 2005, assistance was given to lake management units wishing to implement the recommendations developed by this study, additional EWM mapping and weevil surveys were done, as well as a milfoil weevil rearing trial on Thomas Lake.

Complete summary of study findings and treatment recommendations are given in this report for the eight lakes studied to date.

***Protect your favorite lake...***

The recommendations for each lake include many tools put together to make a comprehensive plan for future management. Public education, annual monitoring and creating "Clean Boats" habits are a large part of these plans. There is too much for a county or any one governmental unit to do alone. Any citizen can learn about exotic species, help control the spread of those species, express their interest in control to local government units, and be an advocate for their favorite lake.

***"Volunteers Prevent Exotic Invader From Entering Crescent Lake"***

In their first summer of operation, volunteer boat inspectors with the Crescent Lake Association stopped four boats with EWM, curly pondweed and zebra mussels from entering their lake. Not only did they protect their lake, they also taught numerous boaters how to check their boats for "hitch hiking" invasives. (WAL 2004)

## II. METHODS

This project was initiated and facilitated by Steve Bradley, the County Conservationist of Portage County. (See Appendix C for contact information.) Project coordination and report preparation was completed by Amy Thorstenson, Golden Sands Resource Conservation & Development (RC&D). All fieldwork was performed or overseen by Amy Thorstenson, with the help of various field assistants. (See Appendix C for contact information.)

All vegetation surveys were planned with the technical guidance of WDNR personnel. Multiple personnel were contacted regarding various issues, but the main contact person was the WDNR regional Aquatic Plant Specialist, Deborah Konkel. Milfoil weevil surveys and rearing trials were planned with technical guidance from Dr. Ray Newman, University of Minnesota, and with personnel from the Vermont Department of Environmental Conservation.

All EWM treatment recommendations given for each lake were developed with, reviewed by and approved by Deborah Konkel (WDNR). (See Appendix C for contact information.) Survey plans and treatment recommendations were also developed with the technical guidance of Nancy Turyk, Water Resources Scientist with the Center for Watershed Sciences and Education at the University of Wisconsin-Stevens Point.

#### Background Data Collection:

Background lake data was gathered for each lake from multiple sources, including records maintained by WDNR, the UW-Stevens Point Robert W. Freckmann Herbarium and preliminary research reports from the University of Wisconsin-Stevens Point and Portage County. Please note that the UWSP and Portage County report cited (*Portage County Lake Study-Preliminary Results 2003*) was indeed a preliminary report, and some of the preliminary data used in this report may differ slightly with what is presented in the Portage County Lake Study final report, which is to be released in early 2006.

#### EWM Mapping Surveys:

EWM surveys on Bear Lake, Jordan Pond, McDill Pond, Lake Pacawa, Springville Pond and Thomas Lake were conducted from a canoe. Lake Emily EWM surveys were conducted from a pontoon boat. In the cases of Lake Pacawa, Jordan Pond and Springville Pond, where the waterbody is shallow enough for EWM to grow at any given point, observers paddled slowly, navigating back and forth across the waterbody until the entire waterbody had been visually searched. On Bear Lake, Lake Emily and Thomas Lake, the depth at the centers of these lakes precludes EWM from growing anywhere but around the periphery of the lakes. In this situation, observers circled the lakes slowly while visually searching for EWM.

Wherever EWM was found, GPS coordinates were recorded to sub-meter accuracy with a Trimble Pro XR. If it was a single plant or a very small colony of plants, a point feature was used to log the location. If the EWM colony was large enough to be recorded accurately as an area feature, the outline of the colony was traced, or corner points were recorded, to map the area feature. The mapping features were then overlain on aerial

photographs to create GIS maps of EWM locations. If depth contours were available, contour lines were also overlain onto the aerial photographs. Please note that in the case of Bear Lake, no EWM was located during field exercises, therefore no GIS maps were created.

Voucher specimens of EWM and northern water milfoil (*Myriophyllum sibiricum*) were collected randomly, bagged in water and kept refrigerated. These were later pressed, mounted and the species identification verified by Dr. Robert Freckmann, professor emeritus, University of Wisconsin - Stevens Point. The mounted specimens will be retained at the Robert W. Freckmann Herbarium on campus.

In the case of McDill Pond, with its shallow maximum depth of 15 feet, EWM is capable of growing most anywhere in the pond and is already widespread. The nutrient rich pond also has dense growth of many native and non-native plant species, including another exotic invasive species, curly pondweed (*Potamogeton crispus*). To combat this problem, mechanical harvesting has already been in practice for several years.

With these factors in mind, the goal of the survey on McDill Pond was not to map individual EWM growths, but rather to gather data that could be compared with pre-harvesting data to identify shifts in plant population dominance. Therefore, the transect method was used to survey for frequency and dominance of all plant species.

Transects on McDill Pond were delineated with GIS before performing the field work. The transects were randomly located, perpendicular to shore, every 1500 feet along the shoreline. The transects were located in the field using a Trimble Pro XR GPS unit. Personnel then sampled from a point randomly chosen along the transect within each depth zone (0-1.5 feet, 1.5-5 feet, 5-10 feet and 10-20 feet). Sampling was performed by dropping a long-handled, steel, thatching rake straight down to the lake bed, then pulling it straight back up and recording the presence and relative density of each plant species present on the rake. At each sample point, the rake was dropped four times, one time within each quarter of a 6-foot diameter quadrant. For each sample point, relative density of each species was rated from 1 to 5. A rating of 1, 2, 3 or 4 indicated the species was present on 1, 2, 3 or 4 rake samples. A rating of 5 was given if the species was *abundantly* present on all four rake samples.

Plant species observed to be present but not sampled were recorded, to compile a more complete list of species present in McDill Pond. Voucher specimens of all plants observed, sampled and not sampled, were collected, bagged in water and kept refrigerated. These were later pressed, mounted and the species identification declared and/or verified by Dr. Robert Freckmann, professor emeritus, University of Wisconsin - Stevens Point. The mounted specimens will be retained at the Robert W. Freckmann Herbarium on the UW-Stevens Point campus.

Weevil Surveys:

Milfoil weevil survey methodology was modeled after the 1996-97 study completed by Laura Jester, in cooperation with the WDNR, as detailed in her 1998 report "*The Geographic Distribution of the Aquatic Milfoil Weevil (Euhrychiopsis lecontei) and Factors Influencing its Density in Wisconsin Lakes*".

Four representative EWM beds were selected for each of the lakes to be surveyed for weevils (Lake Emily, Lake Pacawa, Springville Pond and Thomas Lake). In Springville Pond, where four individual beds were not available, the largest bed was divided into two equal halves. (In Thomas Lake, where EWM grows in a complete ring around the lake, samples were randomly collected all the way around the lake, from all depth zones. Samples from the west half of the lake were kept separate from those from the east half, for comparison purposes.)

Because the weevil lives within the top 20 inches of the stems, only samples 20 inches or more in length were retained for examination. The Jester report stated that 120 samples had been collected for each lake, but in conversations with Jester, she stated that the study had found statistical confidence at about half that number. (Jester 2003, *pers. comm.*)

Initially, the attempt was to collect samples from each bed along three transects extending perpendicular to shore, by snorkeling alongside the canoe and grabbing one plant stem at five roughly equidistant points along the transect, for a total of 60 stems per lake. (4 beds x 3 transects x 5 sample points) Reality proved that snorkeling through thick EWM beds is very difficult. Staying on a perfectly straight transect line at the same time seemed impossible. Thus, the secondary method given in the Jester report (reaching for stems from the canoe) quickly became the preferred method. Additionally, it was decided that maintaining strict transects was not necessary for the purposes of this study, and stem samples were collected by meandering around in the EWM beds and collecting samples from all areas of the bed and across all depths within the bed. Field personnel were conscientious to refrain from visually scanning the stems before picking them, which would have introduced sampling bias. Where EWM was not close to the surface, a long-handled, steel, thatching rake was dropped overboard to snag some stems. The first intact, 20-inch long stem to be randomly selected and untangled from the rake was retained as the sample stem.

Water depth range (deepest and shallowest points) within each sample bed was recorded. Stem samples were stored with water in labeled plastic bags, chilled on ice in a cooler while in the field and later kept refrigerated at approximately 3-4°C until they were examined. Any samples that could not be processed within eight days of collection were preserved with ethyl alcohol to retain the integrity of the sample. Samples were examined under magnification by floating them in shallow water in a clear, glass pan over a light table. All weevils of all life stages found within the stems or clinging to the outsides were preserved in a labeled glass vial. Weevils found in the stem were carefully extracted with dissecting equipment so they could still be identifiable. Because RC&D personnel lacked experience in identification of *E. lecontei*, all 2004 weevil specimens were mailed to Laura Jester, of Jester Consulting in Eden Prairie, Minnesota, for species identification confirmation. All 2005 weevil specimens were examined and species identification confirmed by Amy Thorstenson, the 2003-2005 project leader for RC&D.

### Weevil Rearing:

Weevil rearing methods were modeled after the Vermont Department of Environmental Conservation (DEC) methods outlined in the 1995 report to the U.S. Environmental Protection Agency entitled *Field Collection, Laboratory Rearing and In-lake Introductions of Herbivorous Aquatic Weevil, Euhrychiopsis lecontei, in Vermont*, written by Hanson, et al.

The University of Wisconsin-Stevens Point greenhouse served as the rearing station. An automated system in the greenhouse monitored and adjusted light intensity and temperature to sustain a temperate summer climate. A total of 40 ten-gallon glass aquaria were set-up on tables and 70 white five-gallon buckets were arranged beneath the aquaria tables. An activated carbon filter was used to filter chlorine from the water supply. A hose attached to the filter was used to fill the tanks and buckets.

A canoe was used to collect weevils from Lake Thomas. Field personnel looked for blackened, damaged milfoil stems (of either species) from the canoe. When a damaged stem was found, field personnel collected the top segment of the stem, optimally 20-inches but minimally 15-inches. Stems with flowers were not to be collected as adults will not utilize flowering tips to lay eggs. Visual assessments of the damaged stems were then conducted to determine whether the stems actually contained weevil larvae. Damaged meristems, pinholes, or tunneling are indicators of weevil larvae. Occasionally larvae or adults were directly observed and included in the collection. Damaged stems thought to hold weevil larvae were carefully placed into plastic bags with lake water, 15 damaged stems per bag. The bags were placed into five-gallon buckets half full of lake water to keep the temperature of the bags cool, then transported back to the greenhouse in the buckets. A matching number of healthy stems were also collected and placed into a five-gallon bucket with lake water.

At the greenhouse the tanks/buckets to be used that day were filled with filtered water. The zip-lock bags holding our collected stems were then placed into the tank/buckets to allow the larvae to acclimate. When the stems were considered acclimated they were arranged in glass cake pans and examined over light tables with 3x magnification goggles. Each stem was carefully examined for weevil larvae, adults and eggs. Meristems were examined for eggs. This required peeling back of the outer layers of the meristem as well as looking down upon the anterior end of the meristem. Determining whether a stem contained weevil larvae was somewhat subjective.

Often, larvae were easily visible in the translucent stems that were still in fair condition. However, the more deteriorated stems were darkened and opaque, making visual detection of larvae more difficult. Tunneling and pinholes indicate weevil larvae activity, but if this damage was present from one end of the stem to the other end the larvae was determined to have likely tunneled completely through the portion of stem collected and moved on to a new stem. Sometimes, with a thoroughly collapsed stem, light tapping with a dissecting probe could detect resistance in a segment of appropriate size and shape as would indicate a weevil larvae. With some experience, these larvae could be added to the tally with good confidence. Also damaged meristems indicate activity of early instars of the weevil larvae, but due to their relatively small size and our reluctance to fully dissect the meristem, as the meristem is critical to rearing the weevils, there is some error in confirming the presence of an early instar of the weevil larvae. The

healthy stems collected were also examined for larvae, adults and eggs to assure an undocumented input of weevils did not occur.

Weevils were not removed from their stems. Stems that held larvae, adults or eggs were placed into aquaria or buckets. The number of weevils per life-stage introduced into each tank/bucket was recorded along with the tank/bucket I.D. number. Initially, each 10-gallon aquarium received up to **15** weevils (larvae, adults or eggs), but experimentation revealed that approximately 6 to 8 weevils per tank produced higher reproduction rates. Therefore, for the remainder of the project, each aquarium received about **7** weevils (larvae, adults, or eggs). Each five-gallon bucket received about 5 weevils.

Initially, healthy stems were added to each 10-gallon tank to achieve a total of **15** stems per tank, however, experimentation found that more healthy stems seemed necessary to obtain higher production. Therefore, for the remainder of the project, even though fewer weevil-containing stems were added to the tanks, enough healthy stems were added to achieve a total of about 20 stems per tank. For each 5-gallon bucket, enough healthy stems were added to achieve a total of about 12 stems per bucket. All stems were then attached to a rock with a rubber-band to simulate rooting of the stems and achieve the correct vertical orientation.

Initially, the weevils were left in the tanks/buckets for about 13 days to reproduce, however low reproductive rates initiated a review of protocol, in comparison to the Vermont DEC methods. Review found that our methods differed, in that they were starting with all adult-stage weevils, but we were starting with a combination of mostly larvae and some adults. Therefore, for the remainder of the project, the weevils were left in the tanks/buckets for about 20 days to reproduce. Tanks and buckets were monitored to assure water levels were adequate.

Once the reproduction interval was complete, all stems were removed from the tanks/buckets and examined. Stems were arranged in clear, glass, 9"x13" pans and examined over a light table using 3x magnification goggles. The number of weevils per life-stage extracted from each tank/bucket along with the tank/bucket I.D. number was recorded. Before cleaning the tank/buckets, they were examined for loose adults and larvae, which were included in the tally, when found.

The weevil-containing stems removed from the tanks/buckets were then placed into zip-lock bags filled with tank/bucket water. To keep the bags cool during transportation to the lake, they were placed into a five-gallon bucket that was half-filled with filtered water.

Release of the weevils occurred at a single, pre-determined, marked release point in a milfoil bed on the southern shore of Lake Thomas. The bed was comprised exclusively of Eurasian water milfoil, which is the species preferred by *E. lecontei*. Release was done from a canoe or by wading out to the release site. The weevil-containing stems were placed onto dense mats of milfoil and then intermingled with healthy, rooted milfoil to assure that the weevil larvae could easily crawl onto healthy milfoil.

This process was repeated, in rotation, from the first stem collection on June 14th until the last weevil release on August 23. No further rearing was done after this date, as newly released weevils would need time to acclimate and prepare for hibernation.

III. COUNTY-WIDE RECOMMENDATIONS

a. Exotic Species Awareness Signage at All Landings

Under Wisconsin Statutes, Chapter 30.715, it is illegal to transport boats or equipment that have aquatic plants attached. (*Wisconsin Legislature: Infobases*) To increase boater awareness, signage should be in place at every public boat landing reminding boaters to clean off their boats to the prevent transfer of exotic species from lake to lake. This is important because a single boater transporting a single piece of EWM can be responsible for introducing the exotic plant to a previously uninfested lake. **If signs are missing or damaged, contact the WDNR to have the sign replaced.**



“Help prevent the spread...” signage at Bear Lake public boat landing.

For lakes that are currently not infested with any exotic species, there are “Help Prevent the Spread...” signs available, which instruct boaters to clean equipment before entering that lake. For lakes already infested by one or more exotic species, there are “Exotic Species Advisory” signs, informing of the presence of each exotic species known to be in that lake. (See Appendix A for “Clean Boats, Clean Waters” tips and guidelines.)



“Exotic Species Advisory” sign at McDill Pond public boat landing.

b. Encourage Shoreland Buffers

State code (NR115) and Portage County ordinance 7.7.5 prohibit the removal of trees and shrubbery within 35 feet of the shoreline (with the exception of up to 30 feet within any 100 feet of the shoreline length permitted for clearing as a “view corridor”). While this provides some natural vegetation along the shoreline, the code and ordinance do not mention mowing of grasses and native, non-woody vegetation. A true shoreland buffer zone includes this vital understory that provides food and cover for many wildlife species, including the native milfoil weevil, *Euhrychiopsis lecontei*. (See Appendix B for tips on providing weevil habitat.) Buffer zones that include un-mowed grasses also protect the health of the lake by filtering out sediments, fertilizers and other contaminants from storm water before it trickles into the lake.



A beautiful buffer.

Currently, NR115 is undergoing revisions to prohibit the removal of *all* vegetation within 50 feet of the shoreline. In anticipation of these revisions, and in support of the health of Portage County’s lakes and rivers, county policies and education efforts should strive to encourage the use of shoreland buffers on public and private lands.

Some county-level support for shoreland buffers is already in place. Technical assistance with shoreland restoration projects is available from the Portage County LCD. Additionally, restorations within certain watersheds are eligible for cost-sharing programs. Contact Portage County LCD for more information at (715) 346-1334.

### III. COUNTY-WIDE RECOMMENDATIONS

#### c. Trained Volunteer Watercraft Inspectors



**Clean Boats,  
Clean Waters**

*Kits available for  
check-out from  
Portage Co. LCD or  
Golden Sands RC&D*

Because the public plays such a key role in spreading aquatic invasive species, information about invasive species *must* get into the hands of every boater. Through the 'Clean Boats, Clean Waters' program, a network of volunteers is being trained and organized by the Wisconsin Lakes Partnership (WDNR, UW-Extension and Wisconsin Association of Lakes). Workshops train citizens in identifying aquatic invasive species, how to properly purge and clean a boat and how to teach this information to boaters. Once trained, volunteers can spend time at public boat landings distributing informational pamphlets and showing boaters the steps for inspecting and cleaning their boats. These volunteers can also inspect the area near the boat landing (a hot spot for new infestations) for invasive species and report new infestations. Information about upcoming training workshops or assistance starting a volunteer watercraft inspection program is available from the Volunteer Monitoring Coordinator at (715) 346-3366. (See Appendix C for more contact information.)

Portage County and Golden Sands RC&D are supportive of the 'Clean Boats, Clean Waters' program. Portage County LCD and Golden Sands RC&D have '**Clean Boats' kits available for check-out for any group who needs an extra kit** during their watercraft inspection day.

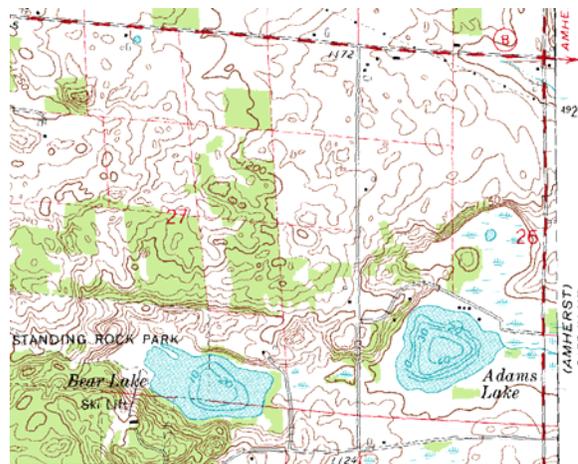
#### d. Public Awareness of Current Infestations

The public at large should be informed of the waterbodies in Portage County containing EWM and how to report new infestations. Lakefront property owners, Portage County lake associations, lake protection groups and Town boards around the eight subject lakes are key groups who should be educated about EWM problems, trained in EWM identification and encouraged to participate in the 'Clean Boats, Clean Waters' program.

## IV. BEAR LAKE

## a. Lake Background

Located approximately one mile south of County Highway B in the Town of Arnott, Bear Lake is a small seepage lake with a surface area of 28 acres and a maximum depth of 28 feet. The water in Bear Lake comes from groundwater, runoff and precipitation. Water leaves the lake via evaporation and seepage to groundwater. Because Bear Lake's water comes from multiple sources, one must think of its watershed in terms of a surface watershed and a groundwater shed. (See Appendix C for definitions of terms.) In the case of Bear Lake, the surface watershed is dominated by forest cover, and the groundwater shed is dominated by both forest cover and non-irrigated cropland. [University of Wisconsin-Stevens Point (UWSP) and Portage County 2003, Preliminary Results] There is a non-trailerable public boat landing on Bear Lake.



*Bear Lake on USGS topographic map.*



*Bear Lake boat landing.*

Total phosphorus levels of 30 ppb or higher categorizes a lake as eutrophic, resulting in more aquatic plant growth, which makes the lake more productive for fish and wildlife than a mesotrophic or oligotrophic lake, but less desirable for swimming. Bear Lake is a eutrophic lake, with total phosphorus levels historically averaging approximately 32 parts per billion (ppb) and average phosphorus levels for the year 2002 of approximately 36 ppb. (UWSP and Portage County 2003, Preliminary Results)

Water clarity in Bear Lake is considered fair when compared with similar lakes in the region. Average historic Secchi depth (a measure of water clarity) was best in June (13 feet) and poorest in September (6 ½ feet). Fluctuations in water clarity are normal, due to increases and decreases of algae population and sedimentation. (UWSP and Portage County 2003, Preliminary Results)

## b. History of Aquatic Plant Control in Bear Lake

No records of previous aquatic plant treatments were found to report for this assessment. Table 1 lists aquatic vegetation species documented in Bear Lake.

Table 1 - List of Documented Aquatic Vegetation  
(Submergent and Floating Leaf Aquatics Only)

Herbarium Records for Bear Lake *		
	Scientific Name	Common Name
1	<i>Brasenia shreberi</i>	Watershield
2	<i>Ceratophyllum demersum</i>	Coontail
3	<i>Elodea Canadensis</i>	Waterweed
4	<i>Lemna turionifera</i>	Perennial duckweed
5	<i>Megalodonta beckii</i>	Water beggar-ticks
6	<i>Myriophyllum sibiricum</i>	Northern water milfoil
7	<i>Myriophyllum spicatum</i> (?) (e)	Eurasian water milfoil
8	<i>Najas flexilis</i>	Slender naiad
9	<i>Nuphar variegata</i>	Bullhead pond lily
10	<i>Nymphaea odorata</i>	White water lily
11	<i>Polygonum amphibium</i>	Amphibious smartweed
12	<i>Potamogeton amplifolius</i>	Large leaf pondweed
13	<i>Potamogeton crispus</i> (e)	Curly leaf pondweed
14	<i>Potamogeton gramineus</i>	Variable pondweed
15	<i>Potamogeton illinoensis</i>	Illinois pondweed
17	<i>Potamogeton natans</i>	Floating leaf pondweed
18	<i>Potamogeton praelongus</i>	White stem pondweed
19	<i>Utricularia gibba</i>	Creeping bladderwort
20	<i>Utricularia intermedia</i>	Flat leaved bladderwort
21	<i>Utricularia minor</i>	Small bladderwort
22	<i>Utricularia vulgaris</i>	Common bladderwort

\* Robert W. Freckmann Herbarium records through November 2003, University of Wisconsin-Stevens Point. (Note: These herbarium records are historical documentation of what has been identified to date at Bear Lake. *This is not an exclusive list.* Further, it cannot be stated with certainty that because a species has not been recorded at that lake recently that the species is no longer present in that lake. However, it has been well documented that as exotic invasives infest a lake, native vegetation is progressively less able to compete and the number of species (diversity) in the lake declines. Anecdotally, this is what has been seen at lakes in Portage County where EWM is present, however it would require quantitative vegetation surveys to confirm this.)

(e) Exotic, invasive

(?) Eurasian Water Milfoil (*Milfolium spicatum*) was sighted washed-up at the boat landing during 2003 plant surveys, and was collected for a voucher specimen to be retained at the Robert W. Freckmann Herbarium on the University of Stevens Point campus. However, no other EWM (washed-up, rooted or floating) could be located within the lake.

c. Mapping Results

Field mapping efforts for this assessment on October 8, 2003 could not locate EWM, either rooted, floating or washed-up on shore. Therefore, **no EWM map was produced** for Bear Lake. It is possible that the EWM collected was a lone piece, removed from a boat before being launched, however, this is hopeful speculation, and Bear Lake should be monitored frequently to catch any EWM infestations early. Until an infestation site is located and confirmed, management should focus on prevention.

d. Recommended Management Plan for Eurasian Water Monitoring:

Prevention and Annual Monitoring

1. **Maintain Invasive Species Information Sign**

The best way to control EWM is to prevent it from entering the water body in the first place. The main method of spread is by hitch hiking from lake to lake on boats, trailers and recreational equipment. Under Wisconsin Statutes, Chapter 30.715, it is illegal to place a boat, trailer or equipment that have aquatic plants attached into a navigable waterway. (Wisconsin Legislature: Infobases). Prominent signage can help remind boaters to check their boats and trailers for “hitch hiking” plants.



*Bear Lake public boat landing - Sign is posted in a visible location.*



Currently, a “Help Prevent the Spread...” sign, designed for uninfected lakes, is posted at the Bear Lake boat landing. If EWM is found in the lake in the future, this signage should then be changed to an “Exotic Species Advisory” sign, to warn of the presence of EWM.

If this sign is missing or damaged the WDNR should be notified.

2. **Annual Surveying**

Annual surveying should be done to search for potential EWM outbreaks.

In 2005, volunteers for annual monitoring were sought. (See Section IV.e.)

a. **Report New Infestations**

If even one live EWM plant is found, rooted or floating, the WDNR Aquatic Plant Specialist for this region should be notified immediately. (See Appendix.) If possible, a sample of the plant

should be collected, kept in chilled water and mailed or delivered to the WDNR for species identification confirmation.

**b. Implement Best Treatment Option**

Treatment options should be implemented by trained volunteers or professionals, at the direction of WDNR personnel. If a floating or washed-up plant was found, the plant should be removed and disposed of and the source infestation (rooted, live EWM plants) searched for. If no source is found, no further treatment is necessary, but if a source can be located, treatment should be implemented as soon as possible. Individual plants or small colonies can be cut at the sediment line or hand pulled, roots and all. (Hand removal of exotic species does not require a permit from the WDNR.) If hand pulling is done, the sediment may need to be loosened with a pitchfork to make total removal of the roots possible. If cutting is done, it is best to time this early in the year, when the plant is expending its winter reserves sprouting new growth. Monthly follow-up cuttings must then be done to continue draining the plants of energy.

**c. Dispose of Plants Removed**

State law requires that ALL PLANT PARTS cut or pulled must be removed from the water and destroyed or disposed of.

**d. Follow-up Monitoring**

Monthly follow-up monitoring must be done through the remainder of the growing season to check for re-sprouts. Again, ALL PLANT PARTS must be removed and destroyed or disposed of. Annual monitoring should be continued, since *EWM eradication is never permanent*.

**3. Trained Volunteer Watercraft Inspectors**

Because aquatic invasive species spread primarily by hitch hiking from lake to lake on boats and boating equipment, information about invasive species must get into the hands of every boater. The presence of trained volunteer watercraft inspectors, especially on major boating weekends, would be helpful to educate boaters about the invasive nature of exotic species and the importance of checking boats and trailers for “hitch hikers”.

Residents of Bear Lake, as well as other conservation groups in Portage County, are encouraged to **protect Bear Lake** by participating in the volunteer watercraft inspector training workshops and the support network offered by the Clean Boats, Clean Water Program through the Wisconsin Lakes Partnership. More information about this program is given in Section III.c.

e. Implementation of Recommendations:

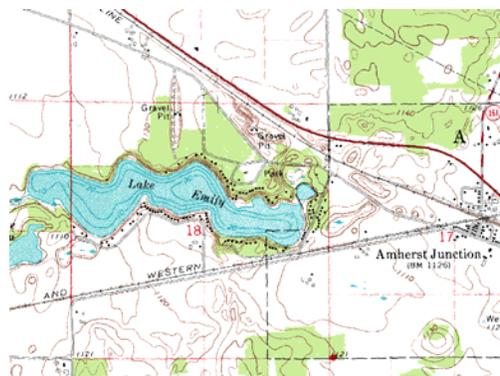
Volunteers were sought in 2005. A Bear Lake resident, Tom Zielinski, stepped forward to take on the responsibility. Tom reported that his first survey in spring of 2005 came up empty handed... which was a *good* thing!



V. LAKE EMILY

a. Lake Background

Located approximately 1/5 mile south of State Highway 10 in the Town of Amherst, Lake Emily is a medium-sized seepage lake with a surface area of 95.5 acres and a maximum depth of 35 feet. The water in Lake Emily comes from groundwater, runoff, precipitation and one intermittent inlet from Mud Lake at the west end. Water leaves the lake via evaporation and seepage to groundwater. Because Lake Emily's water comes from multiple sources, one must think of its watershed in terms of its surface watershed and its groundwater shed. (See Appendix C for definitions of terms.) In the case of Lake Emily, the surface watershed and groundwater shed are both dominated by non-irrigated agriculture. Although residential land use is a small percentage of land area in these watersheds, most of these properties are concentrated directly around the lake shoreline, which heightens their potential to impact the health of the lake. Residential land use has increased significantly since 1948. (UWSP and Portage County 2003, Preliminary Results) This is a heavily recreated lake with high resident usage and a county campground, park, beach and two trailerable boat landings (one maintained by the county, one maintained by the township).



Lake Emily on USGS topographic map.

Total phosphorus levels of 30 ppb or higher categorizes a lake as eutrophic, resulting in more aquatic plant growth, which makes the lake more productive for fish and wildlife than a mesotrophic or oligotrophic lake, but less desirable for swimming. Lake Emily is historically a mesotrophic lake, with Total Phosphorus Levels historically averaging approximately 26 parts per billion (ppb), but average phosphorus levels in 2002 were approximately 33 ppb, which is 3 ppb above the eutrophic level. (UWSP and Portage County 2003, Preliminary Results)

Water clarity in Lake Emily is considered fair when compared with similar lakes in the region. Average historic Secchi depth (a measure of water clarity) was best in May (17 feet) and poorest in July (8 feet). Fluctuations in water clarity are normal, due to increases and decreases of algae population and sedimentation. Average secchi depth readings for 2002 indicated poorer water clarity in late summer than the historic average. (UWSP and Portage County 2003, Preliminary Results)



Lake Emily's East boat landing.

b. History of Aquatic Plant Control in Lake Emily

There were no DNR records of aquatic plant treatments prior to the onset of this study. WDNR records show EWM was first reported in this lake in 1993. (WDNR website) Table 2 lists aquatic vegetation species documented in Lake Emily.

Table 2 - List of Documented Aquatic Vegetation  
(Submergent and Floating Leaf Aquatics Only)

Herbarium Records for Lake Emily *		
	Scientific Name	Common Name
1	<i>Brasenia shreberi</i>	Watersheid
2	<i>Ceratophyllum demersum</i>	Coontail
3	<i>Elodea Canadensis</i>	Waterweed
4	<i>Lemna minor</i>	Small duckweed
5	<i>Lemna turionifera</i>	Perennial duckweed
6	<i>Megalodonta beckii</i>	Water beggar-ticks
7	<i>Myriophyllum sibiricum</i>	Northern water milfoil
8	<i>Myriophyllum spicatum</i> (e)	Eurasian water milfoil
9	<i>Najas flexilis</i>	Slender naiad
10	<i>Nuphar variegata</i>	Bullhead pond lily
11	<i>Nymphaea odorata</i>	White water lily
12	<i>Potamogeton friesii</i>	Fries's pondweed
13	<i>Potamogeton gramineus</i>	Variable pondweed
14	<i>Potamogeton illinoensis</i>	Illinois pondweed
15	<i>Potamogeton natans</i>	Floating leaf pondweed
16	<i>Vallisneria americana</i>	Water celery

\* Robert W. Freckmann Herbarium records through November 2003, University of Wisconsin-Stevens Point. (Note: These herbarium records are historical documentation of what has been identified to date at Lake Emily. *This is not an exclusive list.* Further, it cannot be stated with certainty that because a species has not been recorded at that lake recently that the species is no longer present in that lake. However, it has been well documented that as exotic invasives infest a lake, native vegetation is progressively less able to compete and the number of species (diversity) in the lake declines. Anecdotally, this is what has been seen by researchers at lakes in Portage County where EWM is present, however it would require quantitative vegetation surveys to confirm this.)

(e) Exotic invasive

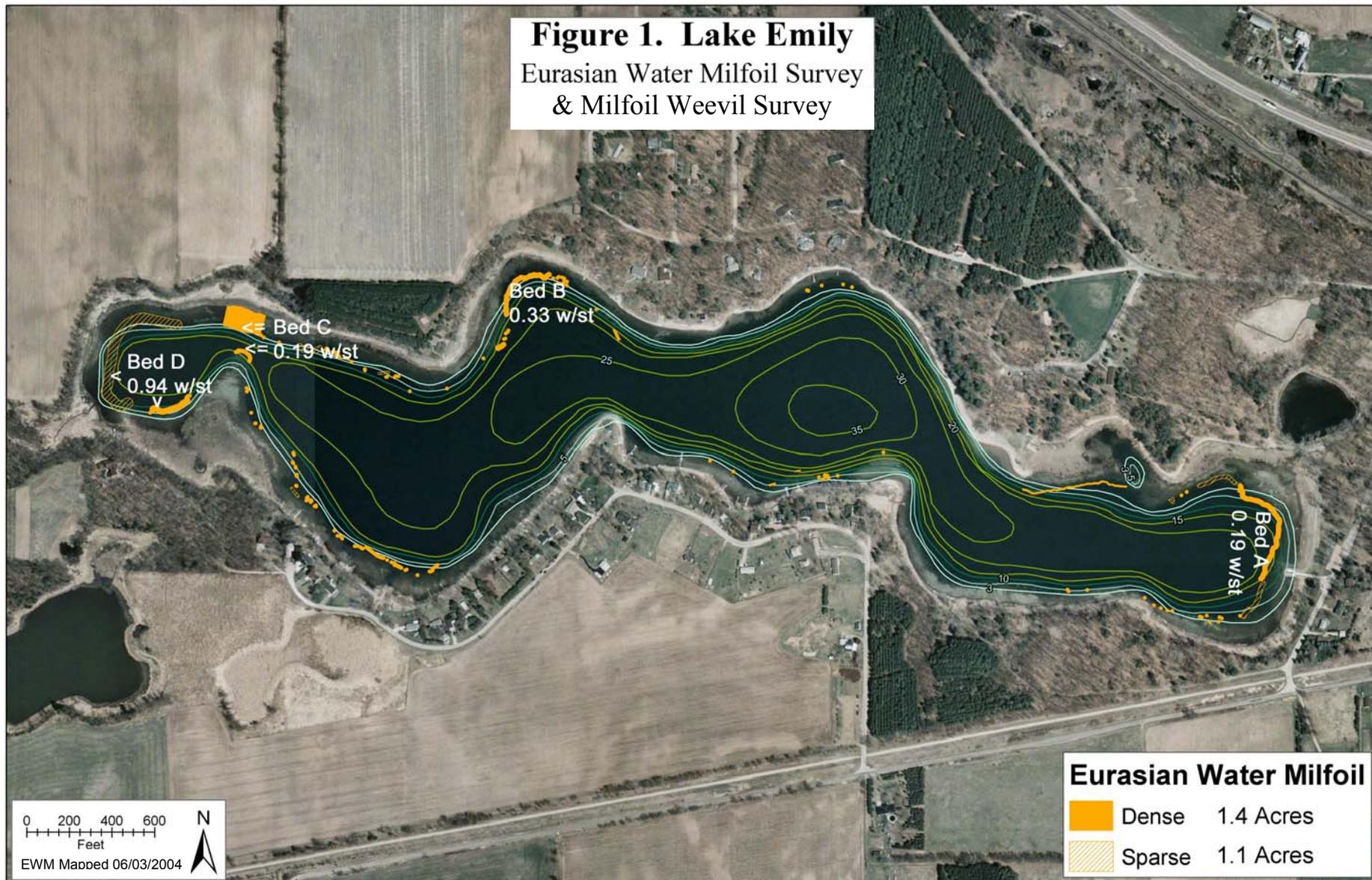
c. Mapping Results

On June 30<sup>th</sup>, 2004, multiple areas of sparse to dense EWM growth were mapped. Dense EWM growth totaled 1.4 acres and sparse growth totaled 1.1 acres. (See Figure 1.)

d. Weevil Population Density Survey Results

The primary recommendation for Lake Emily suggested in the 2003 EWM Assessment Report was to investigate the potential for using biological control. It was suggested that, if biological control proved a viable option under the conditions present at Lake Emily, then this might provide a natural, long-term solution.

Population density surveys were performed in August 2004 to determine the existing natural population of the aquatic milfoil weevil, *Euhrychiopsis lecontei*. EWM stem samples were collected from Lake Emily on August 5<sup>th</sup>, 2004 and examined in the laboratory on August 19<sup>th</sup>–20<sup>th</sup>, 2004. (See Section II for methods.) Extracted weevil specimens were placed in labeled sample vials, preserved in 95% ethyl alcohol and sent to Laura Jester of Jester Consulting, Eden Prairie, MN, for species identification confirmation. (See Figure 1 for sample bed locations and Table 3 for summarized results.)



Beds A, B, C and D surveyed for milfoil weevils (*Eurychiopsis lecontei*) on 08/05/04. Stem samples collected from sample beds were examined in laboratory on 08/19/04 – 08/20/04. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Lake Emily was found to be **0.60 weevils per stem**.

Table 3. Weevil Population Density Survey – Results Summary

Lab Date (2004)	Bed No.*	Depth Range (ft)	Tot # Stem Samples	% Samples marl**-covered	Ave # Broken Tips	Ave # of Apical Tips	% Stems w/ Weevil Damage	Ave # Eggs per Stem	Ave # Larvae per Stem	Ave # Pupae per Stem	Ave # Adults per Stem	Ave Weevils per Stem (All Life Stages)
8/18, 19	<b>A</b>	4 - 11	16	19%	0.19	2.63	19%	0.00	0.06	0.13	0.00	<b>0.19</b>
8/18, 20	<b>B</b>	8 - 13	15	13%	0.40	2.80	87%	0.00	0.27	0.07	0.00	<b>0.33</b>
8/19, 20	<b>C</b>	1 - 12	16	44%	0.75	1.88	31%	0.00	0.19	0.00	0.00	<b>0.19</b>
8/19/04	<b>D</b>	2 - 13	16	56%	0.19	2.31	44%	0.19	0.50	0.13	0.13	<b>0.94</b>
<b>Whole Lake Results</b>		1 - 13	63	33%	0.40	2.40	43%	0.05	0.38	0.13	0.05	<b>0.60</b>

\*See Figure 1 for EWM sample bed locations.

\*\*Marl coating on samples may have been a combination of marl and algae.

#### Survey Notes:

Sample Date: 8/5/2004

Weather Conditions: Sunny Breezy, 70°F

Land Cover @ Shore: Bed A = Park (mowed to shoreline)  
 Bed B = Residential (most mowed to shoreline), Natural (forest and wetlands)  
 Bed C = Residential (most mowed to shoreline), Natural (forest and wetlands)  
 Bed D = Natural (forest and wetlands)

Sample Preservation: Samples were kept in water in labeled plastic bags at 3-4°C until time of examination. Any samples not examined within eight days of collection were preserved with ethyl alcohol. Due to a shortage of available ethyl alcohol, only approximately 30 ml of 95% ethyl alcohol could be added to the sample bags (containing apx. 100-130 ml of lake water). All samples appeared to be in good condition at the time of examination.

Other notes: A leaf deformity, fused lower leaflets, was noted on a few Lake Emily samples. Beds A and C are in main boat traffic thoroughfares. Efforts were made to avoid sampling in severely disturbed sections of these beds, but boat disturbance is likely affecting weevil success in these areas.

Average (*E. lecontei*) milfoil weevil density for Lake Emily was found to be 0.60 weevils per stem, which appears to be a near average natural density. Of the 31 Wisconsin lakes studied by Laura Jester from 1996 to 1997, the mean natural weevil density was 0.65 weevils per stem. (Jester 1998)

Figure 1 shows EWM sample bed locations and average weevil densities for those beds. There was notable contrast in weevil densities between sample beds. Beds B and D had considerably healthier weevil densities, at 0.33 and 0.94 weevils per stem, respectively. Of the 31 Wisconsin lakes studied by Laura Jester, less than a third had natural weevil densities equal to or greater than 0.9 weevils per stem. (Jester 1998) Past studies have indicated that densities greater than 2 weevils per stem are associated with EWM declines, but recent evidence indicates that the density of weevils required to impact EWM is in some cases less than 2 weevils per stem and is highly lake specific. In fact, researchers now suggest that, while densities at or greater than 1 weevil per stem is preferable to achieve EWM *decline*, *control* may occur at levels around 0.5 weevils per stem or lower. (Newman 2004, *pers. comm.*) This may be good news for lakes with low natural weevil densities, and it may also be possible for some lakes to increase weevil populations over time.

Factors found to positively impact weevils are bed locations that are near shore and growing in shallow water, near a higher percentage of natural shoreline, or have a higher number of growing tips per plant (bushier plants). (Jester, et al. 1999) In the case of Lake Emily, sample beds A and C were both found to have a relatively low weevil density of 0.19 weevils per stem. These beds are in high boat-traffic areas and EWM plants were noted to commonly have chopped and mangled tips within the main thoroughfare. These plants were considered to be inappropriate for stem samples, so samples were collected away from the most disturbed sections of the thoroughfare, but weevil densities were still very low in these sample beds. Weevils lay their eggs in the growing tips of the plants, and the larvae feed on the top one-foot or so of the plant stem, so it seems logical that beds where boats are chopping tips or creating a lot of current would have reduced weevil reproduction success.

Bed D shows, by far, the best weevil populations of the four beds sampled (0.94 weevils per stem). This bed is in a relatively low-traffic area, in shallow, calm water, near to shore, and the shoreline has a high percentage of natural vegetation. Weevils overwinter in the mud and leaf litter along shore and, therefore, fare best with a higher percentage of natural shoreline that is not mowed, raked, rip-rapped, sand or sea-walls. (Jester et al. 1999) Of the factors that appear to be affecting weevil populations on Lake Emily, percent of natural shoreline and boat traffic are the two that are within human control.

e. Recommended Management Plan for Eurasian Water Milfoil:

Combination Treatments – Two Options

Friends of Lake Emily, Inc. has chosen to pursue Option 1, reserving Option 2 as a treatment option for the future. (See Section V.f. for summary of implementation.)

At the present extent of the EWM infestation in Lake Emily, the chance for total eradication of the weed is fleeting. An aggressive attack, implemented as soon as possible, might achieve this. If efforts of this magnitude are unattainable, then other things should be done to attempt to achieve control before EWM spreads out of control.

Whether pursuing eradication or control, one must be aware that neither scenario is permanent. Even if EWM is eradicated, it just takes one boat to bring the weed in again and start a new infestation. Likewise, if control is achieved, conditions may arise which throw the balance off, permitting EWM to spread faster than it can be controlled. In short, lake planners must think about EWM management in the **short term** and the **long term**. In the long term, enhancement of weevil winter habitat to build the population over time appears to be the best option at Lake Emily. In the short term, two options hold potential, but regardless of the option pursued, the supplementary measures discussed in Sections V.e.2, 3, 4 and 5 are ESSENTIAL to the success of those efforts!

### 1. Option 1 = Push for Eradication (Herbicide Treatments)

*Chemical treatment requires a permit from the WDNR.*

If a push for eradication is pursued, it will begin with chemical treatment of all the EWM beds and MUST include aggressive hand-pulling of the individual EWM plants peppered around the lake. Herbicide treatment of these individual plants would be cost prohibitive and an excessive use of chemicals. (See Section V.e.2. for details on hand-pulling recommendations.) Chemical treatment using a selective herbicide would serve as an initial “attack” on the EWM. If this “attack” is to be pursued, it should be done so aggressively. The first treatment should take place in spring, when EWM is most susceptible. Hand-pulling of individual plants should follow 30 days after herbicide treatments. Follow-up monitoring in August may determine herbicide re-treatment to be necessary in fall of 2005. *Herbicide treatment should be contracted with service providers who provide precise dosing, accuracy of delivery and follow-up monitoring services.*

For this effort to be successful, there MUST also be follow-up evaluation of results of the 2005 eradication efforts and decision of what methods to pursue in 2006, 2007 and beyond. Those follow-up methods may include another year of herbicides, use of plant barriers and/or more hand-pulling. Consult with Deb Konkel, WDNR Aquatic Plants Specialist, to decide how to proceed in 2006. (See Appendix C for contact information.)

***No matter the amount of effort and money spent in 2005, eradication will NOT be achieved without a commitment to implement treatment efforts in 2006, 2007 and beyond.***

### Option 2 = Invest in Control

Option 2 should be used in conjunction with Option 1 and/or if chemical treatments would be too expensive, too widespread, or appear to be ineffective in Lake Emily.

Biological control may be best achieved with some initial expense and effort to boost the natural milfoil weevil populations at Lake Emily. While milfoil weevils do hold potential to control EWM, it should be understood that that potential varies from lake to lake and, therefore, there is risk of it not working well on Lake Emily. Also, natural, biological control works in a naturally dynamic way. As the weevil’s habitat (EWM) expands, the weevils will multiply to occupy that habitat and eventually impact the habitat, but this does not happen overnight. Once the weevils are numerous enough to impact EWM health, the EWM population will decline and so will the weevils. Thus, it should be understood that biological control will mean natural fluctuations in the amount of EWM seen from year to year.

The natural weevil populations appear to be struggling in high-traffic areas (Beds A and C), but doing reasonably well in quieter, more suitable habitats

(Beds B and D). A few things can be done to boost weevil populations and control the spread of EWM while the weevils are “catching up”:

- ✓ Purchase weevils to add to Beds B and D may help boost numbers in these areas, which can then spread out to other areas. (Approval from the WDNR will be required.)
- ✓ Control of Beds A and C in 2005. These two beds are in high boat-traffic areas, which presents two problems: Motors will chop EWM and spread bits around the lake, and traffic will impede weevil success in those beds. Beds A and C should be controlled using plant barriers or herbicide treatments. It is likely that weevils displaced by those treatments will move to other milfoil beds.
- ✓ Hand-pulling of individual growths to keep EWM from spreading faster than the weevils can keep up. (See Section V.e.2.)
- ✓ Provide weevil habitat. <= **ESSENTIAL !!!** (See Section V.e.3.)

## 2. Hand-pulling Individual Growths – Summer 2005

Whether Option 1 or Option 2 is being pursued, hand-pulling of the individual growths will greatly increase the success of either treatment plan. A resident of Lake Emily who has experimented with hand-pulling EWM stated that the soft marl sediment makes removal of the plant, roots and all, quite easy. Organized efforts, whether wading, snorkeling or diving, will be a *significant* part in EWM control on this lake. (The deeper growths will necessitate the help of divers, and a significant number of hours will be needed.)

Exotic species can be cut or pulled by hand without a permit from the WDNR. Volunteers/professionals engaged in this activity should be trained in the proper identification and removal of EWM. EWM can be cut at the sediment line or (preferably) hand-pulled, roots and all. If hand-pulling is done, the sediment may need to be loosened with a pitch fork to make total removal of the roots possible. Follow-up monitoring must be done to check for re-sprouts. ALL PLANT PARTS must be removed and destroyed or disposed of. (Any piece of EWM stem, two inches or longer, can sprout into a new plant, so removal of any loose, floating EWM stems is important!)

## 3. Provide Weevil Habitat – Beginning Immediately!

Whether Option 1 or Option 2 is being pursued, providing weevil winter habitat may increase chances for long-term control. Under Option 1, if eradication is achieved, there will always be a chance for re-infestation in the future and having good habitat for weevils will provide future options. Under Option 2, the investment in buying weevils can be maximized by providing good winter habitat.

Natural (un-raked, un-mowed) vegetation along shore is essential because weevils spend their winters hibernating in the mud, leaf litter and vegetation

debris on shore. Weevils do not survive in areas that are mowed, raked, rip-rapped or bare sand. (Disturbances such as these also *encourage* the establishment of exotic species.) Because weevils are weak fliers, the day they emerge from the water to fly to shore and hibernate, they are at the mercy of the wind. The more shoreline that is in natural condition the better the weevils' chances are of landing in suitable habitat.

To help the weevils survive and do the job we are asking of them, parks departments and private landowners can:

- ✓ Leave as much un-mowed land as possible within 35' of shore.  
(More is better!) Weevils hibernate in leaf litter and dead grasses.
- ✓ Minimize the area maintained in beach, mowed paths, rip-rap, or otherwise disturbed/manipulated land.
- ✓ Restore disturbed/manipulated areas.  
For cost-sharing or technical assistance on restorations, contact the Portage Co. Land Conservation Dept.
- ✓ Minimize fertilizer use.  
Storm water from fertilized properties can speed EWM growth!

(Also see Appendix B for more tips on providing weevil habitat.)

#### 4. Trained Volunteer Monitoring Program – *Spring 2005*

Whether Option 1 or Option 2 is being pursued, a trained volunteer monitoring crew who can correctly identify EWM and map new EWM beds on an annual or biannual basis will be essential to the management the EWM on Lake Emily. Annual monitoring may help reduce future expenses by identifying problems early or reducing the amount of information a consultant would need to collect. Your WDNR Aquatic Plants Specialist can arrange this training. (See Appendix C for contact information.)

Additionally, all landowners can learn how to keep their dock areas “EWM-free”, thereby helping to control the weed’s spread. Once trained to identify and control EWM, landowners can watch for EWM that washes up on shore and dispose of those plants before it takes hold and starts a new bed. Landowners can also be trained how to pull individual EWM plants found in the shallows around their property to prevent a new bed from developing. (Pulling individual, spotty growths should not negatively impact natural weevil populations and may help keep EWM from spreading faster than the control treatments can work.) Again, landowners should be *trained* for this, so they are not pulling beneficial, native plants.

Landowners  
can learn  
how to keep  
their docks  
EWM-free!

**5. Boating Lanes – Spring 2005**

Whether Option 1 or Option 2 is being pursued, minimizing the boat traffic through Beds A and C will increase the success of either treatment plan. Boat traffic through these beds chops up the stems and assists the spread of EWM. Traffic also impedes the establishment of milfoil weevils. “Boating lanes” or “No-boating” areas should be established to steer traffic around these two beds. If it is not possible to get *around* these beds, boating lanes would confine traffic to a smaller area *through* the beds. (Placement of bouys requires WDNR permit approval. Local permits may also be required.)

Optionally, “No-boating” areas may also established around other EWM beds where stems are within reach of boat props or wash. Weevil densities are only known in four EWM beds, and it is possible that other beds on Lake Emily are also affected by boat traffic and the weevils in those beds may be struggling too.

**6. Create Aquatic Plant Management Plan**

EWM eradication should be considered to be just one part of a larger goal of total lake health. It is recommended that the 2004 survey data be used to create a comprehensive aquatic plant management plan for Lake Emily. Because phosphorus inputs are the main food source for excessive plant and algae growth, special attention should be paid to sources of phosphorus in within the watershed. The Portage County Lake Study and other projects have already gathered a great deal of data needed to create a well-balanced lake management plan.

**7. Maintain Exotic Species Advisory Signs**



*View as launching at the East boat landing. Sign is now more visible than it was as originally posted.*

Under Wisconsin Statutes, Chapter 30.715, it is illegal to place a boat, trailer or equipment that have aquatic plants attached into a navigable waterway. (Wisconsin Legislature: Infobases). “Exotic Species Advisory” signs placed at boat landings can be a reminder to boaters to check for hitch hiking plants.

The signs, as originally posted at the east boat landing on Lake Emily, were not highly visible at a point where boaters would be tending to their equipment and likely to take the time to look for “hitch-hiking” plants. The signs have since been moved and are now more noticeable. Also, the south boat landing was previously not posted, but signs were posted at this landing in summer of 2004.



*Close-up of more visibly posted signs.*

Prominent signage should be maintained in good condition at both boat landings to prevent boaters from bringing additional exotic species to Lake Emily or transferring EWM to other lakes.

If the signs are damaged or missing the WDNR should be notified.

## 8. Volunteer Watercraft Inspection Program

Because aquatic invasive species spread primarily by hitch hiking from lake to lake on boats and boating equipment, information about invasive species must get into the hands of every boater. The presence of trained volunteer watercraft inspectors, especially on major boating weekends, would be helpful to educate boaters about the invasive nature of exotic species and the importance of checking boats and trailers for “hitch hikers”.

Lake Emily has a high recreational value and is held in high regard by the area citizens and the Friends of Lake Emily protection group. This group, as well as other conservation groups in Portage County, should be encouraged to participate in the volunteer watercraft inspector training workshops and the support network offered by the Clean Boats, Clean Water Program through the Wisconsin Lakes Partnership. More information about this program is given in Section III.c. See Appendix B for program contacts.

### f. Implementation of Recommendations:



*Volunteer divers and cleanup crews take a break to enjoy a nice lunch. Over 50 volunteers, kids and adults, helped Lake Emily by participating in the two EWM hand-pulling days. (Photo provided by Friends of Lake Emily, Inc.)*

In 2005, the Portage County EWM Studies assisted the Friends of Lake Emily, Inc. with **implementing Option 1** from their EWM control recommendations. The friends of Lake Emily, Inc. hosted a public informational meeting on April 11<sup>th</sup>, 2005. Pre-treatment GIS mapping of EWM locations was completed by Golden Sands RC&D on May 31<sup>st</sup>, 2005. The herbicide treatment was performed on June 1<sup>st</sup> by Aquatic Engineering, Inc., utilizing RC&D’s GIS mapping for guidance. Because of public concern about potential impacts to spawning fish, GPS locations of spawning beds were marked and no herbicide was applied within 50 feet of the beds. (See Figure 2.)

All public areas and docks within 150 feet of a treatment area were posted by Aquatic Engineering, Inc. with yellow advisory signs to notify the public of the treatment and informed them that there were no safety restrictions on swimming, fishing or fish consumption, but that drinking the lake water and watering gardens was restricted. Unfortunately, vandals ripped down signs, so some water users may not have seen the information.

Some 100 to 200 dead fish turned up in the weeks after the treatment, which alarmed the public. DNR fisheries specialists investigated and found the cause of the fish deaths was unrelated to the herbicide treatments and was actually due to a bacterial disease called “columnaris”, or “cotton mouth”, commonly a problem with a rapid spring warm-up. Lake Emily was not alone in this trouble. Multiple lakes in the area had problems with diseases aggravated by the stress of spawning, unusually low water levels and the rapid warm-up, including McDill Pond in Portage County,

and Mayflower, Big Eau Plaine and Big Bass Lakes in Marathon County. (Meronek 2005)

Fortunately, the fisheries specialists believe the number of fish that died of columnaris this spring was not a significant impact to the fish populations in Lake Emily. To put the numbers into perspective, volunteer watercraft inspectors at Lake Emily found that about 150 fish are caught per day during a typical weekend.



Left: Volunteers divers pulling EWM plants, which float to the surface.  
 Above: Volunteers standing by for cleanup.  
 (Photos provided by Friends of Lake Emily, Inc.)

To remove the smaller EWM beds and individual plants, over 50 volunteers, both kids and adults, held volunteer work-parties on May 21<sup>st</sup> and June 25<sup>th</sup>. Divers pulled the EWM plants and clean-up crews picked up the loose stems so they could not root and form new plants. **These volunteer efforts helped to reduce the size and cost of the herbicide treatments.**

The combined efforts appear to have paid off. On July 19<sup>th</sup>, Aquatic Engineers, Inc. and RC&D personnel conducted a follow-up

survey and found **very good control of EWM around the lake.** Where plant beds had been treated with herbicides, only northern milfoil (a native milfoil) and other native aquatic plants were found, and they were coming back thick, which will help to crowd out potential EWM re-growth. Observations in other areas of the lake found almost no EWM present.

While the surveys show successful control this year, it does not mean that EWM will not come back next year. The Friends of Lake Emily, Inc. can expect to see EWM sprout from the seed bank in spring, though in lesser amounts than was mapped in 2004 and 2005, and must remain vigilant!

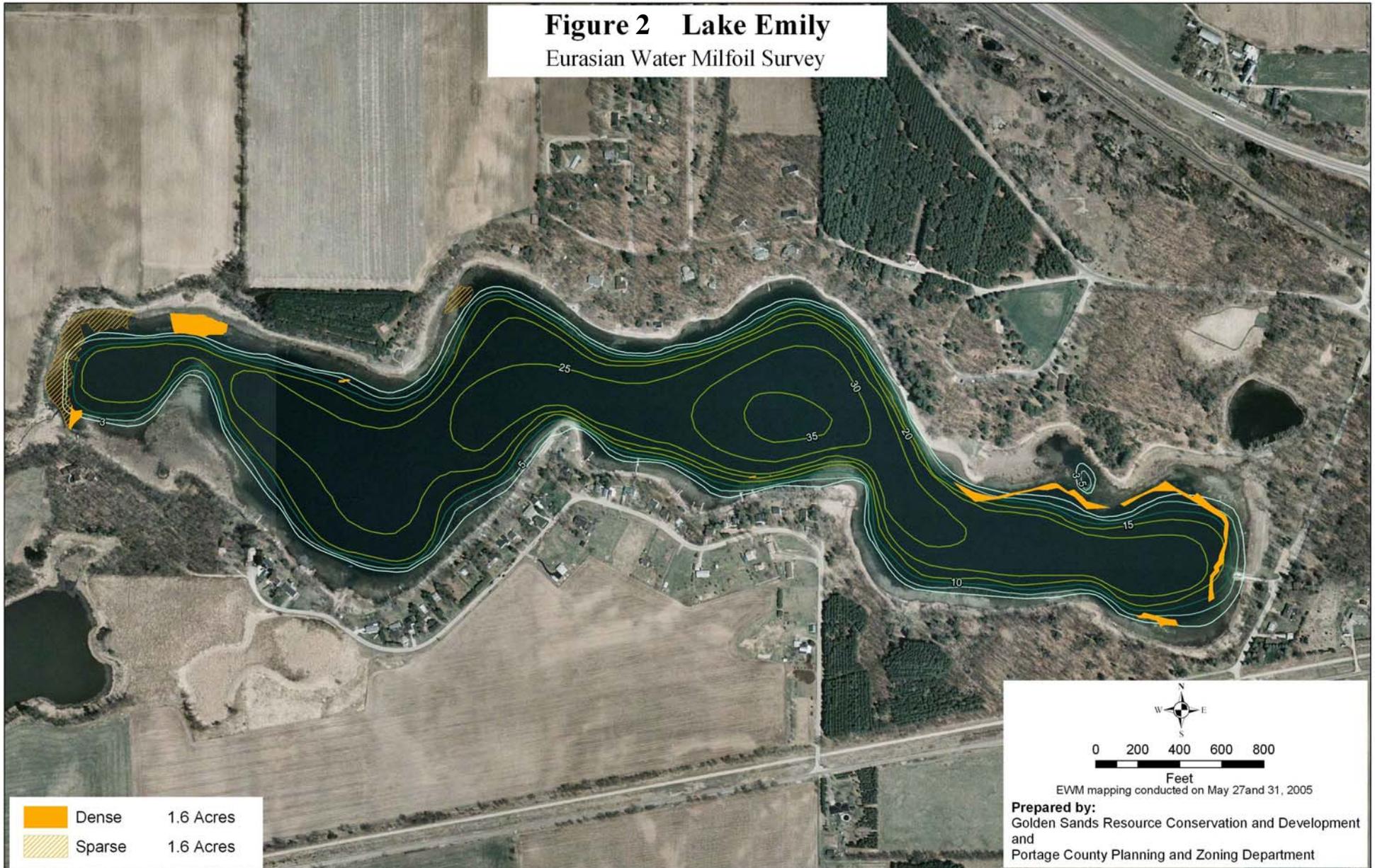
The control recommendations proposed by the Portage County EWM Studies suggested that the hand-pulling / herbicide combination should be done **up to three years in a row.** Then, the Friends of Lake Emily, inc., will need to work with their WDNR Aquatic Plant Specialist to assess the remaining EWM population and select control methods appropriate to the situation.



July 19<sup>th</sup> photos showed native plants flourishing in the absence of Eurasian water milfoil. This area had been treated on June 1<sup>st</sup>, while many native plants were still dormant.

In addition to following the tasks outlined in Option 1, it is also recommended that **annual milfoil weevil surveys** be conducted to track those populations, as biological control may become the primary control method in the future. (Grants for this work is are available from the DNR.)

**Figure 2 Lake Emily**  
Eurasian Water Milfoil Survey



**RESIDENTS ARE ENCOURAGED TO PARTICIPATE**

Residents have been updated and informed of how to get involved with their EWM control plan:

**Planning for 2006 control program should begin NOW.** The Friends of Lake Emily, Inc. have several tasks to accomplish before the 2006 growing season. These tasks will require a group effort, and lake residents are encouraged to actively participate with the Friends of Lake Emily, Inc. (See Appendix C for contact information.)

- ✓ Submit herbicide permit application to WDNR
- ✓ Submit grant application to DNR
- ✓ Organize volunteer diving and clean-up crews

**Join the ‘Clean Boats, Clean Waters’ crew.** This summer, ‘Clean Boats, Clean Waters’ volunteers were active for the first time at Lake Emily. They found out that many people boating on Lake Emily drove a considerable distance to get there. When asked, the boaters often reported they were drawn to Lake Emily’s clear, clean waters because their lakes back home were already spoiled by invasive species and pollution.



*Volunteers at Lake Emily talked with boaters about the importance of inspecting their boats for “hitch hiking” invasive species before entering the lake. (Photo provided by Friends of Lake Emily, Inc.)*

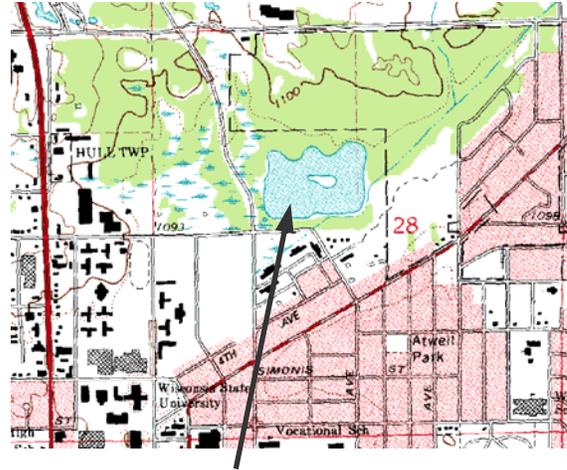
This supports the volunteers’ belief that they need to help defend Lake Emily, because EWM is not the only aquatic invasive species lurking out there! To prevent Lake Emily from suffering the woes of zebra mussels, spiny water fleas or Asian carp, residents are encouraged to join the ‘Clean Boats, Clean Waters’ volunteers at Lake Emily. (See Friends of Lake Emily, Inc. contact information in Appendix C).

**Control EWM around docks.** If residents can distinguish EWM from native milfoils, MANUAL REMOVAL (raking or hand-pulling) is an option to help in the EWM control program. State law allows the manual removal of non-native aquatic species without a permit. (PLEASE NOTE: State law requires the cut or pulled vegetation to be removed from the waterbody! This is to reduce EWM reproduction via stem fragmentation and to reduce the amount of rotting plant material contributing excess nutrients to the waterbody.)

## VI. LAKE JONAS

## a. Lake Background

Lake Jonas is located in Schmeekle Reserve, on the north side of the City of Stevens Point. The lake was a borrow-pit for highway improvement projects that eventually filled with water. The total surface area is 23 acres and the maximum depth is 25 feet. The water of Lake Jonas mostly comes from groundwater, with some contributions coming from runoff and precipitation. Water exits the lake to groundwater. (UWSP and Portage County 2003, Preliminary Results) (See Appendix C for definitions of terms.) The lake is surrounded by a wildlife reserve with well-maintained walking trails around the periphery and hand-carry boat access only.



*Lake Jonas on USGS topographic map.*

Lake Jonas historically has been an oligotrophic lake. Total phosphorus levels historically average approximately 14 parts per billion (ppb). Average phosphorus levels for the year 2002-03 were approximately 21 ppb, which is just over the mesotrophic level of 20 ppb but is still lower than other seepage lakes in Portage County. (UWSP and Portage County 2003, Preliminary Results) (See Appendix C for definitions of terms.)

In Lake Jonas, Secchi depth (a measure of water clarity) has historically ranged from 6 to 14 feet and is considered good when compared with the regional average of 9 feet for similar lakes. Secchi depth averages for 2002-03 was better than historically, with best clarity in May (21 feet) and poorest in July (14 feet). Fluctuations in water clarity throughout the season are normal, due to increases and decreases of algae population and sedimentation. (UWSP and Portage County 2003, Preliminary Results) (See Appendix C for definitions of terms.)

## b. History of Aquatic Plant Control in Lake Jonas

There has been no previous need for nuisance weed control, and there are no WDNR records of treatments. Table 4 lists aquatic vegetation species documented in Lake Jonas.

Table 4 - List of Documented Aquatic Vegetation  
(Submergent and Floating Leaf Aquatics Only)

Survey Records for Lake Jonas *		
	Scientific Name	Common Name
1	<i>Callitriche palustris</i>	Common water starwort
3	<i>Elodea Canadensis</i>	Waterweed
4	<i>Myriophyllum sibiricum</i>	Northern water milfoil
5	<i>Myriophyllum spicatum</i>	Eurasian water milfoil
6	<i>Potamogeton amplifolius</i>	Large leaf pondweed
7	<i>Potamogeton gramineus</i>	Variable pondweed
8	<i>Potamogeton spirillus</i>	Snail-seed pondweed

\* Records collected by Robert W. Freckmann in 2003 for Portage County Lakes Study. (Note: These records are documentation of submersed and floating-leaf vegetation identified at Jordan Pond during that vegetation survey. *This is not an exclusive list.*)

(e) Exotic invasive

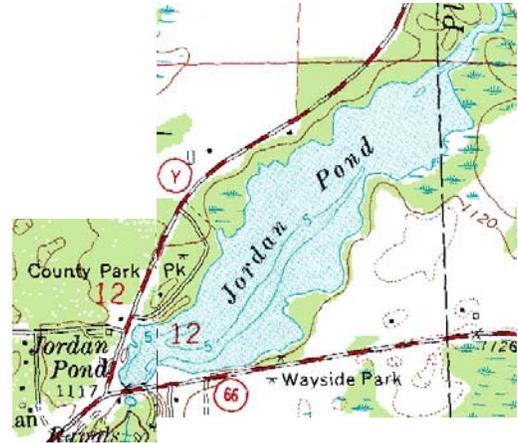
#### c. Investigation Results

In 2004, reports of EWM populations at Lake Jonas were confirmed by WDNR personnel. Portage County EWM Study personnel conferred with the **University of Wisconsin-Stevens Point**, affiliated with the management of Schmeekle Reserve, and the university had recently been made aware of the infestation and **is investigating the Eurasian Water Milfoil infestation**. Therefore, no mapping was conducted by the Portage County EWM Studies and no recommendations have been given.

VII. JORDAN POND

a. Lake Background

Jordan Pond is located at the intersection of State Highway 66 and County Highway Y, approximately 5 miles east of Stevens Point in the Town of Hull. The pond is an impoundment of the Plover River, with a surface area of 84.5 acres and a maximum depth of 8 feet. The water of Jordan Pond mostly comes from the Plover River, with small contributions coming from runoff, groundwater and precipitation. Much of the water exits the pond at a dam on the southern end, and some water moves to the groundwater.



Jordan Pond on USGS topographic map.

Because the majority of Jordan Pond's water comes from the Plover River, one must think of the pond's watershed and the river's watershed as being essentially one in the same. The Plover River's surface watershed has the most impact on the water quality of the river and the pond. (See Appendix C for definitions of terms.) Landuse in that watershed is predominantly forest (approximately 65%), with some land in agriculture (apx. 23%), developed/residential (apx. 5%) and impermeable surfaces (apx. 4%). (UWSP and Portage County 2003, Preliminary Results) The pond is heavily recreated, with a county park, public boat landing and swimming beach. The dam has been restored and is generating electricity.

Jordan Pond historically has been a mesotrophic lake. Total phosphorus levels historically average approximately 27 parts per billion (ppb) but average phosphorus levels for the years 2002-03 were approximately 32 ppb, which is above the eutrophic level of 30 ppb. (UWSP and Portage County 2003, Preliminary Results) (See Appendix C for definitions of terms.)



(Above) Lilly pads at north end of Jordan Pond. (Right) Calla lily in backwaters at north end of pond.



Water clarity in Jordan Pond is considered fair when compared with other impoundments in the region. The natural water color of the Plover River has some affect on the water clarity. Secchi depth (a measure of water clarity) in 2002-03 averaged approximately 4 feet, and was best in May (4.2 feet) and poorest in July (3.2 feet). Fluctuations in water clarity are normal, due to increases and decreases of algae population and sedimentation. (UWSP and Portage County 2003, Preliminary Results)

b. History of Aquatic Plant Control in Jordan Pond

No WDNR records were found for nuisance vegetation treatments. Table 5 lists aquatic vegetation species documented in Jordan Pond.

Table 5. List of Documented Aquatic Vegetation  
(Submergent and Floating Leaf Aquatics Only)

Survey Records for Jordan Pond *		
	Scientific Name	Common Name
1	<i>Ceratophyllum demersum</i>	Coontail
2	<i>Elodea Canadensis</i>	Waterweed
3	<i>Lemna minor</i>	Small duckweed
4	<i>Lemna trisulca</i>	Star duckweed
5	<i>Lemna turionifera</i>	Perennial duckweed
6	<i>Myriophyllum sibiricum</i>	Northern water milfoil
7	<i>Myriophyllum spicatum</i> (e)	Eurasian water milfoil
8	<i>Najas flexilis</i>	Slender naiad
9	<i>Nuphar variegata</i>	Bullhead pond lily
10	<i>Nymphaea odorata</i>	White water lily
11	<i>Potamogeton crispus</i> (e)	Curly leaf pondweed
12	<i>Potamogeton friesii</i>	Fries' pondweed
13	<i>Potamogeton gramineus</i>	Variable pondweed
14	<i>Potamogeton illinoensis</i>	Illinois pondweed
15	<i>Potamogeton pectinatus</i>	Sago pondweed
16	<i>Potamogeton zosteriformis</i>	Flat-stem pondweed
17	<i>Utricularia intermedia</i>	Northern bladderwort
18	<i>Utricularia vulgaris</i>	Common bladderwort
19	<i>Wolffia columbiana</i>	Common water-meal

\* Records collected by Robert W. Freckmann in 2003 for Portage County Lakes Study. (Note: These records are documentation of submersed and floating-leaf vegetation identified at Jordan Pond during that vegetation survey. *This is not an exclusive list.*)

(e) Exotic invasive

c. Mapping Results

A floating stem of EWM was discovered at the Jordan Pond boat landing by Dr. Robert Freckmann while conducting vegetation surveys for the Portage County Lakes Study. The stem was picked up and retained as a herbarium specimen. No further EWM was found during those surveys.

In 2005, field personnel for the Portage County EWM Studies surveyed the pond in effort to identify and map the locations of any EWM beds in the pond. The pond was surveyed thoroughly in June and again in August, but no EWM was found and no maps were produced. Note, however, that water clarity was poor during the surveys. Annual surveys are recommended.

d. Recommended Management Plan for Eurasian Water Milfoil:

Prevention and Annual Monitoring

**1. Maintain Invasive Species Information Sign**



The best way to control EWM is to prevent it from entering the water body in the first place. The main method of spread is by hitch hiking from lake to lake on boats, trailers and recreational equipment. Under Wisconsin Statutes, Chapter 30.715, it is illegal to place a boat, trailer or equipment that have aquatic plants attached into a navigable waterway. (Wisconsin Legislature: Infobases). Prominent signage can help remind boaters to check their boats and trailers for “hitch hiking” plants.

Currently, a “Help Prevent the Spread...” sign, designed for uninfected lakes, is posted at the Jordan Pond boat landing. If EWM is found in the lake in the future, this signage should then be changed to an “Exotic Species Advisory” sign, to warn of the presence of EWM.

If this sign is missing or damaged the WDNR should be notified.



Highly visible signage at Jordan Pond’s boat landing.

**2. Annual Surveying**

Annual surveying should be done to search for potential EWM outbreaks. Volunteers for surveying have not yet been. Potential candidates would be the County Parks Department, volunteers from the connected water bodies of the Plover River or McDill Pond, local conservation/fishery groups, and anyone who regularly boats on Jordan Pond and would be willing to watch for EWM and report it.

**a. Notify WDNR**

If even one live EWM plant is found, rooted or floating, the WDNR Aquatic Plant Specialist for this region should be notified immediately. (See Appendix) If possible, a sample of the plant should be collected, kept in chilled water and mailed or delivered to the WDNR for species identification confirmation.

### b. Implement Best Treatment Option

Treatment options should be implemented by trained volunteers or professionals, at the direction of WDNR personnel. If a floating or washed-up plant was found, the plant should be removed and disposed of and the source infestation (rooted, live EWM plants) searched for. If no source is found, no further treatment is necessary, but if a source can be located, treatment should be implemented as soon as possible. Individual plants or small colonies can be cut at the sediment line or hand pulled, roots and all. (Hand removal of exotic species does not require a permit from the WDNR.) If hand pulling is done, the sediment may need to be loosened with a pitchfork to make total removal of the roots possible. If cutting is done, it is best to time this early in the year, when the plant is expending its winter reserves sprouting new growth. Monthly follow-up cuttings must then be done to continue draining the plants of energy.

### c. Dispose of Plants Removed

State law requires that ALL PLANT PARTS cut or pulled must be removed from the water and destroyed or disposed of.

### d. Follow-up Monitoring

Monthly follow-up monitoring must be done through the remainder of the growing season to check for re-sprouts. Again, ALL PLANT PARTS must be removed and destroyed or disposed of. Annual monitoring should be continued, since *EWM eradication is never permanent*.

## 3. Trained Volunteer Watercraft Inspectors

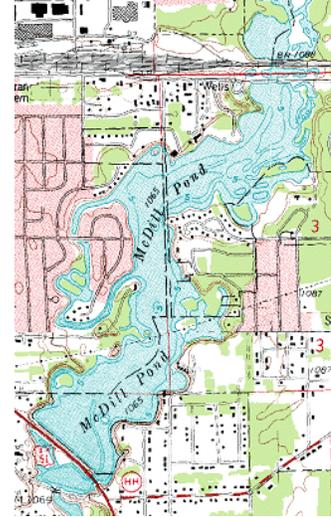
Because aquatic invasive species spread primarily by hitch hiking from lake to lake on boats and boating equipment, information about invasive species must get into the hands of every boater. The presence of trained volunteer watercraft inspectors, especially on major boating weekends, would be helpful to educate boaters about the invasive nature of exotic species and the importance of checking boats and trailers for “hitch hikers”.

Residents of Jordan Pond, as well as other conservation groups in Portage County, are encouraged to **protect Jordan Pond** by participating in the volunteer watercraft inspector training workshops and the support network offered by the Clean Boats, Clean Water Program through the Wisconsin Lakes Partnership. More information about this program is given in Section III.c.

## VIII. McDILL POND

## a. Lake Background

Straddling the Village of Whiting and City of Stevens Point border, McDill Pond is a large impoundment of the Plover River, with a surface area of 261 acres and a maximum depth of 8 feet. The water of McDill Pond mostly comes from the Plover River, with other contributions coming from runoff, groundwater, and precipitation. Much of the water exits the pond at the dam and some water moves to the groundwater. Because the majority of McDill Pond's water comes from the Plover River, one must think of the pond's watershed and the river's watershed as being one in the same. The Plover River's surface watershed has the most impact on the water quality of the river and the pond. (See Appendix C for definitions of terms.) The dominant land use in that watershed is fairly evenly spread between forest (34%), agriculture (23%), wetland (20%) and grassland (18%). (UWSP and Portage County 2003, Preliminary Results)



McDill Pond on USGS topographic map.



McDill Pond's northern boat landing.

Perhaps of greater importance in the case of McDill Pond is the amount of development surrounding the pond. Land use within 1000 feet of the shoreline, which was dominated by open field and forest in 1960, is now 0% forest or open field and is 100% residential, streets, parks and commercial land uses. (UWSP and Portage County 2003, Preliminary Results) This is a highly recreated waterbody with dense residential land, four public parks and two trailerable boat landings.

McDill Pond historically has been a mesotrophic lake. Total phosphorus levels historically average approximately 21 parts per billion (ppb) but average phosphorus levels for the year 2002 were approximately 28.5 ppb, which is just under the eutrophic level of 30 ppb. (UWSP and Portage County 2003, Preliminary Results)

Water clarity in McDill Pond is considered good when compared with similar ponds in the region. Secchi depth (a measure of water clarity) in 2002 was best in September (6 feet) and poorest in July (5 feet). Fluctuations in water clarity are normal, due to increases and decreases of algae population and sedimentation. (UWSP and Portage County 2003, Preliminary Results)

## b. History of Aquatic Plant Control in McDill Pond

Nuisance aquatic plant control and heavy sedimentation has been an ongoing problem in McDill Pond. It's very nature as an impoundment of the Plover River makes it a settling area for sediment and nutrients being carried by the river,

including phosphorus, the nutrient most responsible for excessive plant and algae growth. In the 1950's, a small aquatic plant harvester was operated by the Stevens Point Sportsman Club. (McDill Inland Lake Protection District 1995) From 1959 to 1962, the pond was drained, and several disjointed improvement efforts were made by waterfront property owners, developers and the Village of Whiting. Plant material was collected and burned, channels were straightened and deepened and mucky, sediment-filled areas were scraped. The nuisance plant problem was greatly reduced by these efforts, but by 1966 weed growth was again approaching nuisance levels. (McDill Lake District Technical Committee 1978)

Herbicide use for weed control began in 1967. The list of chemicals (active ingredients) used included Arsenic, Diquat, Endothall and Silvex. (City of Stevens Point and McDill Pond Association 1992) The herbicides were first used in selected areas, then in increasingly larger areas until 1982, when annual plant harvesting was resumed with the goal of reducing available phosphorus in the pond by removing excess plant matter (McDill Inland Lake Protection and Rehabilitation District 1995, Shaw and Mealy 1983). Another less extensive drawdown, or drainage, was done in 1991 to allow for maintenance of the sediment-trapping areas at the pond's headwaters, but intense recreational pressures prevented a prolonged drawdown like that of the 1960's. (City of Stevens Point and McDill Pond Association 1992)

Because the Aquatic Plant Management Plan written for McDill Pond in 1992 found that most of the available control options (drawdowns, herbicides, manual control) were impractical or carried significant drawbacks, mechanical harvesting was determined to be the most practical, responsible and efficient method of weed control for McDill Pond. In addition to recommending this as the best control method for all uses of the pond, the plan also recommended a campaign for responsible riparian land practices to reduce nutrient inputs to McDill Pond and its watershed. (City of Stevens Point and McDill Pond Association 1992)

While the current management plan laid good groundwork, it is now over a decade old. Infestations can increase, decrease or appear in new locations around a water body. The 1996 Aquatic Plant Harvesting Summary showed that 21% of the plant matter removed was milfoil, but 61% was curly leaf pondweed (*Potamogeton crispus*, another invasive exotic specie). (McDill Inland Lake Protection and Rehabilitation District 1996) Anecdotal evidence suggests that this ratio has now changed, with EWM greatly out-competing curly leaf pondweed. With new survey data available, it may be helpful to review and update the management plan. Table 6 lists all aquatic vegetation species documented in McDill Pond.

[Note: A recent dredging operation, *unrelated to aquatic plant control*, was implemented in June-July of 2002 by the McDill Pond Inland Lake Protection & Rehabilitation District. Approximately 147,000 cubic yards of sand was removed from the upper end of the pond to create a sediment trap where the Plover River empties into the pond. (McDill Pond News)]

Table 6 - List of Documented Aquatic Vegetation  
(Submergent and Floating Leaf Aquatics Only)  
\* Most abundant species noted with asterisk \*

Documented Aquatic Vegetation for McDill Pond				
	Scientific Name	Common Name	Historical Records (1)	2004 Surveys (2)
1	<i>Ceratophyllum demersum</i> (n)	Coontail	X *	X *
2	<i>Chara vulgaris</i>	Muskgrass	X	X
3	<i>Elodea Canadensis</i> (n)	Waterweed	X *	X *
4	<i>Lemna minor</i>	Small duckweed	X	X
5	<i>Lemna trisulca</i>	Star duckweed	X	
6	<i>Lemna turionifera</i>	Perennial duckweed	X	
7	<i>Myriophyllum spp.</i> (e)	Milfoil species **	X *	X *
8	<i>Najas flexilis</i>	Slender naiad		X
9	<i>Nuphar variegata</i>	Bullhead pond lily	X	X
10	<i>Nymphaea odorata</i>	White water lily	X	X
11	<i>Potamogeton amplifolius</i>	Large leaf pondweed	X	
12	<i>Potamogeton crispus</i> (e)	Curly leaf pondweed	X *	X *
13	<i>Potamogeton foliosus</i>	Leafy pondweed	X	X
14	<i>Potamogeton natans</i>	Floating leaf pondweed	X	
15	<i>Potamogeton nodosus</i>	Long leaf pondweed	X	
16	<i>Potamogeton pectinatus</i>	Sago pondweed	X *	X
17	<i>Potamogeton praelongus</i>	White stem pondweed	X	X
18	<i>Potamogeton pusillus</i>	Small pondweed		X
19	<i>Potamogeton richardsonii</i>	Clasping leaf pondweed	X	
20	<i>Potamogeton robbinsii</i>	Robbin's pondweed	X	
21	<i>Potamogeton zosteriformis</i>	Flat-stem pondweed		X
22	<i>Ranunculus aquatilis</i>	White water crowfoot	X	X
23	<i>Spirodela polyrhiza</i>	Large duckweed		X
24	<i>Utricularia sp.</i>	Bladderwort	X	
25	<i>Valisneria Americana</i>	Wild celery	X *	
26	<i>Wolffia spp.</i>	Water meal		X
27	<i>Wolffia borealis</i>	Northern water-meal	X	
28	<i>Wolffia columbiana</i>	Common water-meal	X	
29	<i>Zannichellia palustris</i>	Horned pondweed		X
30	<i>Zosterella dubia</i>	Water stargrass	X	

(1) Reported in 1983 plant surveys (Shaw and Mealy 1983), WDNR records, Robert W. Freckmann Herbarium (University of Wisconsin-Stevens Point) records and available reports through November 2003, [Note: These herbarium records are historical documentation of what has been identified to date at McDill Pond. *This is not an exclusive list.* Further, it cannot be stated with certainty that because a species has not been recorded at that lake recently that the species is no longer present in that lake. However, it has been well documented that as exotic invasives infest a lake, native vegetation is progressively less able to compete and the number of species (diversity) in the lake declines.]

(2) Recorded during 2004 plant surveys. (5/26-6/8/04)

\* Reported to be a dominant species during plant surveys

\*\* Refers to both Eurasian (*M. spicatum*) and Northern (*M. sibiricum*) milfoils. 1983 report did not distinguish species (Mealy and Shaw 1983), 1992 report listed only Northern milfoil (City of Stevens Point and McDill Pond Association 1992). The 2004 surveys attempted to distinguish between Eurasian and Northern milfoils, but apparent hybridization between the species made that difficult, therefore the milfoils were lumped together for statistical evaluation.

(e) Exotic, invasive

(n) Native, can be invasive

### c. Vegetation Survey Results

Because McDill Pond has a long history of nuisance plant treatments, EWM surveys would have been exhausting and pointless. However, with historical plant surveys available, new plant surveys could provide updated data to compare to historical data, perhaps giving some insight about changes in the pond and guiding future management choices.

Plant surveys were conducted on McDill Pond on 5/26, 5/28, 6/1, 6/2 and 6/8/04. See Section II for methods used. All species appearing at sample points were recorded. Any additional species noticed between sample points were noted, but not tallied for statistical evaluation. All plants noted during 2004 field surveys are reported in Table 6. Survey transects are shown on Figure 3. Spreadsheets showing survey rankings for all species recorded at sample points are presented in Appendix E. Voucher specimens were collected during sampling, pressed, labeled and will be retained in the Robert W. Freckmann Herbarium on the University of Wisconsin-Stevens Point campus.

Attempts were made during the 2004 plant surveys to distinguish between the exotic Eurasian Water Milfoil (*Myriophyllum spicatum*) and the native Northern Milfoil (*Myriophyllum sibiricum*). However, this proved to be quite difficult at times, and it appears there may be some hybridizing between the two species. The 1983 survey (Shaw and Mealy 1983) did not attempt to distinguish species type, and the 1992 report (City of Stevens Point and McDill Pond Association 1992) listed only *Myriophyllum exalbescens* (the formerly used name for *Myriophyllum sibiricum*). Due to these factors, the 2004 data collected for Northern and Eurasian milfoil were combined together for statistical evaluation.

Overall, four plants were found to have the highest relative density on McDill Pond: milfoils (species combined, see above paragraph), elodea (*Elodea Canadensis*), curly pondweed (*Potamogeton crispus*) and coontail (*Ceratophyllum demersum*), in that order. Looking specifically at depth zones, milfoils rate the highest density across all depth zones, with elodea rating second in depth zones 0-1.5 feet and 1.5-5 feet and curly pondweed rating second in the 5-10 feet depth zone. (No plants were found in the 10-20 feet depth zone.)

A total of 30 submergent or floating aquatic species have been documented at McDill Pond to date. The pond has a good diversity of aquatic plant species. Twelve species listed on Table 4 were historically present but not seen during the 2004 surveys. Six species also were seen during the 2004 surveys that were previously

not recorded. The fact that these species were recorded during one survey and not in others does not *necessarily* mean the species have disappeared from or are new to the pond. However, in comparing new data to historical data, small duckweed (*Lemna minor*) is recorded in the 2004 surveys as a dominant species in Zone 1, which may indicate an increase in nutrient enrichment. Muskgrass (*Chara vulgaris*), a species indicative of disturbance, was found to be a dominant species in Zone 2 during the 2004 surveys. The Floristic Quality Index also indicates that disturbance on McDill Pond has increased since 1983.

Another notable change appears to be the absence of wild celery during the 2004 surveys. (See Table 7.) It was not recorded at sample points, nor as an observed species elsewhere. The 1983 surveys had found it to be a dominant species in Zones 1 and 2. Since mechanical harvesting usually encourages wild celery growth, the cause of this decline is not understood. White water crowfoot (*Ranunculus aquatilis*) was mapped in dense beds in Zone 1 during the 1983 surveys but was only trivially present during the 2004 surveys.

Referring to back to Table 6, also absent during the 2004 surveys was Robbin's pondweed (*Potamogeton Robbinsii*), which was listed as "common" in the 1992 report by the City of Stevens Point and the McDill Pond Association. A markedly decreased abundance of these two native species may indicate that the natives are indeed being out-competed by invasive species, both exotic and native, as has been documented elsewhere.

Table 7. Current and Historic Vegetation Dominance Comparison

		Species Recorded as Dominant or Abundant	
Zone*	Description	1983 <sup>(1)(2)</sup>	2004
1	Headwaters region. Sediment and nutrient build-up, dredged occasionally. Not mech. harvested.	V. Americana, P. crispus, P. pectinatus, E. canadensis	E. Canadensis, C. demersum, Myriophyllum spp., P. crispus, Lemna minor
2	Shallow. Lots of backwater areas. Dense zone of vegetation. Extensive mechanical harvesting.	P. crispus, C. demersum	E. Canadensis, Myriophyllum spp., P. crispus, C. demersum, Chara sp.
3	Dense vegetation more isolated, limited to edges. Some mechanical harvesting.	Myriophyllum sp. and P. crispus, succeeded by C. demersum and V. Americana	Myriophyllum spp., P. crispus, C. demersum, E. Canadensis

\* See Figure 3 for Zone locations.

(1) (Shaw and Mealy 1983)

(2) No survey date could be found in the 1983 Shaw and Mealy report. Because curly pondweed (*Potamogeton crispus*) dominance cycles throughout the summer and varies with water temperature, without knowing the date of the 1983 surveys, direct comparison of curly pondweed dominance between the 1983 and 2004 studies may be invalid.

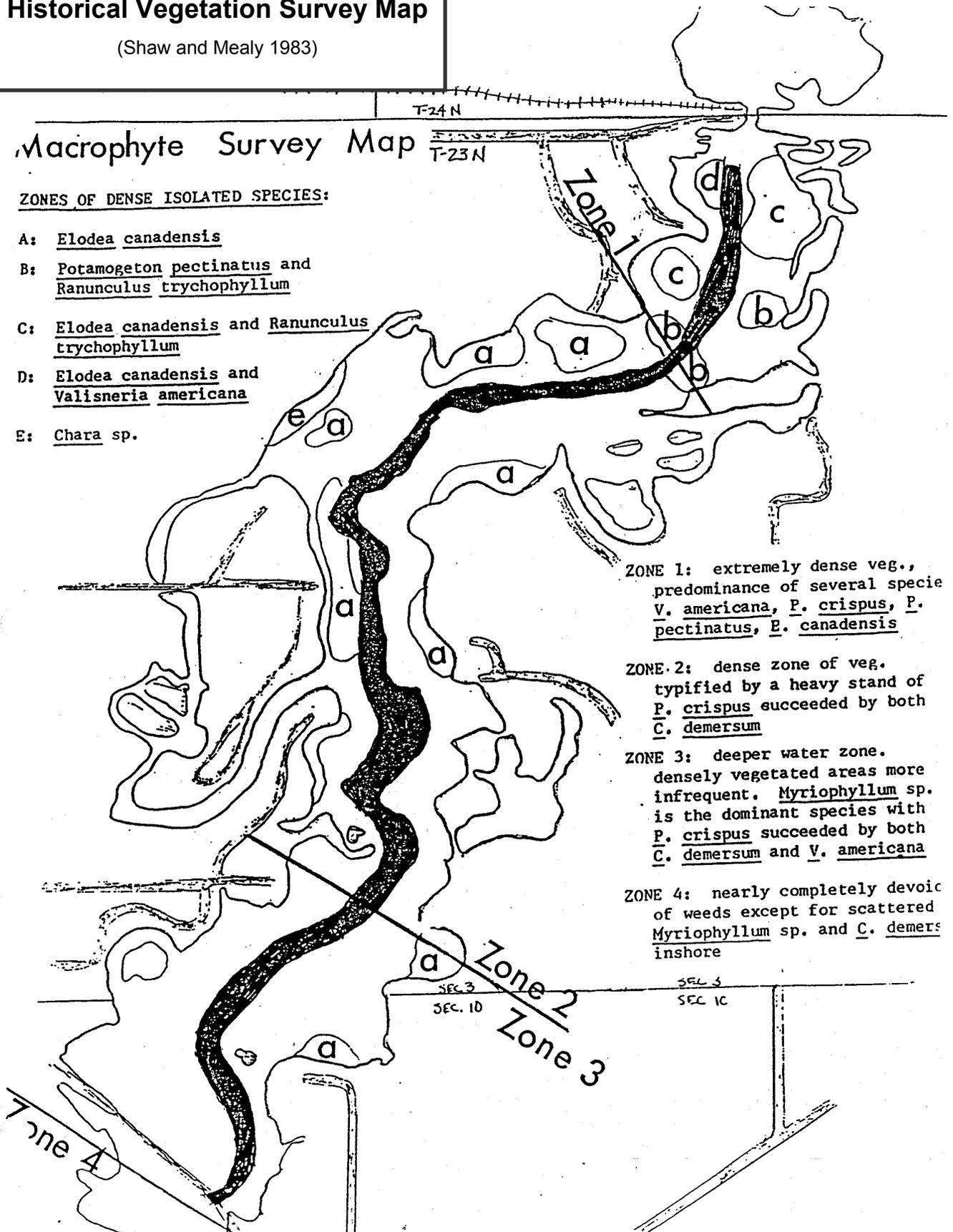


**Figure 4.**  
**Historical Vegetation Survey Map**  
 (Shaw and Mealy 1983)

**Macrophyte Survey Map**

ZONES OF DENSE ISOLATED SPECIES:

- A: Elodea canadensis
- B: Potamogeton pectinatus and Ranunculus trychophyllum
- C: Elodea canadensis and Ranunculus trychophyllum
- D: Elodea canadensis and Valisneria americana
- E: Chara sp.



ZONE 1: extremely dense veg., predominance of several species V. americana, P. crispus, P. pectinatus, E. canadensis

ZONE 2: dense zone of veg. typified by a heavy stand of P. crispus succeeded by both C. demersum

ZONE 3: deeper water zone. densely vegetated areas more infrequent. Myriophyllum sp. is the dominant species with P. crispus succeeded by both C. demersum and V. americana

ZONE 4: nearly completely devoid of weeds except for scattered Myriophyllum sp. and C. demersum inshore

Disturbances like dredging, harvesting, or frequent drawdowns can reduce some native species and, therefore, open up areas to invasion by invasive species, both exotic and native. As these tools are necessary to manage the sediment- and nutrient-rich McDill Pond, it may be helpful to look for ways to use these tools to achieve management goals while also protecting the species diversity of the pond. Protecting the non-invasive, native vegetation may give those species a chance to better compete with the invasive species, thereby offering some *natural* control of those invasive species and possibly reducing the degree of mechanical control needed.

**“Targeted” Harvesting...** One way mechanical harvesting has been used to successfully control invasive species is with “targeted” harvesting, as on Lake Pewaukee. Lake Pewaukee, like McDill Pond, is a nutrient rich, soft sediment impoundment that has its own long history with nuisance weed control. In recent years, the Lake Pewaukee Sanitary District opted to steer completely away from yearly use of herbicides and use a harvesting-only approach, which targets heavily on the nuisance species (mainly EWM). Their harvesters begin operation very early in the spring when EWM is already going strong, but when the less-bothersome, native species are still dormant. Harvesters target the beds of EWM, cutting as close to the bottom as they can. This will deplete the EWM of its stored energy and set the plants back, while doing little, if any, damage to the still-dormant natives. In summer, once the natives come up, the harvesters just cut the tops of EWM beds, to impact the EWM but avoid impacting the native species significantly. An additional summer task is raking and pickup of loose EWM stems that collect along the shoreline. The sanitary district feels this has been very helpful in two ways; it reduces the amount of rotting plant material contributing nutrients to the sediments, and it reduces the amount of reproduction via stem fragments. Windward areas of the lake have benefited most from this practice, seeing very little new establishment of EWM beds, but even leeward areas have seen a significant reduction in new EWM growths.

In fall, when native species go dormant again, the harvesters on Lake Pewaukee resume the deep cutting of EWM. This strategy is also helping in two ways; it deprives the plant the opportunity to store energy for the winter, and it removes the plant before it can autofragment to produce new shoots. After the implementation of these aggressive fall cuttings, harvesting of previously troublesome, shallow bays has been unnecessary until late in the season, presumably because EWM growths struggled to recover for most of the season.

The targeted harvesting and shoreline pickup strategies have, after several years, succeeded in diminishing the EWM populations *and* in allowing the native species to compete again, restoring plant diversity in Lake Pewaukee. With these changes, an increased diversity of invertebrate populations and better balance of fish populations have been observed. This improved control of nuisance species was achieved in spite of steady, high phosphorus levels.

McDill Pond has problems with multiple species, but this targeted harvesting strategy may still be useful. Curly pondweed, coontail and elodea, like EWM, are cold-tolerant species and are actively growing in early spring and late fall. Therefore, it is possible that all four of these problem species could be better controlled by heavy, targeted harvesting in spring and fall.

Additionally, because three of those four problem species reproduce mainly from stem fragments, routine pickup of the loose stems produced by mechanical harvesting may help to control establishment of new growths and reduce the rotting plant material contributing to already high nutrient levels. If needed, pickup efforts could reasonably be limited to downstream and leeward shores where fragments most commonly tend to collect.

d. General Recommendations:

*"Targeted" Harvesting & Shoreline Pickup*

1. **"Targeted" Harvesting and Shoreline Pickup**

The McDill Pond Lake District opted to follow the recommendation of targeted harvesting. (See Section VII.e.)

For McDill Pond, mechanical harvesting is the most appropriate method for yearly control of EWM and the other problem species. This control method, does however have two inherent drawbacks: It can adversely impact non-invasive native species, decreasing their ability to compete and thereby reducing diversity, and it creates loose stem fragments, which can assist the spread of nuisance species and contribute nutrients to the sediments. "Targeted" harvesting and shoreline pickup may help reduce the effects of these two drawbacks. An additional benefit may be the reduction in the amount of harvesting needed over time, which has been seen on Lake Pewaukee.

"Targeted" harvesting has been used on Lake Pewaukee to successfully control EWM. McDill Pond has problems with multiple species, but this strategy may still be useful. Curly pondweed, coontail and elodea, like EWM, are cold-tolerant species and are actively growing in early spring and late fall. Therefore, it is possible that all four of these problem species could be controlled by heavy, targeted harvesting in spring and fall. (See more detailed description of this method in Section VIII.c.) Another critical season for targeting curly pondweed is in late June, when it goes to seed, dies off and releases its phosphorus content back into the water, which feeds the mid-summer algae blooms. Targeted harvesting of curly pondweed beds in late June may help reduce the reproduction of curly pondweed *and* reduce the severity of the mid-summer algae blooms.

Additionally, because three of those four problem species reproduce mainly from stem fragments, routine pickup of the loose stems produced by mechanical harvesting may help to control establishment of those species in new areas and reduce the amount of rotting plant material contributing nutrients to the already nutrient-rich sediment.

Try a **"Test-Bay"** to evaluate the benefits of the targeted harvesting method.

If a cost-benefit analysis is necessary, a targeted harvesting plan could be implemented in one "Test-Bay", over a couple growing seasons, and pickup efforts could reasonably be limited to downstream and leeward shores where fragments most likely tend to collect. The Test-Bay could then be evaluated for reductions in nuisance species, cost of control

methods, etc... before determining whether to implement the strategy pond-wide.

**2. Winter Drawdowns**

Another useful tool available to McDill Pond is winter water level drawdowns. Properly timed and planned, these can be useful in controlling EWM and curly pondweed (*Potamogeton crispus*). Drawdowns require a *Waterway & Wetland Permit Application Form 3500* and a great deal of assistance from the WDNR. Timing and extent of drawdown is critical to accommodate the needs of the amphibians, fish and other wildlife residents.

**3. Evaluate Aquatic Plant Management Plan**

The analysis of the new vegetation survey data that is presented in this report is fairly simple. More in-depth examination of the data by managers of McDill Pond may help to fine-tune and update the existing management plan.

**4. Evaluate Success of Public Education Efforts**

While evaluating the management plan and exploring all future options, the successes or failures of the campaign for responsible riparian land practices should also be evaluated and fine-tuned. Because phosphorus inputs are the main food source for excessive plant and algae growth, special attention should be paid to sources of phosphorus in within the watershed.

**5. Maintain Exotic Species Advisory Signs**

Under Wisconsin Statutes, Chapter 30.715, it is illegal to place a boat, trailer or equipment that have aquatic plants attached into a navigable waterway. (Wisconsin Legislature: Infobases). "Exotic Species Advisory" signs placed at boat landings can be a reminder to boaters to check for hitch hiking plants.

In 2003, there was no sign at the north boat landing, and the sign at McDill Pond's south boat landing only warned of EWM. The WDNR was notified and both items have been addresses. Now that signs are present and up to date at both boat landings, they should be maintained in good condition at visible locations to prevent boaters from bringing *additional* exotic species to McDill Pond or transferring EWM and curly pondweed to other lakes.



Highly visible signage at McDill Pond's south boat landing. Curly pondweed stickers were added in May of 2004. A sign is now also present at the north boat landing



If the signs are damaged or missing the WDNR should be notified.

**6. Volunteer Watercraft Inspection Program**

Because aquatic invasive species spread primarily by hitch hiking from lake to lake on boats and boating equipment, information about invasive species must get into the hands of every boater. The presence of trained volunteer watercraft inspectors, especially on major boating weekends, would be helpful to educate boaters about the invasive nature of exotic species and the importance of checking boats and trailers for “hitch hikers”.

McDill Pond has a high recreational value to the surrounding communities and has an active protection organization, the McDill Pond Association. This group, as well as other conservation groups in Portage County, are encouraged to participate in the volunteer watercraft inspector training workshops and the support network offered by the Clean Boats, Clean Water Program through the Wisconsin Lakes Partnership. More information about this program is given in Section III.c.

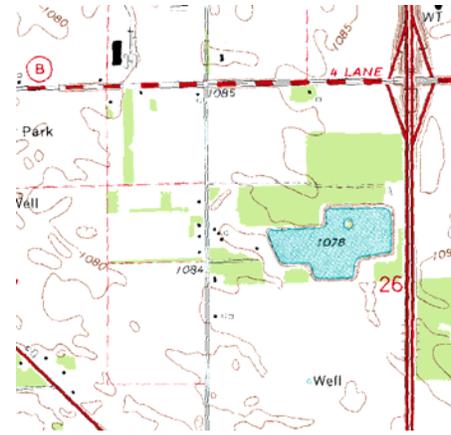
e. Implementation of Recommendations:

The McDill Pond Inland Lake Rehabilitation District has opted to pursue the recommendation of Targeted Harvesting. In 2005, they began working with their WDNR contacts to devise a Targeted Harvesting plan in a “Test-Bay”.

## IX. LAKE PACAWA

## a. Lake Background

Located approximately 200 feet west of U.S. Highway 39 and 1,600 feet south of the County Highway B and US 39 interchange in the Village of Plover, Lake Pacawa is a small man-made lake with a surface area of 12 acres. (“EWM in WI as of 2002”) The lake was a borrow-pit for highway improvement projects that eventually filled with groundwater. Lake Pacawa is a heavily recreated lake surrounded by public beaches, a park, a boat landing and two ball diamonds. A Korean War Memorial is located on the island in the center of Lake Pacawa, accessible by a concrete causeway. The lake also plays host to a Village of Plover annual summertime celebration, called Lake Pacawa Days, as well as other events and festivals.



Lake Pacawa on USGS topographic map.  
(Numbered 1078)

Because of the lake’s small size and man-made origin, it has not been included in many lake studies performed on Portage County lakes. Watershed information, lake depth contour maps or maximum depth records were not available to include in this assessment.



Lake Pacawa with Korean War Memorial  
on island.

Lake Pacawa is a hard water lake and appears to have excellent clarity. Secchi depth (a measure of water clarity) was 9 feet on August 5<sup>th</sup>, 2004, when measured during weevil surveys. (See Section IX.d.) No other secchi depth records were found to report in this assessment. Phosphorus levels were also not available to report. More thorough sampling and testing would be necessary to truly evaluate the overall health of Lake Pacawa.

## b. History of Aquatic Plant Control in Lake Pacawa

According to WDNR records, a herbicide treatment with Aquathol for “nuisance” plant growth was done in July of 1986 to clear the beaches and boating lanes. Table 8 lists aquatic vegetation species documented in Lake Pacawa.

Table 8. List of Documented Aquatic Vegetation  
(Submergent and Floating Leaf Aquatics Only)

Herbarium Records for Lake Pacawa *		
	Scientific Name	Common Name
1	<i>Myriophyllum spicatum</i> (e)	Eurasian water milfoil
2	<i>Potamogeton pectinatus</i>	Sago pondweed

\* Specimens were randomly collected during 10/22/03 field mapping activities and later preserved and submitted for record to the Robert W. Freckmann Herbarium at University of Wisconsin-Stevens Point. Only one previous collection record (sago pondweed, coll'd in 1975) could be found for Lake Pacawa. Fieldwork on 10/22/03 was not focused on identifying all plant species in the lake, therefore, this plant list is NOT an exclusive list. Because little historical plant data is available, it cannot be said whether plant diversity in Lake Pacawa has been adversely affected by the presence of EWM. However, it has been well documented that as invasive species infest a lake, native vegetation is progressively less able to compete and the number of species (diversity) in the lake declines.

(e) Exotic invasive

### c. Mapping Results

Multiple areas of sparse to dense EWM growth were mapped during 10/22/03 field activities. Dense EWM growth totaled 0.4 acres and sparse growth totaled 0.4 acres. (See Figure 4.) EWM specimens were randomly collected to examine for evidence of the presence of the aquatic weevil, *Euhrychiopsis lecontei*. *E. lecontei* is a naturally occurring weevil, usually found where native milfoils occur, and can keep milfoil populations in check. The weevil can effectively impact the health of the milfoil plants by removing vascular tissue and destroying apical growing tips. (Jester 1998) Although no evidence of weevils could be found from the samples collected, a more thorough survey would be required to conclusively determine the presence or absence of *E. lecontei*.



A dense EWM growth in Lake Pacawa.

While the largest beds of dense EWM growth observed on 10/22/03 and 8/5/04 were unsightly, Lake Pacawa does not appear to be “weed-choked”, even 17 years after the only herbicide treatment performed there. It is possible that something in Lake Pacawa may be naturally inhibiting the spread of EWM.

Figure 5. Lake Pacawa  
Eurasian Water Milfoil Survey  
& Milfoil Weevil Survey



Beds A, B, C and D surveyed for milfoil weevils (*Eurychiopsis lecontei*) on 08/05/04. Stem samples collected from sample beds were examined in laboratory on 08/13/04. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Lake Pacawa was found to be **0.28 weevils per stem**.

## d. Weevil Population Density Survey Results:

In the 2003 EWM Assessment Report, one option suggested for Lake Pacawa was to investigate the potential for using biological control. It was suggested that if biological control proved a viable option under the conditions present at Lake Pacawa, this could provide a natural, long-term solution.

Population density surveys were performed in August 2004 to determine the existing natural population of the aquatic milfoil weevil *Euhrychiopsis lecontei*. EWM stem samples were collected from Lake Pacawa on August 5<sup>th</sup>, 2004 and examined in the laboratory on August 13<sup>th</sup>, 2004. Extracted weevil specimens were preserved in 95% ethyl alcohol and sent to Laura Jester of Jester Consulting, Eden Prairie, MN for species identification confirmation. See Figure 5 for sample locations and Table 9 for summarized results.

Table 9. Weevil Population Density Survey – Results Summary

Lab Date (2004)	Bed No.*	Depth Range (ft)	Tot # Stem Samples	% Samples Algae-covered	Ave # Broken Tips	Ave # of Apical Tips	% Stems w/ Weevil Damage	Ave # Eggs per Stem	Ave # Larvae per Stem	Ave # Pupae per Stem	Ave # Adults per Stem	Ave Weevils per Stem (All Life Stages)
8/13	<b>A</b>	3 – 6	15	0%	1.20	5.00	27%	0.00	0.33	0.00	0.00	<b>0.33</b>
8/13	<b>B</b>	6 – 7	15	0%	0.53	3.20	20%	0.00	0.13	0.07	0.00	<b>0.20</b>
8/13,8/17	<b>C</b>	2½ - 6	16	6%	0.56	2.13	19%	0.00	0.50	0.00	0.00	<b>0.50</b>
8/13	<b>D</b>	7 – 7½	15	0%	1.53	2.87	20%	0.07	0.00	0.00	0.00	<b>0.07</b>
<b>Whole-Lake Results</b>		2½ - 7½	61	2%	1.00	3.30	21%	0.02	0.25	0.02	0.0	<b>0.28</b>

\*See Figure 4 for EWM sample bed locations.

Survey Notes:

Sample Date: 8/5/2004

Weather Conditions: Sunny, Breezy, 70°F

Land Cover @ Shore: Bed A = Beach (sand), Park (mostly mowed close to shoreline)  
 Bed B = Natural, but heavily disturbed area nearby (litter/trampled/campfire scar)  
 Bed C = Park (mowed close to shoreline), Natural  
 Bed D = Middle of water, some distance from shore. Shore to far south and east is natural, to far north is park (mowed close to shoreline).

Sample Preservation: Samples were kept in water in labeled plastic bags at 3-4°C until time of examination. Any samples not examined within eight days of collection were preserved with ethyl alcohol. Due to a shortage of available ethyl alcohol, only approximately 30 ml of 95% ethyl alcohol could be added to the sample bags (containing apx. 100-130 ml of lake water). All samples appeared to be in good condition at the time of examination.

Average (*E. lecontei*) milfoil weevil density for Lake Pacawa was found to be 0.28 weevils per stem, which seems at first glance to be a low natural density. Of the 31 Wisconsin lakes studied by Laura Jester from 1996 to 1997, natural weevil densities varied greatly, (0.0 to 2.5 weevils per stem) with a mean of 0.65 weevils per stem. (Jester 1998) Past studies have indicated that densities greater than 2 weevils per stem are associated with EWM declines, but recent evidence indicates that the density of weevils required to impact EWM is sometimes less than 2 weevils per

stem and is highly lake specific. (Jester, et al. 1999) In fact, researchers now suggest that, while densities at or greater than 1 weevil per stem is preferable to achieve EWM *decline*, *control* may occur at levels around 0.5 weevils per stem or lower. (Newman 2004, *pers. comm.*)

Understanding these issues, discussion about the differences in weevil densities between the sample beds may be important. Figure 4 shows EWM sample bed locations and average weevil densities for those beds. There was notable contrast in weevil densities between sample beds. Factors found to positively impact weevils are a higher percentage of natural shoreline, bed locations that are near shore and growing in shallow water, and a higher number of growing tips per plant (bushier plants). (Jester, et al. 1999)

Beds A, B and C all had low to moderate population densities (0.33, 0.20 and 0.50 weevils per stem, respectively), but Bed D had non-detectable levels (0.00 weevils per stem). Bed D may be at a disadvantage due to distance from shore and depth of water, factors which cannot be changed. Beds A and C are possibly being impacted by the high percentage of beach and/or mowed parkland at shore and Bed B is possibly being impacted by the concentration of human activity on that shore (trampling, campfires, litter). These human-induced factors can be ameliorated, to at least some degree, by changes in park maintenance. Weevils overwinter in the mud and leaf litter along shore and, therefore, survive best with a higher percentage of natural shoreline that is not mowed, raked, rip-rapped, sand or sea-walls. (Jester et al. 1999)

By changing mowing practices and reducing concentrated public use of shorelines near EWM beds, weevil densities in Beds A, B and C may have a better survival rate, allowing the population to build-up and eventually populate Bed D more heavily. In essence, though Lake Pacawa currently has a low average weevil density across the lake, there may be opportunities to improve that population.

e. Recommended Management Plan for Eurasian Water Milfoil:

*Biological Control*

The EWM infestation in Lake Pacawa is too big for hand-cutting/pulling and too small for mechanical harvesting. Chemical controls may possibly be capable of eradicating EWM growths but must be repeated for several years to be effective, and it can be a costly and controversial treatment method. Plant barriers may provide an effective, chemical-free treatment option, but are also costly to install and maintain from year-to-year.

If financial support for herbicide treatment or plant barriers is unattainable, it may be possible to use the native aquatic milfoil weevil, *E. lecontei*, as a natural biological control of EWM. Successful biological control would *control* EWM, not *eradicate* it, but biological control would be a long-term, natural control method. Please note that, as stated multiple times in this report, the number of weevils

needed to control EWM varies from lake to lake, and there is *no guarantee* that Lake Pacawa can support high enough populations of weevils to control EWM.

### 1. Provide Weevil Habitat – *Beginning Immediately*

A native population of milfoil weevils already exists at Lake Pacawa, though currently at low levels. That population could possibly be naturally boosted by providing more habitat for winter hibernation. Weevils overwinter in the mud and vegetation debris along shore and, therefore, fare best with a higher percentage of natural shoreline that is not mowed, raked, rip-rapped, sand or sea-walls. (Jester et al. 1999) Also, because milfoil weevils are weak fliers, the day the weevils emerge from the lake to fly to shore they are at the mercy of the wind. The more natural shoreline available, the better their chances of landing on suitable habitat. To easily and affordably help the weevils survive and better control EWM, park managers at Lake Pacawa can:

- ✓ Leave as much un-mowed land as possible within 35' of shore. (More is better!) Weevils hibernate in leaf litter and dead grasses.
- ✓ Minimize the area maintained in beach, mowed paths, rip-rap, or otherwise disturbed/manipulated land.
- ✓ Restore disturbed/manipulated areas. (For technical assistance, Portage County Land Conservation Department.)
- ✓ Minimize fertilizer use. (Runoff from fertilized properties can speed EWM growth!)

(Also see Appendix B for more tips on providing weevil habitat.)

### 2. Augment Natural Population (Optional) – *Summer 2005*

*Stocking weevils requires approval from the WDNR.*

The natural milfoil weevil population could be boosted further by stocking. Stocking may be accomplished by buying weevils from a supplier or by collecting weevils from Lake Pacawa and rearing them in tanks. Either method requires an investment in time and money, and the results cannot be guaranteed. For best results:

- ✓ A solid commitment to providing overwintering habitat may help increase the chances for success.
- ✓ Arrangements for follow-up surveys should be performed to assess the results of stocking, which may guide future plans to continue or discontinue stocking.

### 3. **Trained Volunteer Monitoring Program - Annual**

*EWM control is never permanent.* It will be critical to identify the problem early if the biological control begins to fail. A volunteer monitoring crew, trained to identify EWM and weevil-damaged stems, may help track progress or identify problems. It should be understood that biological control is dynamic and that natural fluctuations between EWM and milfoil weevil populations will occur. However, if concerns arise about the continuing effectiveness of biological control of EWM, the WDNR Aquatic Plant Specialist should be consulted. (See Appendix C for contact information.)

### 4. **Maintain Exotic Species Advisory Sign**

As recommended in the 2003 EWM Assessment report, exotic species advisory signs have now been posted at the boat landing informing boaters of the presence of EWM in Lake Pacawa. Under Wisconsin Statutes, Chapter 30.715, it is illegal to transport boats or equipment that have aquatic plants attached. (Wisconsin Legislature: Infobases) When EWM is present in a water body, there is always a risk of boaters inadvertently transporting pieces of EWM and infesting another lake. "Exotic Species Advisory" signs placed at boat landings can be a reminder to boaters to check for "hitch-hikers".

Although Lake Pacawa does not allow motorized watercraft, and motors are the most likely place to snag EWM, pieces of EWM plants can also get snagged on other equipment. With many "EWM-free" lakes in Portage County, this prominent signage at Lake Pacawa is important and should be maintained in good condition.

If the sign is damaged or missing the WDNR should be notified.

### 5. **Volunteer Watercraft Inspection Program**

Because aquatic invasive species spread primarily by hitch hiking from lake to lake on boats and boating equipment, information about invasive species must get into the hands of every boater. The presence of trained volunteer watercraft inspectors, especially on major boating weekends, would be helpful to educate boaters about the invasive nature of exotic species and the importance of checking boats and trailers for "hitch hikers". These trained volunteers are often also the first to identify new exotic species infestations through their inspections of the water around the boat landing area.

Lake Pacawa has a very high recreational value to the Lions Club, Village of Plover and surrounding communities. These groups, as well as other conservation groups in Portage County, are encouraged to participate in the volunteer watercraft inspector training workshops and the support network offered by the Clean Boats, Clean Waters Program through the Wisconsin Lakes Partnership. More information about this program is given in Section III.c.

X. SPRINGVILLE POND

a. Lake Background

Located on the east side of Business 51 in the Village of Plover, Springville Pond is a small impoundment of the Little Plover River, a Class I trout stream. Total surface area of the pond is 18 acres and maximum depth is 12 feet. The water of Springville Pond mostly comes from the Little Plover River, with other contributions coming from runoff, groundwater, and precipitation. Much of the water exits the pond at the dam and some water seeps back to the groundwater. (UWSP and Portage County 2003, Preliminary Results) Because the majority of Springville Pond's water comes from the Little Plover River, the pond's watershed and the river's watershed are one in the same, with 90-95% of the water coming from groundwater (Weeks et al. 1965). The Springville Pond/Little Plover River watershed lies within the porous, sandy groundwater recharge area for some of the Village of Plover's municipal wells, and groundwater studies and protection efforts have been ongoing for decades. Extensive efforts have been made by many agencies to increase public education regarding groundwater protection.



Springville Pond on USGS topographic map.



Fall colors on Springville Pond.

The three dominant land uses (nearly equal) within the surface watershed are forest, agriculture and residential. Perhaps of greater importance in the case of Springville Pond is the amount of development surrounding the pond. Land use within 1000 feet of the shoreline, which was dominated by open field and forest in 1960, is now primarily residential, parks, streets and commercial land uses. (UWSP and Portage County 2003, Preliminary Results) This is a modestly recreated pond lake with low-impact resident usage (non-motorized watercraft) and one small public park. In the past, one trailerable boat landing existed at the public park, which was removed in recent years. Currently, there is a grassy landing for non-motorized, hand-carry watercrafts.

A lake is categorized as "eutrophic" when total phosphorus levels are 30 ppb or higher, which results in more aquatic plant growth. Springville Pond is a eutrophic lake, with total phosphorus levels in 2002 around 34 ppb, although this level is much better than the state average for impoundments (70 ppb). (UWSP et al. 2003)

Water clarity in Springville Pond is considered good when compared with similar ponds in the region. Secchi depth (a measure of water clarity) in 2002 was best in August (8 feet) and poorest in September (5 feet). Fluctuations in water clarity are

normal, due to increases and decreases of algae population and sedimentation. (UWSP and Portage County 2003, Preliminary Results)

b. History of Aquatic Plant Control in Springville Pond

Nuisance weed treatment and heavy sedimentation has been an ongoing problem in Springville Pond. Its very nature as an impoundment of the Little Plover River makes it the settling area for sediment and nutrients being carried by the river, including phosphorus, the nutrient most responsible for excessive plant and algae growth. WDNR Aquatic Plant Management Treatment Records show herbicide treatments for nuisance aquatic plant growth were used in the pond in 1967, 1991, 1992, 1993, 1994 and 1999. The list of chemicals used included Cutrine Plus, Diquat, Aquathol, Aquathol K, 2, 4-D and X77 surfactant. Sediment dredging was done in 1983, 1985 and 1991. Drawdowns were done in 1985, 1988, 1991, 1996 and 1999. Mechanical harvesting was done in 1987. Planting of native aquatic vegetation was done in 1992 and 1993. (Lampert-Lee & Associates 1997 and WDNR records) Table 10 lists aquatic vegetation species documented in Springville Pond.

(Note: A drawdown *unrelated to plant control* was done in 2003 for dam repairs. According to personnel at the Village of Plover, no dredging or plant control work was done during this drawdown.)

The Little Plover River and Springville Pond Watershed Management Plan, written by Lampert-Lee & Associates in 1997, stated that while chemical treatments may have been the most effective method used in Springville Pond (no quantitative study was done to confirm this), but that the use of chemical treatments has drawbacks, such as toxicity to animals, excessive plant decay causing oxygen depletion, residual by-products and unintended drift. The plan suggested that good environmental practices in the watershed may help to reduce the nutrient loading that boosts nuisance plant growth, thereby reducing the need for chemical treatments. Also, the plan recommended against dredging, since exotics usually have an advantage over native species at repopulating bare substrates.

The watershed management plan and WDNR records show that herbicide treatments usually focused on the eastern third of the pond, which is shallowest and accumulates the most sediment and nutrients. A heavy population of EWM and an isolated bed of curly leaf pondweed (*Potamogeton crispus*, also an exotic invasive plant) persists there. Herbicide treatments also focused on one large, dense patch in the deeper water of the western end, which has been persistent throughout treatment efforts and was present in October 2003.

Table 10. List of Documented Aquatic Vegetation  
(Submergent and Floating-Leaf Aquatics Only)

Herbarium Records for Springville Pond *		
	Scientific Name	Common Name
1	<i>Elodea Canadensis</i>	Waterweed
2	<i>Lemna minor</i>	Small duckweed
3	<i>Myriophyllum sibiricum</i>	Northern water milfoil
4	<i>Myriophyllum spicatum</i> (e)	Eurasian water milfoil
5	<i>Potamogeton crispus</i> (e)	Curly leaf pondweed
6	<i>Potamogeton pectinatus</i>	Sago pondweed
7	<i>Zannichellia palustris</i>	Horned pondweed

\* Robert W. Freckmann Herbarium records through November 2003, University of Wisconsin-Stevens Point. (Note: These herbarium records are historical documentation of what has been identified to date at Springville Pond. *This is not an exclusive list.* Further, it cannot be stated with certainty that because a species has not been recorded at that lake recently that the species is no longer present in that lake. However, it has been well documented that as exotic invasives infest a lake, native vegetation is progressively less able to compete and the number of species (diversity) in the lake declines. Anecdotally, this is what has been seen at lakes in Portage County where EWM is present, however it would require quantitative vegetation surveys to confirm this.)

(e) Exotic invasive

### c. Mapping Results

Multiple areas of sparse to dense EWM growth were mapped during October 2003 field activities. Dense EWM growths totaled 2.1 acres and sparse growths totaled 0.7 acres. (See Figure 5.) The growths mapped were comparable in size and location to growths seen approximately six years prior.

EWM specimens were randomly collected to examine for evidence of the presence of the aquatic milfoil weevil, *Euhrychiopsis lecontei*. *E. lecontei* is a naturally occurring weevil usually found where native milfoils occur and can keep milfoil populations in check. The weevil can effectively impact the health of the milfoil plants by removing vascular tissue and destroying apical growing tips. (Jester 1998) Examination of the EWM samples collected at Springville Pond found an *E. lecontei* pupae. Species identification was confirmed by Laura Jester, of Jester Consulting in Eden Prairie, Minnesota, confirming the presence of the aquatic weevil in Springville Pond. This is the first record of *E. lecontei* identified in Springville Pond, therefore the specimen was preserved, labeled and submitted to the UW-Stevens Point as a voucher specimen. It will be retained with the *E. lecontei* voucher specimens collected during Laura Jester's *E. lecontei* research in 1996-97.

d. Weevil Population Density Survey Results

In the 2003 EWM Assessment Report, the primary recommendation suggested for Springville Pond was to investigate the potential for using biological control. It was suggested that if biological control proved a viable option under the conditions present at Springville Pond, this could provide a natural, long-term solution.

Weevil population density surveys were performed in August 2004 to determine the existing natural population of the aquatic milfoil weevil, *Euhrychiopsis lecontei*. EWM stem samples were collected from Springville Pond on August 4<sup>th</sup> and 5<sup>th</sup>, 2004 and examined in the laboratory on August 9-12, 2004. Extracted weevil specimens were preserved in 95% ethyl alcohol and sent to Laura Jester of Jester Consulting, Eden Prairie, MN, for species identification confirmation. See Figure 5 for sample locations and Table 9 for summarized results.

Table 11. Weevil Population Density Survey – Results Summary (2004)

Lab Date (2004)	Bed No.*	Depth Range (ft)	Tot # Stem Samples	% Samples Algae-covered	Ave # Broken Tips	Ave # of Apical Tips	% Stems w/ Weevil Damage	Ave # Eggs per Stem	Ave # Larvae per Stem	Ave # Pupae per Stem	Ave # Adults per Stem	Ave Weevils per Stem (All Life Stages)
8/10, 8/11	<b>A</b>	6 - 10	19	58%	1.68	2.79	58%	0.00	0.47	0.00	0.00	<b>0.47</b>
8/9, 8/10	<b>B</b>	8 - 10½	15	20%	1.27	2.00	47%	0.00	0.33	0.07	0.13	<b>0.53</b>
8/12	<b>C</b>	2½ - 3½	15	27%	0.87	2.73	80%	0.27	1.27	0.07	0.07	<b>1.67</b>
8/11, 8/12	<b>D</b>	2 - 2½	14	14%	1.21	4.43	93%	1.07	3.29	0.00	0.07	<b>4.43</b>
<b>Whole Pond Results</b>		2 - 10½	63	32%	1.3	3.0	70%	0.30	1.25	0.03	0.06	<b>1.65</b>

\*See Figure 5 for EWM sample bed locations.

Survey Notes:

Sample Date: 8/4 – 8/5/2004

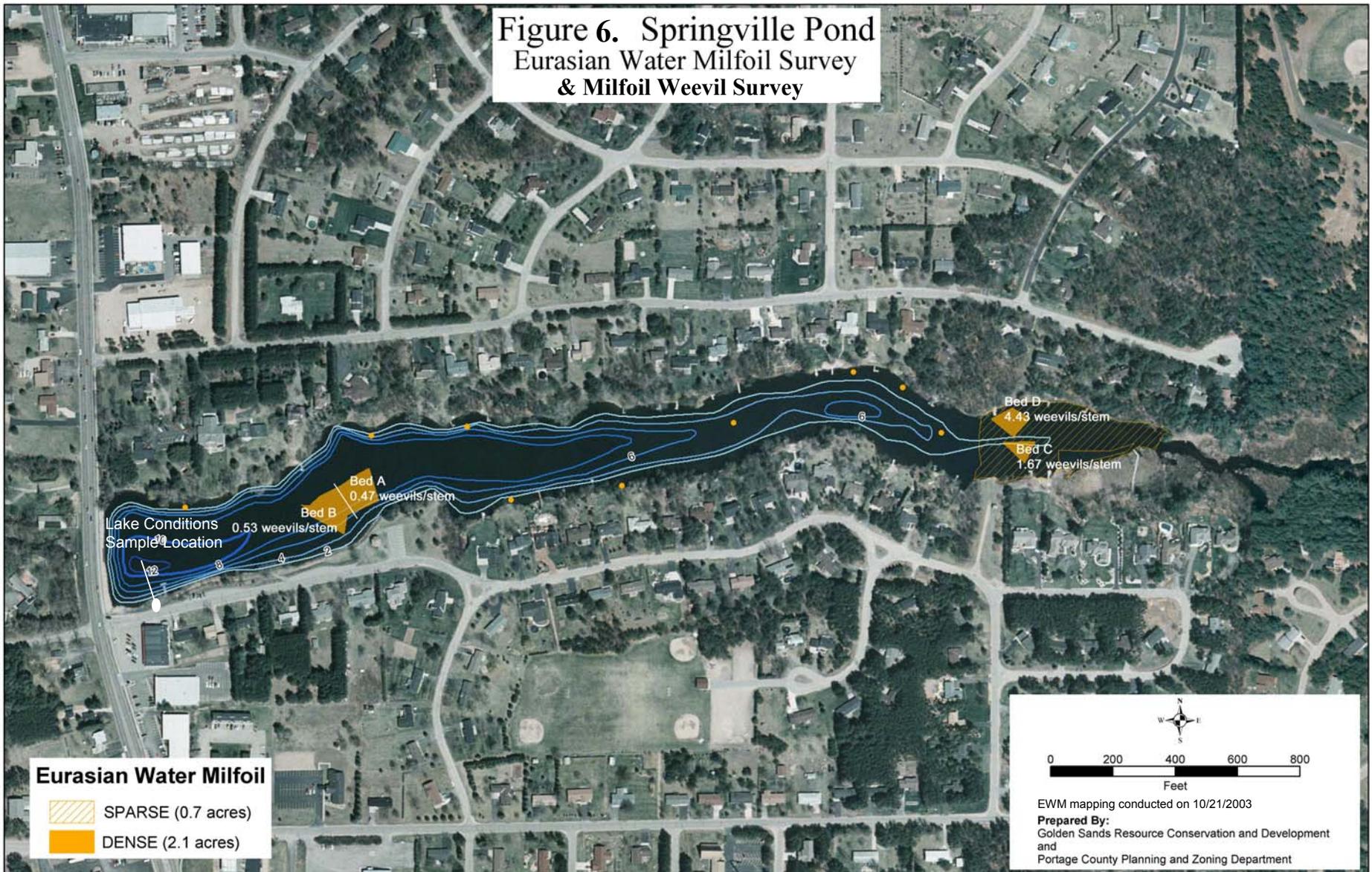
Weather Conditions: Sunny Breezy, 65 – 70°F

Land Cover @ Shore: Bed A = Park (mowed to shoreline\*\*), Residential (most mowed to shoreline)  
 Bed B = Park (mowed to shoreline\*\*), Residential (most mowed to shoreline)  
 Bed C = Residential (some mowed, but more natural along shoreline)  
 Bed D = Residential (some mowed, but more natural along shoreline)

Sample Preservation: Samples were kept in water in labeled plastic bags at 3-4°C until time of examination. All Springville Pond samples were examine within eight days of collection, therefore, they did not require preservation with ethyl alcohol.

Other notes: Somewhat common leaf deformity = fused lower leaflets.

\*\*Park maintenance at Springville Pond had traditionally mowed the entire park to the shore's edge. The park was recently terraced to reduce erosion and storm water runoff into the pond. During the summer of 2004, the mowing program reduced the extent of the mowed area and frequency of mowing times, which will significantly improve the amount of available winter weevil habitat at the park.



Bed A, B, C and D surveyed for milfoil weevils (*Eurychiopsis lecontei*) on 08/04 – 08/05/04. Stem samples collected from sample beds were examined in laboratory on 08/09 – 08/12/04. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Springville Pond was found to be **1.65 weevils per stem**.

Average (*E. lecontei*) milfoil weevil density for Springville Pond was found to be 1.65 weevils per stem, which seems to be a healthy natural density. Of the 31 Wisconsin lakes studied by Laura Jester from 1996 to 1997, only four had natural weevil densities over 1.5 weevils per stem. (Jester 1998) Past studies have indicated that densities greater than 2 weevils per stem are associated with EWM declines, but recent evidence indicates that the density of weevils required to impact EWM may be less than 2 weevils per stem and is highly lake specific. In fact, researchers now suggest that, while densities at or greater than 1 weevil per stem is preferable to achieve EWM *decline*, *control* may occur at levels around 0.5 weevils per stem or lower. (Newman 2004, *pers. comm.*) Factors found to favor weevil population increases are; bed locations that are near shore and growing in shallow water, a higher percentage of natural shoreline, and a higher number of growing tips per plant (bushier plants). (Jester, et al. 1999)

Figure 6 shows EWM sample bed locations and average weevil densities for those beds. There was notable contrast in weevil densities between sample beds. Beds A and B were distinctly lower in weevil densities than Beds C and D at the far eastern end of the pond. One reason for this may be the greater depth and distance to shore of Beds A and B. A second factor could be the type of land cover found around Beds A and B. The shore in this area is park or residential land that was mostly mowed to the shoreline, with some rip-rap, although recent changes to park management have greatly increased the amount of natural shoreline available there. Weevils overwinter in the mud and leaf litter along shore and, therefore, survive best with a higher percentage of natural shoreline that is not mowed, raked, rip-rapped, sand or sea-walls. (Jester et al. 1999) Beds C and D may be better weevil habitat because they possess all three of these factors – they are nearer to shore, in shallower water and have more shoreline maintained with more natural vegetation along the shoreline. Of these factors, the one within human control is percent of natural shoreline.

On September 8<sup>th</sup>, 2004, a site visit to Springville Pond discovered that in Beds A and B weevil-damaged stems were observed, and EWM in Beds C and D had severely declined. When stem samples were collected from Beds C and D on August 5<sup>th</sup>, the EWM had been densely populating the area and stems were trailing along the water's surface, creating a thick canopy for the filamentous algae to cling to. The result was an unattractive, dense mat of weeds and algae on the water surface. Between the August 5<sup>th</sup> and September 8<sup>th</sup> visits, something had severely stressed the EWM, much of it died, and the algae mat broke apart and drifted away leaving behind a patch of clear water with just a few, sickly EWM stems remaining. (Note that the sparse EWM surrounding Beds C and D was still present, but weevil-damaged stems were observed.)

It cannot be said for certain whether the weevils were responsible for this sharp EWM decline, but few other naturally occurring factors could have stressed the EWM so severely and so quickly. If the weevils were indeed responsible for the EWM decline, this is a very good sign for Springville Pond.

## e. Recommended Management Plan for Eurasian Water Milfoil:

Maximize Biological Control and Evaluate Management Plan

The Village of Plover opted to follow the recommendation of biological control. (See Section X.f.)

The use of chemical treatments has drawbacks, such as requiring repeated treatments, toxicity to animals, excessive plant decay causing oxygen depletion, residual by-products and unintended drift. Chemical use has been unsuccessful in eradicating EWM and has become increasingly controversial with residents and area citizens. Biological control, however, would be a long-term, non-toxic control method.

**1. Maximize Biological Control – Beginning Immediately**

Springville Pond already has a healthy population of milfoil weevils, but some steps can be taken to try to boost the weevil population and maximize the control potential the weevils hold. Of the factors suspected to be impacting weevil success in Beds A and B, the one factor within human control is the percent of natural shoreline, a necessity for successful weevil hibernation. Some of the shoreline around Springville Pond is in somewhat natural condition, but could be improved. Other areas are greatly manipulated (mowed lawn, rip-rap, sea-walls, sandy beach) and are not good weevil habitat. Because weevils are weak fliers, the day they emerge from the water to fly to shore and hibernate, they are at the mercy of the wind. The more shoreline that is in natural condition the better the weevils' chances are of landing on suitable habitat. Recent changes in park maintenance at Springville Pond are likely to provide much more habitat this winter than previously and are a step in the right direction.

To help the weevils survive and do the job we are asking of them, the parks department and private landowners can:

- ✓ Leave as much un-mowed land as possible within 35' of shore.  
(More is better!) Weevils hibernate in leaf litter and dead grasses.
- ✓ Minimize the area maintained as beach, mowed paths, rip-rap or otherwise disturbed/manipulated land.
- ✓ Restore disturbed/manipulated areas.  
Contact the Portage County Land Conservation Department for help with involved restorations.
- ✓ Minimize fertilizer use.  
Runoff from fertilized properties can speed EWM growth!

(Also see Appendix B for more tips on providing weevil habitat.)

## 2. No Additional Control Treatments

No additional control methods (cutting, pulling or chemical) should be utilized extensively in the pond. Extensive use of chemicals may set back the existing weevil population and extensive cutting/pulling would reduce the number of EWM growing tips, which would hamper weevil reproduction success.

### a. Exception: Personal Control Around Docks

The exception to the above guideline would be in areas around docks where recreational usage is most affected. In these limited areas, hand-cutting/pulling, chemical treatments or the use of plant barriers (a fabric placed on top of the sediment, marked with buoys to prevent navigational hazards), would benefit recreational usage without significantly impeding weevil success. *(Chemical treatments or use of plant barriers require a permit from the WDNR.)*

### b. Optional Treatment: Winter Drawdowns

A winter water level drawdown is an optional tool for control of EWM in shallow areas, which has been effective in the past and should not significantly impact the milfoil weevils. Drawdowns should be done only every few years, as frequent drawdowns can encourage prolific growth of drawdown-tolerant species, such as sago pondweed (*Potamogeton pectinatus*). Drawdowns require a *Waterway & Wetland Permit Application Form 3500* and a great deal of assistance from the WDNR. Timing and extent of drawdown is critical to accommodate the needs of the amphibians, fish and other wildlife residents.

## 3. Trained Volunteer Monitoring Program -- ESSENTIAL!!! --

*EWM control is never permanent.* Biological control is naturally dynamic and some fluctuation in EWM growths should be expected, but it will be critical to identify severe increases early if the biological control alone is not enough, and additional control methods (such as drawdown) are needed. A trained volunteer monitoring crew who can correctly identify EWM and map new EWM beds on an annual or biannual basis will be essential to the year to year management the EWM on Springville Pond. Your WDNR Aquatic Plants Specialist can arrange this training. (See Appendix B for contact information.)

Landowners  
can learn  
how to keep  
their docks  
EWM-free!

Additionally, landowners should be trained to identify EWM and learn how it is spread. Landowners can watch for EWM that washes up on shore and dispose of those plants before they take hold and start a new bed. Landowners can also pull individual EWM plants found in the shallows to prevent a new bed from developing. (Pulling individual, spotty growths should not impact weevil populations, and may help keep EWM from spreading faster than the weevils can work.) Again, landowners should be *trained* for this, so they are not pulling beneficial, native plants.

**4. Post Exotic Species Advisory Signage**

Under Wisconsin Statutes, Chapter 30.715, it is illegal to place a boat, trailer or equipment that have aquatic plants attached into a navigable waterway. (Wisconsin Legislature: Infobases). "Exotic Species Advisory" signs placed at boat landings can be a reminder to boaters to check for hitch hiking plants.

Although only non-motorized, hand-carry watercrafts are allowed on Springville Pond, these crafts are capable of introducing additional exotic species into the pond or transferring EWM or curly pondweed from the pond to other lakes. There were no signs posted during the August and September of 2004 visits to the pond, but the appropriate WDNR contacts have been notified of this need.

Once signs are posted, if they become damaged or stolen, the WDNR should be notified.

**5. Evaluate Management Plan**

EWM control should be considered to be just one part of a larger goal of total lake health. The Little Plover River and Springville Pond Watershed Management Plan covers many areas for comprehensive water quality improvement. This management plan should be reviewed with the new survey data to update and fine-tune the recommendations. Because phosphorus inputs are the main food source for excessive plant and algae growth, special attention should be paid to sources of phosphorus in within the watershed. Continued conservation, restoration and public education efforts should show slow but steady results.

f. Implementation of Recommendations:



**Above:** Former Bed D - In 2003-04, this area was a solid weed mat of EWM, covered with a layer of algae. Weevil counts were an astronomical 4.43 weevils per stem. On June 21<sup>st</sup>, 2005, the weevils had reduced the weed bed to a few, scattered stems. Ugly blobs of algae remain.

**Below:** Former Bed D, Aug. 5<sup>st</sup>, 2005. EWM still minimal, but algae is abundant due to hot growing conditions.



To track the milfoil weevils' activity on the pond, on June 21, 2005, field personnel from Golden Sands RC&D, working with Portage County on the EWM Studies, took random samples and made visual observations. At that time, personnel found many positive signs that weevils were active and having an impact on the milfoil. Random samples, even from isolated beds, frequently had weevils present, and a Bed D, which had disintegrated due to weevil impacts in September 2004 was still under good control. (See photos.)

Photos taken on June 21<sup>st</sup> show the difference between healthy, pink stems and black, weevil-damaged stems. Stems become weak and disintegrate.

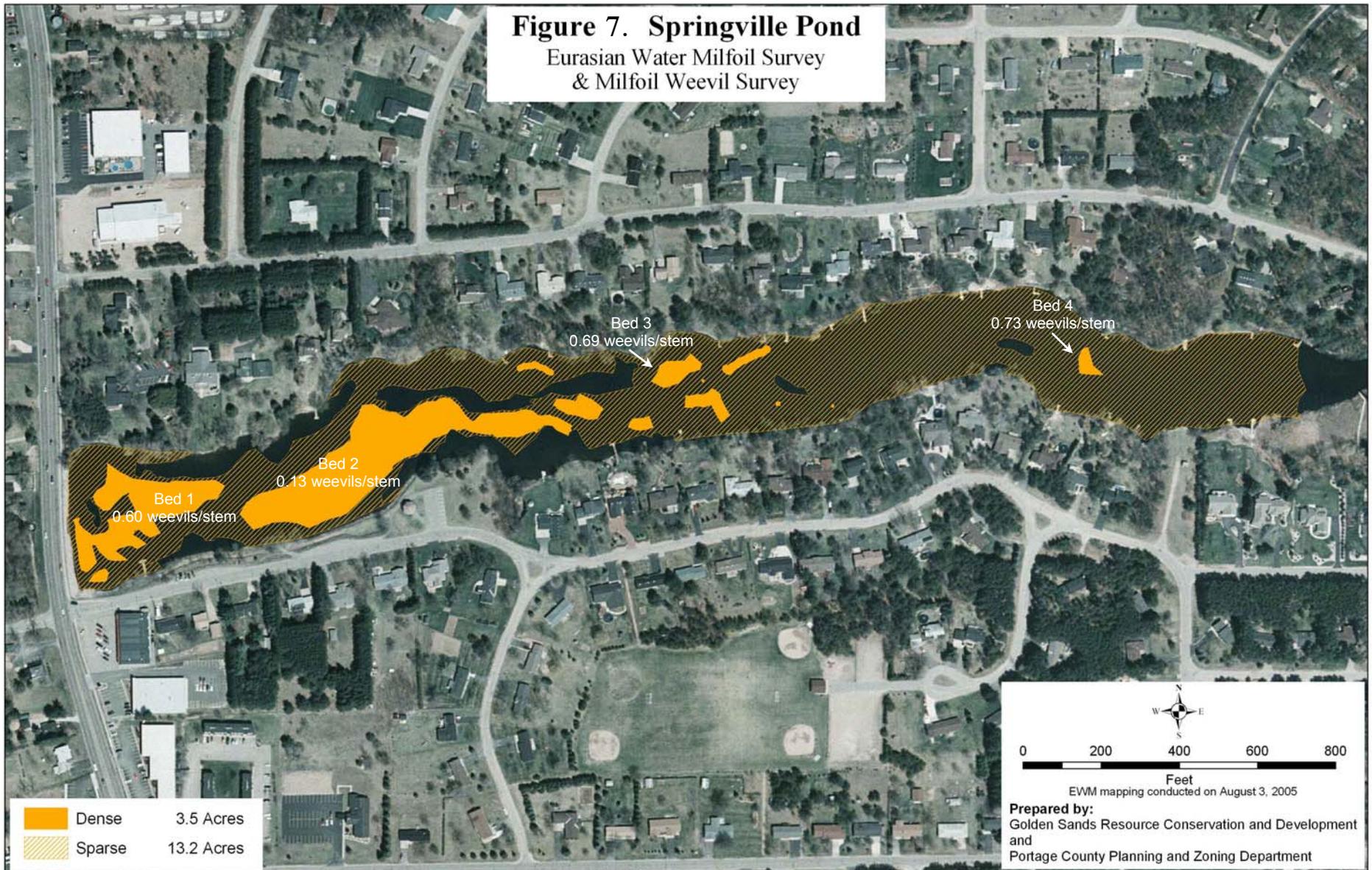


**The heat is on....** Late June brought the start of a record streak of sunny, hot and dry weather. The Stevens Point area saw **50 days** of temperatures at or above 80°F by Labor Day Weekend. In addition, drought stress and increased demands for water in the parched watershed brought on record low water levels to the Little Plover River, which feeds into the pond. This meant almost no fresh, cool water coming into the pond during the hottest, driest parts of the summer. The stagnant water conditions, coupled with the hot, sunny weather, created extreme conditions just *perfect* for rapid EWM growth.

In August, field personnel returned to the pond to map the EWM and survey the weevil populations and found that the dense EWM beds had increased from 2.1 total acres in 2003 to 3.5 acres in 2005. (See Figure 7.) Even more dramatic was the increased area colonized by sparse growth of EWM, from 0.7 acres in 2003 to 13.23 acres in 2005. This documented that new EWM growths had appeared in almost every area of the pond.



Photo taken on August 5<sup>th</sup> of Bed 4, a dense, new EWM bed that sprang up in the summer heat, just west of Former Bed D.



Bed 1, 2, 3 and 4 surveyed for milfoil weevils (*Eurychiopsis lecontei*) on 08/05/05. Stem samples collected from sample beds were examined in laboratory on 08/09/05. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Springville Pond was found to be **0.54 weevils per stem**.

Weevil surveys showed the average population in the pond was 0.54 weevils per stem, a decreased density from the 2004 average of 1.65 weevils per stem. (See Table 12.) It should be noted that these numbers are a ratio of number of weevils to number of EWM stems, therefore the dramatic increase in number of EWM stems gives a skewed impression of the number of weevils. **It is believed that the weevil population in Springville Pond is still healthy and increasing** but was simply unable to keep up with the abnormally rapid EWM growth in 2005.

Table 12. Weevil Population Density Survey – Results Summary (2005)

Lab Date	Bed No.*	Depth Range (ft)	Tot # Stem Samples	Ave # Broken Tips	Ave # of Apical Tips	% Stems w/ Weevil Damage	Ave # Eggs per Stem	Ave # Larvae per Stem	Ave # Pupae per Stem	Ave # Adults per Stem	Ave Weevils per Stem (All Life Stages)
8/9/05	1	4-12	15	0.40	1.80	37%	0.00	0.47	0.13	0.00	<b>0.60</b>
8/9/05	2	6-8	15	0.20	1.60	37%	0.07	0.07	0.00	0.00	<b>0.13</b>
8/9/05	3	2-8	16	0.56	1.63	28%	0.06	0.56	0.06	0.00	<b>0.69</b>
8/9/05	4	2-4	15	0.33	2.20	3%	0.00	0.67	0.00	0.07	<b>0.73</b>
<b>Whole Pond Results</b>		2-12	61	0.40	2.00	26%	0.03	0.44	0.05	0.02	<b>0.54</b>

\*See Figure 7 for EWM sample bed locations.

Survey Notes:

Sample Date: 8/4 – 8/5/2004  
 Weather Conditions: Sunny, 80°F  
 Land Cover @ Shore: Bed 1 = Dam, Park, Residential  
 Bed 2 = Park, Residential  
 Bed 3 = Residential (some mowed, but more natural along shoreline)  
 Bed 4 = Residential (mostly natural along shoreline)  
 Sample Preservation: Samples were kept in water in labeled plastic bags at 3-4°C until time of examination. All Springville Pond samples were examine within one day of collection, therefore, they did not require preservation.  
 Other notes: Exceptionally warm, sunny drought year = low water levels, stagnant conditions.

Whether due to abnormal conditions or not, the alarmingly rapid weed and algae growth caused a great deal of concern among community members and landowners around the pond

**Weighing the options....** The Village of Plover hosted a meeting on November 29th, 2005, that gave landowners an opportunity to ask Deb Konkel, WDNR, and Amy Thorstenson, Golden Sands RC&D, questions about options for controlling the nuisance EWM growth. In response to questions raised about chemical treatments to the EWM beds, which had been done in the past, Konkel stated that the past treatments were only temporary and were ineffective in the long-term. Further, because non-motorized recreation is not substantially impeded by the EWM growths, the risks associated with wide-scale chemical treatments outweigh the benefits to recreation, therefore, the DNR would not approve a permit for such treatments. A winter water level drawdown would not be helpful at this time either, because the 2005 surveys found the EWM beds concentrated in deeper waters. Konkel still supported biological control as the safest, most long-term and cost-effect control method best suited for Springville Pond’s situation.

Thorstenson suggested the possibility of **boosting** natural milfoil weevil populations through a weevil-rearing project the Portage County EWM Studies were planning for 2006. Thorstenson stated that the weevils were likely to catch up to the EWM growth eventually, but that rearing extra weevils may speed that process. Such a project was done at Lake Thomas in 2005, with some visible success by the end of the summer. The rearing and stocking techniques have been refined for 2006, and Thorstenson stated that weevils could be reared for Springville Pond if a grant from the DNR gets approved. The residents and Village of Plover opted to pursue this plan.

### **RESIDENTS ARE ENCOURAGED TO PARTICIPATE:**

Residents have been informed of the ways they can support biological control:

#### **1. Support milfoil weevils:**

- ✓ Practice “catch and release” of large predator fish that feed on pan fish. Pan fish feed on milfoil weevils, and high populations of pan fish can be a critical stumbling block to increasing weevil numbers.
- ✓ Provide winter hibernation habitat for weevils by avoiding mowing and raking within 35 feet (or 50 feet, if possible) of shore from Labor Day through Memorial Day. Weevils hibernate on shore under dead leaves and grasses. An undisturbed, natural shoreline is critical for weevils *and* beneficial for water quality. If residents have a disturbed shoreline (sand, rock, mowed lawn, etc...) and would like to restore it to native vegetation, they can contact the County Conservationist, at 346-1216, for technical assistance.

#### **2. Individual Control:**

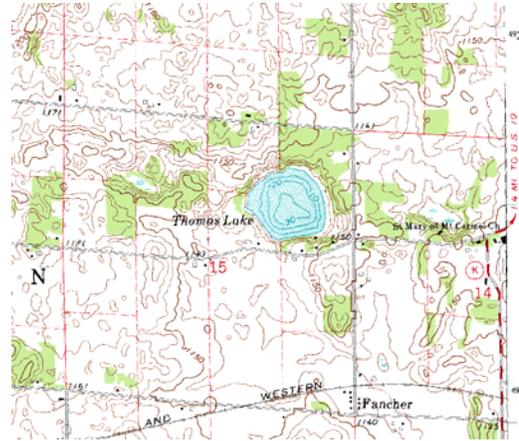
Controlling EWM around docks will help to minimize the spread of EWM in the pond. **Manual removal** (raking or hand-pulling) is also allowed, without a permit, to create an “access corridor” (up to 30-feet wide) to access open water. The law also allows unlimited manual removal of *non-native* plant species, such as EWM, so if you can distinguish these plants from natives, this is an option for control as well. (PLEASE NOTE the state statute requires that whatever vegetation is cut or pulled **must be removed from the waterbody!** This is to minimize reproduction via stem fragmentation and reduces the amount of rotting plant material in the water that contributes excess nutrients and reduces dissolved oxygen levels.)

Optionally, a landowner may apply for an individual DNR permit to use herbicides to control aquatic vegetation and clear an “access corridor” (up to 30-feet wide). Permits will be evaluated for approval on a case-by-case basis. (Note: Any bare areas are prone to invasion by exotic species, so it is wise to limit the size of the access corridor to only what is necessary.)

XI. THOMAS LAKE

a. Lake Background

Located approximately three miles west of Amherst Junction in the Town of Stockton, Thomas Lake is a small seepage lake with a surface area of 32 acres and a maximum depth of 28 feet. The water in Thomas Lake comes from groundwater, runoff and precipitation. Water leaves the lake via evaporation and seepage to groundwater. Because Thomas Lake's water comes from multiple sources, one must think of its watershed in terms of a surface watershed and a groundwater shed. (See Appendix C for definition of terms.) In the case of Thomas Lake, the surface watershed and groundwater shed were historically dominated by non-irrigated agriculture, which has been on the decline since 1948 land use surveys. Currently, the surface watershed is dominated by forest cover, and the groundwater shed is dominated by shrub cover. Residential land use has increased steadily in both watersheds, but remains a lesser component. (UWSP and Portage County 2003, Preliminary Results)



Thomas Lake on USGS topographic map.



Thomas Lake with mats of aquatic vegetation visible at water surface.

A lake is categorized as “eutrophic” when total phosphorus levels are 30 ppb or higher, which results in more aquatic plant growth. Thomas Lake is a eutrophic lake, with total phosphorus levels historically around 34 ppb. (UWSP et al. 2003)

Water clarity in Thomas Lake is considered good when compared with similar lakes in the region. Average historic Secchi depth (a measure of water clarity) was best in July (14 feet) and poorest in September (6 feet). Fluctuations in water clarity are normal, due to increases and decreases of algae population

and sedimentation. Average secchi depth readings for 2002 indicated better water clarity in late summer than the historic average. (UWSP and Portage County 2003, Preliminary Results)

b. History of Aquatic Plant Control in Thomas Lake

No records of previous aquatic plant treatments were found to report for this assessment. Table 13 lists aquatic vegetation species documented in Thomas Lake.

Table 13 - List of Documented Aquatic Vegetation  
(Submergent and Floating Leaf Aquatics Only)

Herbarium Records for Thomas Lake *		
	Scientific Name	Common Name
1	<i>Ceratophyllum demersum</i>	Coontail
2	<i>Elodea canadensis</i>	Waterweed
3	<i>Elodea nuttallii</i>	Slender waterweed
4	<i>Myriophyllum sibiricum</i>	Northern water milfoil
5	<i>Myriophyllum spicatum</i> (e)	Eurasian water milfoil
6	<i>Najas flexilis</i>	Slender naiad
7	<i>Nuphar variegata</i>	Bullhead pond lily
8	<i>Nymphaea odorata</i>	White water lily
9	<i>Polygonum amphibium</i>	Amphibious smartweed
10	<i>Potamogeton amplifolius</i>	Large leaf pondweed
11	<i>Potamogeton foliosus</i>	Leafy pondweed
12	<i>Potamogeton gramineus</i>	Variable pondweed
13	<i>Potamogeton illinoensis</i>	Illinois pondweed
14	<i>Potamogeton pectinatus</i>	Sago pondweed
15	<i>Potamogeton robbinsii</i>	Robbin's pondweed
17	<i>Spirodela polyrhiza</i>	Large duckweed
18	<i>Zosterella dubia</i>	Water stargrass

\* Robert W. Freckmann Herbarium records through November 2003, University of Wisconsin-Stevens Point. (Note: These herbarium records are historical documentation of what has been identified to date at Thomas Lake. *This is not an exclusive list.* Further, it cannot be stated with certainty that because a species has not been recorded at that lake recently that the species is no longer present in that lake. However, it has been well documented that as exotic invasives infest a lake, native vegetation is progressively less able to compete and the number of species (diversity) in the lake declines. Anecdotally, this is what has been seen at lakes in Portage County where EWM is present, however it would require quantitative vegetation surveys to confirm this.)

(e) Exotic invasive

c. Mapping Results

EWM was not identified in Thomas Lake until recent years, but with high phosphorus levels in this eutrophic lake, the exotic plant spread rapidly. EWM has become a dense mass of weeds surrounding the entire periphery of the lake. In those areas, EWM has become so thick at the surface that canoeing is difficult and boating is nearly impossible. The troublesome weed is only precluded from growing in the center of the lake by the water depth.



Dense mats of EWM visible at water surface, entire circumference of lake.

Field mapping on October 22, 2003 found the EWM growth to be mostly limited to a depth of 10 or 12 feet or less. The total surface area of the infestation is approximately 10.0 acres. (See Figure 8.) An infestation of this size cannot be eradicated by methods currently available, however *control* may be possible.



A closer view of dense EWM growth in Thomas Lake.

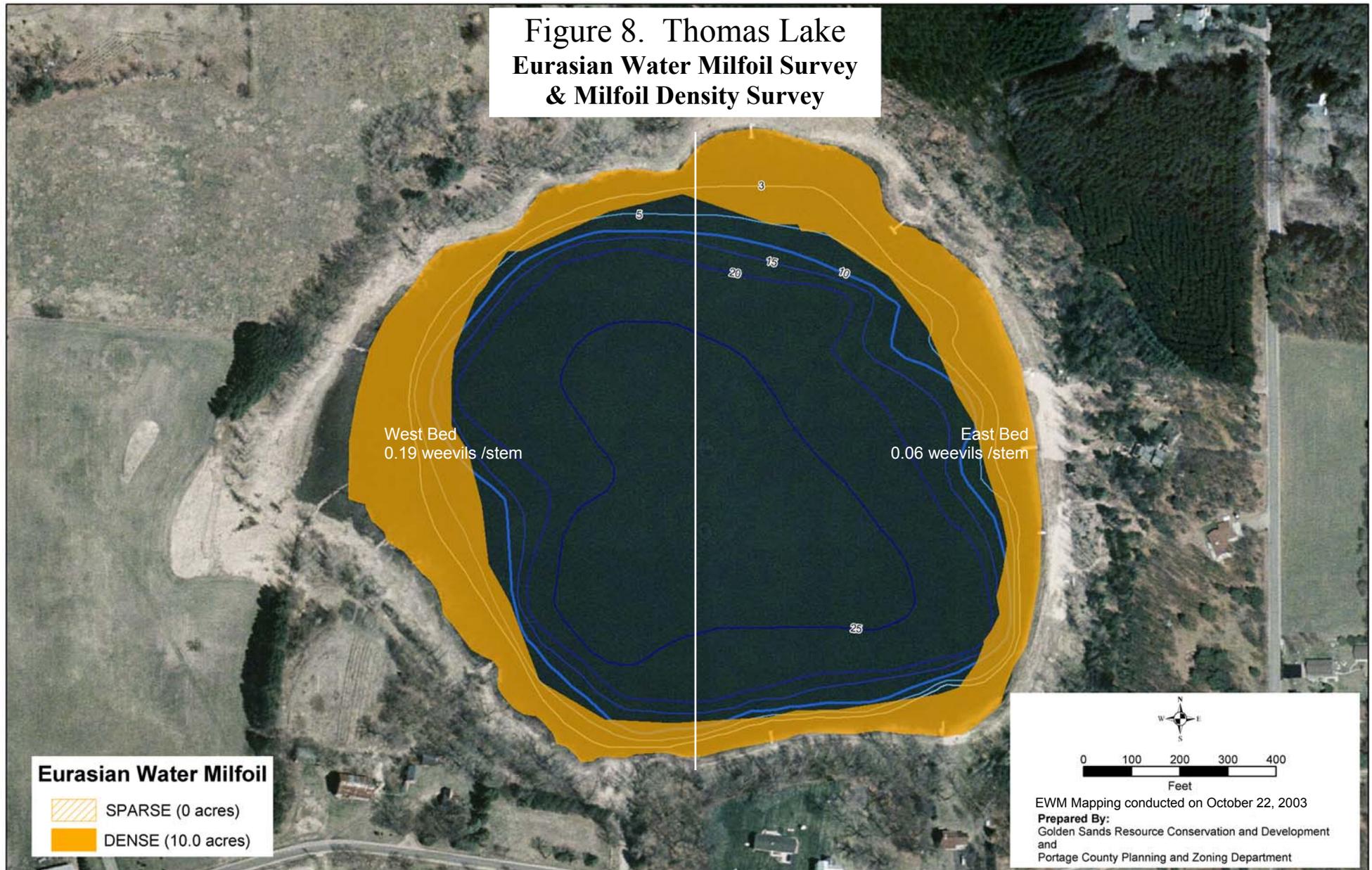
Several random samples of EWM were collected during 2003 field mapping exercises and later examined for evidence of the presence of the native aquatic milfoil weevil, *Euhrychiopsis lecontei*.

Although no evidence of weevils could be found from these samples, it was believed that a more thorough survey would be required to conclusively determine the presence or absence of milfoil weevils.

d. Weevil Density Survey Results

The EWM infestation in Thomas Lake is beyond elimination by chemical or manual control methods. Mechanical harvesting would be impossible around docks and in very shallow water where much of the EWM is located in Lake Thomas. In the 2003 EWM Assessment Report, the primary recommendation for Thomas Lake was to investigate the potential for using biological control. It was suggested that if biological control proved a viable option under the conditions present at Thomas Lake, then this may provide a natural, long-term solution.

Population density surveys were performed in 2004 to determine the existing natural population of the aquatic milfoil weevil, *Euhrychiopsis lecontei*. EWM stem samples were collected from Thomas Lake on August 5<sup>th</sup>, 2004 and examined in the laboratory on August 13<sup>th</sup>, 17<sup>th</sup> and 18<sup>th</sup>, 2004. Extracted weevil specimens were preserved in labeled glass vials with 95% ethyl alcohol and sent to Laura Jester of Jester Consulting, Eden Prairie, MN, for species identification confirmation. See Figure 6 for sample bed locations and Table 14 for summarized results.



East and West Beds surveyed for milfoil weevils (*Eurychiopsis lecontei*) on 08/05/04. Stem samples collected from sample beds were examined in laboratory on 08/13, 8/17 and 8/18/04. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Thomas Lake was found to be **0.13 weevils per stem**.

Table 14. Weevil Population Density Survey – Results Summary (2004)

Lab Date (2004)	Bed No.*	Depth Range (ft)	Tot # Stem Samples	% Samples Algae-covered	Ave # Broken Tips	Ave # of Apical Tips	% Stems w/ Weevil Damage	Ave # Eggs per Stem	Ave # Larvae per Stem	Ave # Pupae per Stem	Ave # Adults per Stem	Ave Weevils per Stem (All Life Stages)
8/13, 8/17	West	0-12	36	31%	0.14	3.86	25%	0.00	0.17	0.00	0.03	<b>0.19</b>
8/17, 8/18	East	0-12	31	48%	0.23	1.87	10%	0.03	0.00	0.03	0.00	<b>0.06</b>
<b>Whole Lake Results</b>		0-12	67	38%	0.20	2.90	16%	0.01	0.09	0.01	0.01	<b>0.13</b>

\*See Figure 6 for EWM sample bed locations.

Survey Notes:

Sample Date: 8/5/2004

Weather Conditions: Sunny Breezy, 70°F

Land Cover @ Shore: West Bed = Natural shoreline (wetland edges and trees/shrubs beyond).  
East Bed = Residential (some mowed to shore, some maintained in sand/beach)

Sample Preservation: Samples were kept in water in labeled plastic bags at 3-4°C. Any samples not examined within eight days of collection were preserved with ethyl alcohol. Due to a shortage of available ethyl alcohol, only approximately 30 ml of 95% ethyl alcohol could be added to the sample bags (containing apx. 100-130 ml of lake water). All samples appeared to be in good condition at the time of examination.

Other notes: A very common leaf deformity (fused lower leaflets) was seen in the Thomas Lake stem samples. It is unknown whether this deformity may affect weevil success. Also, hardening of nodes and easy breakage of stems – stems beginning auto-fragmentation naturally, or early auto-fragmentation due to refrigeration? This was not seen in other samples, which were refrigerated under same conditions.



Common leaf deformity observed in Thomas Lake stem samples.

Average (*E. lecontei*) milfoil weevil density for Thomas Lake was found to be 0.13 weevils per stem, which seems to be a low natural density. Of the 31 Wisconsin lakes studied by Laura Jester from 1996 to 1997, the mean natural weevil density was 0.65 weevils per stem. (Jester 1998)

Current research suggests that EWM control may occur at densities around 0.5 weevils per stem or lower, but that this cannot be predicted from lake to lake because of lake-specific conditions. (Newman 2004, *pers. comm.*) A factor found to negatively impact weevil populations is a high density of predator fish, such as sunfish. (Newman 2003) It is unlikely that fish predation is a significant limiting factor in Thomas Lake, since fish survey data collected for the Portage County Lake Study shows normal, balanced fish communities. (Turyk 2004, *pers. comm.*) Factors found to positively impact weevils are bed locations that are near shore and growing in shallow water, a higher percentage of natural shoreline, and a higher number of growing tips per plant (bushier plants). (Jester, et al. 1999)

Average weevil density in the West bed was found to be 0.19 weevils per stem, and average density in the East bed was notably lower (0.06 weevils per stem). (See Figure 6.) One possible cause for this difference between weevil counts is the high

amount of natural, vegetated shoreline on the West shore, whereas the East shoreline has more mowed lawns and bare, sandy beach areas. Weevils overwinter in the mud and leaf litter along shore and, therefore, survive best with a higher percentage of natural shoreline that is not mowed, raked, rip-rap, sand or sea-walls. (Jester, et al. 1999) If investments will be made in weevil stocking it will be critical to preserve the natural shoreline on the West half of the lake and to increase the amount of natural vegetation on the East half.

e. Recommended Management Plan for Eurasian Water Milfoil:

Biological Control

Biological control of EWM may be possible if the population density of milfoil weevils can be increased. The EWM infestation developed so fast, that the weevil populations are likely having a hard time expanding fast enough to “catch up”. Although research on biological control of EWM using milfoil weevils has shown mixed results, Thomas Lake has numerous conditions that positively correlate with successful biological control: natural shoreline on over half the lake, EWM beds near shore, and EWM populations have already reached maximum distributions. (Jester, et al. 1999)

Investing in biological control would be an investment in a long-term, natural control method. Most control methods provide only temporary reductions in EWM populations. It should be understood, however, that biological control is dynamic and that natural fluctuations between EWM and milfoil weevil populations will occur.

**1. Biological Control**

*Biological control requires approval from the WDNR.*

**a. Weevil Stocking – Summer 2005**

Purchase Weevils for Stocking

Weevils can be purchased for stocking from EnviroScience, Inc. in Ohio (1-800-940-4025). EnviroScience, Inc. recommends that a stocking trial should consist of a minimum of 4000 weevils released together at one location. Follow-up surveys are required by the company to evaluate the success of the trial.

OR

Propagate From Local or Nearby Stock

Thomas Lake, or other lakes nearby that have milfoil weevils, may be able to provide local or nearby propagation stock that would be better acclimated to local lake conditions than stock purchased from out of state. This option may be pursued if there exists the technical and financial support to produce high enough numbers of weevils.

The Town of Stockton opted to follow the recommendation of biological control. (See Section XI.f.)

EnvironScience, Inc. suggests a stocking trial should consist of a minimum of 4000 weevils released together at one location. Follow-up surveys would be necessary to evaluate the success of the trial.

**b. Preservation and Restoration of Natural Shoreline – *Beginning Immediately!***

Milfoil weevils require natural shoreline with leaf litter and vegetation debris to over-winter. Because weevils are weak fliers, the day they emerge from the water to fly to shore and hibernate, they are at the mercy of the wind. The more shoreline that is in natural condition the better the weevils' chances are of landing in suitable habitat. Thomas Lake currently has a good deal of natural shoreline on the West shore, but needs more natural shoreline on the East shore. If money is being invested in weevil stocking, *preservation and restoration of the natural shoreline is strongly recommended.*

See Appendix B for more tips on providing weevil habitat. (For cost-sharing or technical assistance with shoreline restorations, contact the Portage County Land Conservation Department at 346-1334.)

**c. Follow-up Monitoring – *Late Summer 2005***

Biological control may take multiple tries over several seasons for the weevils to become established. Only by monitoring the progress with quantitative sampling can it be determined whether the biological control is succeeding or failing. This may help guide decisions to continue or discontinue the stocking program in 2006 and beyond.

If weevils are purchased from EnviroScience, Inc., monitoring is required by the company. If weevils are propagated from local stock, monitoring is *strongly* recommended.

**2. Optional: Mechanical Harvesting of Fish Lanes**

*Mechanical harvesting requires a permit from the WDNR.*

Mechanical harvesting would be a strategic tool for improving the success of the biological control. Heavy pan fish predation on the weevils would greatly impact the weevil population. Mechanical harvesting can be used to create "fish lanes", or travel lanes, for larger predator fish species to use when patrolling for smaller prey fish, thereby reducing the population of the smaller-sized pan fish feeding on weevils. The fish lanes should be created in multiple locations around the lake, extending perpendicularly from shore out to the open water.

Thomas Lake currently appears to have a balanced fish community, so fish lanes may or may not be a critical element to the success of weevil stocking. However, some of these fish lanes could be strategically located at docks to double as boating lanes for residents to access the open water. The WDNR

can assist with recommendations for the best spacing or frequency of these fish/boating lanes.

To reduce costs of mechanical harvesting, it may be possible to contract the shared use of the Jordan Pond harvester. This water body also has EWM, therefore there would not be a risk of spreading the plant to an uninfested water body. Lake Helen has a harvester but does not have EWM, therefore sharing a harvester with Lake Helen is NOT recommended.

**3. Trained Volunteer Monitoring Crew**

*EWM control is never permanent.* It will be critical to identify the problem early if the biological control begins to fail. A trained volunteer monitoring crew may help identify problems with EWM control, or other emerging water quality problems, by surveying the lake annually. It should be understood that biological control is dynamic and that natural fluctuations between EWM and milfoil weevil populations will occur. However, if concerns arise about the continuing effectiveness of biological control of EWM, the WDNR Aquatic Plant Specialist should be consulted. (See Appendix C for contact information.)

**4. Maintain Exotic Species Advisory Signs**

Under Wisconsin Statutes, Chapter 30.715, it is illegal to place a boat, trailer or equipment that have aquatic plants attached into a navigable waterway. (Wisconsin Legislature: Infobases). “Exotic Species Advisory” signs placed at boat landings can be a reminder to boaters to check for hitch hiking plants.

A well-placed and highly visible sign is currently in place at the boat landing. This sign should be maintained in good condition to help prevent boaters from bringing *additional* exotic species into Thomas Lake or transferring EWM to other lakes.



*Exotic Species Advisory sign at Thomas Lake boat landing*

If this sign become damaged or are stolen the WDNR should be notified.



**5. Lake Residents’ Involvement**

**The effects of these control methods may not be immediately visible.** It may take years for weevil populations to increase enough to have an effect on the EWM population, and that effect will be *control*, not eradication. Residents should be informed about what to expect and the long-term goals of the control plans. Also, the success of the predator fish in controlling the

pan fish populations may be a contributing factor. Residents can participate in supporting weevil populations by refraining from harvesting the larger predator fish.

#### 6. Trained Volunteer Watercraft Inspectors

Because aquatic invasive species spread primarily by hitch hiking from lake to lake on boats and boating equipment, information about invasive species must get into the hands of every boater. The presence of trained volunteer watercraft inspectors, especially on major boating weekends, would be helpful to educate boaters about the invasive nature of exotic species and the importance of checking boats and trailers for “hitch hikers”. These trained volunteers could also play a critical role in the early detection of new exotic species or other emerging water quality issues at Thomas Lake.

Thomas Lake is a quiet, minimally developed lake that provides its residents and area communities with a scenic, peaceful recreational alternative to the more heavily trafficked lakes in the area. Lake residents, as well as other conservation groups in Portage County, are encouraged to participate in the volunteer watercraft inspector training workshops and the support network offered by the Clean Boats, Clean Water Program through the Wisconsin Lakes Partnership. More information about this program is given in Section III.c.

#### f. Implementation of Recommendations:

The Town of Stockton opted to pursue the biological control plan proposed by the Portage County EWM Studies. Therefore, during the summer of 2005, the EWM Studies worked in partnership with Dr. Ronald Crunkilton and the University of Wisconsin-Stevens Point (UWSP) to boost biological control of EWM on Lake Thomas. (See Section II. for methods.)

A total of 1,102 weevils were collected from the Lake Thomas, and 3,464 weevils were released, for a net increase of 2,362 weevils. The project was intended to produce a much higher number of weevils, since many more weevils are needed to notably control the EWM, but by the end of summer an absence of flowering was noted within 15-feet of the release site, indicating that the weevils stocked were having an impact.

## XI. THOMAS LAKE

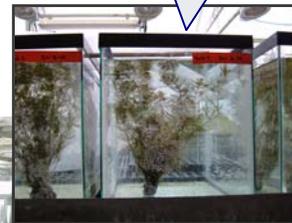
*Field personnel searched Lake Thomas for EWM stems with weevils on/in them.*



*Weevil-containing stems were inspected in the UWSP greenhouse to count the number of weevils on/in them, then bundled together with healthy stems and bound to a rock.*



*On the scheduled release date, stems were inspected to count the number of weevils. Weevil-containing stems were taken to the stocking site and entwined around existing EWM so weevil larvae could easily move to new stems to feed.*



*The bundles were placed in a 10-gallon aquarium or 5-gallon bucket in the UWSP greenhouse. Weevils were held for 13-21 days to reproduce in a predator-free environment.*

Some observations were made for improvements to the rearing techniques. Firstly, the use of five-gallon buckets as rearing tanks should be eliminated. Experimentation with buckets was intended to cut expenses, however, our average return rate from buckets was 0.63 whereas the tanks provided a 3.95 return rate. When this trend of lower productivity became apparent, use of the buckets was discontinued for this project.

The amount of light that penetrated the sides of the buckets was very low and this was most likely the limiting factor. This was evidenced by the health of the milfoil stems within the buckets. The tips of the stems, which received uninhibited light from above, were healthy and bright green, whereas below the top few inches of the plant the stems were a dull green and in many cases turning brown. The lack of photosynthetic surfaces was detrimental to the health of the milfoil stems and, in

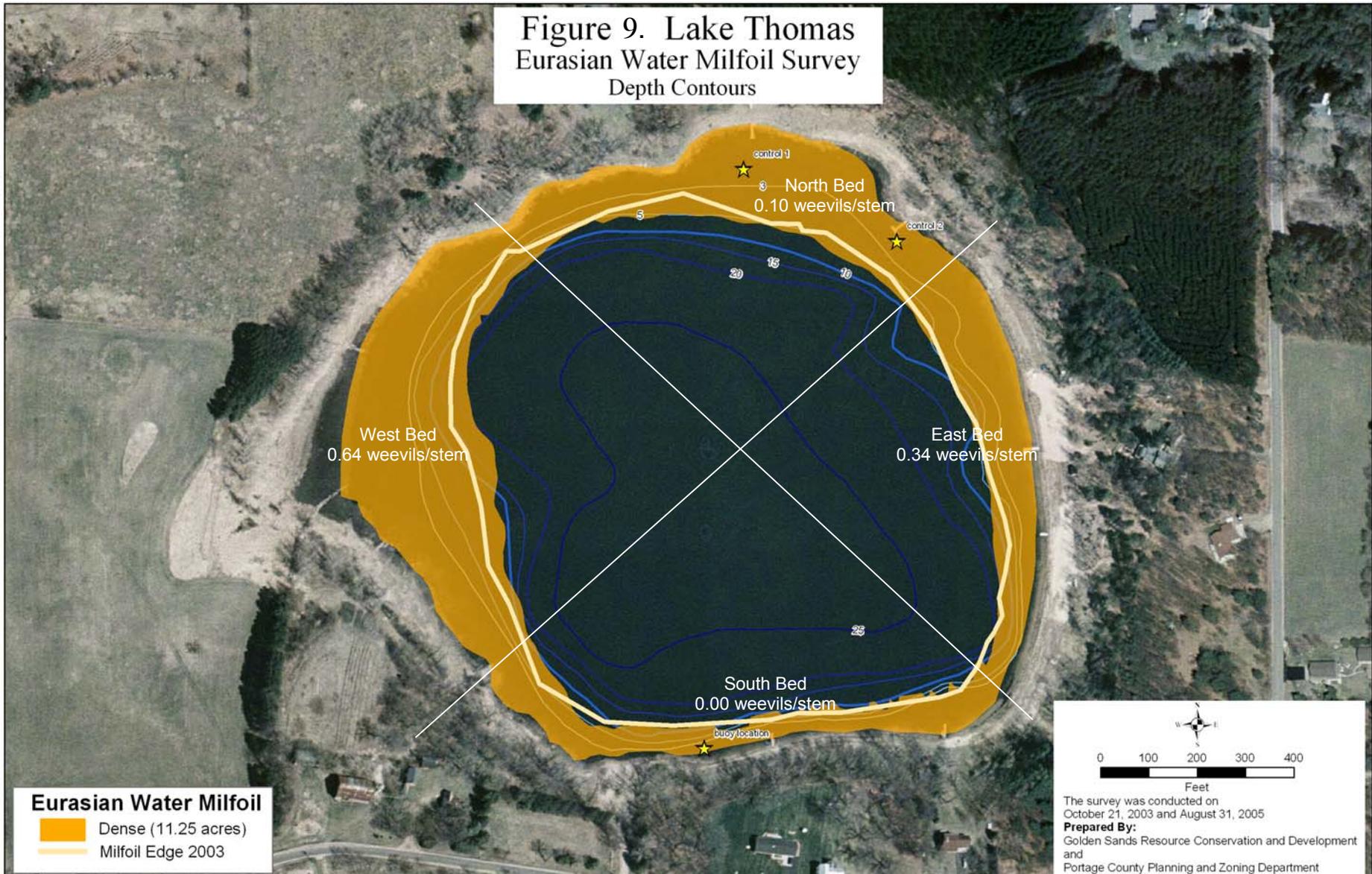
return, is believed to have created adverse conditions for weevils. The weevils in buckets were not only struggling to reproduce, they were probably struggling to survive. In future trials, the exclusive use of glass aquaria is strongly recommended. Aquaria allow for light penetration from all directions.

Rearing labs should not only be entirely composed of glass aquaria, but subsequent attempts should be of greater magnitude. Replacing buckets with aquaria would result in a total of 80 aquaria (800 gallons). This volume should be increased by 50% to 120 aquaria (1200 gallons). Depending on the available workforce—even larger.

In future attempts at rearing weevils it may be worth consideration to “reuse” weevils and allow them a chance to reproduce multiple times in the ideal conditions maintained in the laboratory setting. While research suggests that reproductive rates decline when adults are reused, for the time frame used this project, this would not be a significant factor. Adults, and initially some larvae, could easily be retained and placed in clean tanks with healthy milfoil stems. This method, if proved to be effective, would allow a significant number of collection hours to be applied elsewhere. This recycling of weevils could easily purpose the increased number of aquaria.

Better temperature regulation is also recommended. Although weevils will reproduce under a wide temperature range, the maximum reproductive rate and success occurs at approximately 27 degrees Celcius (80.6 degrees Fahrenheit). Because the greenhouse was equipped to maintain summer conditions, monitoring of water temperatures during this project was irregular, and artificial control of water temperatures was minimally attempted. Although the greenhouse equipment would not have let temperatures drop very low at night, the abnormally *hot* summer weather (the Stevens Point area saw 48 days above 80°F during this rearing project) may have exceeded preferred reproductive conditions. A shade cloth was used experimentally to cover 8 tanks, and it was found that during the summer’s hot-spells, these tanks had the best reproduction rates. When hot-spells passed, however, the reproduction rate dropped below that of the other tanks. While it cannot be said for certain whether the drop in reproduction rate was related to temperature swings, shade cloth, more rigorously applied, could be an inexpensive tool for moderating water temperatures and keeping them closer to ideals.

**Results and Observations....** On August 8<sup>th</sup>, 2005, Lake Thomas was surveyed for milfoil weevils, and on August 31<sup>st</sup>, 2005, the EWM beds were mapped. Figure 9 shows the EWM map and weevil survey results for 2005. For comparison purposes, the milfoil bed edge, as mapped in 2003, is represented on Figure 9. This comparison suggests that the milfoil may have advanced into deeper waters. Note that 2005 was a drought year, therefore, water levels may have been lower, allowing light to penetrate in areas that were otherwise too deep, which would allow the EWM to advance towards the lake’s center.



North, South, East and West Beds were surveyed for milfoil weevils (*E. lecontei*) on 08/08/05. Stem samples collected from sample beds were examined in laboratory on 08/19/05. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Thomas Lake was found to be **0.27 weevils per stem**. Buoy location on map indicates stocking site. Locations of two control sites are also indicated.

EWM stems for weevil surveys were randomly collected from the northern, southern, eastern, and western quadrants of the lake, as indicated on Figure 9. Note that samples were not collected within 30 feet of the stocking site. A summary of results is shown in Table 15.

Table 15. Weevil Population Density Survey – Results Summary (2005)

Lab Date	Bed No.*	Depth Range (ft)	Tot # Stem Samples	Ave # Broken Tips	Ave # of Apical Tips	% Stems w/ Weevil Damage	Ave # Eggs per Stem	Ave # Larvae per Stem	Ave # Pupae per Stem	Ave # Adults per Stem	Ave Weevils per Stem (All Life Stages)
8/19/05	<b>North</b>	0-13	30	0.34	1.53	17%	0.00	0.00	0.00	0.10	<b>0.10</b>
8/19/05	<b>South</b>	0-13	30	0.53	1.53	14%	0.00	0.00	0.00	0.00	<b>0.00</b>
8/19/05	<b>East</b>	0-13	30	0.37	1.84	40%	0.17	0.14	0.00	0.04	<b>0.34</b>
8/19/05	<b>West</b>	0-13	30	0.57	1.67	27%	0.47	0.14	0.00	0.04	<b>0.63</b>
<b>Whole Lake Results</b>		0-12	120	0.45	1.64	25%	0.16	0.07	0.00	0.05	<b>0.27</b>

\*See Figure 9 for EWM sample bed locations.

Survey Notes:

Sample Date: 8/08/05  
 Weather Conditions: Sunny, 80°F  
 Lake Conditions: Secchi Depth = 21 ft  
 Land Cover @ Shore: North Bed = Residential (some mowed to shore)  
 South Bed = Residential / boat landing (natural residential / sandy boat landing)  
 West Bed = Natural shoreline (wetland edges and trees/shrubs beyond).  
 East Bed = Residential (some mowed to shore, some maintained in sand/beach)  
 Sample Preservation: Samples were kept in water in labeled plastic bags at 3-4°C. Any samples not examined within eight days of collection were preserved with ethyl alcohol. Due to a shortage of available ethyl alcohol, only approximately 30 ml of 95% ethyl alcohol could be added to the sample bags (containing apx. 100-130 ml of lake water). All samples appeared to be in good condition at the time of examination.  
 Other notes: At the deep edges, many masses of EWM were “laid over”. This was believed to be an adventitious rooting strategy, not due to weevil impacts, which was confirmed upon examination of samples. Those areas were sampled using a plant rake and kept separate from other samples to allow for separate examination and calculations. Those numbers were later combined with the rest of the data. Therefore, this survey had twice as many stems as the others.

Average (*E. lecontei*) milfoil weevil density for Thomas Lake in 2005 was found to be 0.27 weevils per stem, which is higher than the 2004 average of 0.13 weevils per stem. Comparison between beds shows variation around the lake. As was the case in 2004, higher natural densities appear in the West Bed, which is the shoreline with the most undisturbed, natural shoreline.

Multiple areas of impact from concentrations of the natural population were observed. Control sites observed showed good EWM flowering success, evenly distributed around the area. In contrast, the stocking site, located in the South Bed, had a noticeably circular area (approximately 15 feet in diameter) around the buoy that lacked EWM flowering. This indicates that the plants at the stocking location were sufficiently impacted to prevent flowering capability – an indicator of weevil damage. Weevil survey results from the South Bed found 0.00 weevils per stem, but the stocking area was excluded from sample collections. This may indicate that the weevils had not moved far since stocking began on June 17<sup>th</sup>, 2005.

Although this project had intended to produce more weevils for the stocking site, the lack of EWM flowering surrounding the stocking site does indicate that stocking additional weevils can have an impact on the health and vigor of the EWM in Lake Thomas, which may help to control its spread and reduce its density. The higher 2005 survey results, coupled with the observation of concentrations of natural weevil populations, may suggest that the natural weevil population is building in Lake Thomas. If this is the case, the weevils may eventually become populace enough to notably control the EWM. There is no way to know if this will happen, or how many years it may take. Artificially boosting the population through stocking may help to push this process along.

**Weighing the Options....** On October 11<sup>th</sup>, 2005, Amy Thorstenson, Golden Sands RC&D, presented the results of the 2005 weevil rearing project and surveys to the Town Board of the Town of Stockton. Thorstenson recommended that a 2006 rearing project, using the improved methodologies, would be possible if a grant from the DNR gets approved. Thomas Lake residents at the meeting expressed the need for action on the EWM problem. The Town of Stockton later opted to pursue this plan.

**RESIDENTS ARE ENCOURAGED TO PARTICIPATE:**

Residents of have been informed of how they can support biological control:

**1. Support milfoil weevils:**

- ✓ Practice “catch and release” of large predator fish that feed on pan fish. Pan fish feed on milfoil weevils and high populations of pan fish can be a critical stumbling block to increasing weevil numbers.
- ✓ Provide winter hibernation habitat for weevils by avoiding mowing and raking within 35’ of shore. (Weevils hibernate under dead leaves and grasses.) An undisturbed, **natural shoreline** is good for weevils *and* good for water quality. If residents have a bare shoreline (sand, rock, etc...) and would like to restore it to native vegetation, contact the County Conservationist, at 346-1216, for technical assistance and cost-sharing options.

**2. Individual Control:**

Additionally, a healthy return of native aquatic plant species was observed where residents had controlled EWM around their docks. Therefore, control on an individual level is recommended. Unlimited **manual removal** (raking or hand-pulling) of non-native plant species, such as EWM, is allowed, without a permit. If residents can distinguish EWM from native species, this is an option for control. (PLEASE NOTE the state statute requires that whatever vegetation is cut or pulled must be removed from the waterbody! This is to minimize reproduction via stem fragmentation and to reduce the amount of rotting plant material in the water that contributes excess nutrients and reduces dissolved oxygen levels.)

Optionally, a landowner may apply for an individual DNR permit to use herbicides to control aquatic vegetation and clear an “access corridor” (up to 30-feet wide). Permits are evaluated for approval on a case-by-case basis.

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## XIII. APPENDICES

**Appendix A. How to Prevent the Spread of Aquatic Invasive Species**  
 (Modified from WDNR and UW-Extension Informational Materials)

## Steps **YOU** Can Take to Help Prevent the Spread of Aquatic Invasive Species

- ✓ **Clean your boat.** Inspect your boat and other equipment, such as anchors, fishing lines and boat trailer for aquatic plants, animals and mud, and remove them before leaving the boat landing.
- ✓ **Drain all water.** Drain the water from your boat, motor, live wells, bilge and other equipment before leaving the boat landing.
- ✓ **Dispose of live bait.** Dispose of unwanted live bait in the trash or share it with a fellow angler. Do *not* transfer bait or water from one body of water to another.
- ✓ **Rinse your boat.** Rinse your boat and equipment with high pressure or hot water, especially if moored for more than one day,  
**OR**  
**Dry everything** for at least 5 days before entering another water body.



*Reminder sign at Lake Emily public boat landing*



## Appendix B. How to Help Your Milfoil Weevils

(Compiled from various public education materials)

# How **YOU** Can Help Your Milfoil Weevils Battle Eurasian Water Milfoil

Research on distribution of the native milfoil weevil, *Euhrychiopsis lecontei*, has found the weevil to be present in almost every lake surveyed. However, some important factors may affect the success of the weevil on some lakes. Here's what you can do to help your native population of milfoil weevils do the best job they can at battling Eurasian Water Milfoil...

- ✓ **Provide Habitat.** Create "Buffer Zones" along the lakeshore, where vegetation and leaf litter within 35 feet of shore is left natural and **not mowed, raked or removed**. This will provide milfoil weevils with good winter habitat for hibernation and help keep the lake healthy, too! If you don't live on the water, you can still encourage your local park department to use buffer zones! (If tidy lawns are "your thing", at least refrain from mowing or raking from Labor Day to Memorial Day.)



*Natural vegetation helps milfoil weevils, adds beauty, protects water quality and attracts wildlife, too! A buffer zone of 35 feet is good, but MORE IS BETTER!*

- ✓ **No-wake Zones.** Work with your lake association to establish no-wake zones, marked with buoys, around Eurasian Water Milfoil beds where stems are within reach of boat props or wash. This will help prevent the spread of Eurasian Water Milfoil and help the weevils get established in that bed.
- ✓ **Discourage Eurasian Water Milfoil.** Removal of native aquatics, like bull rushes or lily pads, not only impacts wildlife and increases shore erosion, but also opens up new territory for invasive species to get established. Scores of scattered new growths may help milfoil spread faster than the weevils can find the plants.



*Sandy beaches, sea-walls, rip-rap and mowed lawns do NOT offer good winter habitat for milfoil weevils.*

*Decorative edging, bird houses, eye-catching wildflowers or a winding path to access the waterfront can add to the attractiveness of your buffer zone.*



## Appendix C. Contacts and Resources

- **For Copies of this Report:**

Steve Bradley, County Conservationist, Portage County Land Conservation Division of the Planning & Zoning Department, Portage County Courthouse Annex, 1462 Strongs Avenue, Stevens Point, WI 54481, (715) 346-1334

- **WDNR Aquatic Plants Contact:**

Deborah Konkel, Aquatic Plant Specialist, WDNR, 1300 West Clairemont Avenue, PO Box 4001, Eau Claire, WI 54702, (715) 839-2782

- **Questions About this Report:**

Amy Thorstenson, Project Assistant, Golden Sands Resource Conservation & Development Council, Inc., Portage County Courthouse Annex, 1462 Strongs Avenue, Stevens Point, WI 54481, (715) 343-6215, [thorstea@co.portage.wi.us](mailto:thorstea@co.portage.wi.us)

- **Clean Boats, Clean Waters Program:**

Laura Felda, Volunteer Monitoring Coordinator, UW-Extension Lakes Program, UW-Stevens Point-CNR, 1900 Franklin Street, Stevens Point, WI 54481-3897, (715) 346-3366

- **Friends of Lake Emily, Inc.:**

Gary Nilsen, President, (715) 824-5051, Jerry Stremkowski, Volunteer Coordinator, (715) 824-3859.

- **Contacts and Resources On-Line:**

The Wisconsin WDNR and Wisconsin Lakes Partnership have compiled a directory, "The Wisconsin Lakes Partnership Contacts", which lists the Wisconsin Association of Lakes, WDNR contacts, UW-Extension Statewide Lake Specialists, Self-Help Lake Monitors; Adopt-A-Lake contacts and other resources. It is Publ-FH-407 "**The Lake List**" and can also be viewed at <http://www.WDNR.state.wi.us/org/water/fhp/lakes/contacts.htm>.

- **Aquatic Plant Identification Guide:**

An excellent aquatic plant field guide, *Through the Looking Glass: A Field Guide to Aquatic Plants*, by S. Borman, R. Korth and J. Temte is available from the Wisconsin Lakes Partnership, UW-Extension Lakes Program, UW-Stevens Point-CNR, 1900 Franklin Street, Stevens Point, WI 54481-3897, (715) 346-3366.

- **Grant Funding for Control of EWM:**

*Aquatic Invasive Species Grant Program:* Provides state cost-sharing assistance for the plan development, invasive species surveys, watercraft inspections, development of educational materials and WDNR approved control plans. This program does not cover routine control of wide-spread infestations, such as mechanical harvesting or annual herbicide applications. Only units of local government, such as counties, villages, tribes, lake districts and sanitary districts, are eligible for this program. For more information, contact the WDNR Lake Coordinator or Environmental Grant Specialist for the West Central Region at (715) 839-3700.

*Recreational Boating Facilities Program:* Provides state cost-sharing assistance for various lake recreation improvement projects, including the routine EWM control projects not covered under the Aquatic Invasive Species Grant Program. Only government units and qualified lake associations are eligible for this program. For more information, contact the Community Services Specialist for the West Central Region at (715) 836-6574.

**Appendix D. Terms and Definitions**

Watershed = Land surface over which water flows before reaching a lake or water body.

Surface Watershed = Land area where water runs off the surface of the land and drains toward the lake (UWSP and Portage County 2003, Preliminary Results).

Groundwater Shed = Land area where water soaks into the ground and travels underground to the lake (UWSP and Portage County 2003, Preliminary Results).

Oligotrophic = A waterbody poor in nutrients, biomass and plant life and rich in oxygen (Collins English Dictionary ©2000). Phosphorus is the limiting nutrient in over 80% of Wisconsin's lakes (UWSP and Portage County 2003, Preliminary Results). Usually a "young" lake with very clear water.

Mesotrophic = A waterbody of intermediate levels of nutrients, biomass, plant growth and water clarity.

Eutrophic = A waterbody rich in organic and mineral nutrients and supporting abundant biomass and plant life, which while living supplies the oxygen for animal life but in the process of decaying also depletes oxygen. (Collins English Dictionary ©2000) Phosphorus is the limiting nutrient in over 80% of Wisconsin's lakes, and levels of 30 parts-per-billion indicate a eutrophic status. Excessive phosphorus leads to nuisance plant growth and frequent algae blooms. Usually an "old" lake, but lakes can be prematurely aged by excessive phosphorus inputs from human activities. (UWSP and Portage County 2003, Preliminary Results)

Secchi Depth Reading = The depth to which a secchi disk can be lowered into the water and still be visible. A measurement of water clarity. A low secchi depth numbers indicate poor water clarity, which may be due to sedimentation, algae blooms, tannins and other dissolved or suspended materials.

Drawdown = To lower the water level of a water body by a desired amount using a water level control structure, such as a dam.

**Appendix E. Plant Survey Spreadsheets – McDill Pond\***

**(See attached pages)**

**Portage County Eurasian Milfoil Assessment - McDill Pond Aquatic Plant Relative Abundance Ratings**

Sample Date	Transect	Depth Zone (feet)	Rating	Milfoils	Curly pondweed	Water plantain	Algae	Muskgrass	Coontail	White water crowfoot	Elodea	Common rush	Small duckweed	Slender naiad	Stoneworts	Spatterdock	White water lily	Reed canary grass
				<i>Myriophyllum</i> spp.	<i>Potamogeton crispus</i>	<i>Alisma</i> sp.? (immature)	<i>UK</i> sp.	<i>Chara</i> sp.	<i>Ceratophyllum demersum</i>	<i>Ranunculus longirostris</i>	<i>Elodea canadensis</i>	<i>Juncus effusus</i>	<i>Lemna minor</i>	<i>Najas flexilis</i>	<i>Nitella</i> sp.	<i>Nuphar variegata</i>	<i>Nymphaea odorata</i>	<i>Phalaris arundinacea</i>
6/2/04	1	0-1.5	Rating:	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
	1	1.5-5	Rating:	2	3	0	4	1	1	0	4	0	0	0	0	0	0	0
	1	5-10	*ID*															
	1	10-20	*ID*															
6/8/04	2	0-1.5	Rating:	4	2	0	4	0	1	0	2	0	0	0	0	0	0	0
	2	1.5-5	Rating:	4	2	0	3	0	3	0	2	0	0	0	0	0	0	0
	2	5-10	Rating:	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	10-20	*ID*															
6/8/04	3	0-1.5	Rating:	4	3	0	4	0	5	0	3	0	2	0	0	0	0	1
	3	1.5-5	Rating:	5	2	0	5	0	3	0	3	0	2	0	0	0	0	0
	3	5-10	Rating:	2	4	0	3	0	2	0	0	0	0	0	0	0	0	0
	3	10-20	*ID*															
6/2/04	4	0-1.5	Rating:	3	0	0	1	3	1	0	2	0	0	0	0	0	0	0
	4	1.5-5	Rating:	3	3	0	0	2	2	0	3	0	0	0	0	0	0	0
	4	5-10	Rating:	3	0	0	0	1	2	0	4	0	0	0	0	0	0	0
	4	10-20	*ID*															
6/2/04	5	0-1.5	Rating:	4	1	0	0	0	2	0	3	0	0	0	0	0	0	0
	5	1.5-5	Rating:	4	1	0	0	0	0	0	2	0	0	0	0	0	0	0
	5	5-10	Rating:	1	0	0	0	0	2	0	2	0	0	0	0	0	0	0
	5	10-20	*ID*															
6/2/04	6	0-1.5	Rating:	1	0	0	2	2	0	0	1	0	0	0	0	0	0	0
	6	1.5-5	Rating:	2	0	0	4	2	2	0	2	0	0	0	0	0	0	0
	6	5-10	*ID*															
	6	10-20	*ID*															
6/2/04	7	0-1.5	Rating:	1	0	0	0	0	1	0	2	0	0	0	0	0	0	0
	7	1.5-5	Rating:	0	0	0	2	2	0	0	1	0	0	0	0	0	0	0
	7	5-10	*ID*															
	7	10-20	*ID*															
6/2/04	8	0-1.5	Rating:	1	0	0	2	3	1	0	1	0	2	0	0	0	0	0
	8	1.5-5	Rating:	1	0	0	4	3	0	0	0	0	0	3	0	0	0	0
	8	5-10	*ID*															
	8	10-20	*ID*															
6/2/04	9	0-1.5	Rating:	4	0	0	1	0	0	0	2	0	0	1	0	0	0	0
	9	1.5-5	Rating:	3	1	0	0	0	1	0	4	0	0	0	0	0	0	0
	9	5-10	Rating:	3	0	0	0	1	1	0	3	0	0	0	0	0	0	0
	9	10-20	*ID*															
6/1/04	10	0-1.5	Rating:	1	2	0	2	2	1	0	1	0	0	0	0	0	0	0
	10	1.5-5	Rating:	1	1	0	2	4	0	0	1	0	0	0	0	0	0	0
	10	5-10	Rating:	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0
	10	10-20	*ID*															
6/2/04	11	0-1.5	Rating:	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	11	1.5-5	Rating:	1	1	0	2	4	0	0	1	0	0	0	0	0	0	0
	11	5-10	*ID*															
	11	10-20	*ID*															
6/2/04	12	0-1.5	Rating:	0	1	0	0	3	0	0	1	0	0	0	0	0	0	0
	12	1.5-5	Rating:	2	0	0	3	3	1	0	3	0	0	0	0	0	0	0
	12	5-10	Rating:	1	0	0	0	2	1	0	0	0	0	0	0	0	0	0
	12	10-20	*ID*															
5/28/04	13	0-1.5	Rating:	4	4	0	2	1	0	0	1	0	2	0	0	0	0	0
	13	1.5-5	Rating:	4	4	0	2	2	3	0	3	0	4	0	0	0	0	0
	13	5-10	*ID*															
	13	10-20	*ID*															
5/28/04	14	0-1.5	Rating:	0	0	0	4	0	2	0	1	0	0	0	0	0	0	0



5/26/04	<b>29</b>	0-1.5	Rating:	4	1	0	0	0	0	0	2	0	0	1	0	0	0	0
	<b>29</b>	1.5-5	Rating:	3	1	0	0	0	0	0	2	0	0	1	0	0	0	0
	<b>29</b>	5-10	Rating:	4	3	0	0	0	0	0	1	0	0	1	0	0	0	0
	<b>29</b>	10-20	*ID*															
5/26/04	<b>30</b>	0-1.5	Rating:	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	<b>30</b>	1.5-5	Rating:	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	<b>30</b>	5-10	Rating:	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0
	<b>30</b>	10-20	*ID*															
5/26/04	<b>31</b>	0-1.5	*ID*															
	<b>31</b>	1.5-5	Rating:	3	2	0	0	0	2	0	1	0	0	0	0	0	0	0
	<b>31</b>	5-10	Rating:	4	4	0	0	0	1	0	0	0	0	0	0	0	0	0
	<b>31</b>	10-20	*ID*															
<b># of Sample Pts</b>		<b>Average Ratings:</b>																
30	0-1.5	<b>1.967</b>	1.033	0.033	1.933	0.733	0.967	0.033	<i>1.500</i>	0.000	0.567	0.133	0.000	0.000	0.033	0.067		
30	1.5-5	<b>2.067</b>	1.333	0.000	1.567	1.167	1.133	0.033	<i>1.800</i>	0.000	0.200	0.133	0.000	0.000	0.000	0.000		
22	5-10	<b>1.364</b>	1.136	0.000	0.500	0.864	0.545	0.045	0.864	0.000	0.000	0.045	0.000	0.000	0.000	0.000		
2	10-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
84	All Depths:	<b>1.798</b>	1.143	0.012	1.381	0.905	0.893	0.036	<i>1.405</i>	0.000	0.274	0.107	0.000	0.000	0.012	0.024		

**Bold = Most abundant species**

*Italics = Second most abundant species*

Gray = Not ranked, non-vascular

"ID" = Insufficeint Depth

Rating Values = At each sample point, relative density of each species was rated from 1 to 5. A rating of 1, 2, 3 or 4 indicated the species was present on 1, 2, 3 or 4 rake samples. A rating of 5 was given if the species was *abundantly* present on all four rake samples.





	<b>28</b>	10-20	*ID*									
5/26/04	<b>29</b>	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	<b>29</b>	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	<b>29</b>	5-10	Rating:	0	0	0	0	0	0	0	0	0
	<b>29</b>	10-20	*ID*									
5/26/04	<b>30</b>	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	<b>30</b>	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	<b>30</b>	5-10	Rating:	0	0	0	0	0	0	0	0	0
	<b>30</b>	10-20	*ID*									
5/26/04	<b>31</b>	0-1.5	*ID*									
	<b>31</b>	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	<b>31</b>	5-10	Rating:	0	0	0	0	0	0	0	0	0
	<b>31</b>	10-20	*ID*									
<b># of Sample Pts</b>		<b>Average Ratings:</b>										
30	0-1.5			0.067	0.100	0.000	0.300	0.033	0.133	0.067	0.500	0.033
30	1.5-5			0.033	0.200	0.000	0.067	0.000	0.000	0.067	0.333	0.100
22	5-10			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.136	0.000
2	10-20			0	0	0	0	0	0	0	0	0
84	All Depths:			0.036	0.107	0.000	0.131	0.012	0.048	0.048	0.333	0.048

**Bold = Most abundant species**

*Italics = Second most abundant species*

Gray = Not ranked, non-vascular

"ID" = Insufficeint Depth

Rating Values = At each sample point, relative density of each species was rated from 1 to 5. A rating of 1, 2, 3 or 4 indicated the species was present on 1, 2, 3 or 4 rake samples. A rating of 5 was given if the species was *abundantly* present on all four rake samples.