AN AQUATIC PLANT MANAGEMENT PLAN FOR LOWER SPRING LAKE

JEFFERSON COUNTY, WISCONSIN

Prepared by:

Environmental Horizons, Incorporated

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The preparation of this publication was financed in part through a grant from the Wisconsin Department of Natural Resources Lake Management Planning Grant Program.

September 2005

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Chapter I

INTRODUCTION

Lower Spring Lake, wholly located within the Village and Town of Palmyra, Jefferson County, Wisconsin, is a valuable natural resource offering a variety of recreational and related opportunities to the resident community and its visitors. The Lake is an integral part of this lake-oriented community. However, the recreational and visual value of the Lake is perceived to be adversely affected by excessive aquatic plant growth within the Lake. Seeking to improve the usability and to prevent deterioration of the natural assets and recreational potential of Lower Spring Lake, the Lower Spring Lake Protection and Rehabilitation District continues to undertake an annual program of lake and aquatic plant management, in cooperation with the Village and Town of Palmyra.

Lower Spring Lake is a 104-acre drainage lake, and the third in a chain of lakes along the Scuppernong River—the River originating in the vicinity of Ottawa Lake in Waukesha County and flowing through Upper Spring Lake in Jefferson County. The Scuppernong River drains in a southwesterly direction to its confluence with the Bark River within Jefferson County. Both the Scuppernong River and Bark River form tributary stream systems of the Lower Rock River Basin.[1]

An aquatic plant management plan for Lower Spring Lake has been prepared, adopted and implemented by the Lower Spring Lake Protection and Rehabilitation District,[2] and the Lake was included in an experimental program to assess the effectiveness of biological control of Eurasian water milfoil, conducted by the Wisconsin Department of Natural Resources and the University of Wisconsin-Stevens Point.[3] This report sets forth an inventory of aquatic plant communities present within Lower Spring Lake, and represents part of the ongoing commitment of the Lower Spring Lake Protection and Rehabilitation District to sound planning with respect to the Lake. This inventory was prepared during 2005 by Environmental Horizons, Incorporated, in cooperation with the Lower Spring Lake Protection and Rehabilitation District, and includes the results of field surveys conducted during mid-June 2005. The aquatic plant survey was conducted by Environmental Horizons staff using the modified Jesson

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[1]*Wisconsin Department of Natural Resources Publication No. PUBL-WT-280-98-REV,* Lower Rock River Basin Water Quality Management Plan*, October 1998.*

[2]*Northern Environmental,* Aquatic Macrophyte Survey: Lower Spring Lake, Palmyra, Wisconsin*, December 1993.*

[3]*Laura L. Jester, Michael A. Bozek, and Daniel R. Helsel, Wisconsin Cooperative Fishery Unit,* Wisconsin Milfoil Weevil Project: Lower Spring Lake—Final Report*, March 1999.*

and Lound[4] transect method employed by the Wisconsin Department of Natural Resources. The planning program was funded by the Lower Spring Lake Protection and Rehabilitation District, with funding provided in part through the Chapter NR 190 Lake Management Planning Grant Program.

This inventory is intended to be a refinement of the aquatic plant management plan for Lower Spring Lake, and has been prepared pursuant to recommendations made in the aforereferenced Lower Rock River Basin plan. The scope of this report is limited to a consideration of the aquatic plant communities present within Lower Spring Lake, the documentation of historic changes in this plant community based upon currently existing data and information, and refinement of those management measures which can be effective in the control of aquatic plant growth. In addition, recommendations are made with respect to the Lower Spring Lake Protection and Rehabilitation District operations relating to aquatic plant and in-lake management activities.

The recreational lake use goals and objectives for Lower Spring Lake were developed in consultation with the Lower Spring Lake Protection and Rehabilitation District. The goals and objectives are to:

1. Protect and maintain public health, and promote public comfort, convenience, necessity and welfare, in concert with the natural resource, through the environmentally sound management of native vegetation, fishes and wildlife populations in and around Lower Spring Lake;

2. Effectively control the quantity and density of aquatic plant growths in portions of Lower Spring Lake basin to better facilitate the conduct of water-related recreation, improve the aesthetic value of the resource to the community, and enhance the resource value of the waterbody;

3. Effectively maintain the water quality of Lower Spring Lake to better facilitate the conduct of water-related recreation, improve the aesthetic value of the resource to the community, and enhance the resource value of the waterbody; and,

4. Promote a quality, water-based experience for residents and visitors to Lower Spring Lake consistent with the policies and objectives of the Wisconsin Department of Natural Resources as set forth in the Lower Rock River Basin plan.

This inventory and plan, which conforms to the requirements and standards set forth in the relevant *Wisconsin Administrative Codes*,[5] should serve as an initial step in achieving these objectives over time.

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[4]*R. Jesson, and R. Lound, Minnesota Department of Conservation Game Investigational Report No. 6,* An Evaluation of a Survey Technique for Submerged Aquatic Plants*, 1962.*

[5]*This plan has been prepared pursuant to the standards and requirements set forth in the following chapters of the* Wisconsin Administrative Code*: Chapter NR 1, "Public Access Policy for Waterways;" Chapter NR 103, "Water Quality Standards for Wetlands;" Chapter NR 107, "Aquatic Plant Management;" and Chapter NR 109, "Aquatic Plants Introduction, Manual removal and Mechanical Control Regulations."*

Chapter II

INVENTORY FINDINGS

INTRODUCTION

Lower Spring Lake is located in the east central portion of Jefferson County, in the Village and Town of Palmyra, as shown on Map 1. As set forth in the Lower Rock River Basin plan,[1] Lower Spring Lake is the third in a chain of lakes along the Scuppernong River, comprised of Ottawa Lake in Waukesha County, and Upper Spring Lake in Jefferson County. The Scuppernong River drains in a southwesterly direction to its confluence with the Bark River within Jefferson County. Both the Scuppernong River and Bark River form tributary stream systems to the Lower Rock River Basin. The Lake outflow is controlled by a dam and a fixed-height overflow structure, both located on the western side of Lower Spring Lake just upstream of STH 59. The dam discharges in a westerly direction through a concrete culvert into the Scuppernong River.

WATERBODY CHARACTERISTICS

Lower Spring Lake is a 104-acre waterbody, the hydrographical characteristics of which are set forth in Table 1. The Lake is a throughflow lake with extensive shallow areas, especially in the eastern portions of the Lake, and a single deep basin. The waterbody has a maximum depth of approximately 11 feet, a mean depth of 4 feet, and a volume of 416 acre-feet. The bathymetry of the Lake is shown on Map 2.

TRIBUTARY DRAINAGE AREA AND LAND USE CHARACTERISTICS

The total drainage area tributary to Lower Spring Lake, shown on Map 1, is approximately 27 square miles in areal extent. Portions of the total tributary drainage area extend into the Towns of Eagle and Ottawa, in Waukesha County, and into the Towns of Palmyra and Sullivan and the Village of Palmyra, in Jefferson County. Significant portions of the drainage area are located within the Southern Unit of the Kettle Moraine State Forest and Scuppernong State Wildlife Area, and the Ice Age National Scenic Trail passes in close proximity to the southern shores of the Lake.

The surrounding land uses within that portion of the drainage basin directly tributary to Lower Spring Lake are primarily rural agricultural lands, especially adjacent to the eastern portions of the Lake basin, with low-density urban residential development being the dominant land use adjacent to the southwestern portions of the basin. Existing land uses as of 1992 are shown on Map 3, for the total

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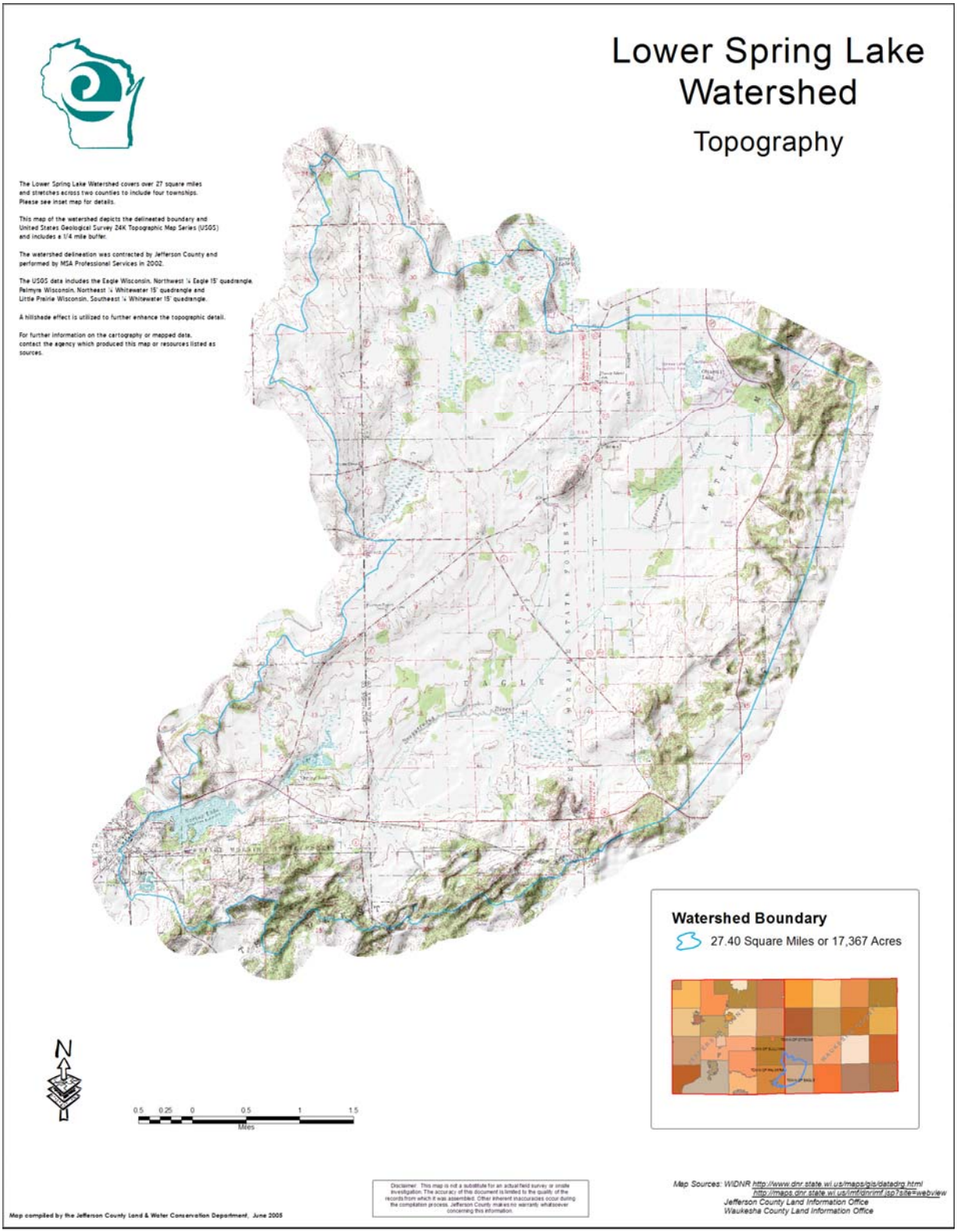
[1]Wisconsin Department of Natural Resources Publication No. PUBL-WT-280-98-REV, *Lower Rock River Basin Water Quality Management Plan*, October 1998.

Map 1

TOTAL TRIBUTARY DRAINAGE AREA TO LOWER SPRING LAKE



Source: Jefferson County Land and Water Conservation Department.

drainage area tributary to Lower Spring Lake, and are summarized in Table 2. Changes in land use within the drainage area tributary to the Lake include limited further urban development, infilling of already platted lots, and possible redevelopment of existing properties.

Table 1

HYDROLOGY AND MORPHOMETRY OF LOWER SPRING LAKE

Parameter	Measurement
Size (total)	
Total Area	104 acres
Total Drainage Area	17,447 acres
Volume (total)	451 acre-feet
Residence Time[a] (estimated from runoff)	0.3 years
Shape	
Maximum Length of Lake	0.8 miles
Length of Shoreline	3.1 miles
Maximum Width of Lake	0.3 miles
Shoreline Development Factor[b]	2.2
Depth	
Percentage of Surface Area of Lake	
Less than Three Feet	19 percent
Three to 20 Feet	81 percent
Mean Depth	4 feet
Maximum Depth	11 feet

[a] *Residence Time: Time required for a volume equivalent to the full volume of the Lake to flow into the Lake. Estimated inflow is derived as the product of the area of the drainage basin and the average annual rainfall of about 31 inches, multiplied by the mean annual runoff of about 25 percent.*

[b] *Shoreline Development Factor: Ratio of shoreline length to the circumference of a circular lake of the same area.*

Source: Wisconsin Department of Natural Resources and Jefferson County Land and Water Conservation Department.

SHORELINE PROTECTION STRUCTURES

Erosion of shorelines results in the loss of land, damage to shoreline infrastructure, and interference with lake access and use. Wind-wave erosion, ice movement, and motorized boat traffic usually cause such erosion. A survey of Lower Spring Lake shoreline, conducted by Environmental Horizons staff during June 2005, identified significant areas with natural shorelines and areas protected by riprap and similar structural shoreline protection measures, primarily in the vicinity of the main lake basin, as shown on Map 4. No obvious erosion-related problems were observed.

WATER QUALITY

Water quality measurements on Lower Spring Lake have been undertaken by the Wisconsin Department of Natural Resources[2] at intervals since August 1979 through June 2000, as shown in Table 3. Secchi-disc transparency readings were often between six feet and ten feet, and are indicative of a waterbody with fair water clarity.[3] Since 2004, Lower Spring Lake has been served by a volunteer monitor working under the auspices of the Wisconsin Department of Natural Resources Self-Help Monitoring Program. Secchi disc water quality data acquired by this volunteer during 2004 ranged from 2.4 feet to 4.7 feet, with an average Secchi disc transparency of about 4.0 feet, as shown in Table 3.

During 1979 and 1980, the Wisconsin Department of Natural Resources conducted a detailed examination of the aquatic environment of Lower Spring Lake. These data suggest that the Lake is a hard water, mesotrophic waterbody, similar in character to many southeastern Wisconsin lakes.[4] The chlorophyll-*a* concentrations reported from the Lake by the Wisconsin Department of Natural Resources during these studies averaged seven micrograms per liter (7 µg/l). This concentration is indicative of relatively low growths of algae in the water column, and is consistent with the total phosphorus concentration of about 20 µg/l and soluble reactive phosphorus concentration of 6 µg/l. The total nitrogen to total phosphorus ratio (N:P ratio) reported during that survey was 55, strongly indicative of phosphorus limitation of algal growth. Phosphorus limitation implies that the addition of phosphorus

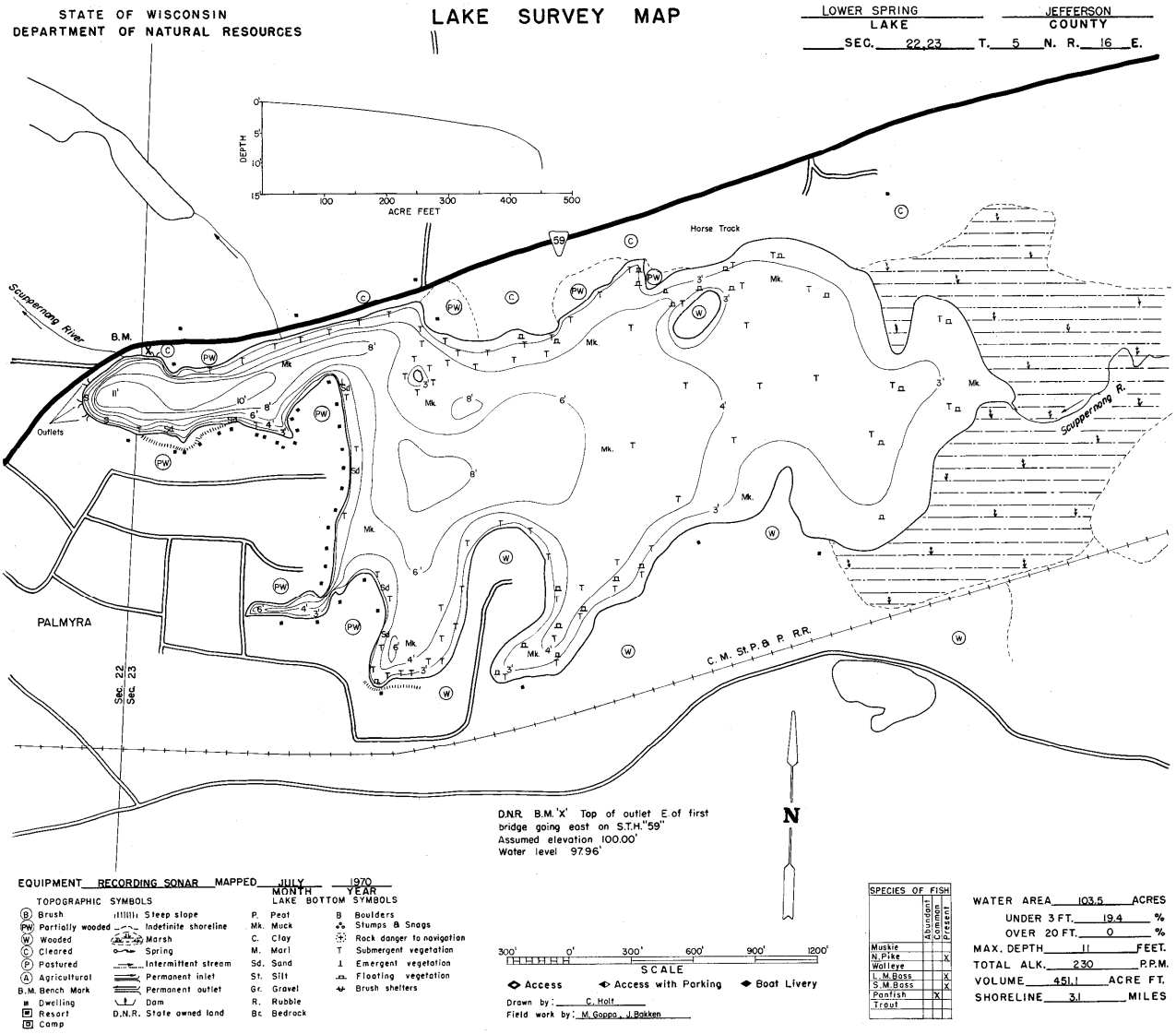
[2] *Data from the U.S. Environmental Protection Agency STOrage and RETrieval system database.*

[3] *R.A. Lillie and J.W. Mason,* Limnological Characteristics of Wisconsin Lakes*, Wisconsin Department of Natural Resources Technical Bulletin No. 138, 1983.*

[4] Ibid.

Map 2

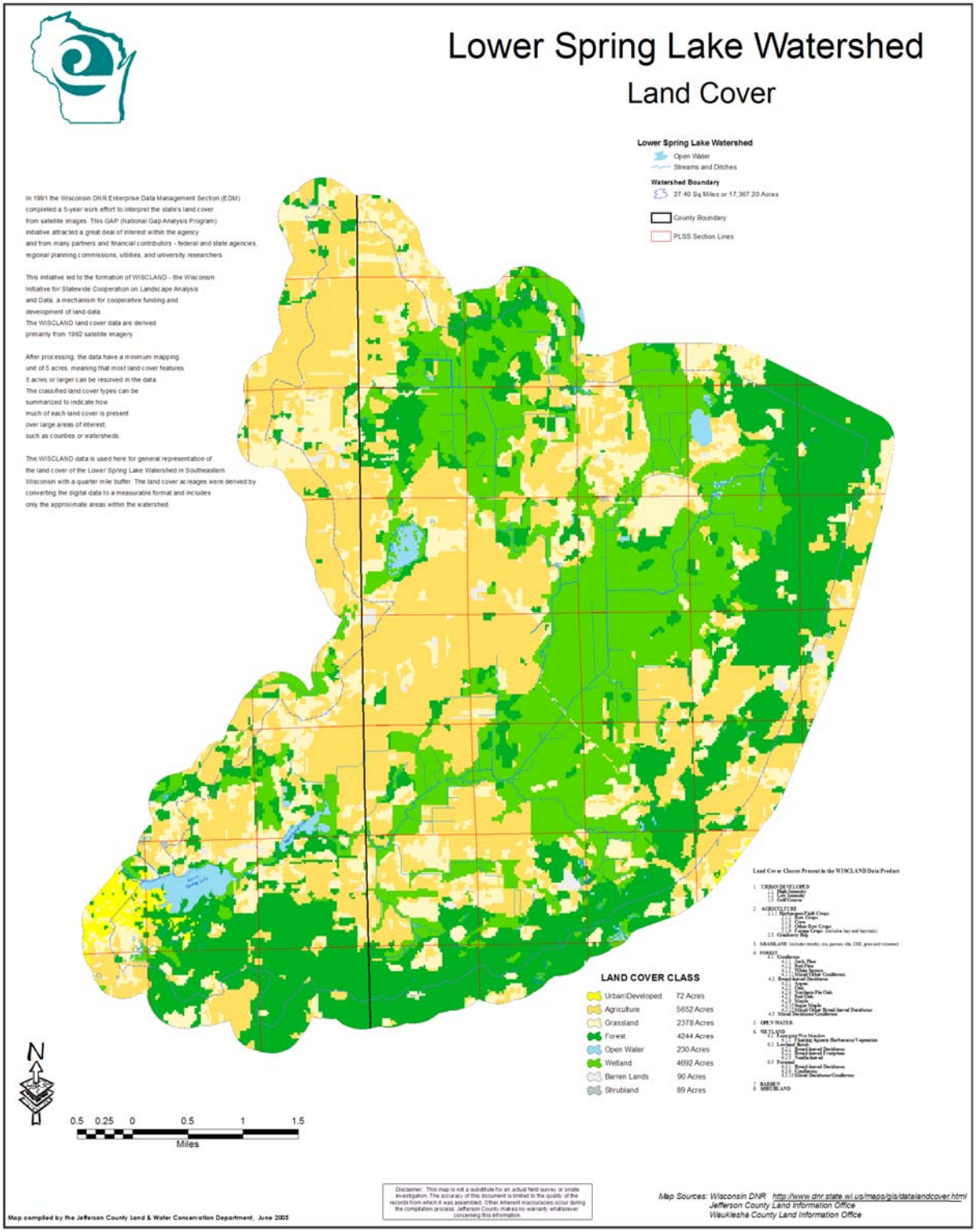
BATHYMETRIC MAP OF LOWER SPRING LAKE



Source: Wisconsin Department of Natural Resources.

Map 3

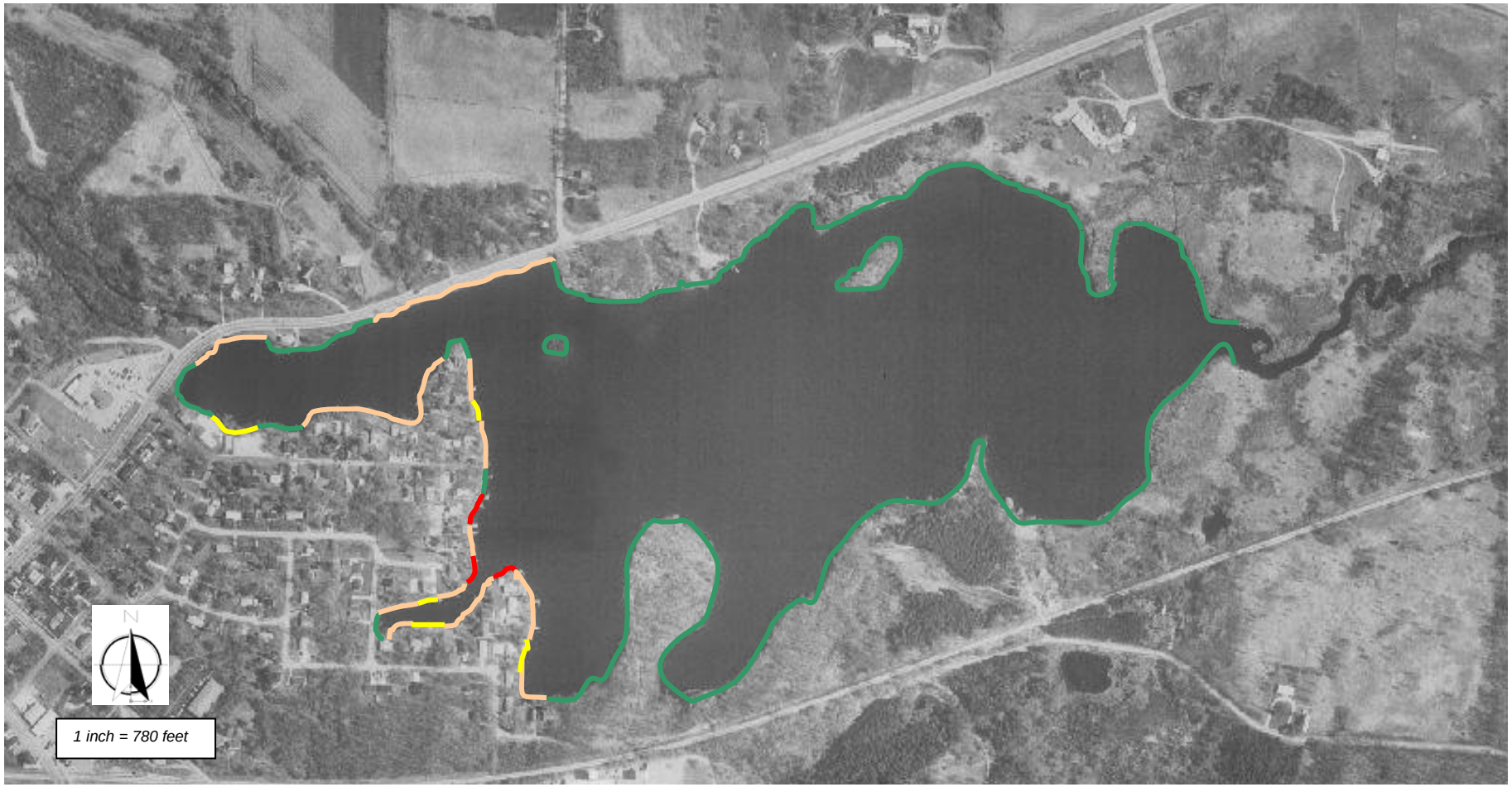
EXISTING LAND USES WITHIN THE TOTAL TRIBUTARY DRAINAGE AREA OF LOWER SPRING LAKE: 2000



Source: Jefferson County Land and Water Conservation Department.

Map 4

SHORELINE PROTECTION STRUCTURES ON LOWER SPRING LAKE: 2005



	Natural Shoreline
	Beach
	Bulkheads
	Riprap

Source: Environmental Horizons, Inc.

Table 2

EXISTING LAND USE WITHIN THE DRAINAGE AREA TRIBUTARY TO LOWER SPRING LAKE: 2000

Land Use Categories	1992 Land Use Area (acres)
Urban	
Residential	72
Other Open Lands	90
Subtotal	162
Rural	
Agricultural	5,652
Grasslands	2,378
Woodlands	4,244
Wetlands	4,692
Water	230
Other	89
Subtotal	17,285
Total	17,447

Source: Jefferson County Land and Water Conservation Department.

to the lake water column from land-based surfaces will result in greater quantities of algal and aquatic plant growth.

Lower Spring Lake had a Wisconsin Trophic State Index (WTSI) value that generally was between 45 and 50, indicative of mesotrophic or moderately enriched conditions.[5] During the present survey, a Secchi disc transparency of 7.25 feet was observed, which equates to a WTSI of 48, consistent with the previously reported values. Mesotrophic lakes, while relatively fertile and supporting abundant aquatic plant growths and productive fisheries, generally do not exhibit nuisance growths of algae and plants. Many of the cleaner lakes in Southeastern Wisconsin are classified as mesotrophic.[6]

Notwithstanding, during 2004, consistently lower Secchi disc transparencies were measured, resulting in an average WTSI value based on the average Secchi disc water transparency of 57. This WTSI value is indicative of potentially enriched conditions. Enriched, or eutrophic, lakes often support greater abundances of aquatic plant growths that can reach nuisance proportions, and higher numbers of fishes generally considered to be

Table 3

LOWER SPRING LAKE PRIMARY WATER QUALITY INDICATORS: 1979-2004

Parameter	1979-1980	1994	2000	2004
Secchi disc transparency (feet) (range)	9.85	6.25	9.60	3.95 (2.4 – 4.7)
Nitrogen, total (mg/l)	1.1	- -	- -	- -
Nitrogen, nitrate plus nitrite N (mg/l)	0.073	- -	- -	- -
Phosphorus, total (mg/l)	0.02	- -	- -	- -
Phosphorus, soluble reactive (mg/l)	0.006	- -	- -	- -
Conductivity (mS/m)	609	- -	- -	- -
pH	8.1	- -	- -	- -
Alkalinity (mg/l)	236	- -	- -	- -
Chlorophyll-a (µg/l)	7	- -	- -	- -
Wisconsin Trophic State Index Value (SDT)	44	50	45	57

Source: Wisconsin Department of Natural Resources and Environmental Horizons, Inc.

[5] *R.E. Carlson, "A Trophic State Index for Lakes,"* Limnology and Oceanography*, Volume 22, No. 2, 1977.*

[6] *R.A. Lillie, and J.W. Mason,* Limnological Characteristics of Wisconsin Lakes*, Wisconsin Department of Natural Resources Technical Bulletin No. 138, 1983.*

of lesser quality by sport anglers. These values may represent inter-annual variability, but could signal the potential for deterioration of water quality in Lower Spring Lake if remedial measures are not undertaken.

The WTSI values, shown in Table 3, indicate historically fair transparency conditions, and suggest that the Lake is a meso-eutrophic waterbody. As such, the Lake should be able to support a variety of active and passive recreational uses, as well as a healthy and productive fishery

AQUATIC PLANTS: DISTRIBUTION AND MANAGEMENT AREAS

A previous survey of the aquatic plant communities in Lower Spring Lake was conducted by Northern Environmental during July 1993, to support the current aquatic plant management program of Lower Spring Lake Protection and Rehabilitation District.[7] Subsequently, the Environmental Horizons staff conducted a comprehensive survey of aquatic plant species in the Lake basin during June 2005. The results of these surveys are presented in Table 4, and the results of the 2005 survey are graphically depicted on Map 5.

Table 4

AQUATIC PLANT SPECIES IN LOWER SPRING LAKE: 1993 THROUGH 2005

Plant Species	1993	2005
Ceratophyllum demersum (coontail)	X	X
Chara vulgaris (musk grass)	X	X
Elodea canadensis (elodea)	X	X
Lemna minor (duckweed)	X	X
Lemna triscula (duckweed)	- -	X
Myriophyllum spicatum (Eurasian water milfoil)	X	X
Najas sp. (bushy pondweed)	X	X
Nelumbo lutea (American lotus)	X	- -
Nuphar microphyllum (yellow water lily)	X	- -
Nymphaea odorata (white water lily)	X	X
Potamogeton amplifolius (floating-leaf pond weed)	X	X
Potamogeton crispus (curly-leaf pondweed)	- -	X
Potamogeton gramineus (variable pondweed)	- -	X
Potamogeton illinoensis (Illinois pondweed)	- -	X
Potamogeton pectinatus (Sago pondweed)	X	X
Potamogeton richardsonii (clasping-leaf pondweed)	- -	X
Potamogeton zosterformis (flat-stemmed pondweed)	X	- -
Spirodela polyrhiza (big duckweed)	X	- -
Utricularia vulgaris (bladderwort)	X	- -
Vallisneria americana (water celery)	X	X

Source: Northern Environmental and Environmental Horizons, Inc.

Past and Present Aquatic Plant Management Practices

Aquatic plants have occurred within Lower Spring Lake in such abundance that they have frequently been perceived of as a problem, interfering with recreational uses and aesthetic enjoyment of the Lake. The aquatic plant surveys conducted on Lower Spring Lake within the last 10 years indicate a relatively stable aquatic plant community. Few changes are apparent during this period, despite the conduct of

[7] *Northern Environmental,* Aquatic Macrophyte Survey: Lower Spring Lake, Palmyra, Wisconsin*, December 1993.*

an extensive aquatic plant management program. The Lake generally supports an extensive stand of Eurasian water milfoil (*Myriophyllum spicatum*), which occur throughout the waterbody.

An aquatic plant management program has been carried out on Lower Spring Lake in a documented manner since the early 1990s, when the Lower Spring Lake Protection and Rehabilitation District purchased an aquatic plant harvester to augment their historic aquatic herbicide-based control program. A program of active management of the aquatic plant community in Lower Spring Lake has been conducted by the District using this two-pronged approach since that time. Harvesting is conducted by the District during the four- to five-month summer period. During 1993, an estimated 200 tons of aquatic plants were harvested from the Lake. Additional control has been provided by applications of aquatic herbicides, typically during late-spring and mid-summer, annually. The herbicides 2,4-D, endothall, and diquat have been applied to control aquatic macrophytes, while copper-sulphate (Cutrine-Plus) has been used to control phytoplankton or algal growths in the Lake.

Aquatic Plant Communities in Lower Spring Lake

The results of the 1993 and 2005 macrophyte surveys are set forth in Table 3. The 1993 survey identified 15 species of aquatic plants, many of which were reported to be relatively scarce. An equal number of plant species was observed during the 2005 survey, with little change in the aquatic plant community composition was noted during this period. Those changes that are noted most likely reflect inter-annual variability rather than a shift in the Eurasian water milfoil-dominated aquatic plant community. Plant growth occurred throughout the Lake. The theoretical maximum depth of colonization (MDC),[8] estimated from the 2005 observed Secchi disc transparency, is about 10 feet, which is approximately the same as the maximum depth of the waterbody. Consequently, aquatic plants occurred throughout the Lake. Diversity was low, with most species, except for Eurasian water milfoil occurring in scattered assemblages in the western portions of the main lake basin. Chara or muskgrass, a macroscopic alga, was present in some relative abundance in this area. White water lilies were dense in the shallow eastern areas of the Lake, adjacent to the debouchment of the Scuppernong River into the Lake. Common aquatic plants found in Lower Spring Lake are illustrated in Appendix A.

In 1993, coontail (*Ceratophyllum demersum*) was the most frequently-occurring aquatic plant, occurring at two-thirds of the sites sampled. Eurasian water milfoil (*Myriophyllum spicatum*) and white water lily (*Nymphaea odorata*) were the next most frequently-occurring species. Duckweeds (*Lemna minor* and *Spirodela polyrhiza*) were the plants that occurred in greatest density, together with white water lily. Of the submerged aquatic plants, chara (*Chara* sp.), coontail and Eurasian water milfoil were most dense, with coontail and Eurasian water milfoil being the most common of the submerged aquatic plants.

During the 2005 aquatic plant survey of Lower Spring Lake, Eurasian water milfoil was the dominant species throughout the Lake (photo 1), although in the shallow water areas of the debouchment, duckweed (*Lemna minor*) and white water lily (*Nymphaea odorata*), two floating-leaved species, were dominant (photo 2). The results of this survey are set forth in tabular form in Table 5, with the distribution of the major aquatic plant communities being shown in graphic form on Map 5. The number of aquatic plants suggests a similar aquatic plant community to that previously recorded from the Lake. Few changes in the composition of the aquatic plant community were recorded in Lower Spring Lake. Indeed, any differences most likely reflect seasonal variations in plant community composition. The appearance of the pondweeds in the system is generally considered to be a positive sign. Table 6 outlines the positive ecological significance of all aquatic plant species found in Lower Spring Lake.

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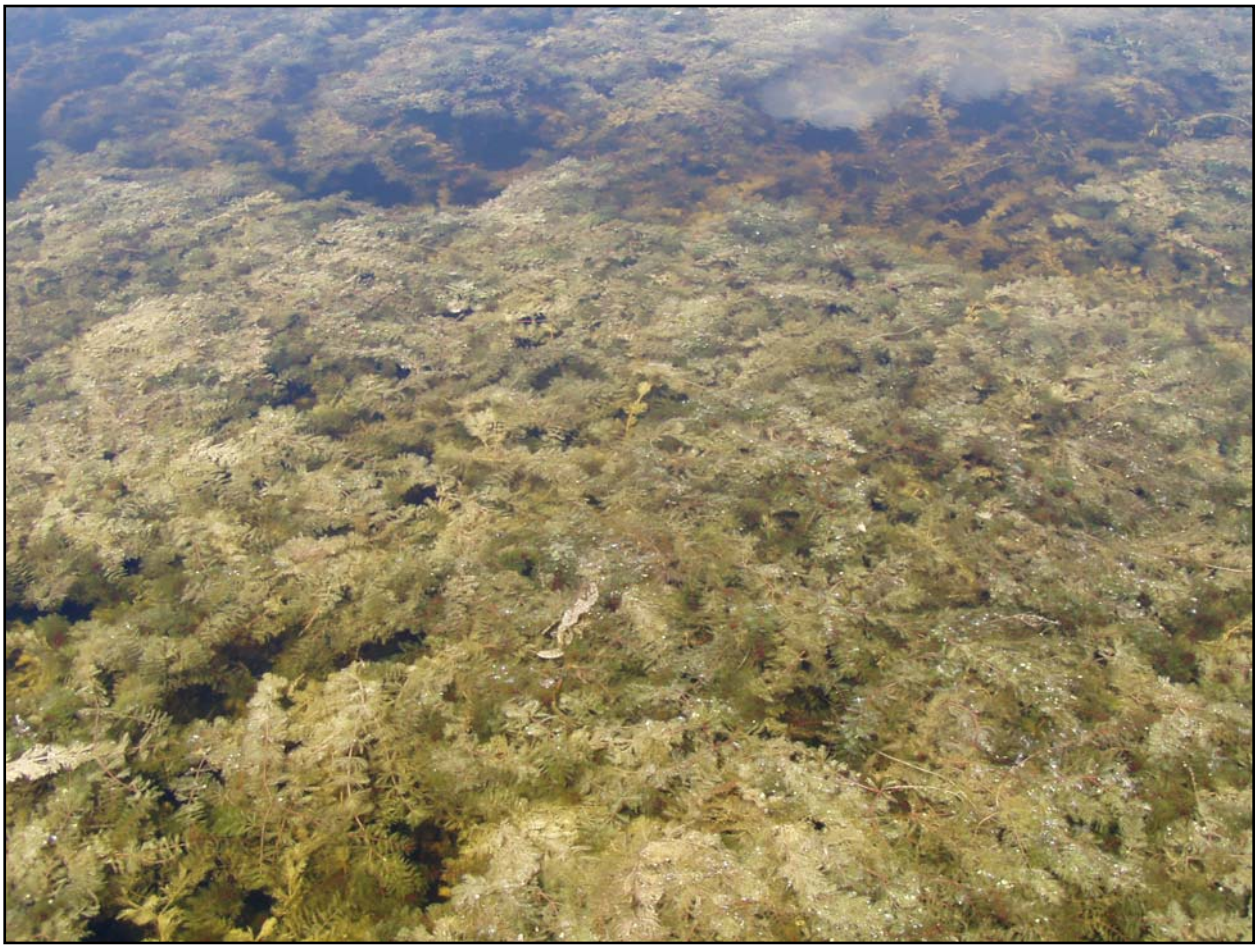
[8] *G. Dennis Cooke, Eugene B. Welch, Spencer A. Peterson and Peter R. Newroth,* Restoration and Management of Lakes and Reservoirs*, Lewis, Boca Raton, 1993.*

Photo 1

Eurasian water milfoil bed in Lower Spring Lake



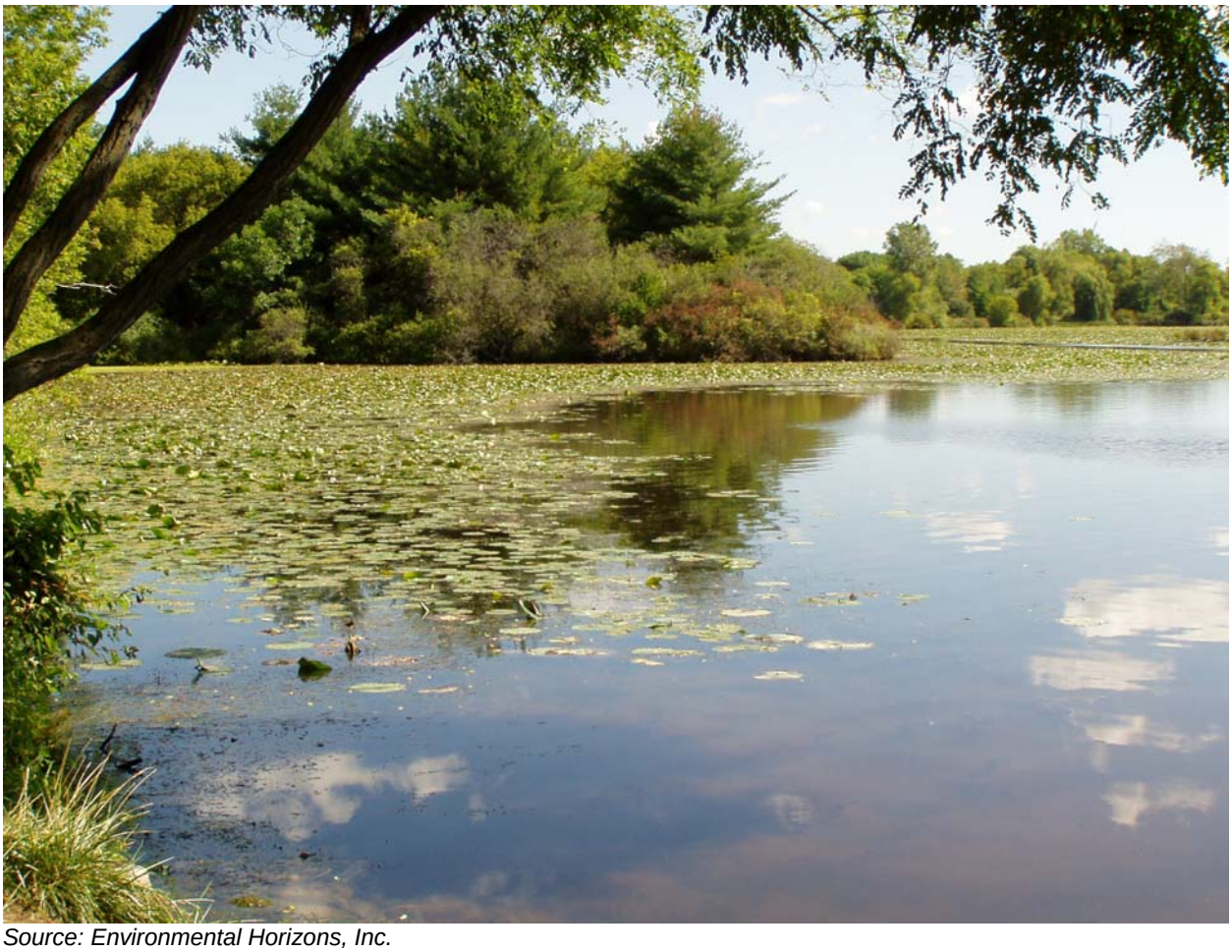
Source: Environmental Horizons, Inc.

In contrast, Eurasian water milfoil (*Myriophyllum spicatum*) was dominant in much of the Lake. Eurasian water milfoil is one of eight milfoil species found in Wisconsin and the only one known to be exotic or nonnative. Because of its nonnative nature, Eurasian water milfoil has few natural enemies that can inhibit its explosive growth under suitable conditions. The plant exhibits this characteristic growth pattern in lakes with organic-rich sediments, or where the lake bottom has been disturbed. In such cases, the Eurasian water milfoil populations displace native plant species and interfere with the aesthetic and recreational use of the waterbodies. This plant has been known to cause severe recreational use problems in lakes within the Southeastern Wisconsin Region.

Eurasian water milfoil reproduces by the rooting of plant fragments. Consequently, some recreational uses of lakes can result in the expansion of Eurasian water milfoil communities, especially when boat propellers fragment Eurasian water milfoil plants. These fragments, as well as fragments that occur for other reasons such as wind-induced turbulence or fragmentation of the plant by fishes, are able to generate new root systems, allowing the plant to colonize new sites. The fragments also can cling to boats, trailers, motors, and/or bait buckets, and can stay alive for weeks contributing to the transfer of

Photo 2

White water lily habitat in the east end of Lower Spring Lake



Source: Environmental Horizons, Inc.

Table 5

FREQUENCY OF OCCURRENCE AND DENSITY RATINGS OF SUBMERGENT AND OTHER PLANT SPECIES LOWER SPRING LAKE: JUNE 2005[a]

Aquatic Plant Species Present[b]	Sites Found	Frequency of Occurrence (percent)	Relative Density[c]	Importance Value
Submergent species				
Bushy Pondweed	1	1.1	1.0	1.1
Coontail	7	7.4	1.6	11.7
Clasping Leaf Pondweed	1	1.1	1.0	1.1
Curly-Leaf Pondweed	25	26.6	1.6	41.5
Eel Grass	1	1.1	2.0	2.1
Elodea	9	9.6	2.3	22.3
Eurasian Water Milfoil	40	42.6	3.6	153.2
Floating-Leaf Pondweed	1	1.1	1.0	1.1
Illinois Pondweed	5	5.3	1.6	8.5
Muskgrass	14	14.9	2.4	35.1
Sago Pondweed	13	13.8	1.8	24.5
Variable Pondweed	5	5.3	2.0	10.6

Aquatic Plant Species Present[b]	Sites Found	Frequency of Occurrence (percent)	Relative Density[c]	Importance Value
Algae and Floating-leaved species				
Cladophora	3	3.2	1.7	5.3
Duckweed	2	2.1	2.0	4.3
White Water Lily.....	6	6.4	3.3	21.3

NOTE: There were 41 total sample sites during the June 2005 survey.

[a]*Floating-leaved plants, such as duckweed and white water lily, are not measurable using the Jesson and Lound Survey Technique for Submerged Aquatic Plants.*

[b]*Information obtained from* A Manual of Aquatic Plants *by Norman C. Fassett, University of Wisconsin Press;* Guide to Wisconsin Aquatic Plants*, Wisconsin Department of Natural Resources; and,* Through the Looking Glass...A Field Guide to Aquatic Plants*, Wisconsin Lakes Partnership, University of Wisconsin-Extension.*

[c]*Species relative density for all sample points including sample points where a particular species did not occur in Lower Spring Lake: Abundant (density rating = 4 to 5). Common (density rating = 2 to 3), Scarce (density rating = 1), and - = Absent (density rating = 0).*

Source: Environmental Horizons, Inc.

milfoil to other lakes. For this reason, it is very important to remove all vegetation from boats, trailers, and other equipment after removing them from the water and prior to launching in other waterbodies.

The 2005 aquatic plant survey of Lower Spring Lake was conducted using the modified Jesson and Lound transect method as adopted by the Wisconsin Department of Natural Resources. This methodology, when utilized in successive aquatic plant surveys, will allow the statistical evaluation of changes in the aquatic plant community within the Lake.[9] The methodology is described in Appendix B. Where specific indices can be calculated based upon available data collected during the year 2005 aquatic plant survey, the values are given in Table 5. These indices include:

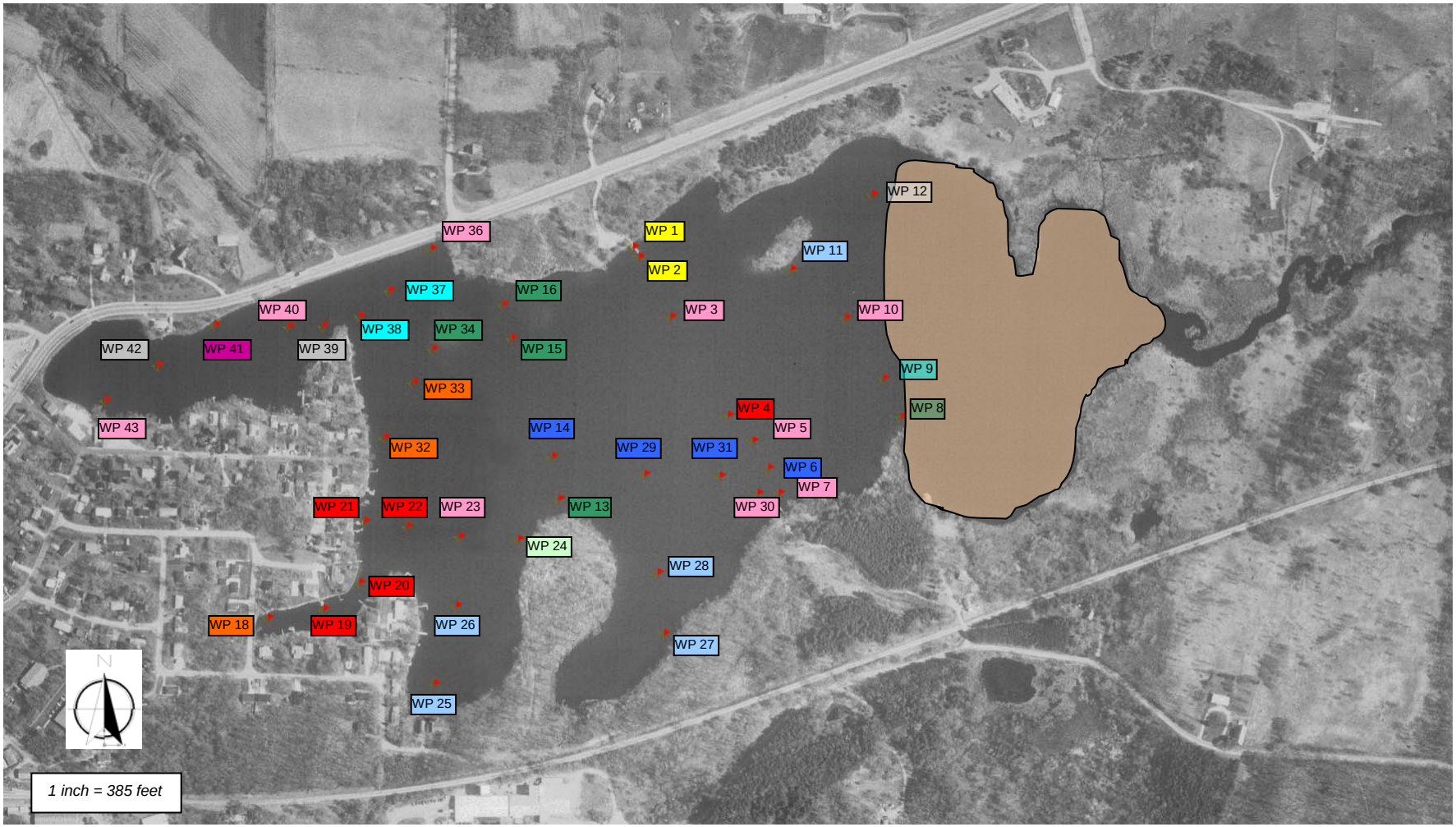
1. The frequency of occurrence (FREQ) is the number of occurrences of a species divided by the number of samples with vegetation, expressed as a percentage. It is the percentage of times a particular species occurred when there was aquatic vegetation present, and is analogous to the Jesson and Lound point system.

2. The relative frequency of occurrence (RFREQ) is the frequency of a species divided by the total frequency of all species. The sum of the relative frequencies should equal 100 percent. This statistic presents an indication of how the plants occur throughout a lake in relation to each other. It is used in the calculation of the Importance Value and Simpson Diversity Index set forth below.

[9]*Memo from Stan Nichols, to J. Bode, J. Leverence, S. Borman, S. Engel, D., Helsel, entitled "Analysis of macrophtye data for ambient lakes-Dutch Hollow and Redstone Lakes example," Wisconsin Geological and Natural History Survey, University of Wisconsin-Extension, February 4, 1994.*

Map 5

AQUATIC PLANT COMMUNITY DISTRIBUTION IN LOWER SPRING LAKE: 2005



Source: Environmental Horizons, Inc.

- Eurasian water milfoil, Curly leaf pondweed, Variable leaf pondweed
- Eurasian water milfoil Muskgrass, Curly leaf pondweed, Elodea
- Eurasian water milfoil, Muskgrass
- Eurasian water milfoil, Curly leaf pondweed, Sago pondweed
- Eurasian water milfoil, Coontail, Elodea
- Eurasian water milfoil
- White water lily, Duckweed
- Eurasian water milfoil Curly leaf pondweed
- Eurasian water milfoil Sago pondweed
- Eurasian water milfoil, Coontail, Curly leaf pondweed
- Eurasian water milfoil Coontail, Muskgrass
- Muskgrass
- Eurasian water milfoil Floating leaf pondweed, Eel grass

Table 6

LOWER SPRING LAKE AQUATIC PLANT ECOLOGICAL SIGNIFICANCE

Aquatic Plant Species Present	Ecological Significance
Ceratophyllum demersum (coontail)	Provides good shelter for young fish and supports insects valuable as food for fish and ducklings
Chara vulgaris (muskgrass)	Excellent producer of fish food, especially for young trout, bluegills, small and largemouth bass, stabilizes bottom sediments, and has softening effect on the water by removing lime and carbon dioxide
Elodea canadensis (waterweed)	Provides shelter and support for insects which are valuable as fish food
Lemna minor (duckweed)	Provides an often important wildfowl food and attracts small aquatic animals, in addition to muskrat
Lemna trisulca (duckweed)	Provides an often important wildfowl food and attracts small aquatic animals
Myriophyllum spicatum (Eurasian water milfoil)	None known; may provide shelter for fish
Najas flexilis (bushy pondweed)	Stems, foliage, and seeds important wildfowl food and produces good food and shelter for fish
Nymphaea tuberosa (white water lily)	Provides food for waterfowl and marsh birds; roots eaten by waterfowl and marsh birds; beaver, deer, muskrats, and porcupine; provides shade and shelter for fish
Potamogeton amplifolius (floating-leaf pondweed)	Provides food for ducks and shelter for fish
Potamogeton crispus (curly-leaf pondweed)	Provides food, shelter and shade for some fish and food for wildfowl
Potamogeton gramineus (variable pondweed)	Provides habitat for fish and food for waterfowl, in addition to muskrat, beaver, and deer
Potamogeton illnoensis (Illinois pondweed)	Provides shade and shelter for fish; harbor for insects; seeds are eaten by wildfowl
Potamogeton pectinatus (Sago pondweed)	This plant is the most important pondweed for ducks, in addition to providing food and shelter for young fish
Potamogeton richardsonii (clasping-leaf pondweed)	Provides food, shelter and shade for some fish, food for some wildfowl, and food for muskrat. Provides shelter and support for insects, which are valuable as fish food
Vallisneria americana (eelgrass or water celery)	Provides good shade and shelter, supports insects, and is valuable fish food

[a]*Information obtained from* A Manual of Aquatic Plants *by Norman C. Fassett, University of Wisconsin Press;* Guide to Wisconsin Aquatic Plants*, Wisconsin Department of Natural Resources; and,* Through the Looking Glass...A Field Guide to Aquatic Plants*, Wisconsin Lakes Partnership, University of Wisconsin-Extension.*

Source: Environmental Horizons, Inc.

3. The average or relative density (ADEN) is the sum of the density ratings for a species divided by the number of sampling points with vegetation. The maximum density rating of 4.0 is assigned to plants that occur at all points sampled at a given depth, the modified Jesson and Lound protocol adopted by the Wisconsin Department of Natural Resources uses four sampling points per depth sampled. The average density presents an indication of how abundant the growth of a particular plant is throughout the lake. This measure, along with the percent occurrence, gives a good indication of the distribution of aquatic plant communities in a lake.

4. The Simpson Diversity Index (SDI) is defined as one minus the sum of the relative frequencies squared, and is expressed in equation form as:

$$SDI = 1 - 3(RFREQ)^2$$

where SDI is the Simpson Diversity Index and RFREQ is the relative frequency value defined above. Based upon this index of community diversity, the closer the SDI value is to one, the greater the diversity between the communities being compared.

5. The importance value (IV) is defined as the product of the relative frequency and the average density, expressed as a percentage:

   i. IV = (RFREQ) (ADEN) (100)

where IV is the importance value, RFREQ is the relative frequency, and ADEN is the average density. This number provides an indication of the dominance of a species within a community based upon both frequency and density. It also somewhat addresses the problem of difference in stature between different plant species.

6. The similarity index (SI) is a means of comparing two communities by estimating the degree to which the communities share common components. The index is calculated as:

   i. SI = 2W / A + B

where SI is the similarity index value, W is the amount two communities have in common or the lowest relative frequency of a species pair, and A plus B is the sum of the relative frequency for both communities, which should always be about 200 since the relative frequency of each community should equal 100 percent. This index could be calculated based upon average density or the importance values. However, relative frequency is a better measure since it does not change much during the growing season so the results remain comparable, even if the timing of sampling is not exactly the same, and, given that there are several methods for assigning average density, use of average density may yield a result that is not directly comparable. Use of relative frequency avoids such interpretation problems. It should be noted that, although a 100 percent similarity is theoretically possible, repeated sampling studies from the same community has shown that a similarity index of 85 percent or higher should be considered indicative of no community change.

7. The p-value, or Pearson chi-squared test, is calculated using a statistical program for personal computers.[10] The p-values are calculated based upon a two by two frequency table. A p-value of less than or equal to 0.05 is the limit used to identify a significant difference between two populations. This means that, at p = 0.05, there is a 95 percent probability that two populations are different, or that, after comparing 100 mean values from each data set, 95 would be different and five would overlap.

[10] *Statistics for Windows, General Conventions and Statistics, 1995, Statsoft, Inc., Tulsa, Oklahoma.*

FISHERIES

The Wisconsin Department of Natural Resources[11] reports that the fish population of Lower Spring Lake included smallmouth bass, which were reported to be abundant, as well as largemouth bass and bluegill, which were reported to be common. Northern pike were reported to be present.

RECREATIONAL USES AND FACILITIES

Lower Spring Lake is a multi-purpose waterbody serving a variety of recreational uses. Recreational uses include boating, swimming, and fishing during the summer months. The Lake is well-served by public access sites, including an operational public recreational boating access site located in the north central portion of the Lake shore adjacent to STH 59, and a developed public park located within the Village of Palmyra on the southwestern extreme of the Lake shore at the southeastern corner of the intersection of STH 59 and Anenome Avenue, as shown on Map 6.

The Lake is used year around as a visual amenity, walking, bird watching and picnicking are popular passive recreational uses of the waterbody, and is heavily utilized during open water periods for a variety of recreational activities. Recreational boating, especially associated with angling activities, is a popular active recreational use of the Lake, as summarized in Table 7. The types of watercraft found on the Lake include fishing boats, pontoons, paddleboats, and canoes/kayaks, as shown in Table 8. The Lake is considered by the Wisconsin Department of Natural Resources to have adequate public recreational boating access, as defined in Section NR 1.91 of the *Wisconsin Administrative Code*.

LOCAL ORDINANCES

Lower Spring Lake and its surrounds is subject to ordinances promulgated by the Village of Palmyra, while lands within the Town of Palmyra are under the jurisdiction of the Jefferson County ordinances. The Village ordinance contains land division and erosion control and stormwater runoff provisions applicable to lands within the Village as well as provisions for shoreland-wetland, floodland, and conservancy districts. The County ordinance contains provisions creating, *inter alia*, waterfront, shoreland-wetland, conservancy, and residential/recreational zoning districts applicable to the unincorporated areas of the County as well as shoreland provisions relating to protection of shorelines and shoreland vegetation. In addition the County has a floodplain ordinance and subdivision ordinance. Recreational boating on Lower Spring Lake is regulated by the State of Wisconsin boating regulations promulgated pursuant to Chapter 30, *Wisconsin Statutes*.

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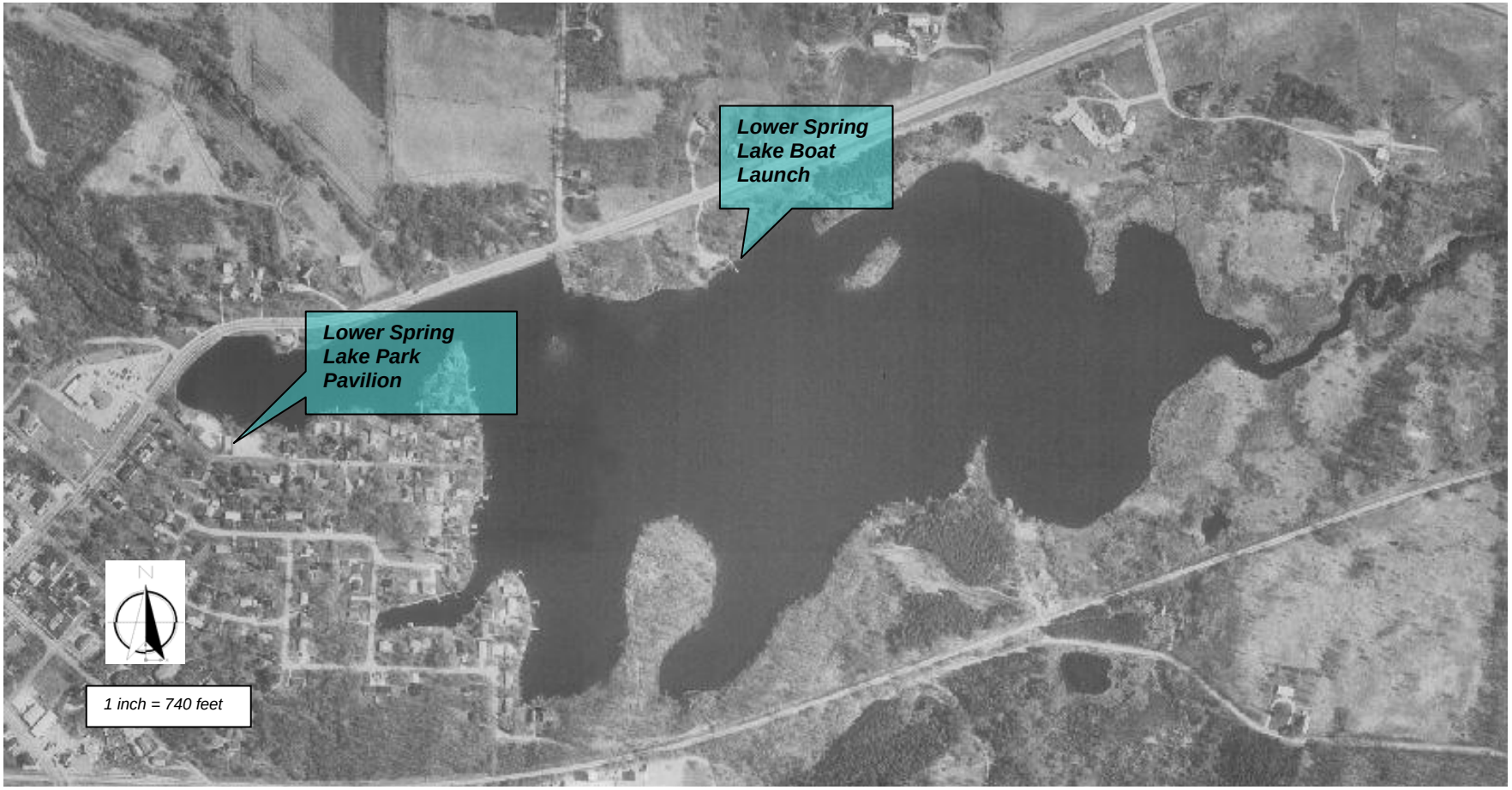
[11] *Wisconsin Department of Natural Resources Publication No. PUBL-FM-800 2005,* Wisconsin Lakes*, 2005.*

Map 6

PARK AND LAKE-ACCESS SITES IN THE VICINITY OF LOWER SPRING LAKE



Source: Environmental Horizons, Inc.

Table 7

RECREATIONAL USE SURVEY ON LOWER SPRING LAKE: 2005

Date and Time	Weekend Participants						
	Fishing from Shoreline	Swimming	Canoeing/ Kayaking	Fishing Boat	Paddleboat	Other	Total
June 19, 2005 1:30 p.m. to 3:30 p.m.	3	- -	2	5	1	- -	11
Percent	27	- -	18	45	10	- -	100

Source: Environmental Horizons, Inc.

Table 8

WATERCRAFT ON LOWER SPRING LAKE: 2005

Type of Watercraft								
Power Boat	Fishing Boat	Pontoon Boat	Canoe	Paddleboat	Sailboat	Kayak	Other	Total
3	8	14	3	5	1	- -	- -	34

Source: Environmental Horizons, Inc.

Chapter III

ALTERNATIVE AND RECOMMENDED AQUATIC PLANT MANAGEMENT PRACTICES

INTRODUCTION

The abundance of aquatic plants, including muskgrass, coontail, and Eurasian water milfoil, continues to be perceived as a nuisance by Lower Spring Lake users. Ongoing aquatic plant management measures have, in part, maintained the abundance and distribution of these plants in such a condition as to minimize user-related concerns. Notwithstanding, localized recreational use problems are experienced in various areas of the Lake. These problems depend on the uses in those portions of the Lake, but generally involve the abundant growths of Eurasian water milfoil. These plants often grow to the surface of the Lake, making certain recreational uses in those areas of the Lake less enjoyable, in addition to impairing the aesthetic quality of the Lake. These plants primarily interfere with recreational boating activities by entangling propellers and clogging cooling water intakes, impairing slow-speed boating activity, and impeding navigation by human-powered watercraft. The shallow portions of the Lake especially have severe boating limitations as a result of the extensive and abundant growths of aquatic plants in this area. Without control measures, this area could become impassable for navigation. In addition to boating activities, the Lake is used extensively for fishing. Fishing and swimming also are adversely affected by aquatic plant growths. The swimming area at the Village park on the western shores of the Lake is coincident with an area of Eurasian water milfoil dominance, posing potential problems for swimming. Lakewide, Eurasian water milfoil growths can interfere with angling activities. In general, the abundance of aquatic plants throughout the lake basin is perceived as adversely affecting the aesthetic enjoyment of lake residents and visitors to the Lake.

Following a brief summary of the ongoing lake management program, alternatives and recommended refinements to the existing aquatic plant management plan[1] are described in this chapter. The alternatives and recommendations set forth herein are focused on those measures which are applicable to the Lower Spring Lake Protection and Rehabilitation District, with lesser emphasis given to measures which are applicable to others with jurisdiction within the drainage area tributary to Lower Spring Lake.

PAST AND PRESENT AQUATIC PLANT MANAGEMENT ACTIONS

The residents of Lower Spring Lake, in conjunction with the Village and Town of Palmyra, have long recognized the importance of informed and timely action in the management of Lower Spring Lake. The

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[1]*Northern Environmental,* Aquatic Macrophyte Survey: Lower Spring Lake, Palmyra, Wisconsin*, December 1993*.

Lower Spring Lake Management District was created as the principle organ for the conduct of lake management activities within the Lower Spring Lake basin. As noted in the adopted aquatic plant management plan, this District has undertaken regular water quality and aquatic plant monitoring. Some of these activities were conducted under the auspices of the Wisconsin Department of Natural Resources Self-Help Monitoring Program, and the District currently has a volunteer enrolled in the monitoring program.

Abundant aquatic plant growths in Lower Spring Lake led the Lower Spring Lake Management District to operate an aquatic plant harvester throughout the summer months, and treat specific areas of the Lake with chemical herbicides. Even so, concerns continue to exist over the lake water quality, primarily in relation to the control of aquatic plants. Therefore, this report is designed to update and refine the existing Lower Spring Lake aquatic plant management plan.

AQUATIC PLANT MANAGEMENT MEASURES

Aquatic plant management[2] refers to a group of management and restoration measures aimed at both the removal of nuisance vegetation and the manipulation of species composition in order to enhance and provide for recreational water use and encourage the development of a natural plant community that will result in a healthy lake ecosystem. Generally, aquatic plant management measures are classed into four groups; namely, physical measures which include water level management; manual and mechanical measures which include harvesting and removal; chemical measures which include using aquatic herbicides; and biological controls which include the use of various organisms, including insects. These controls are stringently regulated and require a State permit pursuant to the provisions of Chapters NR 107 and/or NR 109 of the *Wisconsin Administrative Code*.

The costs of aquatic plant management actions range from minimal for manual removal of plants using rakes and hand-pulling to upwards of $120,000 for the purchase of a mechanical plant harvester with operational costs of about $40,000 per year or more, depending on staffing and operating policies. Harvesting is probably the measure best applicable to large areas, while chemical controls may be best suited to confined areas and initial control of invasive plants. Planting of native plant species and control of Eurasian water milfoil by the weevil, *Eurhychiopsis lecontei*, are largely experimental in lakes, but can be considered in specialized shoreland areas.

Aquatic Herbicides

Chemical treatment with aquatic herbicides is a short-term method of controlling heavy growths of aquatic macrophytes and algae. The use of herbicides can contribute to an ongoing aquatic plant problem by increasing the natural rates of accumulation of decaying organic matter, in turn contributing to an increased oxygen demand which may cause anoxia. The use of herbicides can also potentially damage or destroy nontarget plant species that provide needed habitat for fish and other aquatic organisms. As a result, less desirable, invasive, introduced plant species may outcompete the more beneficial, native species. Hence, this is not a feasible management option to be used on a large scale. However, chemical control is often a viable technique for the control of the relatively small-scale infestations of Eurasian water milfoil and certain other plants such as curly-leaf pondweed and purple loosestrife. Chemicals are applied to the growing plants in either liquid or granular form. Chemical treatment can be administered at a relatively low cost and is, therefore, considered a viable management option to continue. This measure is considered as viable for selected areas in Lower Spring Lake.

Chemical applications should be conducted in accordance with current Department of Natural

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[2]*U.S. Environmental Protection Agency Report No. EPA-440/4-90-006,* The Lake and Reservoir Restoration Guidance Manual*, August 1990.*

Resources administrative rules, under the authority of a State permit, and by a licensed applicator working under the supervision of WDNR staff. Records accurately delineating treated areas, and the type and amount of herbicide used in each area, should be carefully documented and used as a reference in applying for permits in the following year. A recommended checklist is provided as Figure 1.

Aquatic Plant Harvesting

On the basis of previous use of a mechanical harvester on Lower Spring Lake, mechanical harvesting of aquatic plants appears to be a practical and efficient means of controlling plant growth as it removes the plant biomass and nutrients from Lower Spring Lake. Aquatic macrophytes are mechanically harvested with specialized equipment consisting of a cutting apparatus which cuts up to five feet below the water surface and a conveyor system that picks up the cut plants and hauls them to shore. Harvesting leaves enough plant material in the lake to provide shelter for fish and other aquatic organisms and to stabilize sediments. Mechanical harvesting does have some potentially negative impacts to fish and other aquatic life, may cause fragmentation and spread of some plants, and could disturb loosely consolidated bottom sediments. However, if done correctly and carefully, it has shown to be of benefit in ultimately reducing the regrowth of nuisance plants. Mechanical harvesting is a recommended method to continue as a control of aquatic plants in Lower Spring Lake.

Manual Harvesting

Due to an inadequate depth of water, it is not always possible for harvesters to reach the shoreline of every property. Manual harvesting, using rakes or other devices, can be effective in these limited water depths. Specially designed rakes are available to manually remove aquatic plants from the shoreline area and can be purchased commercially. Should the Lake Management District acquire a number of these specialty rakes, the rakes could be made available for the riparian owners to use on a trial basis to test their operability before purchasing them individually. The advantage of the rake is that it is easy and quick to use, immediately removing the plants from the lakeshore. Using this method also removes the plants from the lake, avoiding the accumulation of organic matter on the lake bottom adding to the nutrients that favor more plant growth. This method also gives the harvester more time to cover larger areas of the lake as maneuvering between the piers takes time and skill, and increases risk of collateral damage to boats and property. Manual harvesting is considered a feasible aquatic plant management measure for shallow waters of limited surface area.

Biological Controls

Another approach to controlling nuisance aquatic plant conditions, particularly in the case of Eurasian water milfoil, is biological control. Classical biological control has been successfully used to control a variety of aquatic plants.[3] Recent documentation states that *Eurhychiopsis lecontei*, an aquatic weevil species, has potential as a biological control agent for Eurasian water milfoil.[4] However, very few studies have been completed in Wisconsin using *Eurhychiopsis lecontei* as a means of aquatic plant management control, with those studies that have been completed suggesting variable responses by in-lake aquatic plant communities to these aquatic insects. One of the lakes studied during these investigations was Lower Spring Lake.[5] In general, these findings have indicated that the success of

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[3]*C.B. Huffacker, D.L. Dahlsen, D.H. Janzen, and G.G. Kennedy,* Insect Influences in the Regulation of Plant Population and Communities*, 1984, pp. 659-696; C.B. Huffacker and R.L. Rabb, editors,* Ecological Entomology*, John Wiley, New York, New York, USA.*

[4]*Sally P. Sheldon, "The Potential for Biological Control of Eurasian Water Milfoil (*Myriophyllum spicatum*) 1990-1995 Final Report," Department of Biology Middlebury College, February 1995.*

[5]*Laura L. Jester, Michael A. Bozek, and Daniel R. Helsel, Wisconsin Cooperative Fishery Unit,* Wisconsin Milfoil Weevil Project: Lower Spring Lake—Final Report*, March 1999.*

aquatic weevils for Eurasian water milfoil control in lakes that experience heavy boating traffic has been limited, with the insects being easily disturbed and washed off the plants by boat-generated wakes. While high-speed boating traffic in Lower Spring Lake is limited, the extensive use of the lake by motorized watercraft for angling purposes led to only localized success in the control of Eurasian water milfoil by the weevils.[6] Thus, use of biological controls is not recommended for use on Lower Spring Lake at this time. Nevertheless, the use of the aquatic weevils should continue to be periodically evaluated as a potentially viable measure applicable to Lower Spring Lake. The use of grass carp, *Ctenopharyngodon idella*, is not permitted in Wisconsin.

Figure 1

DISTRICT CHECKLIST FOR HERBICIDE APPLICATION

- ☐ Nuisance report completed defining areas of potential treatment
- ☐ Permit filed with the Wisconsin Department of Natural Resources
- ☐ Certified applicator hired[a]
- ☐ Required public notice in the newspaper
- ☐ Public informational meeting (required if five or more parties request a meeting)
- ☐ Posting of areas to be treated in accordance with regulations (discussed previously in report)
- ☐ Weather conditions cooperating
  - Wind direction and velocity
  - Temperature

[a]*A licensed applicator will determine the amount of herbicide to be used, based upon discussions with appropriate staff from the Wisconsin Department of Natural Resources, and will keep records of the amount applied.*

Source: Environmental Horizons, Inc.

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[6] Ibid.

A variation on biological controls is the use of shoreland vegetation in the land-water ecotone that lies across the lake shoreline. As shown on Map 4, much of the developed shoreline is protected with riprap and other structural shoreline protection measures. Such measures do not provide water quality benefit to the Lake, but simply act to stabilize the shore itself. Use of natural shoreline vegetation can not only provide benefit in securing the stability of the shoreline, but also can mitigate runoff from developed lands within the shore zone, while use of natural plantings of largely native plants can take advantage of the extensive and deep root systems of these plants to hold and protect the shoreline. A consequence of this, too, is the presence of taller vegetation in the shore zone that limits the degree of intrusion of resident goose populations onto the shorelands. This is in contrast to lawned areas that provide ideal resting and grazing habitat for these waterfowl. For these reasons, installation of shoreline buffer strips is recommended for Lower Spring Lake.

Physical Measures

Lake bottom covers and light screens provide limited control of rooted plants by creating a physical barrier which reduces or eliminates the sunlight available to the plants. They have been used to create swimming beaches on muddy shores, to improve the appearance of lakefront property, and to open channels for motorboating. Sand and gravel are usually readily available and relatively inexpensive to use as cover materials, but plants readily recolonize areas so covered in about a year. Synthetic materials, such as polyethylene, polypropylene, fiberglass, and nylon, can provide relief from rooted plants for several years. However, these structures must be placed and removed annually. Because of the limitations involved, lake bottom covering as a method to control aquatic plant growth is not recommended for Lower Spring Lake.

In addition to the placement of materials on the lake bed, manipulation of the water surface forms an alternative physical management measure. Periodic drawdowns can not only allow shoreline restoration work to proceed, but also can help to consolidate sediments and control the growths of rooted aquatic plants. Overwinter drawdowns have been known to freeze out certain plant species, including Eurasian water milfoil.[7] Unfortunately, water lily, elodea and coontail are also generally affected negatively by such measures.[8] Consequently, the use of periodic drawdown for aquatic plant management is not recommended; however, such measures can be used to allow for the installation of shoreline buffers, repair of structural shoreline protection measures, and related purposes. It should also be noted that over-winter drawdowns typically result in early spring refilling of the Lake, which practice captures the nutrient-rich spring runoff that has the potential to trap additional amounts of plant nutrient within a lake basin, offsetting the potential benefit of the drawdown. In addition, many lakes exhibit extensive algal growths upon refilling.

Boating Ordinances

The promulgation of more stringent controls on the use of powered watercraft within Lower Spring Lake is one means of regulating the conduct of boat traffic which could be harmful to the most important ecologically valuable areas in the Lake. These areas include the eastern portions of the Lake basin. The areas in which the greatest diversity of native aquatic plant species occurs, and the major islands in the Lake basin which require stabilization of erosional areas on their shorelines, that could also benefit from reduced wake waves in their vicinities.

Additional controls could be put in place by amending the current provisions to further limit boating activity within specific areas of the Lake to defined traffic lanes within the Lake, thereby minimizing new

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[7] *G. Dennis Cooke, Eugene B. Welch, Spencer A. Peterson and Peter R. Newroth,* Restoration and Management of Lakes and Reservoirs*, Lewis, Boca Raton, 1993.*

[8] Ibid.

colonization and proliferation of Eurasian water milfoil and the propagation of nuisance plant species by the operation of watercraft. Should such an alternative be considered, boat traffic lanes must be designated by approved regulatory markers and conform to Section NR 5.09 of the *Wisconsin Administrative Code*.[9] This section requires that restrictions placed on the use of the waters of the State be predicated upon the protection of public health, safety, or welfare. Boating ordinances, enacted in conformity with State law, must be clearly posted at public landings in accordance with the requirements of Section 30.77(4) of the *Wisconsin Statutes*. Notwithstanding, given the current level of regulation of public recreational boating traffic on the Lake, no further regulation appears to be warranted at this time on Lower Spring Lake.

Public Information

Aquatic plant management usually centers on the eradication of nuisance aquatic plants for the improvement of recreational lake use. The majority of the public views all aquatic plants as "weeds" and residents often spend considerable time and money removing desirable plant species from a lake without considering their environmental impacts. Thus, public information is an important component of an aquatic plant management program for Lower Spring Lake, and is recommended as an ongoing element of the aquatic plant management program on the Lake. Posters and pamphlets are available from the University of Wisconsin-Extension and Wisconsin Department of Natural Resources that provide information and illustrations of aquatic plants, their importance in providing habitat and food resources in aquatic environments, and the need to control the spread of undesirable and nuisance plant species.

RECOMMENDED AQUATIC PLANT MANAGEMENT MEASURES

The goal of the management program is to accommodate a range of recreational uses of the Lake to the extent practicable and to enhance the public perception of the Lake as a centerpiece of the Village and Town of Palmyra, without inflicting irreparable damage to the ecosystem of Lower Spring Lake and its structure and functioning. To accomplish this goal, specific control measures are recommended to be applied in various areas of the Lake. The refined recommended Lower Spring Lake aquatic plant management measures are summarized in Table 9, and the recommended measures are graphically summarized on Map 7. It is recommended that the Lower Spring Lake Management District continue to take the lead in implementing the refined plan.

Harvesting Plan

The recommended aquatic plant management plan consists of the integrated use of mechanical and manual harvesting, supplemented as necessary through the limited application of appropriate aquatic herbicides, designed to minimize the negative impacts on the ecologically valuable areas of the Lake while providing a level of control needed to facilitate the desired recreational uses of the Lake. In addition, such management measures are recommended to be supplemented by an informational and educational program.

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[9]*Two general types of buoyage exist: regulatory buoys, such as those used to demarcate slow-no-wake or exclusionary areas; and informational buoys, such as those used to enhance public awareness. Buoys must be white in color, cylindrical in shape, seven or more inches in diameter, and extend 36 or more inches above the water line. Regulatory buoys include buoys used to demarcate restricted areas, prohibit boating or types of boating activities in specific areas, and control the movements of watercraft. Regulatory buoys used to demarcate regulated areas display their instructions in black lettering. Some types of regulatory buoys display an orange diamond with an orange cross inside; others display an orange circle. Informational buoys are similar in construction to the regulatory buoys, but contain an orange square on the white background. Whereas regulatory markers are enforceable, informational buoys are not.*

Table 9

RECOMMENDED AQUATIC PLANT MANAGEMENT PLAN ELEMENTS FOR LOWER SPRING LAKE

Plan Element	Subelement	Location	Management Measures	Initial Estimated Cost	Management Responsibility
Recreational Use Management	Recreational use zoning	Entire Lake	Protect native aquatic plant communities, and fish breeding and habitat areas	$ 500	Lower Spring Lake Management District, Village and Town of Palmyra and WDNR
	Lakewide nonnative species management program	Eurasian water milfoil control zone, purple loosestrife and zebra mussel control	Prevent the spread of nonnative plants and animals through cleaning of boats, trailers and related facilities throughout the Lake; limited use of herbicides in spring, manual removal during summer and fall, is recommended	- -	Lower Spring Lake Management District, Village and Town of Palmyra and WDNR
	Public informational programming	Direct drainage area tributary to Lower Spring Lake	Continue public awareness and information programming	- -	Lower Spring Lake Management District
Aquatic Plant Management	Manual harvesting	Localized areas of shoreline	Harvest nuisance plants, including Eurasian water milfoil and purple loosestrife, as required around docks and piers; collect plant fragments arising from boating and harvesting activities	- -[a]	Lower Spring Lake Management District and individuals
	Mechanical harvesting	Major and minor channel harvesting	Harvest nuisance plants, including Eurasian water milfoil, to maintain public recreational boating access promote public safety and convenience, and enhance angling opportunities	$40,000[b]	Lower Spring Lake Management District
	Chemical controls	Localized areas of the Lake, especially in proximity to docks and piers	Control aquatic plants through limited use of herbicides in spring; manual removal, as noted above, is recommended during summer and fall	$ 5,000	Lower Spring Lake Management District
	Eurasian water milfoil control	Lakewide	Control nonnative, invasive species as required to prevent the spread of nuisance species within the Lake; use of herbicides in spring to limit the volume of decomposing biomass and quantity of herbicides required is recommended	$10,000	Lower Spring Lake Management District and individuals
	Public informational programming	Direct drainage area tributary to Lower Spring Lake	Continue public awareness and information programming; continue monitoring of aquatic plant communities	$ 1,500[b,c]	Lower Spring Lake Management District

[a]*Measures recommended generally involve low or no cost and would be borne by private property owners. Cost is included under public informational and educational component.*

[b]*Partial funding available through the Wisconsin Department of Natural Resources grant programs.*

[c]*Periodic additional surveys are recommended at five- to 10-year intervals.*

Source: Environmental Horizons, Inc.

In order to implement the recommended aquatic plant management program, the following management actions are recommended:

1. The continued operation by the Lower Spring Lake Management District of the existing harvesters and transport equipment (Photo 3), and replacement of that equipment as required.

2. The conduct of shoreline clean up activities to collect aquatic plant fragments and limit the spread of Eurasian water milfoil in the Lake; consideration should be given to the acquisition and operation of skimming equipment as one means of facilitating the collection and removal from the Lake of aquatic plant fragments that accumulate in nearshore areas.

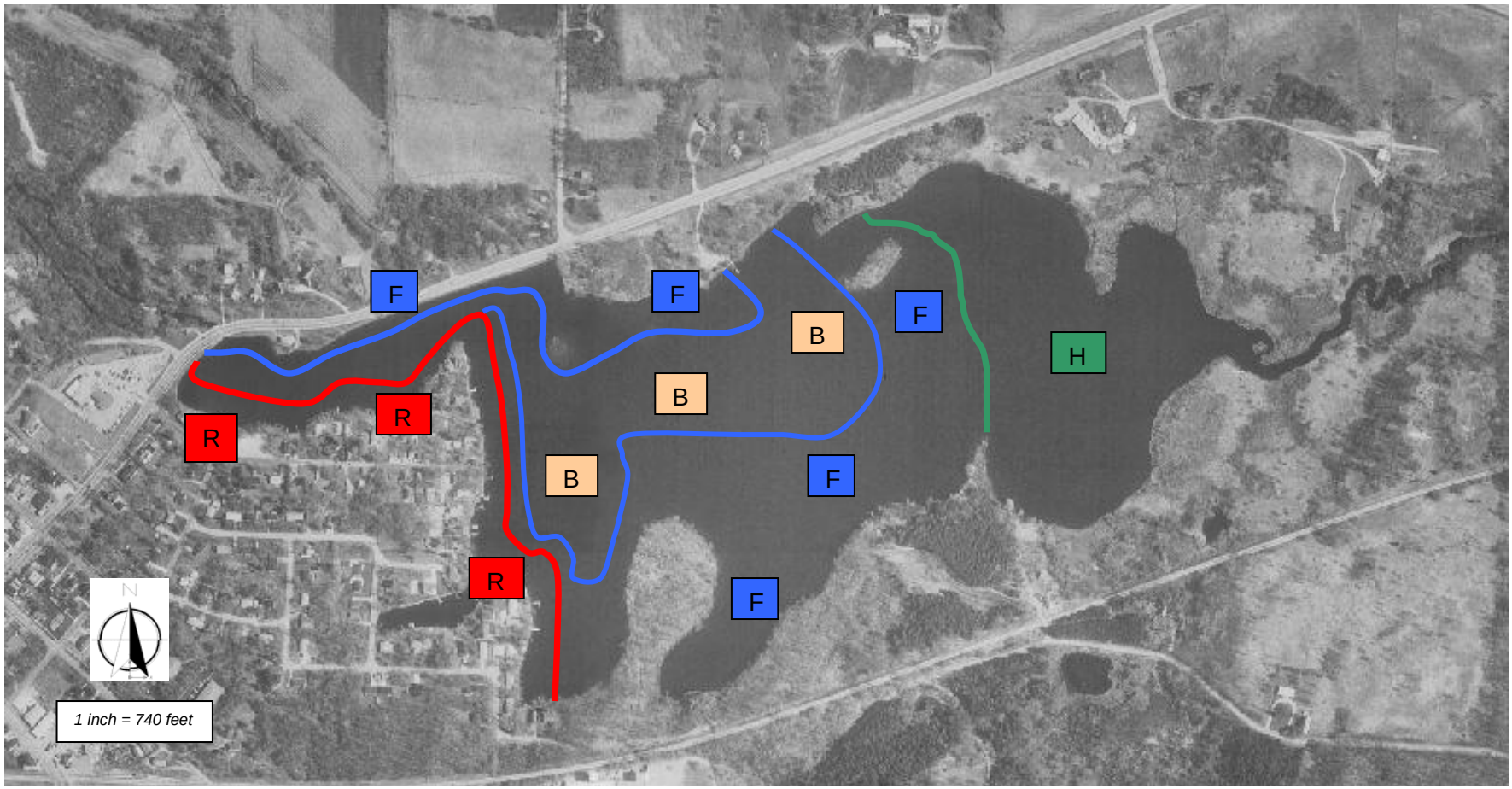
3. The maintenance of the shared access channels, which should be harvested in such manner as to minimize the potential detrimental effects on the fish and invertebrate communities. Directing boat traffic through these common channels would help to delay the regrowth of vegetation in these areas. Provision of appropriate signage and buoyage, especially at the public recreational boating access site, is recommended.

4. The use of shallow harvesting, cutting at approximately two feet to remove the surface canopy of nonnative plants such as Eurasian water milfoil, to provide a competitive advantage to the low-growing native plants in the Lake is recommended. By not disturbing these low-growing species, which generally grow within one to two feet of the lake bottom and in relatively low densities, and leaving the root stocks and stems of the cut plants in place, the resuspension of sediments in the Lake will be minimized. This type of harvesting should be focused, primarily, on boating channels around the perimeter of the principle lake embayments, and, secondarily, on other areas with extensive growths of Eurasian water milfoil.

5. The control of State-designated nonnative aquatic plant species, including those currently proposed for specific control measures pursuant to Chapter NR 109 of the *Wisconsin Administrative Code*, Eurasian water milfoil and curly-leaf pondweed, using mechanical harvesting supplemented as appropriate by use of aquatic herbicide treatments throughout the Lake. Consideration of the use of a “whole lake” treatment, using an experimental herbicide such a fluridone, could be considered, with due consideration of the likelihood of

Map 7

RECOMMENDED AQUATIC PLANT MANAGEMENT PLAN FOR LOWER SPRING LAKE



Source: Environmental Horizons, Inc.

R Riparian access – harvesting: moderate priority; chemicals: moderate priority.

F Fishing – harvesting: low priority; herbicides: none.

B Boating access – harvesting: high priority; herbicides: high priority, where necessary.

H Habitat – no harvesting; no chemical control.

Photo 3

Lower Spring Lake Aquatic Plant Harvester

Source: Environmental Horizons, Inc.

extreme weather events that could result in washout of the herbicide.[10]

6. The use of chemical herbicides, notwithstanding those applications indicated for the control of State-designated nonnative invasive species, should be limited elsewhere in the Lake, if found to be necessary, to controlling nuisance growths of aquatic plants in shallow water around docks and piers. Only herbicides that are selective in their control, such as 2,4-D and fluridone, should be used. Algicides, such as Cutrine Plus, generally are not recommended as algal blooms are rare in the Lake, and valuable macroscopic algae, such as *Chara*, may be killed by this product. It is recommended that chemical applications, if required, should be made in early spring to maximize their effectiveness on nonnative plant species, minimize their impacts on native plant species, and act as a preventive measure to reduce the development of nuisance conditions.

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[10]*Fluridone requires a significantly longer contact time at lower effective concentrations to be effective than do similar herbicides, such as 2,4-D that are currently used to control Eurasian water milfoil growths in the Lake. Use of herbicides requires a Wisconsin Department of Natural Resources permit and applications should be carried out by licensed applicators.*

7. The control of rooted vegetation between adjacent piers is recommended to be left to the riparian owners concerned, as it is time consuming and costly for the mechanical harvester to maneuver between piers and boats and such maneuvering may entail liability for damage to boats and piers. As an alternative, it is recommended that the Lower Spring Lake Management District obtain informational brochures regarding shoreline maintenance, such as information on hand-held specialty rakes made for this specific purpose, to be made available to these residents.

8. It is recommended that ecologically valuable areas be restricted from aquatic plant management activities, especially during fish spawning seasons in early summer and autumn.

9. The continuation by the Lower Spring Lake Management District and riparian communities of educational and informational programming within the aquatic plant management program for the Lake is recommended. Such programming can provide students and householders with information on the types of aquatic plants in Lower Spring Lake and the value of and the impacts of these plants on water quality, fish, and on wildlife; and on alternative methods for controlling existing nuisance plants, including the positive and negative aspects of each method. An organized aquatic plant identification “day” is one method of providing effective informational programming to lake residents. Other sources of information and technical assistance include the Department of Natural Resources Aquatic Plant Monitoring Program and the University of Wisconsin-Extension Service. The aquatic plant illustrations provided in Appendix A may assist individuals interested in identifying plants near their residences. Residents should be encouraged to observe and document changes in the abundance and types of aquatic plants in their part of the Lake on an annual basis.

As noted, mechanical controls, or aquatic plant harvesting, supplemented, as necessary, by manual removal of plants in shallow water areas or around piers and docks, and limited use of herbicides, are recommended as the primary aquatic plant management measures for Lower Spring Lake. The ecologically valuable areas should be restricted from harvesting. In addition, harvesting should not take place in shallow waters, generally three feet or less, to avoid disturbance of fish spawning areas and beds of native aquatic plants. Special care should be taken to avoid disturbing major spawning areas of bass in Lower Spring Lake during spring spawning season, May 1st to June 30th, annually.

The primary objective of the management program is to accommodate recreational uses of the Lake, and to enhance the public perceptions of the Lake, without inflicting irreparable damage to the structure and functioning of the lake ecosystem. To accomplish this objective, specific control measures should be applied in each of the lake zones as summarized in Table 10. The Lake has been divided into high-, moderate-, and low-priority harvesting areas. High-priority harvesting areas are those areas that are used for public recreational boating access. Moderate-priority harvesting areas are the areas used for general recreation. Low-priority harvesting areas are areas that are used primarily for passive recreation and/or where plant growth is observed to be sparse. Additional areas have been designated as “no control” areas, and include important areas for fish spawning and habitat. These spawning and habitat areas should not be subjected to aquatic plant control measures before mid-June of each year, except in Eurasian water milfoil control areas where the dense growths of Eurasian water milfoil can negatively affect such habitat.

Harvesting operations elsewhere in the Lake basin should continue to be timed to minimize any impact on the fish spawning season. For this reason, harvesting generally should begin in mid- to late-May of each year. Also, harvesting should not take place in shallow waters, generally three feet or less in depth, to avoid disturbance to fish habitat and beds of native aquatic plants. As is currently the practice

Table 10

RECOMMENDED AQUATIC PLANT MANAGEMENT TREATMENTS FOR LOWER SPRING LAKE

Zone and Priority	Recommended Aquatic Plant Management Treatment
Zone B (Boating) Moderate-Priority Harvesting	Harvesting to be limited to maintaining 75-foot-wide navigational channels along the perimeter of the Lake, and 30-foot-wide shared access lanes perpendicular to the shoreline extending towards the center of the Lake to allow access to the public recreational boating access site
	Limited late season harvesting (late August to early September) may be necessary to maintain adequate open water areas in the central portion of the Lake
Zone F (Fishing) Low-Priority Harvesting	Zone F is intended to accommodate fishing from a boat
	It is recommended that approximately 15-foot-wide channels be harvested perpendicular to the shore at about 100-foot intervals
	Chemical use, if required, should be restricted to selective control of nuisance species near the public access sites; no chemical controls are recommended during fish spawning periods in early spring and late autumn
Zone H (Habitat) No Harvesting	No harvesting or in-lake chemical application should be permitted, except in special instances where selective herbicide application may be allowed for the control of nuisance species
	Debris and litter cleanup would be needed in some adjacent areas; the immediate shoreline should be preserved in natural, open use to the extent possible
Zone R (Riparian Access) High-Priority Harvesting	Littoral zone. The entire area may not require intensive plant management
	Aquatic macrophyte growth within 150 feet of shoreline should be harvested to provide maximum opportunities for boating, fishing, and limited swimming
	Areas between piers should not be harvested due to potential liability and maneuverability problems. Residents are encouraged to manually harvest aquatic plants in these areas
	Chemical use, if required, should be restricted to pier and dock areas and should not extend more than 100 feet from shore; subject to permit requirements
Approximate Total Area to Be Harvested	40 acres

[a]*Control of State-designated nonnative aquatic plant species, currently including Eurasian water milfoil and curly-leaf pondweed, using appropriate aquatic plant control measures including harvesting, targeted herbicide treatment, and public informational programming, is recommended for lakewide application.*

Source: Environmental Horizons, Inc.

in the ongoing aquatic plant harvesting operations of the District, harvesting activities within areas where operators observe significant capture of fishes, eggs, fry, or fingerlings should be immediately curtailed so as to minimize potential impacts on the Lake fishery. The refined plan better targets the nuisance aquatic plants such as Eurasian water milfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*), as well as dense growths of coontail (*Ceratophyllum demersum*). The recommended, generalized sequence of the harvester operations on Lower Spring Lake is set forth in Figure 2. The operators of the harvester will be provided with laminated copies of the approved harvesting plan showing the limits of harvesting operations, as shown on Map 7. A copy of this map is to be kept on the harvester at all times.

To benefit the fishery, harvesting of “cruising” lanes or areas wherein visual predators, such as largemouth bass and northern pike, can control the growths of panfish, such as bluegill. These lanes tend to run perpendicular to the boating lanes and can be considered as low-priority harvesting areas.

Figure 2

HARVESTING SEQUENCE FOR LOWER SPRING LAKE[a]

A. HARVEST NAVIGATIONAL CHANNELS IN **ZONE B** IN LOWER SPRING LAKE. MANUALLY HARVEST MOORINGS AND BEACH AREAS OF NO MORE THAN 30 LINEAR FEET OF SHORELINE FOR RIPARIAN ACCESS IN **ZONE R**, AS SHOWN ON MAP 7. HARVESTING TO BE CARRIED OUT BY INDIVIDUAL HOUSE-HOLDERS WITH PIERHEAD COLLECTION OF HARVESTED PLANTS BY LOWER SPRING LAKE MANAGEMENT DISTRICT

B. HARVEST CHANNELS 30 FEET IN WIDTH PARALLEL TO THE SHORELINE AND 30-FOOT-WIDE SHARED-ACCESS LANES PERPENDICULAR TO THE SHORELINE EXTENDING TOWARDS THE CENTER OF THE LAKE, AS SHOWN IN **ZONE R** ON MAP 7. THIS ENTIRE AREA MAY NOT REQUIRE INTENSIVE MANAGEMENT

C. HARVEST FISH LANES OF ABOUT 15 FEET IN WIDTH AS NECESSARY TO PROMOTE ANGLING WITHIN **ZONE F**, AS SHOWN IN MAP 7. DO NOT CLEAR CUT

D. CONTROL STATE-DESIGNATED NONNATIVE INVASIVE SPECIES AS REQUIRED THROUGHOUT THE LAKE BASIN: CONTROL MEASURES MAY INCLUDE MANUAL HARVESTING, MECHANICAL HARVESTING, AND TARGETED HERBICIDE TREATMENTS, AND SHOULD INCLUDE PUBLIC INFORMATIONAL PROGRAMMING WITH APPROPRIATE SIGNAGE AT ACCESS SITES.

NOTE: Sequence A and B could be done concurrently in one area of the Lake as a time-saving measure.

[a]*No harvesting would be conducted in Zone H, within 100 feet of the island areas, except as required for control of State-designated nonnative invasive species.*

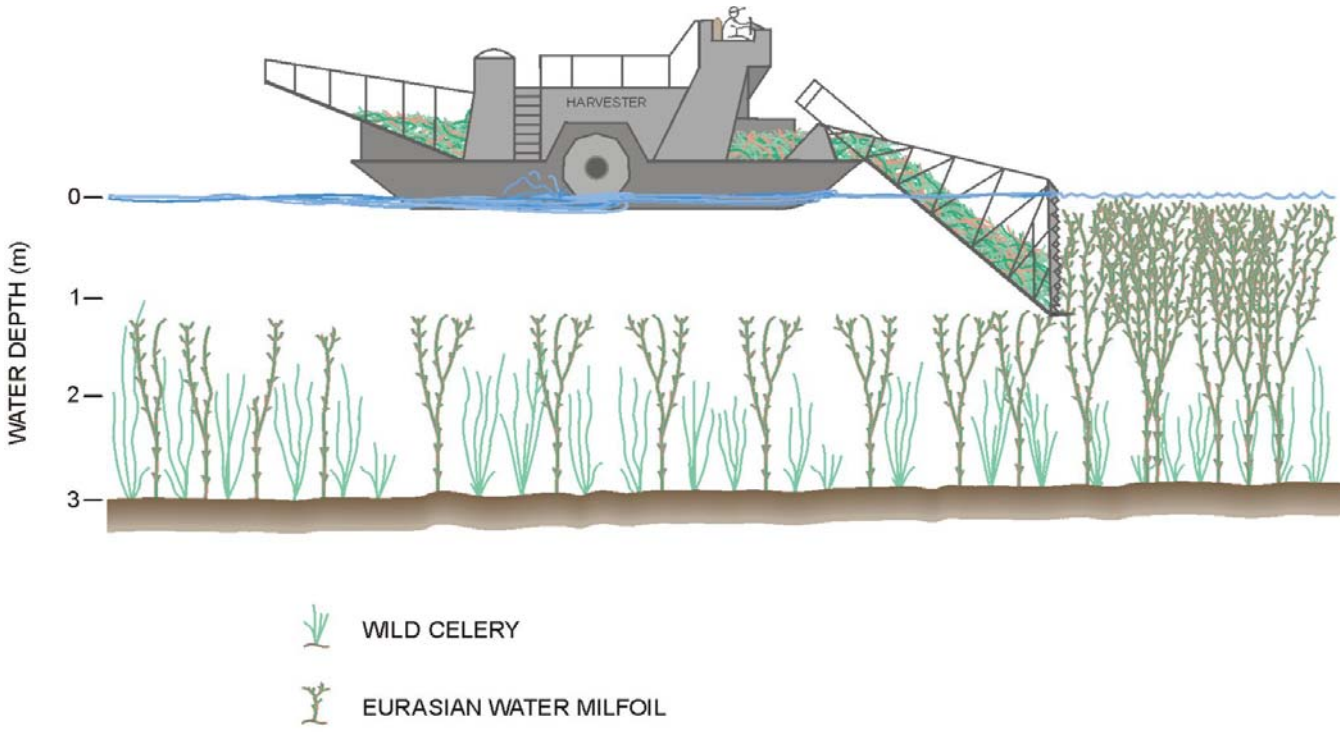
Source: Environmental Horizons, Inc.

Depth of Harvesting and Treatment of Fragments

The Aquarius Systems model H-420 Aquatic Plant Harvester has a maximum cutting depth of five feet. While this exceeds the water depth of about four-fifths of the Lake, it is not the intention to clear the Lake of aquatic plants given the heavy angling use, its morphology (which, in places, is not conducive to unrestricted motorized boat traffic), and the program goals. Sufficient plant life will be retained in the Lake to minimize resuspension of lake bottom sediments, to maintain desirable plant communities, and to continue to provide adequate habitat for fish and aquatic life. To this end, top cutting of plants, such as Eurasian water milfoil, as shown in Figure 3, is recommended, especially in Zones B and F, where narrow channels could be harvested to provide navigational access and “cruising lanes” for predator fish to migrate into the macrophyte beds to feed on smaller fish. The harvester will collect all plant cuttings and fragments on site. The District or the riparian householders should collect fragments accumulating on the shore. Fragments can be used as garden mulch.

Figure 3

PLANT CANOPY REMOVAL WITH AN AQUATIC PLANT HARVESTER



NOTE: Selective cutting or seasonal harvesting can be done by aquatic plant harvesters. Removing the canopy of Eurasian water milfoil may allow native species to reemerge.

Source: Wisconsin Department of Natural Resources and Environmental Horizons, Inc.

Buoyage

Temporary marker buoys may be used to direct harvesting operations in the Lake by marking the areas to be cut. However, the size of the Lake generally precludes the need for such buoys, except as they are required for the control of boating traffic. Demarcation of navigational channels within the boating access areas shown on Map 6, using regulatory buoys, is recommended to minimize the spread of nonnative plants, such as Eurasian water milfoil, within the Lake. The harvester operators will be provided with a laminated copy of the updated harvesting plan and made familiar with the plan and local landmarks to the degree necessary to carry out the plan without the use of buoys. District staff regularly supervise harvesting operations.

Harvested Plant Material Transfer and Disposal Sites

Off-loading of harvested plant material takes place at the boating access site, as shown on Map 7. Plant material is removed from the harvester, where it is transferred to a dump truck using a conveyor, and transported to disposal sites identified by the Lower Spring Lake Management District. Plant material should be collected and disposed of daily to avoid leaching of nutrients back into the Lake and to minimize the visual degradation of the area near the boat-launching site. The operators will strictly police the off-loading site to ensure minimal disruption of boaters and of the people using the riparian areas of the Lake.

Chemical Treatment

Chemical herbicides may be considered for the control of State-designated nonnative invasive species, currently including Eurasian water milfoil and curly-leaf pondweed, throughout the Lake basin. Use of targeted aquatic herbicides, approved for use within the State of Wisconsin, are recommended to be used as necessary to manage occurrences of designated nonnative species. Elsewhere, aquatic herbicides should be limited to controlling nuisance growths of exotic species in shallow water around docks and piers. As noted above, policies governing the use of these chemicals should first be developed by the Lower Spring Lake Management District, in consultation with the Village and Town of Palmyra, and Wisconsin Department of Natural Resources. Only registered herbicides that are selective in their control, such as 2,4-D or fluridone,[11] should be used. Algicides, such as Cutrine Plus, are not generally recommended, except as required to treat periodic recurring blooms of filamentous or planktonic algae in the Lake.

The Lower Spring Lake Management District, Village and Town of Palmyra, and the Wisconsin Department of Natural Resources should work together to develop a reasonable herbicide usage policy to control the growth of purple loosestrife, curly-leaf pondweed and Eurasian water milfoil growths in and around the Lake. Early spring treatment to control Eurasian water milfoil and curly-leaf pondweed growth in the Lake has proven effective in other lakes in Southeastern Wisconsin and is recommended. It is recommended that chemical application be made in the early spring to maximize its effectiveness and to act as a preventive measure to target Eurasian water milfoil and curly-leaf pondweed. This treatment should be done in late May for best results. Treatment of purple loosestrife stands is recommended to be undertaken prior to the flowering of the plant; treatment conducted thereafter should be done in such manner as to ensure that the seed heads are “bagged” prior to cutting the plant and applying the herbicide to limit reseeding of the plant.

Precautions to Protect Wildlife, Fish, and Ecologically Valuable Areas

Harvester operators and chemical applicators will be provided with a laminated copy of the approved harvesting plan, set forth on Map 7. It is proposed that aquatic plant management activities be restricted in certain ecologically valuable areas of the Lake. Areas considered important for fish spawning, areas of three feet or less in depth, should also be excluded from aquatic plant management operations. In addition to these generalized precautions, the Lower Spring Lake Management District trains staff to visually observe fishes and aquatic animals being captured during the harvesting operations, and adjust their operations accordingly; where numbers of juvenile or mature fishes and aquatic animals are observed, the harvester operators cease operations within the area and withdraw the harvester. Continuation of these practices is recommended to protect fish and wildlife within Lower Spring Lake.

Harvesting Schedule

The harvesting season is recommended to begin in mid- to late-May to accommodate the fish spawning activities and should end no later than mid-September of each year. Harvesting should average between 30 and 35 hours per week over a five-day week, depending on weather conditions and plant growth, to minimize recreational use conflicts. In addition, harvesting will be confined to daylight hours to minimize public disturbances resulting from these operations.

Evaluation and Monitoring

Daily Record-Keeping Relating to the Harvesting Operation

The operators of the harvesting equipment will record daily harvesting activities in a harvesting log. This includes daily maintenance and service records showing engine hours, fuel consumed, and oil used. An annual summary of the harvesting program will be submitted to the Lower Spring Lake Management

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[11]*As of 2004, the Wisconsin Department of Natural Resources considers the use of fluridone in Wisconsin to be experimental.*

District Board of Commissioners (or other designated committee) at the annual meeting of the District, and made available to the electors of the District at that time.

It is the intention of the Lower Spring Lake Management District to undertake a periodic, formal review of the harvesting program as set forth in the adopted lake management plan for Lower Spring Lake, a copy of which has been lodged with the Wisconsin Department of Natural Resources Southeast Region office. Further, it is the intention of the District to publish periodic refinements of the aquatic plant management element of the lake management plan as recommended in the adopted lake management plan. It recommended that a further inventory be prepared in two to three years to confirm that the changes in the plant community are for reasons other than annual variability.

Recreational Use Management

Recommended actions for the management of ecologically valuable areas and aquatic plants should be effected by the Village and Town of Palmyra through its existing boating ordinance. It is recommended that motorized boat traffic within the Eurasian water milfoil control areas shown on Map 7 be limited to essential traffic only and define watercraft transit speeds and lanes consistent with the milfoil control areas and established patterns of recreational boating usage on the Lake. Such regulation may require buoyage depending on the sufficiency of the signage and notices provided to lake users and the level of compliance achieved. Copies of such an ordinance must be placed at the public access site as set forth in Section 30.77(4) of the *Wisconsin Statutes*.

Public Information

It is the policy of the Lower Spring Lake Management District and Village and Town of Palmyra to maintain an active dialogue with the community. This is done through the medium of the public press and through public meetings and other scheduled hearings. In addition, it is recommended that a public education and information program continue to be conducted. This program should discourage human disturbances in ecologically valuable areas, except as may be necessary to provide riparian residents with a reasonable level of access to the main body of the Lake, and encourage Lake residents and visitors to be made aware of the invasive nature of species such as purple loosestrife and Eurasian water milfoil. This effort should also include awareness of zebra mussel control and related efforts to minimize the further spread of other exotic or nonnative species. Posting appropriate signage at public recreational boating access sites around the Lake is recommended. In addition, citizens and visitors should be encouraged to participate in citizen-based control programs coordinated by the Wisconsin Department of Natural Resources and University of Wisconsin-Extension. Where necessary, personal contacts with homeowners should be made, most likely through the Lower Spring Lake Association.

SUMMARY

This plan, which documents the findings and recommendations of a study requested by the Lower Spring Lake Management District, is a refinement of the aquatic plant management measures recommended in the adopted lake management plan for Lower Spring Lake.

The refined Lower Spring Lake aquatic plant management plan, shown on Map 7 and summarized in Tables 9 and 10, recommends actions to be taken to limit further human impacts on the in-lake macrophyte beds and reduce human impacts on the ecologically valuable areas adjacent to the lake and in its watershed. The plan recommends continued reliance on aquatic plant harvesting as the primary aquatic plant management measure employed on Lower Spring Lake. In addition to aquatic plant harvesting, the plan recommends the supplemental use of aquatic herbicides as appropriate to control the growth of nonnative aquatic plants in the Lake, as well as selected manual removal and surveillance activities at this time, mainly in the cases where purple loosestrife, curly-leaf pondweed and Eurasian water milfoil are present. The plan also recommends the use of demarcated boating lanes to limit motorized boating traffic through macrophyte beds that contain Eurasian water milfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*) to attenuate the further proliferation of this plant. Support for the conservation of lands within the State Forest and Natural Area

to ensure the protection and preservation of ecologically valuable areas within the drainage area tributary to Lower Spring Lake is also recommended.

Finally, the recommended plan includes the continuation of an ongoing program of public information and education being provided to both riparian residents and lake users. For example, additional options regarding household chemical usage, lawn and garden care, shoreland protection and maintenance, and recreational usage of the Lake should be made available to riparian householders, thereby providing riparian residents with alternatives to traditional alternatives and activities. Informational programming on the control of nonnative or exotic species, such as Eurasian water milfoil and zebra mussel, designed to limit their spread and onward transmission from Lower Spring Lake to other lakes within the southeastern Wisconsin region, is also recommended.

This recommended plan refines the adopted lake management plan for Lower Spring Lake, and seeks to balance the demand for high-quality residential and recreational opportunities at Lower Spring Lake with the requirements for environmental protection.

APPENDIX A

PHOTOS OF COMMON AQUATIC PLANTS IN LOWER SPRING LAKE

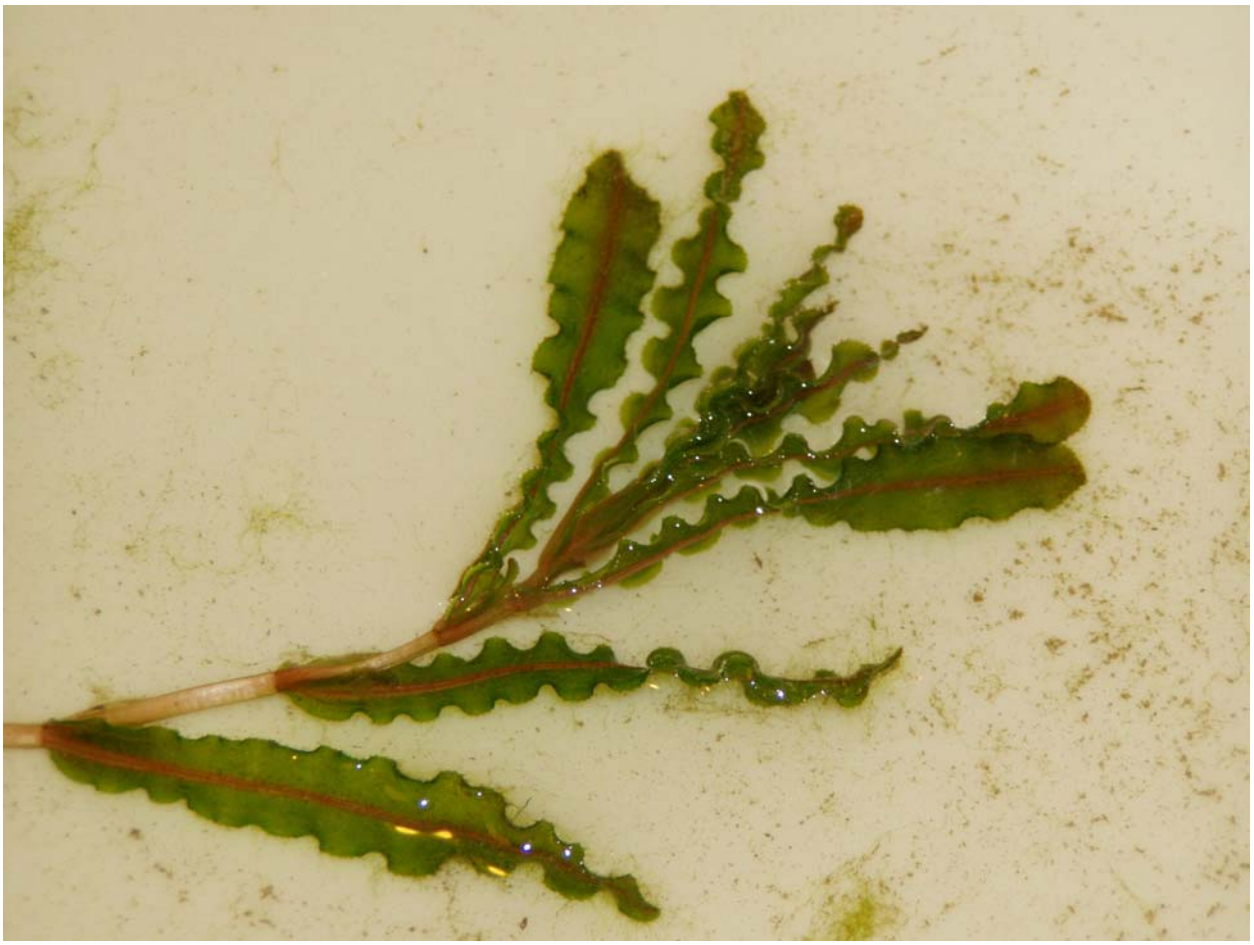
Figure A-1

Eurasian water milfoil – *Myriophyllum spicatum*

Source: Environmental Horizons, Inc.

Figure A-2

Curly leaf pondweed – *Potamogeton crispus*



Source: Environmental Horizons, Inc.

Figure A-3

Illinois pondweed – *Potamogeton illinoensis*

Source: Environmental Horizons, Inc.

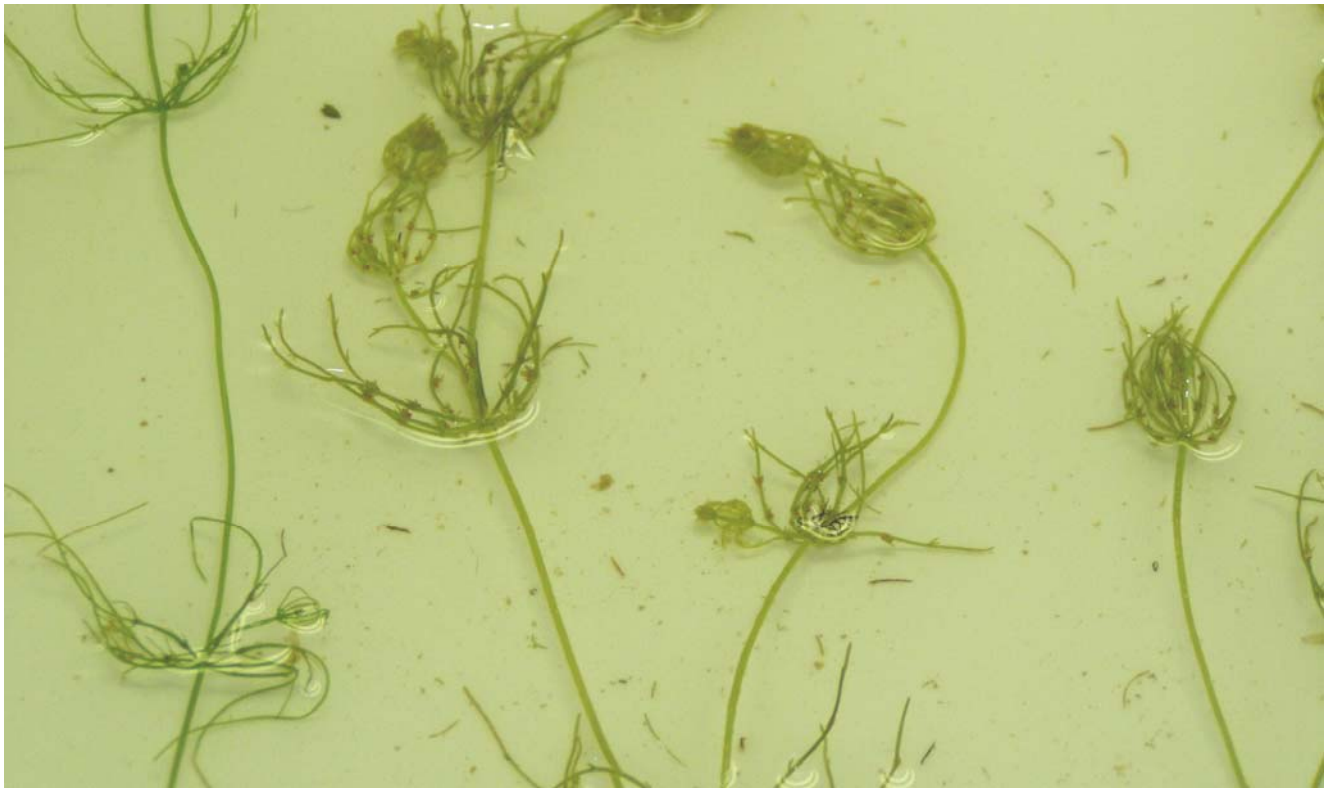
Figure A-4

Sago pondweed – *Potamogeton pectinatus*

Source: Environmental Horizons, Inc.

Figure A-5

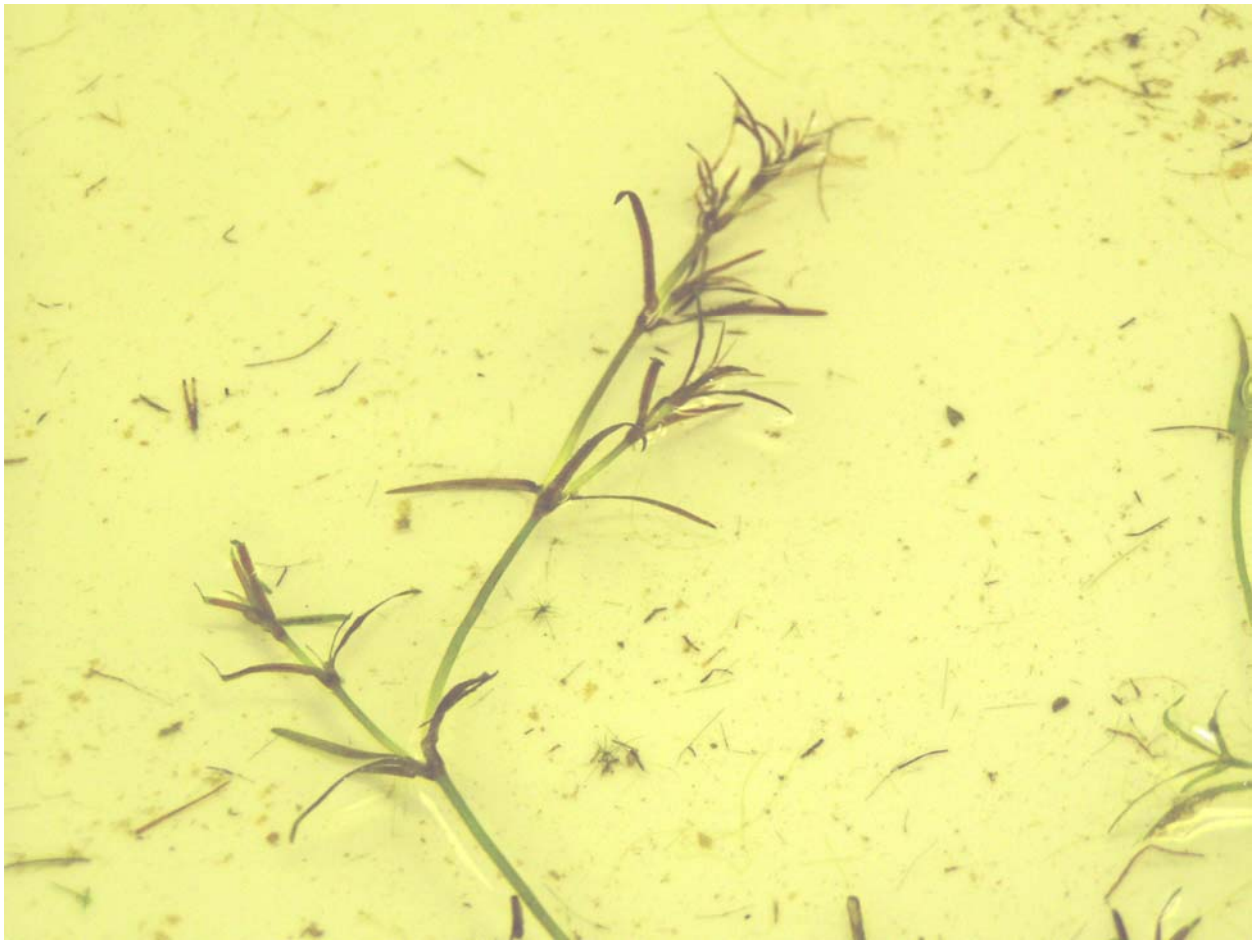
Muskgrass – *Chara* spp.



Source: Environmental Horizons, Inc.

Figure A-6

Slender naiad, Bushy pondweed – *Najas flexilis*



Source: Environmental Horizons, Inc.

Figure A-8

Coontail – *Ceratophyllum demersum*

Source: Environmental Horizons, Inc.

Figure A-9

Common waterweed – *Elodea canadensis*

Source: Environmental Horizons, Inc.

Figure A-10

White water lily – *Nymphaea odorata*

Source: Environmental Horizons, Inc.

APPENDIX B

JESSON AND LOUND TRANSECT METHOD

METHODOLOGY

The inventory data used in developing the refined aquatic plant management plan for Lower Spring Lake were gathered using standard aquatic plant plant survey techniques and protocols. The aquatic plant survey of Lower Spring Lake was conducted by Environmental Horizons staff using the modified Jesson and Lound[1] transect method employed by the Wisconsin Department of Natural Resources for aquatic plant surveys throughout the State. The protocol was modified to better reflect the relatively shallow nature of Lower Spring Lake, relative to the calculated Maximum Depth of Colonization of about 10 feet. The coincidence of this depth and the maximum depth of waterbody means that aquatic plant growths occur through the Lake basin.

To better assess the nature of this community, the Wisconsin Department of Natural Resources modification of the Jesson and Lound methodology was further modified through use of intermediate stations, located based upon a position within the Lake basin, rather than strictly upon depth of sampling. This technique of locating sampling sites is known as the "point-intercept" or "grid-sampling" technique. This technique includes the imposition of additional station within a basin that would not ordinarily be sampled using the Wisconsin Department of Natural Resources modification of the Jesson and Lound methodology.

Prior to the initiation of the field survey, Environmental Horizons staff identified a series of transects or sampling line running perpendicular to the shoreline and extended from shallow to deeper water at intervals around the Lake. These transects were located at easily identifiable points, typically adjacent to structures or other landmarks that are likely to be permanent landscape features. These transects allow subsequent sampling of the same sites at future dates, and comparison of the data gathered during the 2005 survey with data gathered at that future date. The current transects, shown on Map B-1 and described in Table B-1, were located in the same vicinity as were the transects used in the initial aquatic plant survey of Lower Spring Lake. Samples were proposed to be obtained from depth intervals of approximately 1.5 feet, 3 feet, 6 feet and 9 feet, where such depths were present.

Because the range of depths was limited within the Lower Spring Lake basin, additional sampling sites were located along the transects at intervals. These sites, plus the pre-identified transect locations, are shown on Map B-2 as "waypoints" tabulated by the global positioning systems (GPS) and summarized in Table B-2. Water depth, surface water temperature and substrate data are also shown in the Table.

Aquatic plants at each location were sampled using a modified garden rake. At depths of three feet or less, aquatic plants were sampled using a standard rake; at depths in excess of three feet, aquatic plants were sampled by a modified rake equipped with a throwing line that facilitated sampling at depths that were beyond the reach of the rake handle. Plants obtained during each rake "haul" were identified and recorded. Type specimens of each species of aquatic plant were photographed and are documented in Appendix A. Four samples were obtained at each station, with one sample being obtained from each quarter of the boat. The presence or absence of each species was noted. These data allow for statistical analysis of the data set as described in Chapter II of this report. Species that were present in abundance were

[1] *R. Jesson and R. Lound, Minnesota Department of Conservation Game Investigational Report No. 6,* An Evaluation of a Survey Technique for Submerged Aquatic Plants*, 1962*.

recorded as being present in a greater number of rake hauls than species that were less common in the aquatic plant population. These data were recorded in the field.

Analysis of these data was conducted using a spreadsheet. The data are summarized in Table B-3. Based upon the presence of specific species, a number of aquatic plant communities were identified. These communities share similar assemblages of aquatic plants, and, therefore, are amenable to being managed in a similar manner. As noted in Chapter I, the aquatic plant management objectives are based upon managing the Lake so as to:

1. Protect and maintain public health, and promote public comfort, convenience, necessity and welfare, in concert with the natural resource, through the environmentally sound management of native vegetation, fishes and wildlife populations in and around Lower Spring Lake;

2. Effectively control the quantity and density of aquatic plant growths in portions of the Lower Spring Lake basin to better facilitate the conduct of water-related recreation, improve the aesthetic value of the resource to the community, and enhance the resource value of the waterbody;

3. Promote a quality, water-based experience for residents and visitors to Lower Spring Lake consistent with the policies and objectives of the Wisconsin Department of Natural Resources as set forth in the relevant *Wisconsin Administrative Codes.*[2]

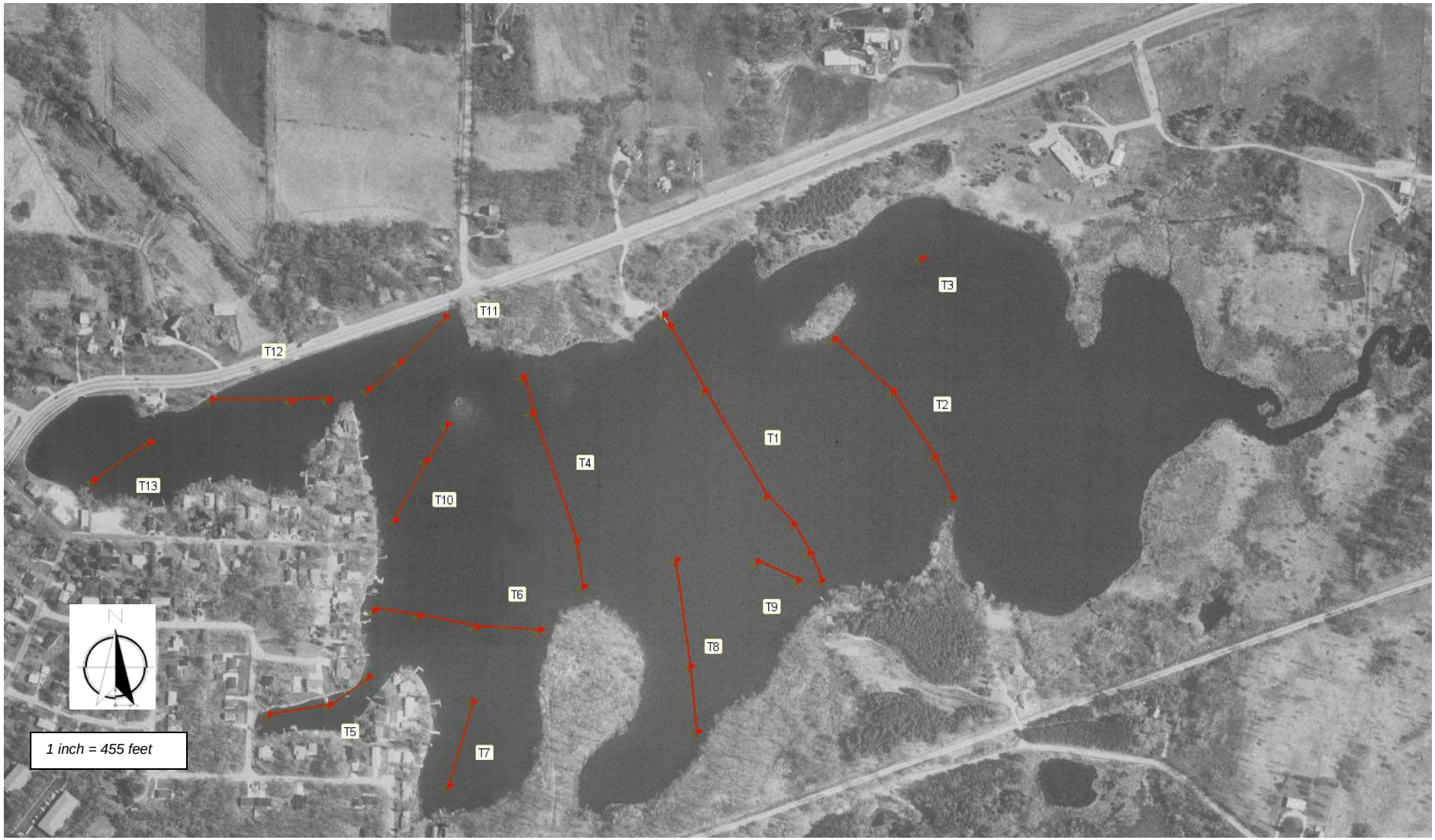
Consequently, while the aquatic plant management program set forth in Chapter III targets nonnative aquatic plant species, especially those designated as nonnative invasive species, it should be noted that these plants occur in assemblages that include the more desirable native plants which may also be affected by specific management measures. Hence, in developing the recommended aquatic plant management plan, it is important to recognize these assemblages so as to avoid damaging the underlying native aquatic plant species and negatively impacting the lake ecosystem by interfering with the essential function of the aquatic plants. Such functions include provision of habitat and foodstocks for fish and wildlife, as summarized in tabular form in Chapter II. These various assemblages were transferred from Table B-3 to the aquatic plant community distribution map included in Chapter II as Map 5, although the totality of the aquatic plant species that contribute to each community were abbreviated on the Map to only those species that were most frequently occurring at each location for purposes of clarity of presentation. By examining these assemblages, it was possible to develop the aquatic plant management program for Lower Spring Lake as set forth in Chapter III.

The foregoing methodology is consistent with the guidance provided in the draft publication, *Aquatic Plant Management (APM) in Wisconsin*, currently in preparation by the Wisconsin Lakes Partnership.

[2]*This plan has been prepared pursuant to the standards and requirements set forth in the following chapters of the* Wisconsin Administrative Code*: Chapter NR 1, "Public Access Policy for Waterways;" Chapter NR 103, "Water Quality Standards for Wetlands;" Chapter NR 107, "Aquatic Plant Management;" and Chapter NR 109, "Aquatic Plants Introduction, Manual removal and Mechanical Control Regulations."*

Map B-1

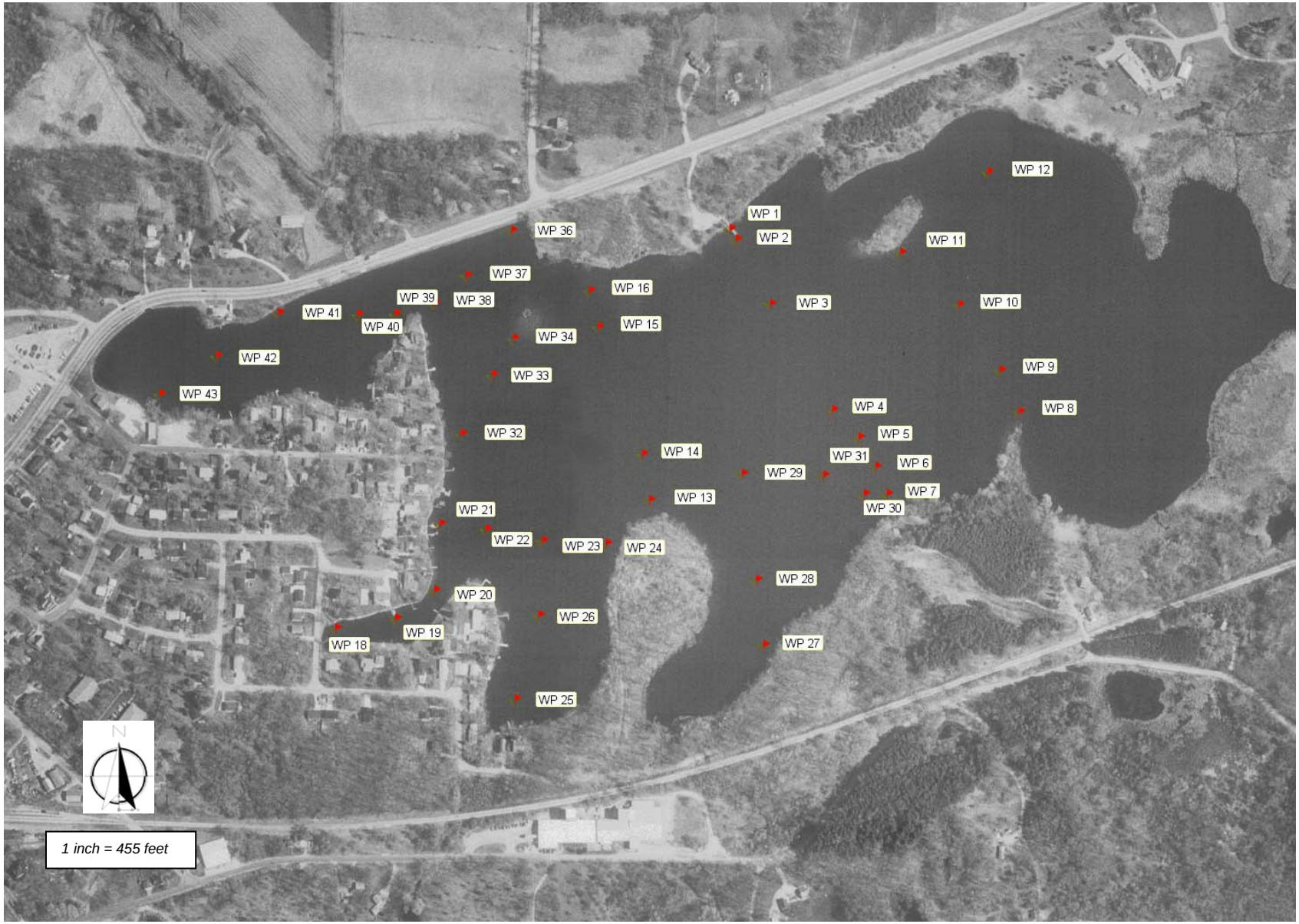
LOWER SPRING LAKE TRANSECTS



Source: Environmental Horizons, Inc.

Map B-2

LOWER SPRING LAKE AQUATIC VEGETATION SAMPLING POINTS



Source: Environmental Horizons, Inc.

Table B-2

TRANSECT DATA

Transect Identification Number	Transect Length - Miles
T1	0.21
T2	0.14
T3	- -[a]
T4	0.15
T5	0.07
T6	0.11
T7	0.06
T8	0.12
T9	0.03
T10	0.07
T11	0.07
T12	0.08
T13	0.04

[a] *Transect consisted of only one point, so transect length is not provided.*

Source: Environmental Horizons, Inc.

Table B-2

SAMPLING POINT DATA

Sampling Point Identification Number	Location – Latitude and Longitude (degrees/minutes)	Depth - feet	Date	Substrate	Water Temperature - Degrees Fahrenheit
WP1	N42 52.905 W88 34.426	1.5	06/19/2005	Sand and Gravel	- -[a]
WP2	N42 52.898 W88 34.421	2.0	06/19/2005	Silt and Sand	70.1
WP3	N42 52.859 W88 34.391	4.0	06/19/2005	Silt and Sand	71.0
WP4	N42 52.795 W88 34.338	5.0	06/19/2005	Silt	71.5
WP5	N42 52.779 W88 34.315	5.0	06/19/2005	Silt	71.3
WP6	N42 52.761 W88 34.301	2.0	06/19/2005	Silt	71.3
WP7	N42 52.744 W88 34.291	2.0	06/19/2005	Silt	- -
WP8	N42 52.796 W88 34.183	0.5	06/19/2005	Muck	73.8
WP9	N42 52.821 W88 34.199	2.0	06/19/2005	Silt	69.7
WP10	N42 52.861 W88 34.235	3.0	06/19/2005	Silt	- -
WP11	N42 52.892 W88 34.284	2.0	06/19/2005	Silt	73.3
WP12	N42 52.942	0.5	06/19/2005	Muck	- -

Sampling Point Identification Number	Location – Latitude and Longitude (degrees/minutes)	Depth - feet	Date	Substrate	Water Temperature - Degrees Fahrenheit
	W88 34.213				
WP13	N42 52.738 W88 34.489	3.0	06/19/2005	Silt and Sand	- -
WP14	N42 52.766 W8834.495	8.0	06/19/2005	Silt	73.7
WP15	N42 52.843 W88 34.534	7.0	06/19/2005	Silt	74.6
WP16	N42 52.865 W88 34.542	4.0	06/19/2005	Silt	76.4
WP18	N42 52.656 W88 34.747	4.5	06/19/2005	Muck	78.6
WP19	N42 52.663 W88 34.697	3.0	06/19/2005	Silt	- -
WP20	N42 52.686 W88 34.665	2.0	06/19/2005	Silt	- -
WP21	N42 52.721 W88 34.662	3.0	06/19/2005	Silt	80.7
WP22	N42 52.718 W88 34.624	5.0	06/19/2005	Silt	80.3
WP23	N42 52.712 W88 34.577	5.0	06/19/2005	Silt	79.1
WP24	N42 52.711 W88 34.524	3.0	06/19/2005	Silt	79.2
WP25	N42 52.615 W88 34.597	3.0	06/19/2005	Silt	81.6
WP26	N42 52.666 W88 34.579	5.0	06/19/2005	Silt	- -
WP27	N42 52.504 W88 34.392	2.5	06/20/2005	Silt	70.8
WP28	N42 52.690 W88 34.399	3.0	06/20/2005	Silt	71.4
WP29	N42 52.755 W88 34.412	4.5	06/20/2005	Silt	- -
WP30	N42 52.744 W88 34.310	2.0	06/20/2005	Silt	71.5
WP31	N42 52.755 W88 34.344	3.0	06/20/2005	Silt	71.6
WP32	N42 52.776 W88 34.646	6.0	06/20/2005	Silt	73.9
WP33	N42 52.813 W88 34.621	6.0	06/20/2005	Silt	74.2
WP34	N42 52.835 W88 34.604	3.0	06/20/2005	Silt	74.1
WP36	N42 52.901 W88 34.607	3.0	06/20/2005	Silt	74.1
WP37	N42 52.873 W88 34.644	7.0	06/20/2005	Silt	73.9
WP38	N42 52.856 W88 34.670	9.0	06/20/2005	Silt	74.0
WP39	N42 52.849	7.0	06/20/2005	Silt	74.6

Sampling Point Identification Number	Location – Latitude and Longitude (degrees/minutes)	Depth - feet	Date	Substrate	Water Temperature - Degrees Fahrenheit
	W88 34.703				
WP40	N42 52.848 W88 34.734	8.0	06/20/2005	Silt	74.7
WP41	N42 52.848 W88 34.800	3.0	06/20/2005	Silt	75.2
WP42	N42 52.821 W88 34.851	5.0	06/20/2005	Silt	75.4
WP43	N42 52.797 W88 34.897	9.0	06/20/2005	Silt	75.5

[a] *Data not available.*

Source: Environmental Horizons, Inc.

Table B-3

LOWER SPRING LAKE SPECIFIC AQUATIC PLANT DISTRIBUTION BY TRANSECT AND WAYPOINT LOCATIONS

Transect No.	Sampling Point No.	Depth - ft	Eurasian Water milfoil	Coon-tail	Musk-grass	Elodea	Bushy Pondweed	Curly Leaf Pondweed	Sago Pondweed	Clasping Leaf Pondweed	Variable Leaf Pondweed	Floating Leaf Pondweed	Illinois Pondweed	Eel Grass	White Water Lily	Duck-weed	Cladophara
1	WP1	1.5	2					1			2						
	WP2	2.0	3					1			4						
	WP3	4.0	4					1									
	WP4	5.0	4	1	1			1	1								
	WP5	5.0	4					2									
	WP6	2.0	4						2		1						
	WP7	2.0	3					2									
2	WP8	0.5	3		2	1		1					1		3	3	2
	WP9	2.0	4	1				4									
	WP10	3.0	4		1			2									
	WP11	2.0	4		1			4	4						1	1	
3	WP12	0.5	4	3	3										4		
4	WP13	3.0	4		3	1					1		2				
	WP14	8.0	4						3								
	WP15	7.0	2		2												
	WP16	4.0	3		3												
5	WP18	4.5	4			3											
	WP19	3.0	3		2	3		1	1								
	WP20	2.0	4		4	3		2									
6	WP21	3.0	4		4	3		1									1
	WP22	5.0	4		1	1		2	2								
	WP23	5.0	4					1									
	WP24	3.0			3												
7	WP25	3.0	4					1	2								
	WP26	5.0	4					2	1								
8	WP27	2.5	3					1	1				3				2
	WP28	3.0	4					2	1								
	WP29	4.5	4						1	1			1				
9	WP30	2.0	4					1							4		
	WP31	3.0	4						3				1				
10	WP32	6.0	3	1		3											
	WP33	6.0	4	2		3											
	WP34	3.0	4		3		1		1		2						
11	WP36	3.0	4					2							4		
	WP37	7.0	4	1				1									
	WP38	9.0	3	2				1									
12	WP39	7.0	2														
	WP40	8.0	4					1									
	WP41	3.0	4									1		2			
13	WP42	5.0	4														
	WP43	9.0	2					1									
Total	***41***		***144***	***11***	***33***	***21***	***1***	***39***	***23***	***1***	**10**	***1***	***8***	***2***	***20***	***4***	***5***

Source: Environmental Horizons, Inc.

ENVIRONMENTAL HORIZONS, INCORPORATED

"Providing Innovative Solutions for Land and Water Resource Management"

***LeAnn S. Colburn**, President, MS, Wisconsin Professional Soil Scientist, ARCPACS Certified Professional Soil Scientist, Certified Soil Erosion Inspector*

***Jeffrey A. Thornton**, Vice President, PhD, MBA, Wisconsin Professional Hydrologist, Certified Lake Manager*

November 22, 2005

Mr. William Alveshire
Commissioner
Lower Spring Lake Management District
317 Shore Drive
Palmyra, WI 53156

Dear Mr. Alveshire,

Subsequent to the transmittal of the report entitled An Aquatic Plant Management Plan for Lower Spring Lake, Jefferson County, Wisconsin, Environmental Horizons, Inc. has received comment from the Wisconsin Department of Natural Resources. In response to these comments, we are providing the following additional information to you for inclusion in the records of the Lower Spring Lake Management District.

With respect to the water quality condition of Lower Spring Lake, application of the Wisconsin Spreadsheet Model (WiLMS, version 3.3) to the land use data supplied by the Jefferson County Land and Water Conservation Department, documented in Table 2 of the report, supports the observed trophic state of the Lake. The forecast phosphorus load to Lower Spring Lake, derived from the WiLMS model, is summarized in the table below. Approximately 2,400 pounds of phosphorus are exported from the drainage area tributary to Lower Spring Lake annually. Agricultural land uses are the largest source of nonpoint-sourced phosphorus to the Lake, contributing about 1,500 pounds of phosphorus per year. No point sources are present within the drainage area.

Applying the forecast phosphorus load in the Vollenweider-OECD phosphorus loading relationship results in a forecast in-lake phosphorus concentration of about 17 micrograms per liter (µg/l), a value that agrees well with the observed in-lake total phosphorus concentration of about 20 µg/l reported in Table 3 of the report. No internal phosphorus loading from the lake sediments is indicated.

The forecast in-lake phosphorus value is derived from the lower likely load estimate generated by WiLMS, a fact that is consistent with the relatively undeveloped rural nature of the upper reaches of the Scuppernong River. As land uses within this drainage area are not expected to change significantly in the foreseeable future—some limited additional urban residential development, however, may occur in the drainage area, no major changes in the phosphorus load are anticipated.

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Table

FORECAST PHOSPHORUS LOADING TO LOWER SPRING LAKE: 2005

Land Use Categories	Land Use Area (acres)	Forecast Phosphorus Load (pounds/year)
Urban		
Residential	72	10
Other Open Lands	90	- -
Subtotal	162	10
Rural		
Agricultural	5,652	1,510
Grasslands	2,378	210
Woodlands	4,244	190
Wetlands	4,692	420
Water	230	10
Other	89	- -
Subtotal	17,285	2,340
Total	17,447	2,350

Source: Jefferson County Land and Water Conservation Department, Wisconsin Department of Natural Resources, and Environmental Horizons, Inc.

Notwithstanding, ongoing water quality monitoring under the auspices of the Wisconsin Department of Natural Resources Self-Help Monitoring Program remains a viable and reasonable recommended action. Complementary to this, continued public informational programming to promote good residential shoreland management practices is indicated. Both of these recommendations are set forth in the recommended lake management plan for Lower Spring Lake as summarized in Table 9 of the report. In closing, we urge the Lower Spring Lake Management District to continue your vigilance and stewardship of Lower Spring Lake in view of the threats posed by increasing numbers of nonnative species.

We appreciate this opportunity to provide these planning services to you and thank you for selecting Environmental Horizons, Inc., to assist you in this planning project.

Faithfully yours,

Jeffrey A. Thornton PhD PH CLM
Vice-President: Water Resources Division

cc: Ms Susan Graham, WDNR-SR
Ms Patricia Cicero, Jefferson County

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Environmental Horizons, Inc., is a newly formed (2004) corporation based in Racine, Wisconsin. Our principals include Dr Jeffrey A. Thornton, Managing Director of International Environmental Management Services Ltd., a nonstock not-for-profit Wisconsin corporation that has operated worldwide since 1992.

We have assisted several Wisconsin lake organizations. These include the following:

Kirby Lake Management District, Barron County
Preparation of a lake protection plan, including a review of aquatic plant and water quality management measures applicable to this groundwater-fed lake.

Rock Lake and Lake Ripley, Jefferson County
Preparation of an aquatic plant inventory for these two major lakes.

Beaver Dam Lake Management District, Barron County
Provision of organizational assistance in the consideration of public sanitary sewer service to the Beaver Dam Lake community.

Red Cedar Lake Association, Barron and Washburn Counties
Preparation of a Chapter NR 191 Lake Protection and Classification Grant for a watershed survey and lake monitoring program conducted by the U.S. Geological Survey.

Lower Spring Lake Management District, Jefferson County
Preparation of a Chapter NR 190 Lake Management Planning Grant for an aquatic plant management plan. Environmental Horizons, Inc., has been awarded the contract to prepare the aquatic plant management plan during 2005.

Round - Trade Lake Improvement Association, Burnett County
Preparation of a Chapter NR 190 Lake Management Planning Grant for a lake protection plan. Environmental Horizons, Inc., has been awarded the contract to prepare the lake protection plan during 2005.

Town of West Point, Columbia County
Preparation of a Chapter NR 190 Lake Management Planning Grant for a land use planning document focusing on the improvement and protection of Lake Wisconsin within the Town of West Point. Environmental Horizons, Inc has been awarded the contract to prepare the planning document during 2005 and 2006.

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