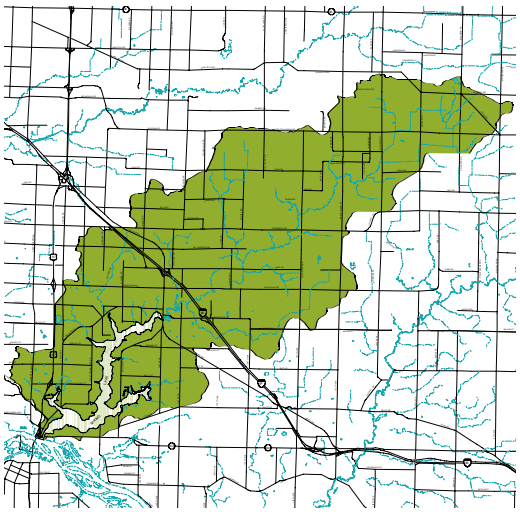

Watershed Management Plan

Spring Lake
Watershed Management Plan

Prepared for:
Spring Lake - Lake Board
414 Washington Street, Room 107
Grand Haven, MI 49417

Prepared by:
Progressive AE
1811 4 Mile Road, NE
Grand Rapids, MI 49525-2442
616/361-2664

April 2001

Project No: 54060102

ProgressiveAE

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Table of Contents

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

Introduction

Spring Lake has a surface area of 1,298 acres and a long convoluted shoreline, most of which is urbanized. The lake is a drowned river mouth that empties into the Grand River approximately 2 miles east of the Lake Michigan shoreline. A small portion of the lake is contained within Muskegon County and the remainder lies within Ottawa County. Spring Lake abuts five municipalities: Fruitport Township and the Village of Fruitport in Muskegon County; and Spring Lake Township, the Village of Spring Lake, and the City of Ferrysburg in Ottawa County (T8-9N, R16W; Figure 1). The Spring Lake watershed comprises approximately 50 square miles (Figure 2), a land area nearly 25 times larger than the lake itself. The watershed includes all or part of 11 municipalities (Figure 3). Approximately three-fourths of the watershed is in Muskegon County and the remainder is in Ottawa County. Spring Lake is highly eutrophic and may violate water quality standards with respect to nutrients and dissolved oxygen.

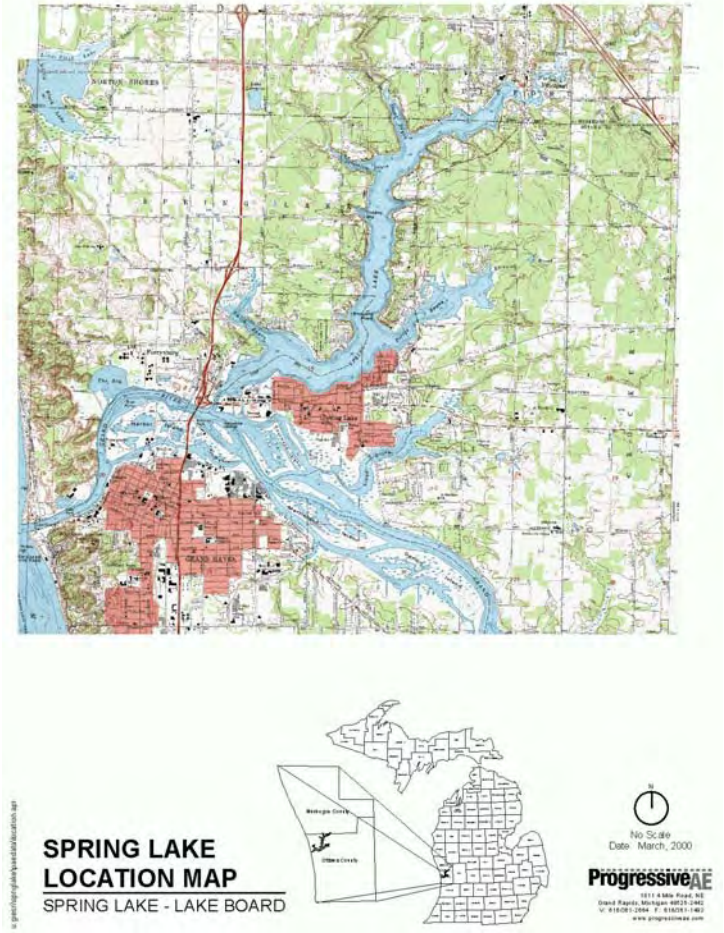

Figure 1. Spring Lake location map.

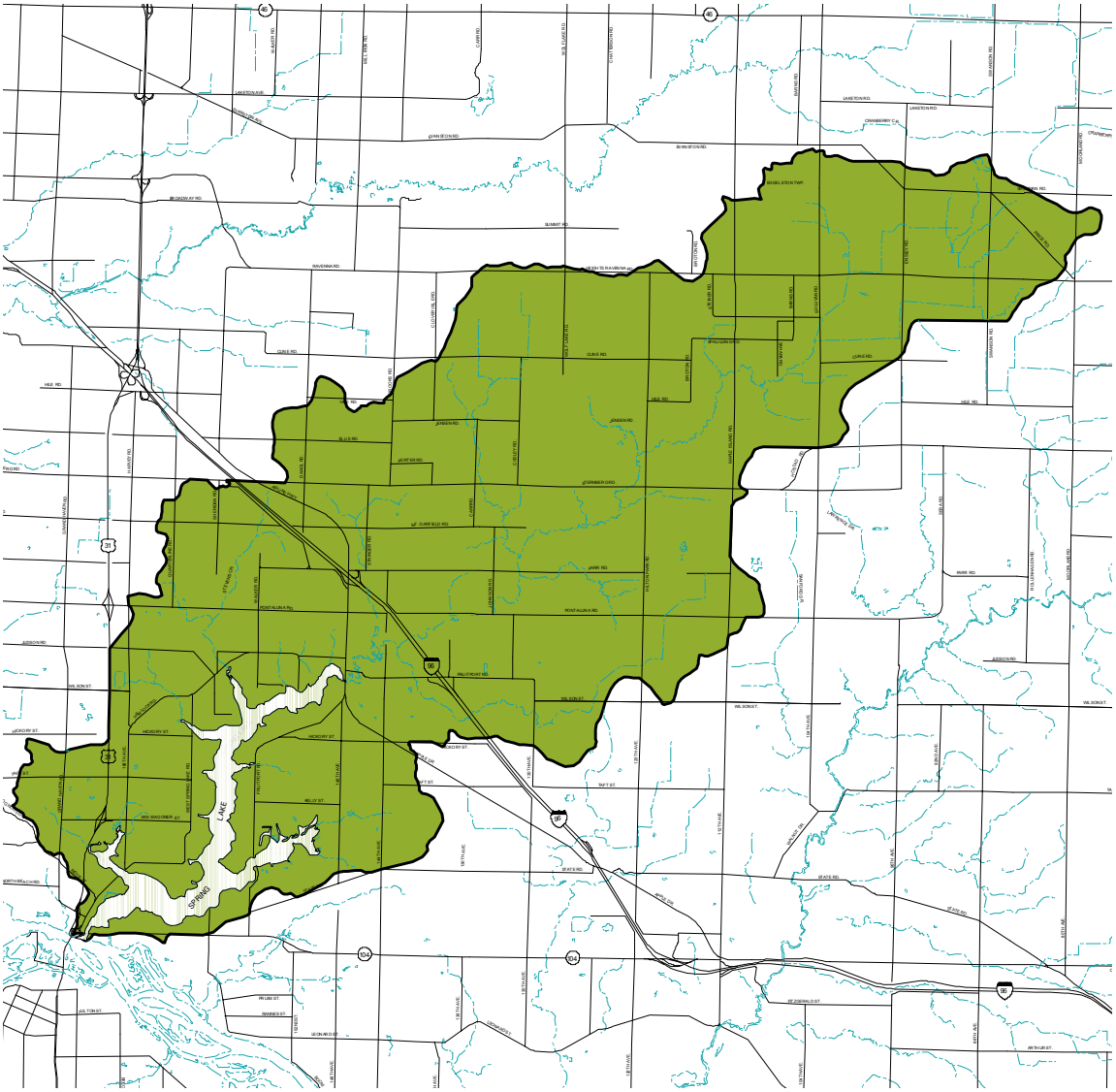

Figure 2. Spring Lake watershed map.

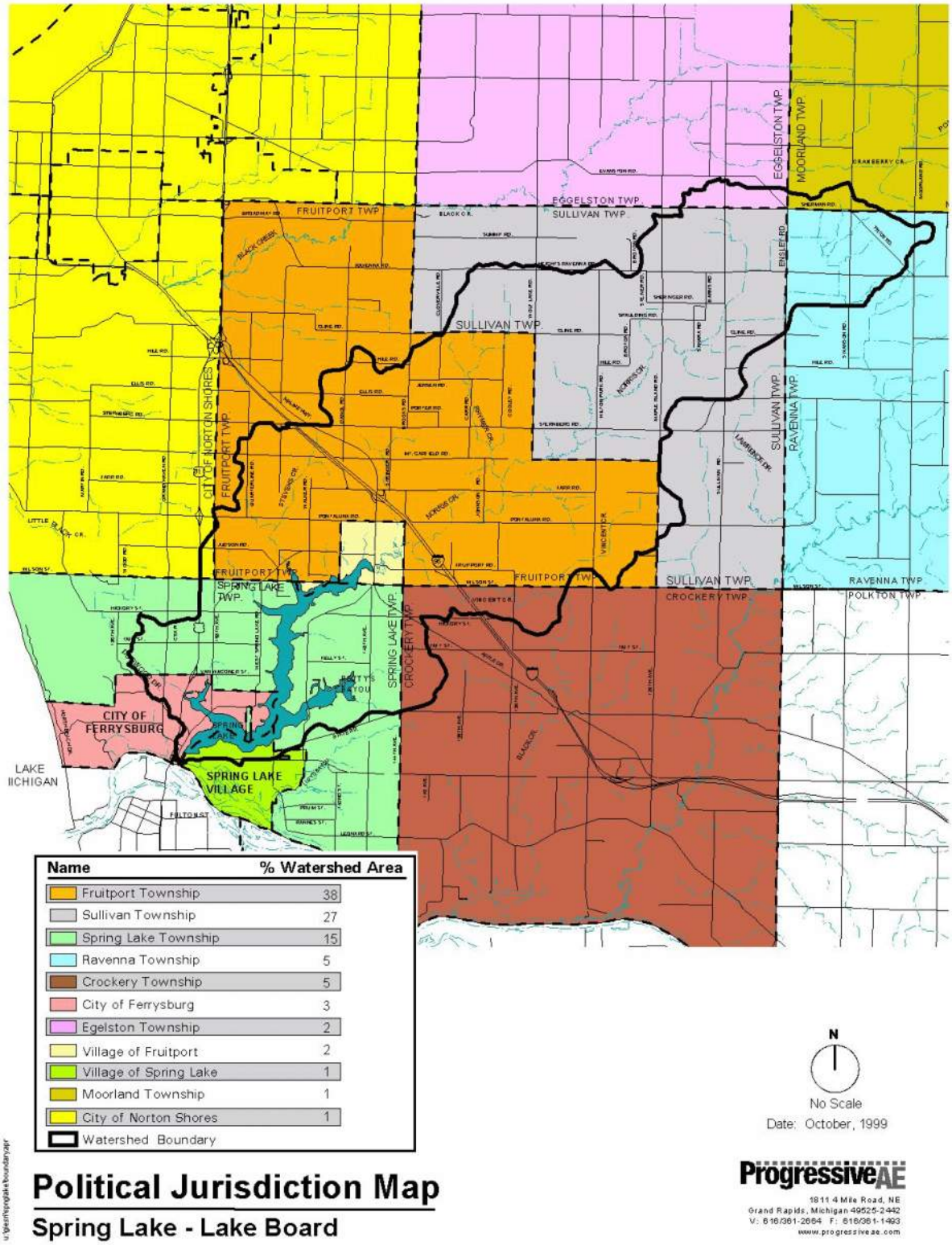

Figure 3. Spring Lake watershed political jurisdiction map.

In recent years, lake residents expressed a desire to control nuisance aquatic plant growth and improve the water quality of Spring Lake. To address these issues, the Spring Lake - Lake Board was formed in 1997 under provisions of Part 309 of the Natural Resources and Environmental Protection Act, Act 451 of 1994. The 11-member lake board is comprised of a lake resident, representatives from each of the five abutting municipalities, a county commissioner from Muskegon and Ottawa counties, the Muskegon and Ottawa county drain commissioners, and a representative from the Department of Environmental Quality. Six of the current lake board members are Spring Lake property owners.

In April of 1999, the lake board retained Progressive AE to develop and define an improvement plan for Spring Lake (Appendix A). In late summer of 1999, presentations regarding the plan were made to each of the municipalities around the lake, and the lake board held formal public hearings to document support for the plan. The Spring Lake Improvement Plan consists of aquatic plant control, development of a watershed management plan, watershed management, information and education, and water quality monitoring. A special assessment district has been established in accordance with Part 309 to finance the improvement plan. Development of this watershed management plan fulfills one objective of the Spring Lake Improvement Plan. This document has been formatted to comply with rules developed for the Clean Michigan Initiative (CMI) Nonpoint Source Pollution Control Grants (Appendix B), the CMI Clean Water Fund (Appendix C), and with criteria contained in *Developing a Watershed Management Plan for Water Quality - An Introductory Guide* (Brown et. al. 2000).

Water Quality Summary

Spring Lake is eutrophic: total phosphorus concentrations are high; water clarity is low; bottom-water dissolved oxygen is depleted in summer; and the lake supports abundant rooted plant and algae growth. The lake may violate state water quality standards with respect to nutrients and dissolved oxygen. Spring Lake's eutrophic condition is caused by both internal and external loading of nutrients, especially phosphorus. That is, phosphorus is recycled within the lake from the lake bottom (i.e., internal loading), and washes into the lake from shoreland areas and tributary streams (i.e., external loading). In addition to nutrients, pollutants of primary concern include sediment, oil, grease, heavy metals, and possibly *E. coli* bacteria. Sources and potential sources of these pollutants in the Spring Lake watershed can be grouped into four critical geographic areas: (1) Agricultural land in the headwaters region of the watershed; (2) stream corridors; (3) urban land surrounding Spring Lake; and (4) within Spring Lake itself.

The term "designated uses" refers to the uses which can be made of all Michigan's surface water bodies as established by the state's water quality standards. As a result of pollution inputs, five designated uses in Spring Lake are threatened or impaired, including: (1) Navigation; (2) warmwater fishery; (3) other indigenous aquatic life and wildlife; (4) partial body contact recreation; and (5) total body contact recreation between May 1 and October 31. (In addition to the five designated uses that are threatened or impaired in Spring Lake, the state also recognizes agriculture, industrial water supply, and public water supply as designated uses of the state's surface waters.) The goal of the Spring Lake Watershed Management Plan is to protect threatened designated uses and to restore impaired designated uses within Spring Lake. These goals can be achieved by meeting state water quality standards for dissolved oxygen and nutrients, and by reducing sediment, oil, grease, heavy metals, and *E. coli* inputs into Spring Lake.

To accomplish these goals and meet water quality standards, watershed pollution inputs to Spring Lake must be substantially reduced. These reductions in pollution loadings are proposed to be accomplished through implementation of a combination of structural and non-structural management practices in the Spring Lake watershed. Structural management practices are proposed to include the establishment of vegetative buffer strips along agricultural drains and lake shorelands, stabilization of eroding streambanks and road-stream crossings, and the installation of pollution control devices on existing storm sewers. Non-structural measures are proposed to include the implementation of nutrient management programs on agricultural lands in the watershed; protection of environmentally sensitive areas in the watershed such as wetlands and stream corridors through zoning and/or conservation easements; an information dissemination program to promote practices that reduce pollution inputs from Spring Lake shorelands; stormwater management; and water quality monitoring to identify and correct failing septic systems and illicit storm sewer connections.

WATER QUALITY SUMMARY

The Spring Lake - Lake Board is seeking grants through the Clean Michigan Initiative (CMI) grant program and the U.S. Environmental Protection Agency Nonpoint Source Pollution Control program to implement the Spring Lake Watershed Management Plan. The Spring Lake - Lake Board, with its organizational structure and special assessment authority, is ideally suited to implement a project of this complexity and scope.

Geographic Scope of the Watershed

GENERAL DESCRIPTION OF SPRING LAKE AND ITS WATERSHED

Spring Lake has the appearance of an impounded river, with its long irregular shoreline and numerous coves and bayous. The lake bottom is shaped somewhat like a bathtub with steep side slopes close to shore, then flattening to a depth of about 25 to 30 feet deep across the center of the lake (Figure 4). Because it is possible to navigate to Lake Michigan from Spring Lake via the Grand River, Spring Lake is a popular haven for large motorboats and sailboats. There are a great many docks, marinas, and piers on Spring Lake. The desirability of access to Spring Lake, the Grand River, and Lake Michigan makes Spring Lake property very valuable. The pressure to develop the few remaining natural areas on the lake is high.

Most of the Spring Lake shoreline is urbanized with high-density residential, commercial, and some industrial property. Most of the natural vegetation has been removed in the urbanized shoreline areas and has been replaced with cover such as turf grass, beach sand, seawalls, pavement, concrete, or riprap. The Spring Lake shoreline is characterized as being both very flat in some areas and very steep in others. Shoreline erosion is generally not a problem, even in the steeply sloped areas, with some exceptions.

There are several streams that drain to Spring Lake, the largest of which is Norris Creek. Water also drains to the lake from county drains and storm sewers. The watershed is nearly 25 times larger than the lake itself. It is generally flat with sandy soils, thus runoff is minimized. There are few wetlands in the watershed, and most are contiguous to inlet streams. Water in the streams is generally clear, and the stream bottoms are sandy. The small amount of steeply-sloped land in the watershed occurs along the streambanks. There is very little farming in the watershed, and it is generally restricted to the headwaters of Norris Creek where some loamier soils occur. However, some intensive farming operations do exist, such as dairy and cucumbers, the latter of which requires high fertilizer and high irrigation rates on the sandy soils. Much forested land remains, especially along the streams and on current or former U.S. Forest Service pine plantations. There is also a moderate amount of open land and idle farmland in the watershed.

Although significant erosion is occurring along streambanks and road-stream crossings, most of the streambanks are well protected by natural vegetation. The greatest threat to stream water quality is urban development. If the increasing watershed population concentrates in the more rural areas in the watershed, the removal of natural buffers and the increase in stormwater and imperviousness will greatly alter the character and quality of the streams and the watershed. The same is true for the few

undeveloped lakeshore areas. Wetland and stream corridor protection are the most important proactive measures to be taken in the Spring Lake watershed.

A geographic information system (GIS) was developed as part of the plan to analyze land and water features within the Spring Lake watershed. The GIS will prove an extremely valuable tool in the implementation of the Spring Lake Watershed Management Plan.

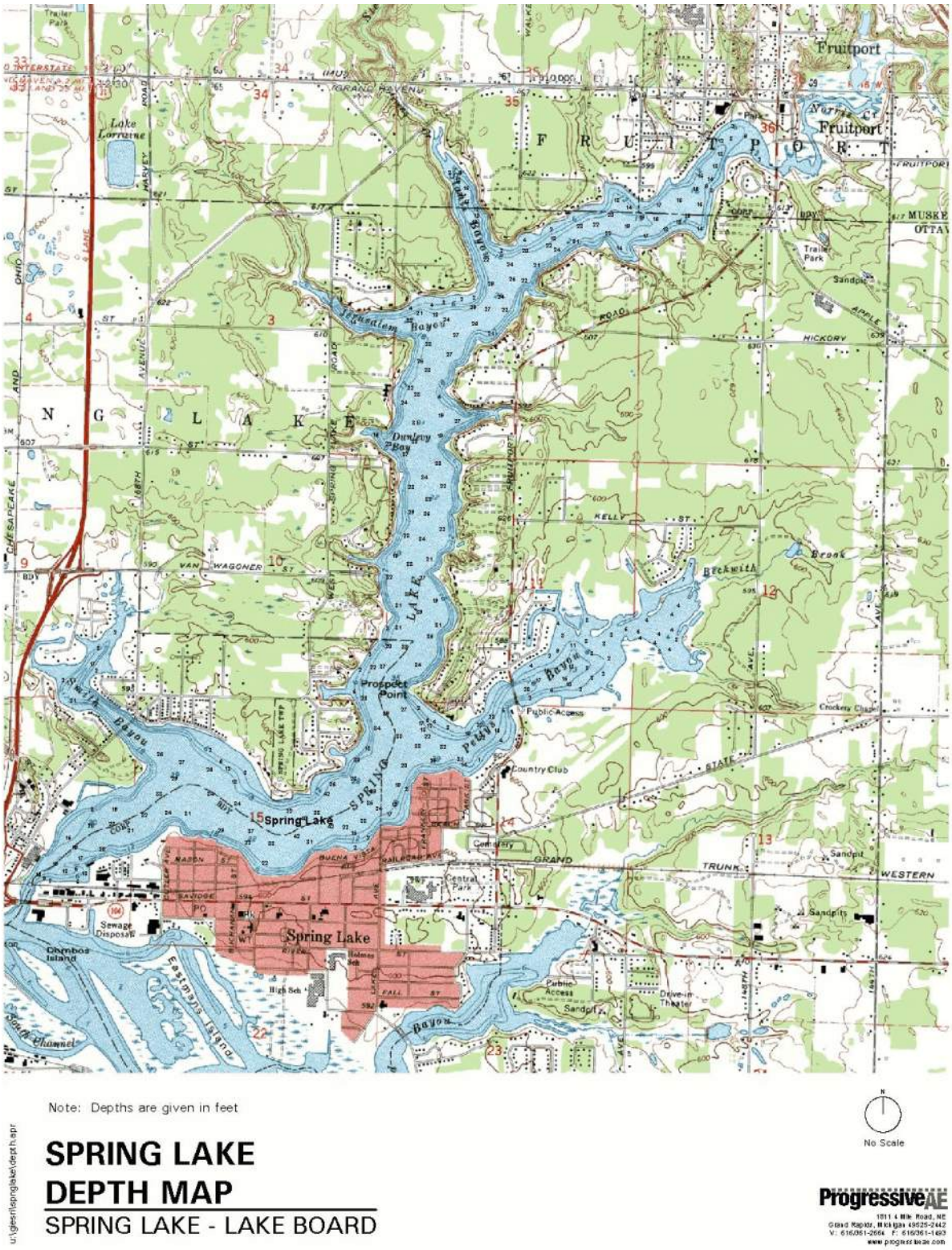

Figure 4. Spring Lake depth map.

PHYSICAL CHARACTERISTICS

The physical characteristics of Spring Lake and its watershed are listed in Table 1. Spring Lake has a surface area of 1,298 acres and a maximum depth of 42 feet (Figure 4). At 19.7 feet, the mean or average depth of Spring Lake is greater than the maximum depth at which most plants can grow (15 feet). The lake shoreline is 23 miles in length and the shoreline development factor is 5. The shoreline development factor indicates the degree of irregularity in the shape of the shoreline. That is, compared to a perfectly round lake with the same surface area as Spring Lake (i.e., 1,298 acres), the shoreline of Spring Lake is 5 times longer because of its irregular shape. Spring Lake's shoreline is highly irregular in shape because the lake is actually a drowned river mouth, much like an impoundment, although there is no artificial dam retaining water in Spring Lake. As such, Spring Lake has a long, narrow, convoluted configuration with several large bayous at the mouths of its tributaries. Despite the fact that Spring Lake is relatively deep, its long shoreline provides extensive area for rooted plant growth as well as residential development on shore.

TABLE 1
SPRING LAKE AND WATERSHED PHYSICAL CHARACTERISTICS

Lake Surface Area	1,298	Acres
Maximum Depth	42	Feet
Mean Depth	19.7	Feet
Lake Volume	25,253	Acre-Feet
Shoreline Length	23	Miles
Shoreline Development Factor	5	
Lake Elevation	580	Feet
Watershed Area	31,986	Acres
Ratio of Lake Area to Watershed Area	1 :	25
Approximate Water Residence Time	6.8	Months[1]

TRIBUTARIES AND DRAINS

Water drains to Spring Lake via approximately 8 named tributaries, several unnamed tributaries and county drains, and approximately 70 storm sewers (Figure 5; Table 2). Lauber (1999) estimated the total inflow water volume to Spring Lake is approximately 13 billion gallons, 95 percent of which is from tributary streams and drains. The estimated water residence time is approximately 7 months. It appears as though hydrology within the main tributary, Norris Creek, and the minor tributaries is stable. That is, flow within the streams is relatively steady, and the rise in stage and flow during storm events is characteristic of streams in undeveloped watersheds, as apposed to the "flashiness" associated with more urban streams.

[1] Lauber 1999.

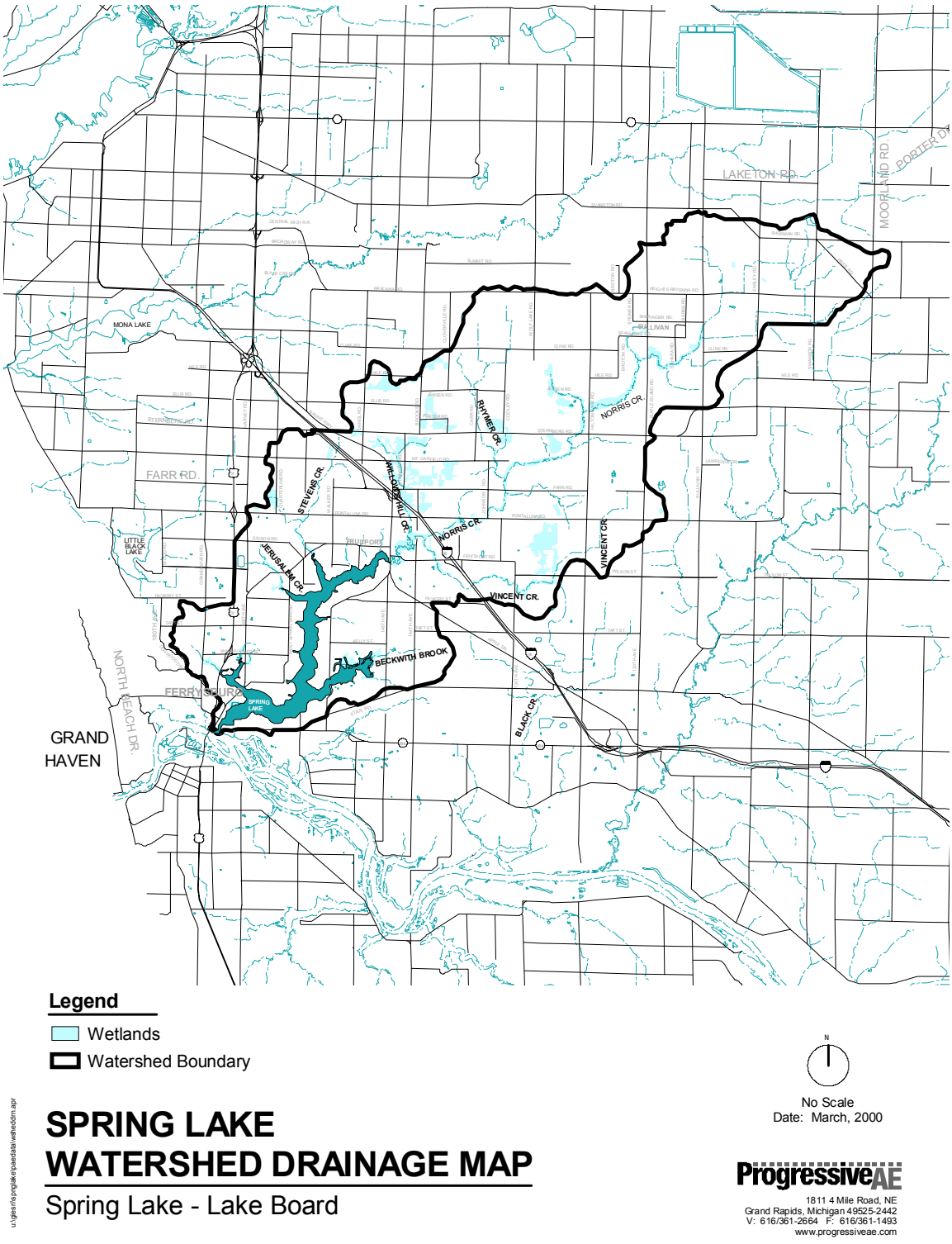

Figure 5. Spring Lake watershed drainage map.

TABLE 2
SPRING LAKE TRIBUTARY AND COUNTY DRAIN CHARACTERISTICS

Name	Drains To	Length (miles)
Bowen/Spencer Drain	Vincent Creek	0.7
Castle Drain	Spring Lake, Petty's	0.2
Hickory Spring Drain	Gildner Creek	0.7
Lovell Park Storm Drain	Spring Lake	0.2
Spring Lake Drain	Spring Lake	0.5
Spring Lake Drain	Spring Lake, Smith	2.0
VanderWall Drain	Tributary to Petty's	0.7
Artibey Drain	Norris Creek	1.0
Bowen Drain	Vincent Creek	1.3
Bussing Drain	Rhymer Creek	0.5
Dolph Drain	Norris Creek	1.0
Eadie Drain	Norris Creek	3.5
Farkas Drain	Willow Hill Creek	2.5
Harvey Drain	Jerusalem Creek	0.2
Knudsen Drain	Norris Creek	1.4
Norris Drain	Norris Creek	2.9
Rice Drain	Norris Creek	0.9
Westover Drain	Norris Creek	3.0
Wooley Marsh Drain	Rhymer Creek	2.0
Youngs Drain	Norris Creek	1.1
Norris Creek	Spring Lake	13.3
Vincent Creek	Norris Creek	
Willow's Hill Creek	Norris Creek	
Rhymer Creek	Norris Creek	4.1
Steven's Creek	Spring Lake	2.5
Jerusalem Creek	Spring Lake	
Smith Creek	Spring Lake	
Beckwith Creek	Spring Lake	
Gildner Creek	Spring Lake	
Timber Creek	Spring Lake	

The level of Lake Michigan has a direct effect on the level of Spring Lake. During the summer of 2000, Lake Michigan was near its historic low level (Figure 6). Similarly, the level of Spring Lake was also quite low, exposing considerably more bottomland than normal while leaving many docks well above the water's surface (Figures 7 and 8).

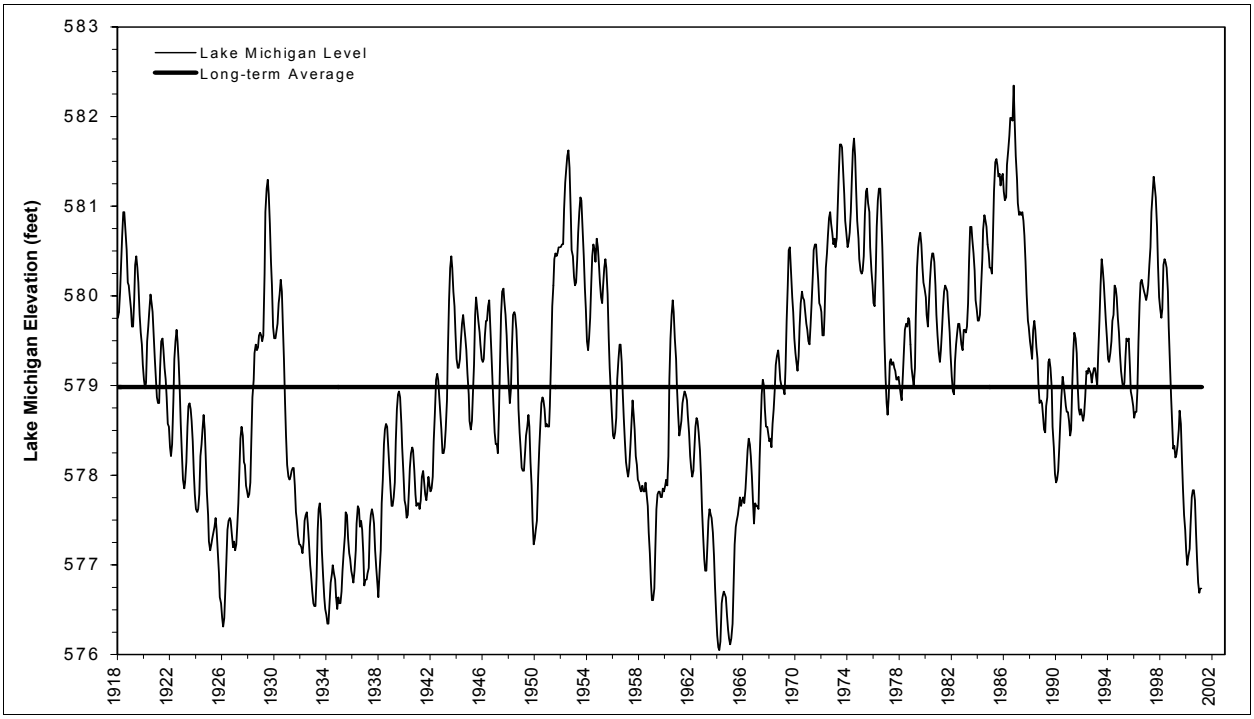

Figure 6. Lake Michigan historic lake levels. The solid line shows the average lake level at 579 feet above mean sea level, since 1918.

Figure 7. Exposed bottomland in Spring Lake, summer 2000.

Figure 8. Docks in Spring Lake, summer 2000. Lower-than-normal lake levels left many docks well above the water's surface.

RAINFALL CHARACTERISTICS

According to the Soil Survey of Ottawa County (1972),

> Ottawa County is on the eastern shore of Lake Michigan. Westerly winds prevail, so the flow of air generally is from the lake. The lake has a moderating effect on the weather throughout the county but most noticeably in the western part. Extremely high and extremely low temperatures are rare. Spring is late because the cold lake water chills the incoming air. After warming up during summer, the water stays warm long enough to modify the first outbreaks of cold weather in fall. Summer is pleasant because of the cool lake breezes. Winter temperatures are mild, but snow flurries, are frequent and the average total snowfall is heavy.

The Soil Survey also discusses precipitation, specifically:

> More than half the annual precipitation–an average of 57 percent–falls during the 6-month period April through September. September is the month of the heaviest average precipitation, and February the month of the lightest. The wettest month of record was September 1892, when precipitation totaled 9.37 inches. [Since publication of the Ottawa County Soil Survey in 1972, the wettest month of record for Grand Haven was September of 1986 at 10.76 inches. The wettest month of record for Muskegon was February of 1912 at 19.44 inches.] The driest month of record was November 1904, when precipitation measured only a trace. About once in 2 years, as much as 1.3 inches of rain falls in an hour, as much as 1.6 inches in 2 hours, and as much as 2.5 inches in 24 hours. About once in 10 years, as much as 3.7 inches falls in 24 hours, and once in 50 years, as much as 4.6 inches.

Table 3 summarizes precipitation data from Grand Haven (since 1933) and Muskegon (since 1897), and monthly precipitation for these two locations is shown in Figures 9 and 10.

TABLE 3
RAINFALL CHARACTERISTICS FOR GRAND HAVEN AND MUSKEGON

	Annual Precipitation (inches)		Monthly Precipitation (inches)	
	Grand Haven	Muskegon	Grand Haven	Muskegon
Mean	32.2	31.0	2.7	2.6
Standard Deviation	4.8	5.3	1.5	1.5
Median	31.5	30.9	2.4	2.4
Minimum	23.0	16.6	0.0	0.0
Maximum	45.4	46.8	10.8	19.4

TOPOGRAPHY

The Spring Lake watershed tends to be relatively flat in the upland areas, and steeply sloped along the streambanks and some lakeshore areas (Figure 11). Norris Creek, the largest tributary, descends from an elevation of approximately 703 feet to the lake elevation of approximately 580 feet over a distance of about 13.3 miles, or just over 9 vertical feet per horizontal mile.

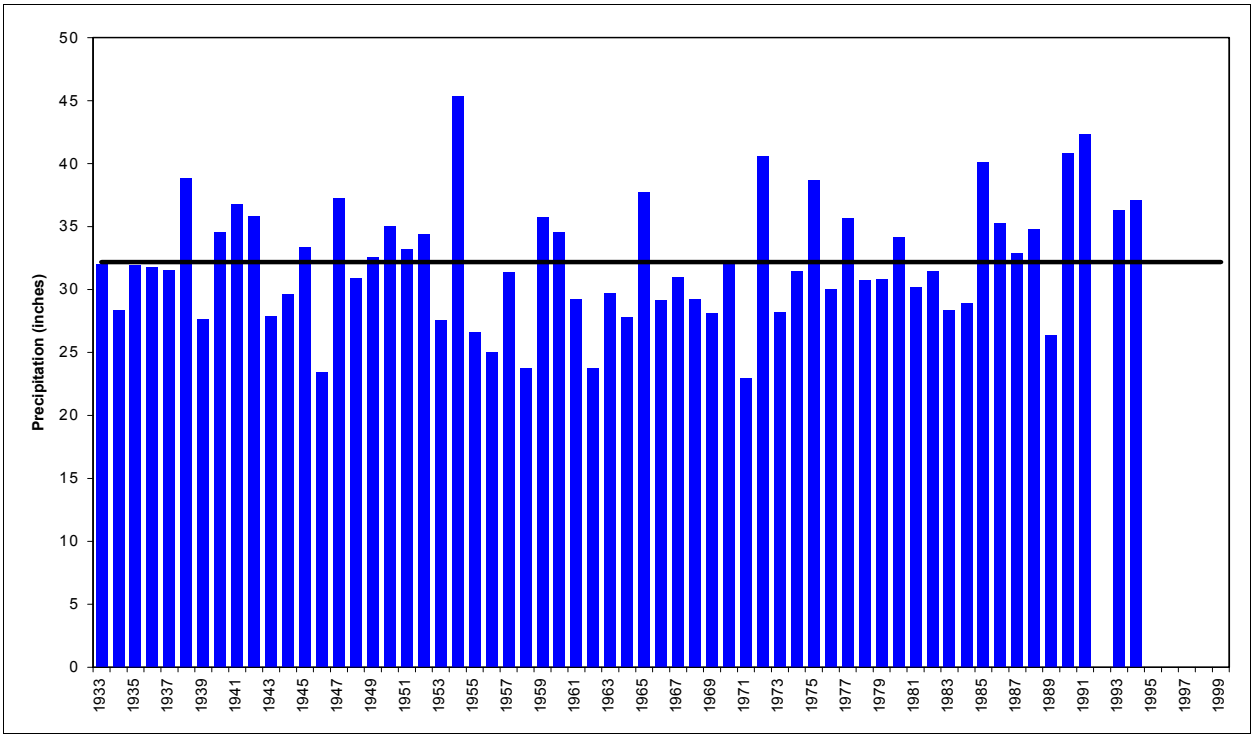

Figure 9. Monthly annual precipitation (in inches), Grand Haven, Michigan, 1933 - 1994. Source: Michigan State University Climatology.

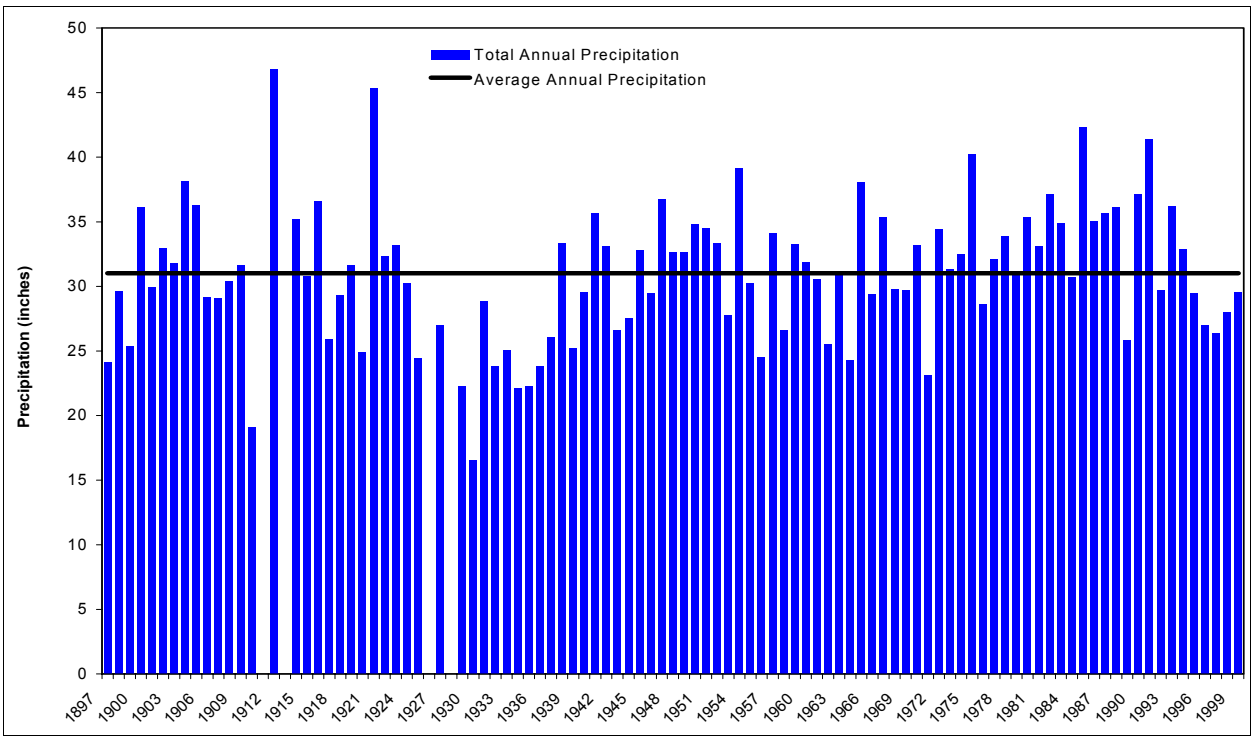

Figure 10. Monthly annual precipitation (in inches), Muskegon, Michigan, 1897 - 1999. Source: Michigan State University Climatology.

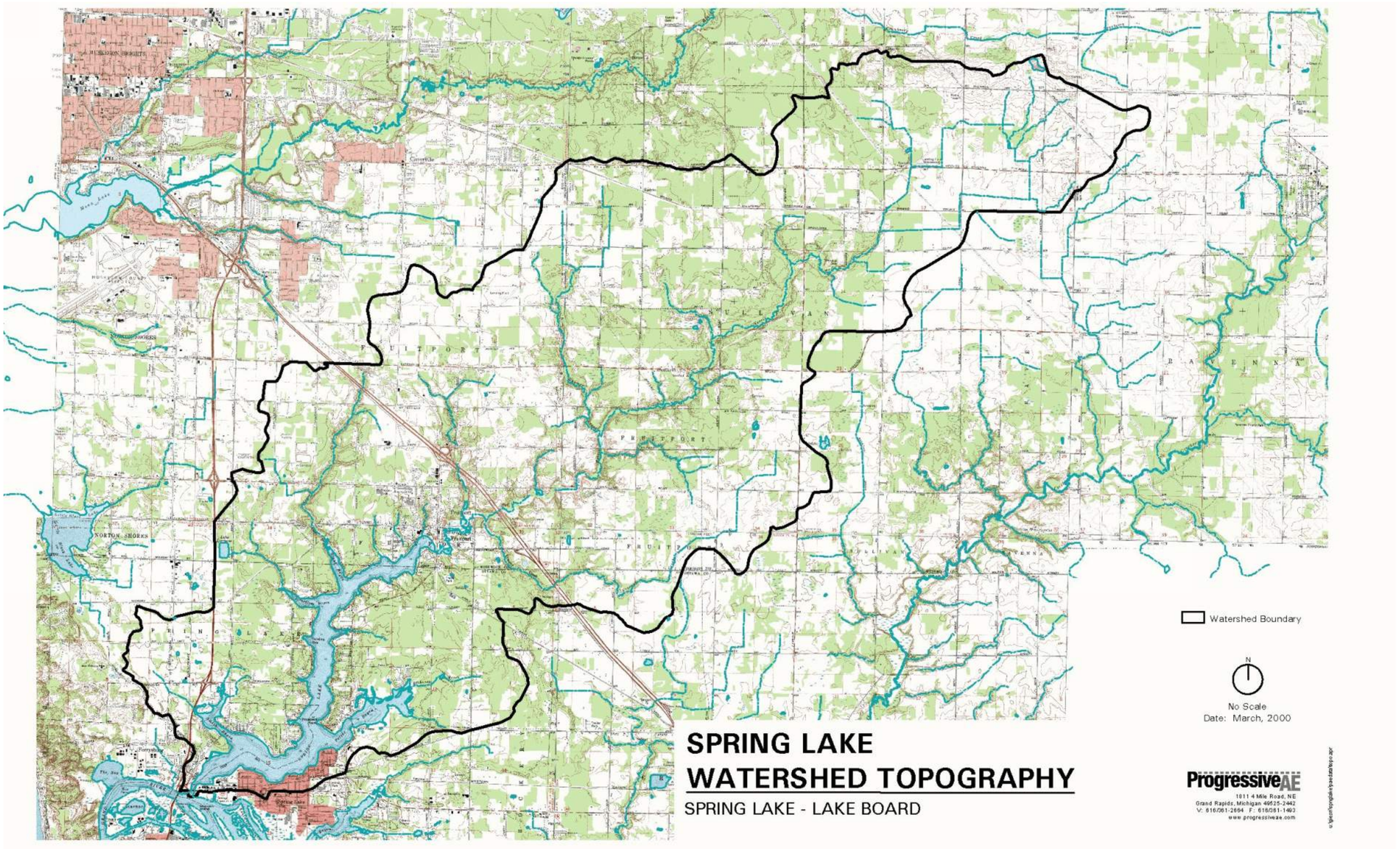

Figure 11. Spring Lake watershed topography.

SOIL TYPES

The predominant soils in the Spring Lake watershed are highly permeable sands such as Rubicon, Au Gres, and Deer Park sands (Figure 12). As such, water tends to infiltrate these soils and runoff potential is low, thus the potential pollutant load is reduced as well.

Most of the soils in the vicinity of the Norris Creek drainage area comprise the Rubicon-Au Gres-Roscommon soil association, which is referred to as "Association 2" by the U.S. Department of Agriculture Soil Conservation Service (SCS) in its Soil Survey of Muskegon County (1968). According to SCS (1968), "the soils are poor for farming." SCS notes further:

> The soils in this association, like those in association 1, were cleared of trees and farmed, were severely damaged by soil blowing, and were abandoned. . . After the logging period, nearly all farms in association 2 consisted of a combination of Rubicon, Au Gres and Roscommon soils. The dry, sloping Rubicon soils were planted largely to grape vineyards and orchards, and the wetter Au Gres and Roscommon soils were used for general crops. The vineyards and orchards did not last long, because they could not withstand the frost, drought, erosion, and low fertility. Some of the worst wind-eroded areas in the county were those old vineyards and orchards and tracts of Rubicon soils. Blowouts, 5 to 10 feet deep, appeared on many of the dry sandy ridges. In Sullivan Township, a blowout area of 2,000 acres was widely known as Sullivan Sahara.
>
> The soils in this association are suited as woodland and for community developments, limited farming, and recreation.

Steeply sloped soils occur along the streambanks and some Spring Lake shoreland areas (Figure 13). Elsewhere, most soils have less than 6 percent slope.

LAND USE

The predominant land use in the Spring Lake watershed is forested land (Figure 14; Table 4). Intensive agriculture is precluded from much of the watershed because of the poor soils, but does occur primarily in the flat, upper reaches of the Norris Creek subbasin, northeast of Spaulding Road. Residential and commercial land is concentrated along the shoreland of Spring Lake and along the US-31 corridor. Between Spring Lake and Spaulding Road, the stream corridors are lined with forested wetlands, and the remainder of the land area is forested, low-density residential, and open land. The major change that is occurring in the watershed is the construction of new single-family homes, primarily in open land, but small areas of forested land are being cleared as well.

Lauber (1999) recorded land use changes in the watershed since 1978. Residential lands have replaced agriculture as the second largest land use (after forest land). In fact, agriculture was the only land use to decrease between 1978 and the mid 1990's. While approximately 4,700 acres of agriculture remain, nearly 2,500 acres were converted to forest land (949 acres), residential land (773 acres), orchards (330 acres), commercial land (215 acres), and open field (180 acres).

In general, agricultural and residential lands tend to contain large quantities of nutrients and sediments in runoff, while forest land and wetland are considered beneficial land uses for protecting water quality. Urban land in the Spring Lake watershed is most problematic because of its proximity to the lake and

the lack of detention or filtration of runoff prior to entering the lake. Indeed, some 70 stormwater outfalls discharge directly to the lake. Conversely, agricultural land in the watershed is situated far from the lake, and agricultural runoff tends to be filtered by watershed wetlands and forests.

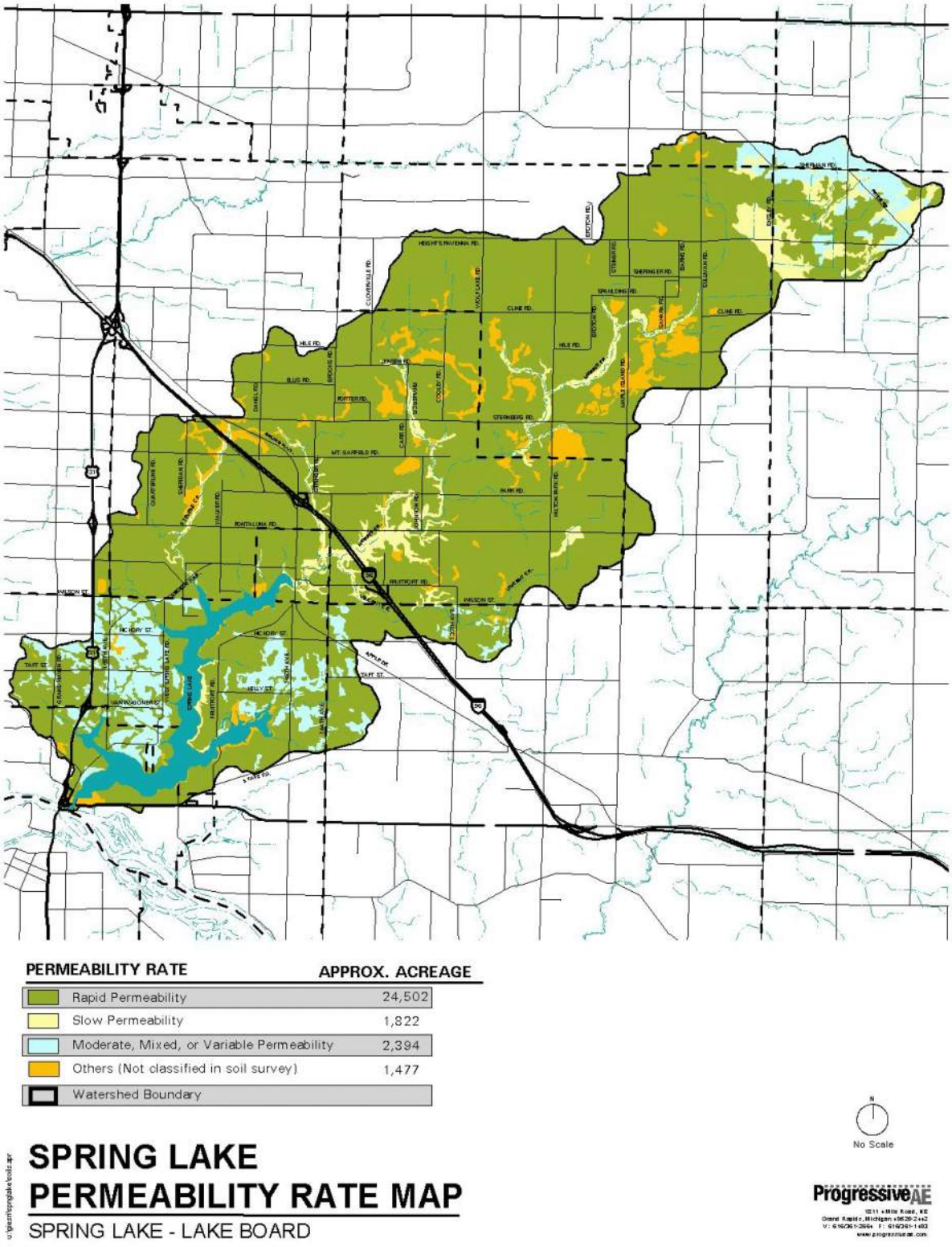

Figure 12. Spring Lake watershed soil permeability map.

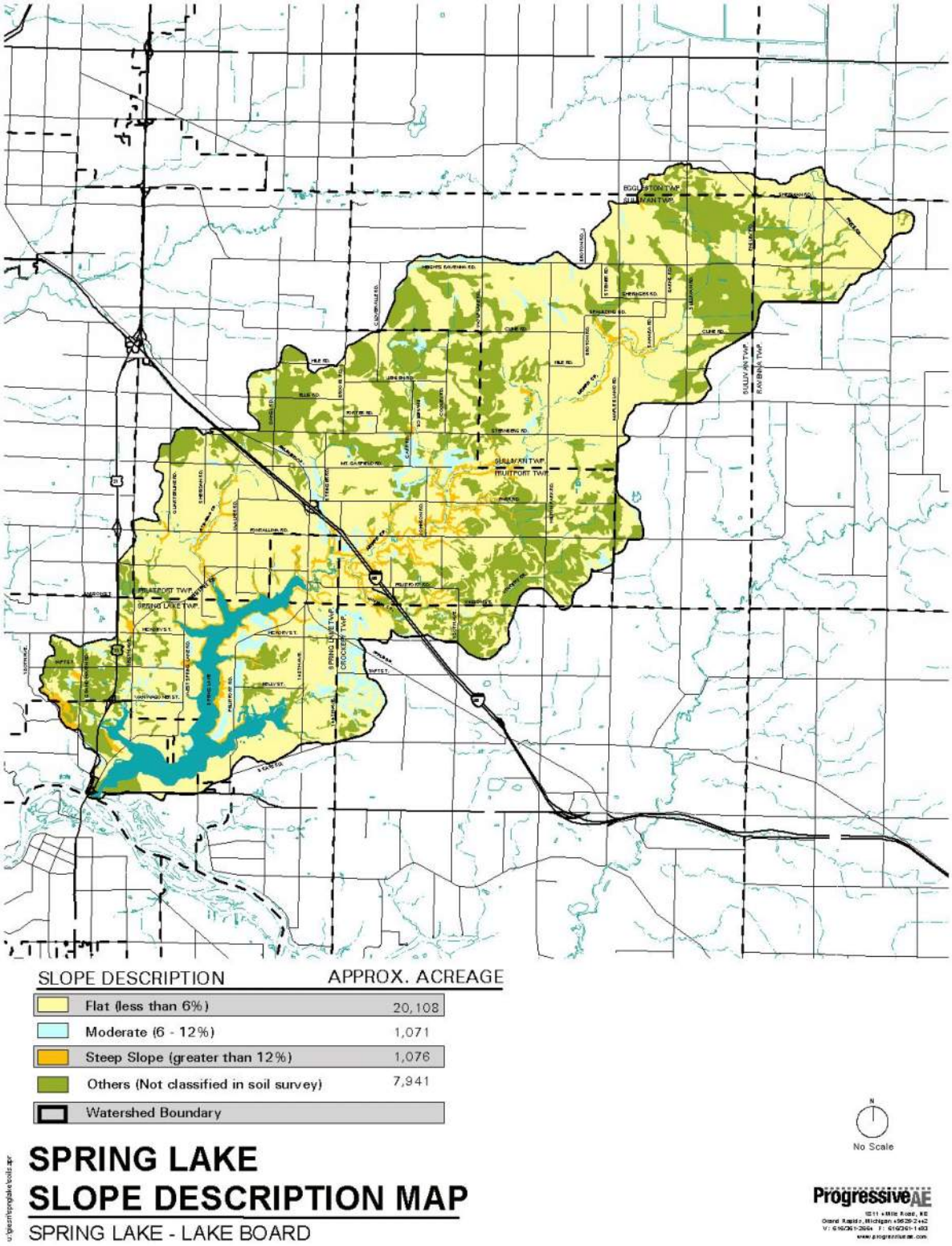

Figure 13. Spring Lake watershed soil slope map.

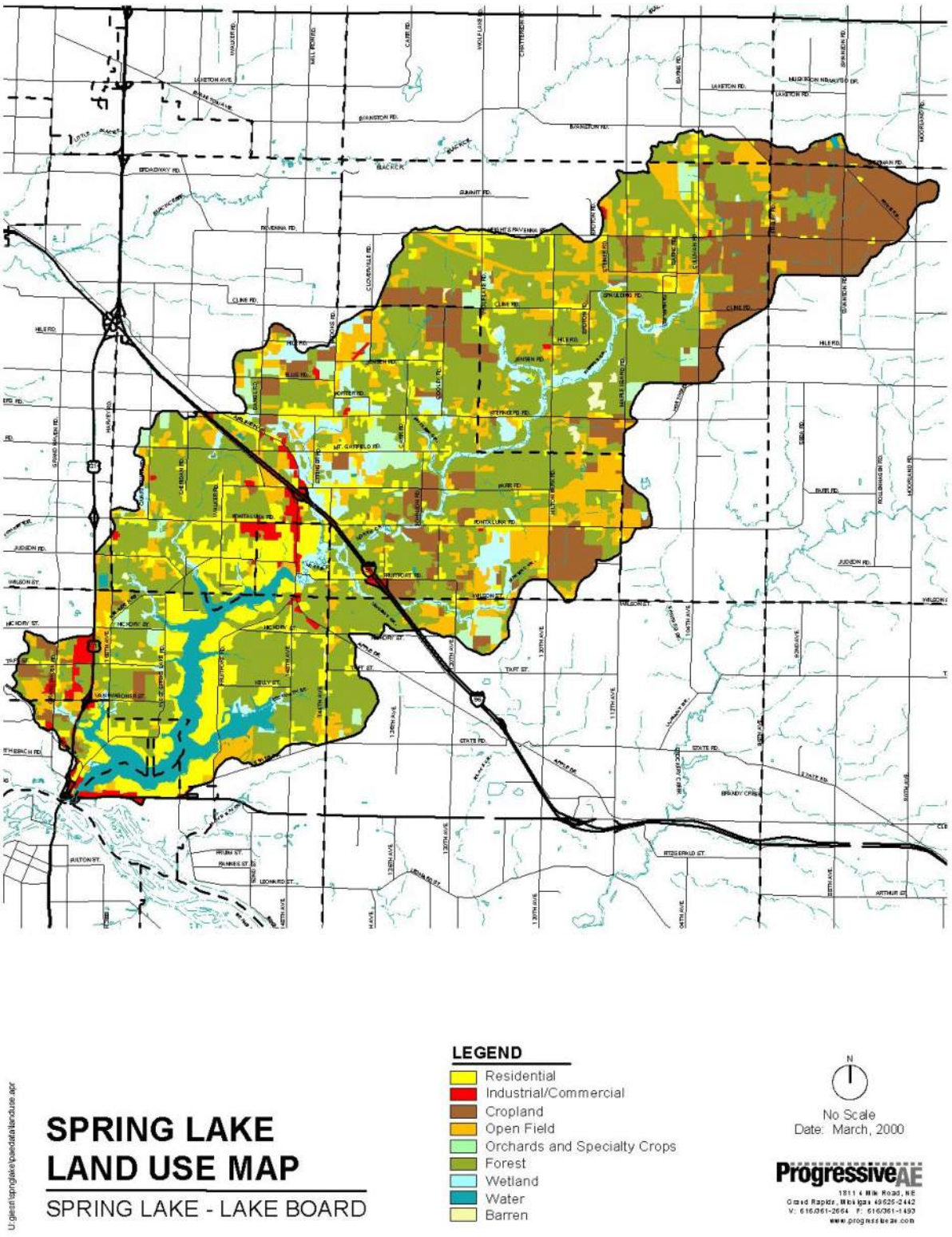

Figure 14. Spring Lake watershed land use.

TABLE 4
SPRING LAKE WATERSHED LAND USE[1]

Watershed Land Uses	Acres	Percent of Total
Agriculture	4,718	15
Orchards	819	3
Residential Development	4,917	15
Commercial, Industrial	1,408	4
Forested	14,114	44
Open Field	4,029	13
Barren (sand dunes)	133	>1
Wetlands	1,848	6
	31,986	100

SIGNIFICANT NATURAL RESOURCES

According to the Michigan Natural Features Inventory, there are three plant species and one species of turtle that are threatened in the Spring Lake watershed (Table 5; Figure 15). In addition, the watershed contains a mesic northern forest. Further information regarding *Pterospora andromeda* and mesic northern forests is included in Appendix D.

TABLE 5
SIGNIFICANT NATURAL FEATURES IN THE SPRING LAKE WATERSHED

Scientific Name	Common Name	Status
Lycopodium appressum[2]	Northern appressed clubmoss	Threatened
Clemmys guttata	Spotted turtle	Threatened
Eleocharis tricostata	Three-ribbed spike-rush	Threatened
Pterospora andromeda	Pine drops	Threatened
Mesic northern forest		

[1] From Lauber (1999). Lauber categorized approximately 1,588 acres of lowland hardwoods and lowland conifers as forest land; in this management plan, these areas are classified as wetland.

[2] *Lycopodium appressum* has been split into two species: *Lycopodiella margueriteae*, which is threatened, and *Lycopodiella subappressa*, which is a special concern species. Since the reclassification, it is not known which species is present in the Spring Lake watershed.

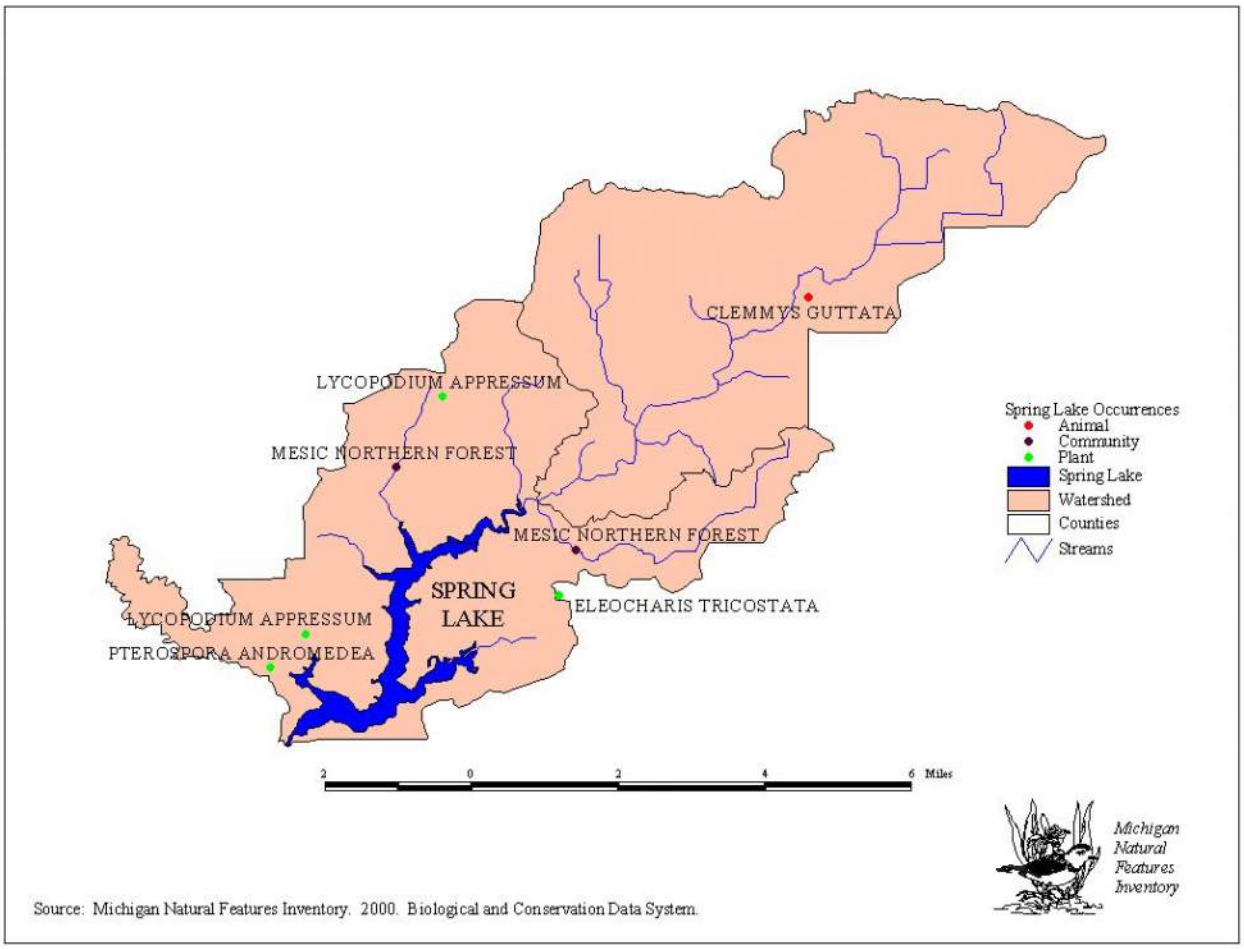

Figure 15. Spring Lake watershed natural features inventory map.

COMMUNITY PROFILE

Spring Lake is heavily used. Currently, approximately 900 homes and businesses border the lake, and approximately 350,000 people reside within about 20 miles of Spring Lake (Table 6). The total population of Spring Lake watershed communities is nearly 68,000, while the Muskegon and Ottawa County populations are approximately 159,000 and 188,000, respectively (Figure 16). Population in the watershed and Muskegon County has been nearly level since 1970, but there was a significant increase in the watershed population from 1960 to 1970. There has been a double-digit percent increase in the Ottawa County population every decade since 1950; Ottawa County was 155% larger in 1990 than in 1950. Between 1950 and 1990, the population of municipalities within the watershed (exclusive of Norton Shores) nearly doubled. On the whole, population for the municipalities abutting Spring Lake has increased (Figure 17). Significantly, Fruitport Township and the City of Ferrysburg populations have increased over 100 percent since 1950. For most of the near-shore municipalities, the largest population increases occurred before 1970, although Spring Lake Township and the City of Ferrysburg both experienced double-digit percent increases from 1980 to 1990.

TABLE 6
INCOME (1990) AND POPULATION (1950-1990) OF SPRING LAKE WATERSHED MUNICIPALITIES[1]

Municipality	Median Household Income ($)	Population				
		1950	1960	1970	1980	1990
Fruitport Township	31,626	4,464	7,949	10,214	10,646	11,485
Village of Fruitport	29,083	688	1,037	1,409	1,143	1,090
Sullivan Township	32,108	1,020	1,577	2,051	2,356	2,230
Ravenna Township	27,625	1,544	2,105	2,403	2,471	2,354
Moorland Township	27,697	1,063	1,285	1,488	1,789	1,543
Egelston Township	27,633	3,941	6,104	9,690	7,310	7,640
Norton Shores	33,646			22,271	22,025	21,755
Muskegon County	25,617	121,545	149,943	157,426	157,589	158,983
Spring Lake Township	36,222	5,524	8,016	8,103	9,588	10,751
Village of Spring Lake	29,811	1,824	2,063	3,034	2,731	2,537
City of Ferrysburg	35,643	1,454	2,590	2,196	2,440	2,919
Crockery Township	30,159	1,763	2,402	2,861	3,536	3,599
Ottawa County	36,507	73,751	98,719	128,181	157,174	187,768

There are two state-owned public access sites on Spring Lake. In addition, it is possible to navigate from Spring Lake to Lake Michigan via the Grand River. As such, Spring Lake harbors many large motorboats and sailboats for use on Lake Michigan, and the lake itself sustains heavy traffic for boating, fishing, water skiing, and jet skiing.

[1] U.S. Department of Commerce. 1990. Bureau of Census Data.

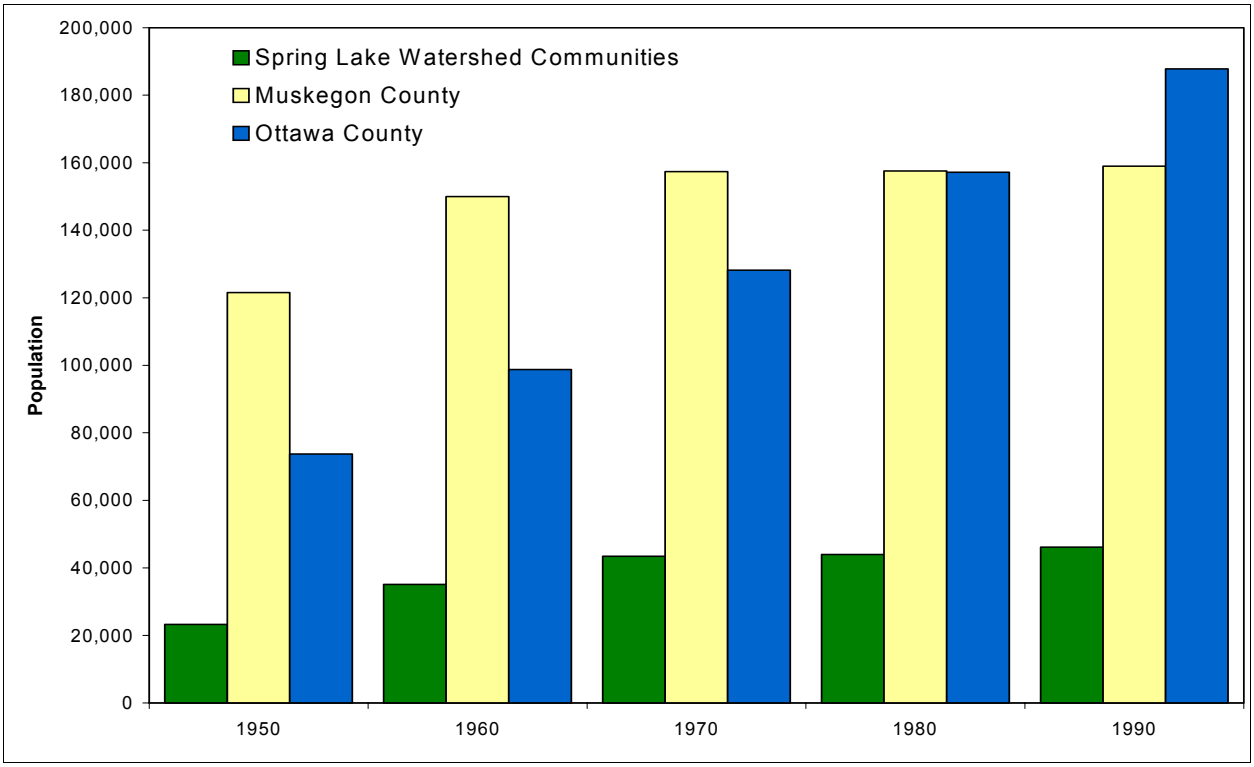

Figure 16. Regional population chart.

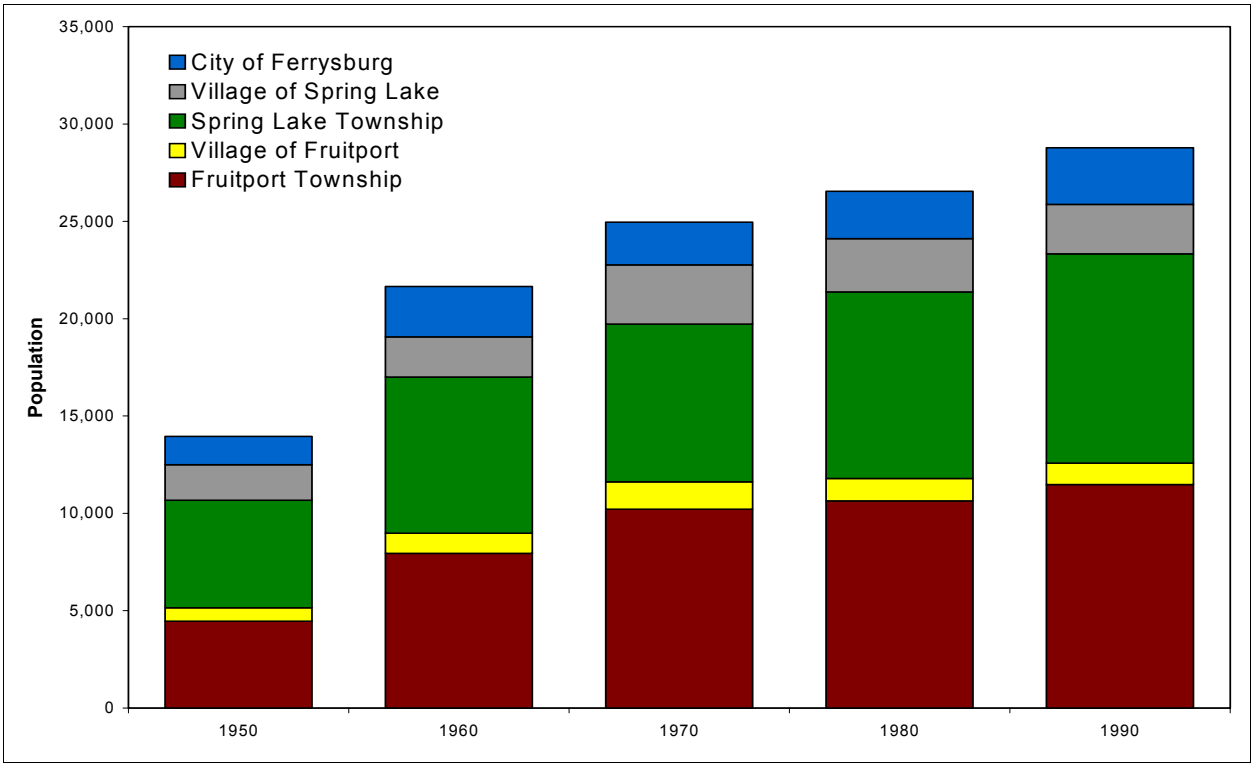

Figure 17. Near-shore population chart.

WATER QUALITY

As noted in the Spring Lake Improvement Plan (Appendix A):

> Current and historical water quality data indicate Spring Lake is eutrophic. Deep-water dissolved oxygen becomes depleted in late summer; levels of the plant nutrient phosphorus are very high; algae growth is excessive as reported by lake residents and as indicated by periodic high concentrations of chlorophyll-*a*; rooted plant growth is abundant; and water clarity is low. Spring Lake is nutrient-enriched and highly productive. Spring Lake contains excess levels of plant nutrients that support abundant rooted plants and algae, which form the base of a very productive food chain. Because the lake is so biologically active, plant and animal matter rapidly accumulates on the lake bottom, causing oxygen to be depleted relatively early in the summer in the course of decomposition. Water clarity is reduced by excessive algae growth, but may also be caused by sediments that are resuspended from the lake bottom or that wash into the lake from the shoreline, tributaries, and storm drains.

Water quality data collected in 2000 shows that water quality in Spring Lake violated the state's dissolved oxygen standard. The Department of Environmental Quality rule regarding dissolved oxygen levels in inland lakes that are not designated trout lakes states that "during stratification, a minimum dissolved oxygen concentration of 5 milligrams per liter shall be maintained throughout the epilimnion. At all other times, dissolved oxygen concentrations greater than 5 milligrams per liter shall be maintained." On September 25, 2000, Spring Lake was not thermally or chemically stratified. At 11 sampling locations, dissolved oxygen levels were less than 5 milligrams per liter (Figure 18 and Table 7).

TABLE 7
SPRING LAKE DISSOLVED OXYGEN CONCENTRATIONS (in milligrams per liter)
BELOW STATE WATER QUALITY STANDARDS
SEPTEMBER 25, 2000

Depth (feet)	Dissolved Oxygen Sampling Station Number										
	147	148	149	151	152	153	154	155	156	157	158
1	4.9	4.3	4.4	4.6	4.8	4.9	4.7	4.4	3.8	4.6	4.3
5	4.8	4.3	4.4	4.6	4.8	4.9	4.6	4.4	3.7	4.6	4.3
10	4.9	4.5	4.3	4.6	4.8	4.9	4.6	4.3	3.6	4.6	4.4
15	5.0	4.5	4.3	4.9	4.7	4.9	4.5	4.2	3.6	4.5	4.5
20	4.9	4.3	4.3	5.4	4.7	4.9	4.4	3.9	3.5	4.6	
25	5.2	4.1			4.6	4.8	4.6	3.8	3.6		
30					4.3	4.6	4.2	3.1			
35						4.3					

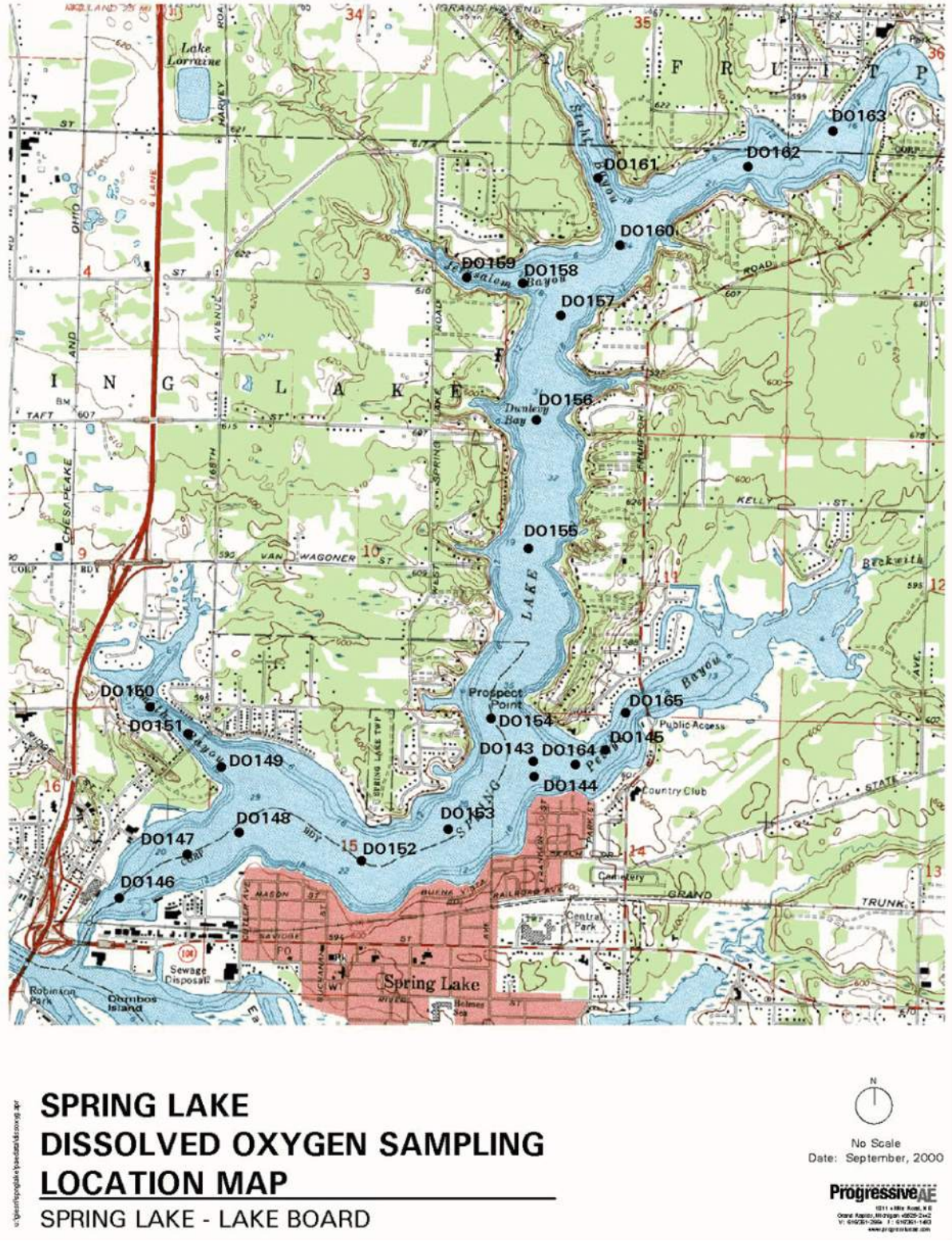

Figure 18. Location of violations of the dissolved oxygen standard, September 25, 2000.

In addition to low dissolved oxygen levels, Spring Lake also contains extremely high total phosphorus concentrations. For example, on August 28, 2000, the average total phosphorus concentration measured throughout the lake was 143 ± 33 micrograms per liter, and the median concentration was 137 micrograms per liter (Figure 19 and Table 8). These levels are well above those needed to cause "stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi, or bacteria which are or may become injurious to the designated uses of the waters of the state." [R 323.1060 Plant nutrients, of the state water quality standards]

TABLE 8
SPRING LAKE TOTAL PHOSPHORUS CONCENTRATIONS (in micrograms per liter)
AUGUST 28, 2000

	In-lake Sampling Locations						
Depth	**Fruitport**	**Prospect Point**	**Spring Lake**	**Stahl Bayou**	**Jerusalem Bayou**	**Petty's Bayou**	**Smith Bayou**
1	187	117	117	132	122	139	125
5	166	131	109	171	197	256	122
10	147	118	112	159	155	141	109
15	154	104	115	173	137	104	112
20		168	117				
25		141	137				
30		192	166				

Lake residents have also noted water quality problems, especially blue-green algae and foam (Figure 20). Water quality data collected to date along with observations by lake residents indicate that not only is Spring Lake highly productive and eutrophic but, at times, state water quality standards are apparently exceeded.

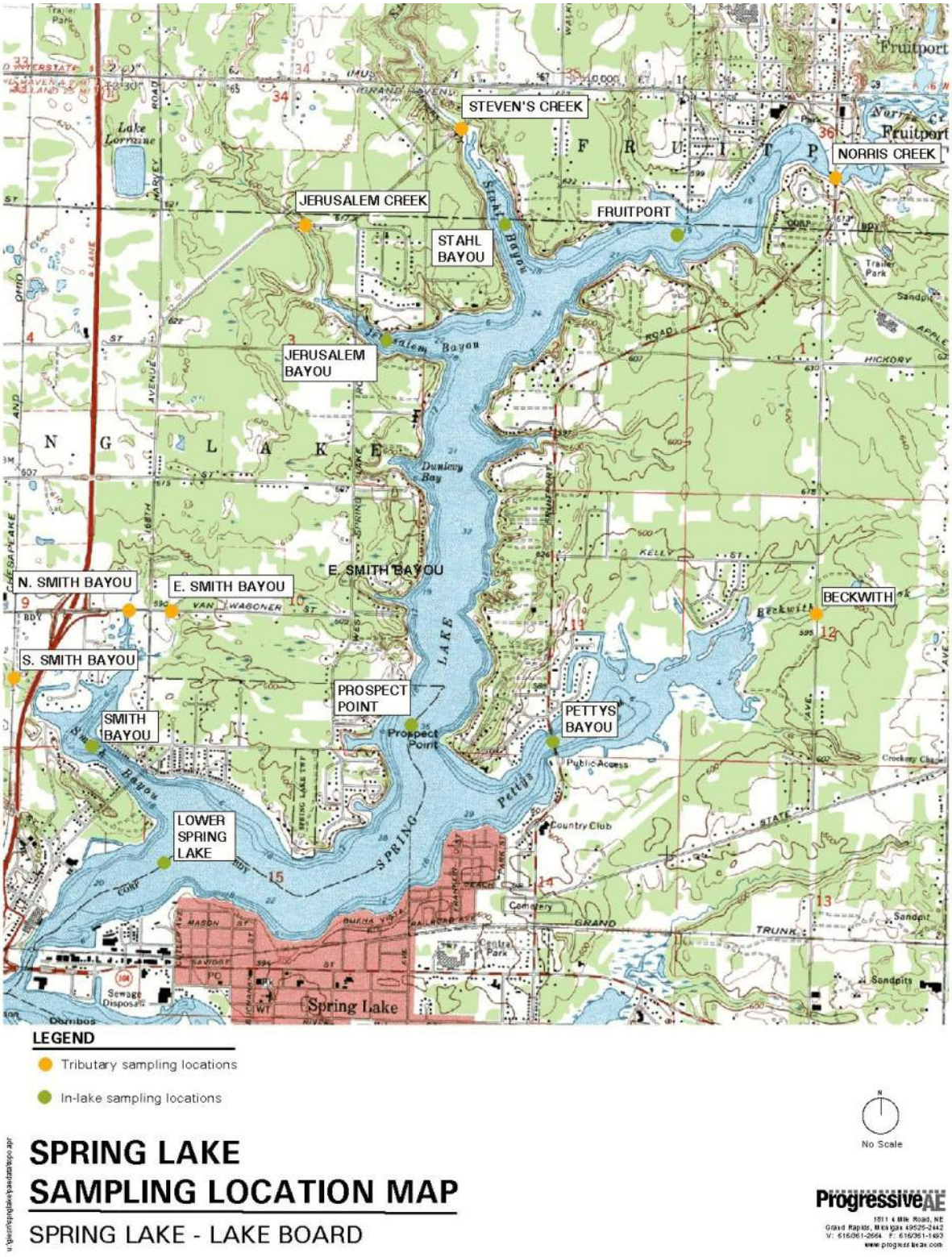

Figure 19. Water quality sampling location map.

Figure 20. Foam along the west shore of Spring Lake, November 12, 2000.

Watershed Uses

DESIGNATED USES OF THE WATERSHED

The term “designated uses” and its relationship to Michigan’s water quality standards was described by Sayles (1996):

> In 1968, the State of Michigan established a set of rules describing the water quality to be achieved in Michigan's surface waterbodies, including the Great Lakes, inland lakes, rivers and streams. These rules, most recently updated in 1994, are the Michigan Water Quality Standards. The standards identify the minimal uses for which Michigan waters are to be protected. These "designated uses" are agriculture, navigation, industrial water supply, public water supply at the point of water intake, warmwater fish, other aquatic life and wildlife, partial body contact recreation, and total body contact recreation (between May 1 and October 31). Certain waterbodies identified by the Director of the Department of Natural Resources are also protected for coldwater fish.
>
> Specific criteria for meeting the designated uses are described in the Water Quality Standards. For instance, the standards include acceptable numbers of microorganisms such as *E. coli* needed to meet the partial body contact use. Other water quality characteristics covered by the standards include dissolved solids, chlorides, pH, nutrients, dissolved oxygen, and temperature. Each standard is developed to assure protection of the applicable designated use.
>
> If one or more designated use(s) is(are) not being met, the cause may be that one or more of the Water Quality Standards are not being met. Identifying the reason for not meeting the standard can be difficult, particularly when it is due to multiple causes or if natural background conditions are contributing to the problem.
>
> The Water Quality Standards require that waterbodies that do not meet standards be improved to meet the standard, unless it is due to natural causes (where meeting the standards may not be possible). In those cases, the standards prohibit further reductions in water quality rather than requiring standards be met.
>
> To protect a water for a designated use means:
>
> - The water is suitable for crop irrigation and livestock watering (agriculture).
> - Watercraft are able to navigate waterways unobstructed by floating materials, and the water does not contain chemicals that interfere with boat functions (navigation).
> - The water is of adequate quality to be used by industry in industrial processes (industrial water supply).
> - The water is suitable for human consumption where public water supply intakes are located (public water supply).

- Warmwater or coldwater fish can thrive and reproduce (warmwater or coldwater fish).
- Animals that rely on surface waters, other than fish, can thrive and reproduce (other aquatic life).
- The water causes "no unacceptable conditions" in people involved in activities such as fishing, wading, or boating (partial body contact recreation).
- The water causes "no unacceptable conditions" in people involved in activities where they may become totally immersed in water, such as swimming (total body contact recreation).

The actual language in the administrative rule for water quality standards which protects the designated uses is as follows:

> R 323.1100 Designated uses.
> Rule 100. (1) At a minimum, all surface waters of the state are designated for, and shall be protected for, all of the following uses:
> (a) Agriculture.
> (b) Navigation.
> (c) Industrial water supply.
> (d) Public water supply at the point of water intake.
> (e) Warmwater fishery.
> (f) Other indigenous aquatic life and wildlife.
> (g) Partial body contact recreation. [This use is defined in the rules as “any activities normally involving direct contact of some part of the body with water, but not normally involving immersion of the head or ingesting water, including fishing, wading, hunting, and dry boating”]
> (2) All surface waters of the state are designated for, and shall be protected for, total body contact recreation from May 1 to October 31 in accordance with the provisions of R 323.1062. Total body contact recreation immediately downstream of wastewater discharges, areas of significant urban runoff, combined sewer overflows, and areas influenced by certain agricultural practices is contrary to prudent public health and safety practices, even though water quality standards may be met.

Thus, Spring Lake’s designated uses include all of the minimum uses, i.e., agriculture, navigation, industrial water supply, public water supply at the point of water intake, warmwater fishery, other indigenous aquatic life and wildlife, partial body contact recreation, and total body contact recreation from May 1 to October 31. There are additional water quality standards that apply to lakes that have been designated as either coldwater lakes or trout lakes, but Spring Lake does not have either designation. As discussed previously (see preceding report section), Spring Lake may currently violate state water quality standards for dissolved oxygen and nutrients. Spring Lake’s designated uses that are threatened or impaired are included in Table 9.

TABLE 9
SPRING LAKE IMPAIRED OR THREATENED DESIGNATED USES

Designated Uses	Impaired or Threatened
Navigation	Threatened
Warmwater fishery	Impaired
Other indigenous aquatic life and wildlife	Threatened
Partial body contact recreation	Threatened
Total body contact recreation between May 1 and October 31	Impaired

DESIRED USES OF THE WATERSHED

Desired uses for the Spring Lake watershed include all designated uses that are threatened or impaired. In addition, the protection of critical stream corridors and wetland areas, and the restoration of natural shoreland vegetative buffers, have been identified as desired uses in the watershed.

Water Quality Threats or Impairments

INVENTORY METHODS

The Spring Lake watershed was inventoried using remote and field survey methods to determine the type and location of pollution sources. The remote survey involved review of available mapping, aerial photography, interviews, and field surveys. U.S. Geological Survey topographic maps, U.S. Department of Agriculture soils data, and Michigan Resource Inventory System (MIRIS) land cover maps were reviewed to identify road-stream crossings, steeply sloped land areas, high-intensity land uses (agriculture and urban land), and highly-erodible soils. A global positioning system (GPS) and photographs were used to record specific problem sites which were found by traversing the watershed by car and on foot (Appendix E). To inventory storm drain outfall locations, the project consultant cruised the entire shoreline by boat, recording a GPS location, storm drain size, and photographing each outfall (Appendix F). Field surveys are summarized as follows:

March 7 - Project consultant inventoried road-stream crossings.

March 23 - Project consultant began inventory of storm drain outfalls.

March 31 - Project consultant completed outfall inventory.

April 3 - Project consultant and NRCS conservationist survey agricultural areas.

May 30 - Project consultant, lake resident, and Muskegon County Drain Commissioner visited erosion areas.

July 19 - Project consultant, lake resident, and Ottawa County Drain Commissioner visited erosion sites.

CRITICAL AREAS

There are four geographic areas within the Spring Lake watershed that are critical for water quality improvement and protection: 1) Agricultural land, generally located in the headwaters of Norris Creek; 2) corridors along major tributaries, the primary being the Norris Creek corridor; 3) the Spring Lake shoreland area; and 4) the waters of Spring Lake itself. A map of the critical areas is shown in Figure 21. Focusing on these critical areas is important for cost-effectiveness and manageability.

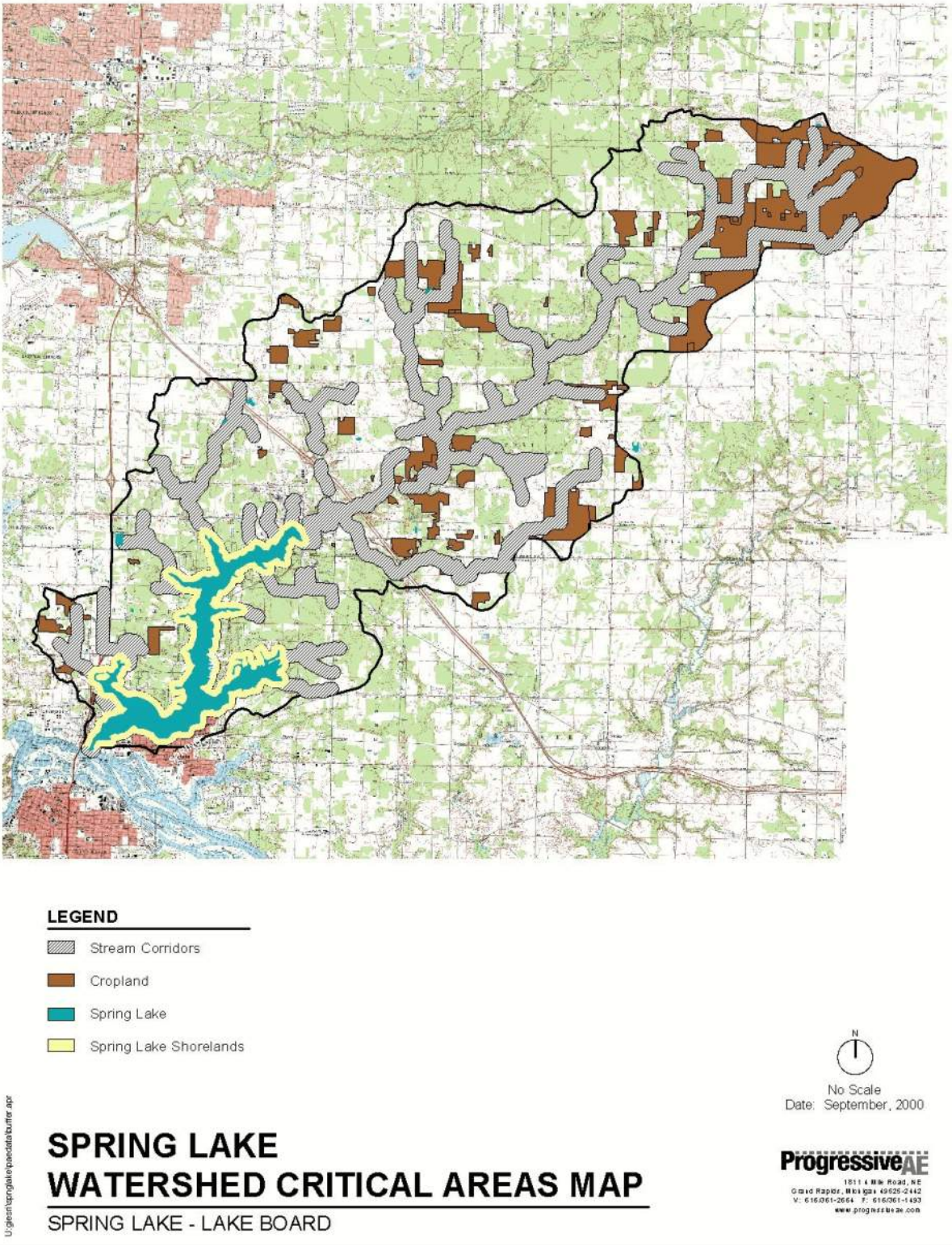

Figure 21. Spring Lake watershed critical areas.

Headwaters Agricultural Land: The sandy soil conditions throughout much of the watershed restrict farming to a relatively small number of acres that tend to be located on loamy soils near the headwater areas. The largest contiguous areas of agriculture are in the headwaters of Norris Creek in Ravenna Township. Two of the more intense farming operations in the watershed are the pickling cucumbers operations in Fruitport and Sullivan Townships and the dairy operation in Ravenna Township. Overall, very little agriculture in the watershed is located directly adjacent to waterbodies; however, most agricultural land drains to Norris Creek. Field surveys of the headwater areas indicate that nutrient management, in particular fertilizer and manure management, and the establishment of filter strips, will be most beneficial to downstream water quality.

Stream Corridors: Erosion is a problem along select streambanks in the Spring Lake watershed. A listing of priority problem sites is included in Appendix E). However, much of the land along the major tributary streams has remained in a relatively natural state and is currently either forested or wetland. If development pressures were to increase along the stream corridors and land were to be developed improperly, water quality in the tributaries and in Spring Lake would be severely threatened. Therefore, a major emphasis of the Spring Lake Watershed Management Plan is the protection of lands along the stream corridors by establishing building setbacks, restricting development of wetlands, and restricting vegetation removal. This plan element is proposed to include the acquisition of conservation easements to permanently protect environmentally sensitive areas such as steeply sloped lands, wetlands, and forest lands. In addition, strict enforcement of existing state laws regarding soil erosion and sedimentation control, wetland protection, and inland lakes and streams will be a priority. The lake board is proposing to play a role by reviewing local soil erosion and sedimentation control rules and by reviewing pending applications for permits required under Part 301 and Part 303 of Michigan's Natural Resources and Environmental Protection Act.

Spring Lake Shoreland: Like the stream corridors, the Spring Lake shoreland is important because of its proximity to the lake. However, unlike the watershed stream corridors, the Spring Lake shoreland has generally not remained in a natural state. Most of the shoreland has been developed for residential, commercial, or industrial uses. There are few remaining wetlands or forested areas. Much of the shoreland area is drained by an extensive network of storm sewers which hasten the conveyance of water (and pollutants) to the lake. A total of approximately 70 storm sewers were identified during the course of plan development (Appendix F). Of those, approximately 30 appear to drain highly urbanized areas and have the potential to contribute substantial quantities of nutrients, oil, grease, and heavy metals (Figure 22). In light of these findings, efforts in lake shoreland areas will focus on establishment of vegetative buffers, reducing use of lawn fertilizers containing phosphorus, proper lakefront lawncare and lakeside landscaping, septic system maintenance, stormwater management, street sweeping/vacuuming, identification and correction of failing septic systems and illicit storm sewer connections, and wetland protection.

Spring Lake: Water quality problems within Spring Lake are a result of both internal and external pollution sources. As part of the Spring Lake Improvement Plan, the Spring Lake - Lake Board is coordinating a nuisance aquatic plant control program which includes the limited use of herbicides to control Eurasian milfoil (*Myriophyllum spicatum*) and blue-green algae blooms (*Microcystis* sp.), and mechanical harvesting of other aquatic plants growing at nuisance levels. After implementation of the watershed plan, consideration will be given to a lake alum (i.e., aluminum sulfate) treatment to mitigate internal (i.e., sediment) phosphorus release in Spring Lake.

Figure 22. Storm sewer outlet to Spring Lake.

SPRING LAKE POLLUTANTS

Pollution loading to Spring Lake has resulted in nuisance growth of aquatic plants and algae, poor water clarity, and low dissolved oxygen levels. These conditions impair or threaten designated uses in Spring Lake. A listing of Spring Lake pollutants is provided in Table 10, and the location of existing and potential pollution sources is shown in Figure 23.

TABLE 10
SPRING LAKE POLLUTANTS

Threatened or Impaired Use	Pollutants
Navigation	Sediment and nutrients
Warmwater fishery	Sediment, nutrients, and oil, grease, heavy metals (suspected)
Other indigenous aquatic life and wildlife	Sediment, nutrients, and oil, grease, heavy metals (suspected)
Partial body contact recreation	Sediment and nutrients
Total body contact recreation between May 1 and October 31	*E. coli* (suspected), sediment, nutrients, and oil, grease, heavy metals (suspected)

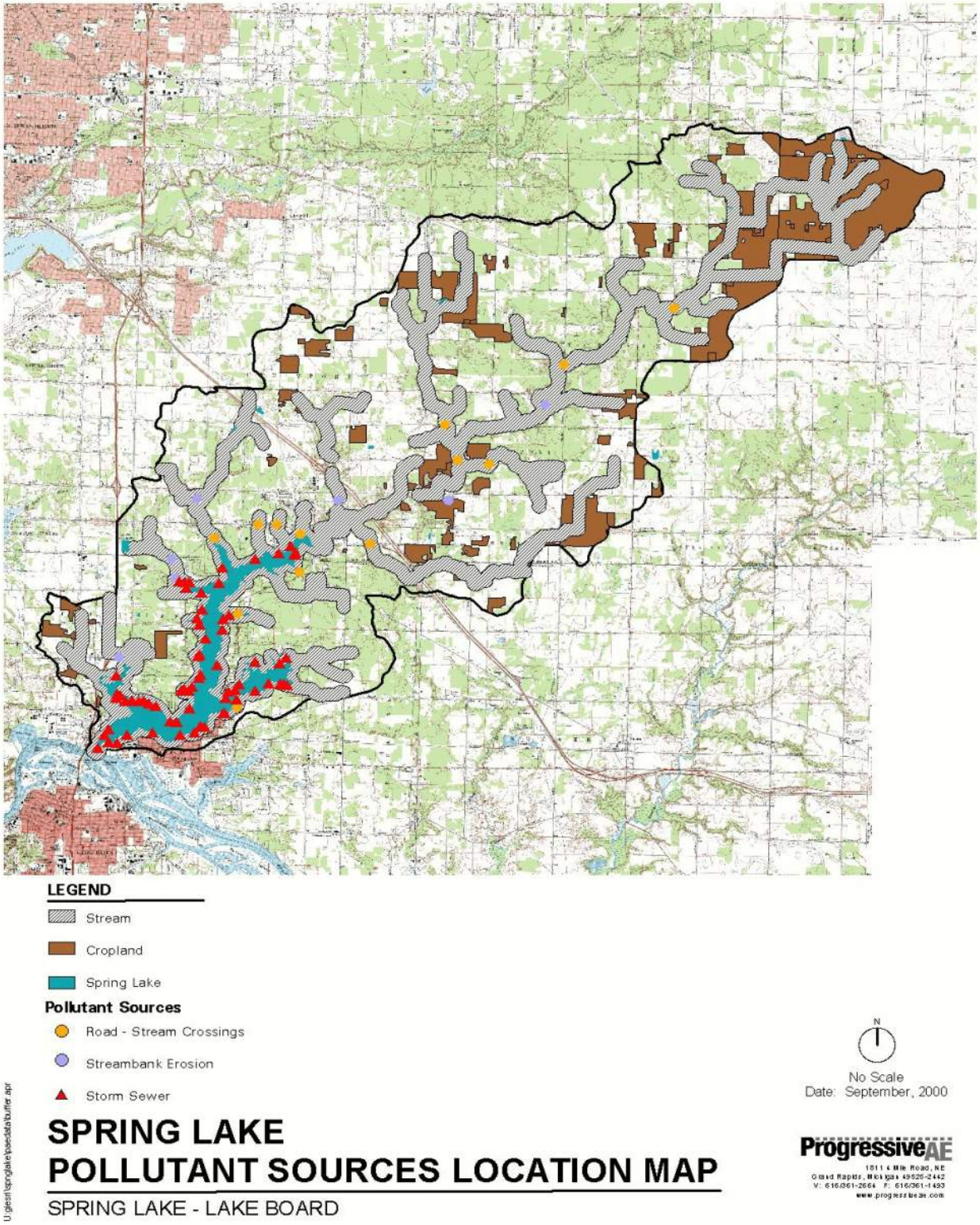

Figure 23. Location map of Spring Lake pollutant sources.

PRIORITIZATION OF POLLUTANTS, SOURCES AND CAUSES

Phosphorus was chosen as the highest priority pollutant because of its direct impact on the eutrophication of Spring Lake (Table 11). Sediments were given the next highest priority since sedimentation is also a factor in eutrophication and phosphorus often adheres to sediments. Oil, grease, heavy, metals, and *E. coli* were given a lower priority because they are only suspected pollutants.

TABLE 11
SPRING LAKE PRIORITIZATION OF POLLUTANTS

Priority	Pollutants	Sources	Causes
1	Nutrients (phosphorus)	Urban shorelands.	Improper lakeside landscaping, lawn care practices, and septic system maintenance. Extensive storm sewer network.
		Agricultural lands in headwaters.	Lack of vegetative buffers & fertilizer/ manure management.
		Spring Lake sediments.	Biological oxygen demand and unstable thermal stratification.
2	Sediments	Urban shorelands. Stream corridors.	Lack of vegetative cover/armor on streambanks and road crossings.
3	Oil, grease, heavy metals (suspected)	Urban shorelands.	Impervious surfaces.
4	*E. coli* (suspected)	Urban shorelands.	Septic systems improperly designed or maintained.

Of the pollutant sources and causes (Tables 12 and 13, respectively), urban shorelands were the highest priority because of their proximity to Spring Lake. Repair of eroding streambanks was the next priority because of the potential for delivery of sediments downstream to Spring Lake. Headwater agricultural lands were a relatively low priority because of their remoteness relative to Spring Lake. Spring Lake sediments have the lowest priority since watershed pollutant sources will be addressed first to improve longevity of alternatives to control internal phosphorus release (i.e., lake alum treatment).

TABLE 12
SPRING LAKE PRIORITIZATION OF POLLUTANT SOURCES

Priority	Sources	Causes
1	Urban shorelands.	Improper lakeside landscaping, lawn care practices, and septic system maintenance. Extensive storm sewer network. Impervious surfaces. Septic systems improperly designed or maintained.
2	Stream corridors.	Lack of vegetative cover/armor on streambanks and road crossings.
3	Agricultural lands in headwaters.	Lack of vegetative buffers and fertilizer/manure management.
4	Spring Lake sediments.	Biological oxygen demand and unstable thermal stratification.

TABLE 13
SPRING LAKE PRIORITIZATION OF POLLUTANT CAUSES

Priority	Causes
1	Improper lakeside landscaping, lawn care practices, and septic system maintenance.
2	Extensive storm sewer network.
3	Impervious surfaces.
4	Lack of vegetative cover/armor on streambanks and road crossings.
5	Septic systems improperly designed or maintained.
6	Lack of vegetative buffers and fertilizer/manure management.
7	Biological oxygen demand and unstable thermal stratification which exacerbate internal phosphorus loading.

Water Quality Improvement and Protection Goals

The goal of the Spring Lake Watershed Management Plan is to protect threatened designated uses and to restore impaired designated uses, including:

- Improving navigation.
- Restoring the warmwater fishery.
- Protecting other indigenous aquatic life.
- Protecting partial body contact recreation.
- Restoring total body contact between May 1 and October 31.

These goals can be achieved by meeting state water quality standards for dissolved oxygen and nutrients, and by reducing sediment, oil, grease, heavy metals, and *E. coli* inputs into Spring Lake.

Most of the project goals have the same objectives. For example, reducing nutrient loading to Spring Lake is an objective common to all of the project goals: Nutrient inputs accelerate rooted plant and algae growth, which impedes navigation, and interferes with partial and total body contact recreation. In addition, excessive rooted plant and algae growth increases biological oxygen demand which, at times, decreases dissolved oxygen levels below state water quality standards. The low dissolved oxygen levels impair the warmwater fishery and other indigenous aquatic life. The objectives of the project (and the goals to which they apply) are to:

- Reduce sedimentation (all 5 goals): Repair and stabilize eroding streambanks and road-stream crossings, and street sweeping/vacuuming.
- Reduce nutrient loading (all 5 goals): Implementation of agricultural best management practices (BMP's) including fertilizer management, manure management, and establishment of vegetative buffer strips along drains; implementation of land protection measures including ordinances and conservation easements for stream corridors, wetlands, and other environmentally sensitive areas; implementation of urban best management practices including shoreland vegetative buffers, and promotion of proper lakeside landscaping and septic system maintenance practices.
- Reduce oil, grease, and heavy metal inputs (restore the warmwater fishery, other indigenous aquatic life, and total body contact recreation): Implement structural and non-structural measures to manage stormwater.
- Reduce levels of *E. coli* (restore total body contact recreation): Identify failed septic systems and illicit connections.

Tasks And Costs

BEST MANAGEMENT PRACTICES

Best management practices (BMP's) are structural, vegetative, and managerial practices implemented to control nonpoint source pollution. The BMP's proposed for the Spring Lake watershed are included in Table 14.

TABLE 14
SPRING LAKE WATERSHED BEST MANAGEMENT PRACTICES

Sources	BMP's Needed
Urban shorelands.	Information and education: lakeside landscaping, lawn care, septic maintenance. Vegetative buffers, bioengineering Storm sewer inserts and retrofits Illicit connection and failed septic identification and correction Zoning and/or conservation easements Stormwater management
Stream corridors: Eroded streambanks; road-stream crossings	Bioengineering, vegetative cover/armor Zoning and/or conservation easements
Agricultural lands in headwaters	Filter strips Fertilizer/manure management

ORDINANCES AND LAND MANAGEMENT TOOLS

Ordinances are administrative tools that can be used to establish land use policies and rules to protect water resources within municipalities. As part of plan development, provisions related to water resource protection within the master plans and zoning ordinances from key watershed communities were compiled and reviewed. To varying degrees, all of the communities included water resources protection in their planning and zoning documents. For example, the Master Plan for Spring Lake Township cites specific environmental protection goals including "the protection of surface water quality in the Grand River, Spring Lake and Lake Michigan." The purpose of the Fruitport Township Zoning Ordinance provision regarding drainage courses is "to promote the public health, safety and general welfare of the Township by regulating and restricting the development of areas along or in drainageways, channels, streams and creeks." This provision prohibits filling or excavating within 200

feet of a drainage course without a certificate of zoning compliance. The certificate ensures that filling or excavating will not obstruct the flow of water or otherwise reduce the carrying capacity of the drainage course; will not divert water from the established channel; will not cause flooding of lands outside the drainage course; will not cause erosion; and will not otherwise impair the design and character of the drainage course. In addition, the Ottawa County Drain Commissioner has established standards and specifications for subdivision drainage and stormwater control policies for several drains.

These ordinances provide an excellent foundation upon which to address specific water quality concerns in the Spring Lake watershed. Specifically, as part of plan implementation, ordinances are proposed to be drafted that include the following:

- The establishment of an overlay zoning district over Norris Creek and other significant tributaries that will help ensure uniform development guidelines with respect to building setbacks and the preservation of vegetative cover.
- Open space (cluster) zoning as a means of preserving environmentally sensitive areas such as wetlands and steeply sloped forested lands in the watershed.
- Stormwater management regulations that address both the quantity and quality of stormwater emanating from development sites in the watershed.
- Wetland protection via local ordinances and local review of pending permit applications for activities impacting wetlands in the watershed.

Another land protection tool that is being proposed as part of plan implementation is the acquisition of conservation easements over environmentally sensitive lands in the watershed. A conservation easement is a legal agreement in which a landowner retains ownership of private property but conveys certain specifically identified rights to a land conservation organization or a public body. By limiting or prohibiting development, a conservation easement can permanently protect environmentally sensitive areas in a watershed. A landowner conveying a conservation easement may be eligible for significant tax benefits.

The GIS developed as part of the project will greatly facilitate identification and analysis of land and water features in the watershed and, thus, will provide a valuable tool in support of land management programs.

INFORMATIONAL AND EDUCATIONAL ACTIVITIES

The information and education (I/E) component of the Spring Lake Watershed Management Plan will include a multi-faceted information dissemination program designed to foster an understanding of project goals and objectives amongst all project participants. I/E activities will focus on each of the geographic areas of concern in the watershed that are critical to water quality improvement and protection (i.e., urban shorelands, stream corridor areas, and agricultural headlands). Target audiences will include lake residents, local government decision-makers and agricultural producers in the watershed. Key elements of the I/E program include the following:

Watershed Publications

Newsletters will be produced and mailed on a bi-annual basis to all project stakeholders (i.e., lake residents, local units of government, and agriculture land owners along critical drain ways). The newsletters will be four-to-eight pages in length and convey information about project activities in an easy-to-read, non-technical format. Each newsletter will focus on one or two issues of concern and target specific stakeholders. For example, in order to address nutrient loading from lake shorelands, specific guidelines will be developed regarding proper lakeside landscaping, fertilizer controls, septic system maintenance, and stormwater management techniques. The newsletters will also include a section about actions being taken by local governmental units to address watershed issues of concern.

To facilitate understanding and acceptance of desired pollution control alternatives, a series of resource publications will be developed and disseminated to provide information about specific watershed management approaches and techniques. Separate publications will be prepared which include information about water quality, development guidelines to protect environmentally sensitive areas (such as wetlands, stream corridors, and lake shorelands), planning and zoning techniques to protect water quality, wetlands protection, stormwater management, and agricultural best management practices.

Community Surveys

Two community surveys will be conducted to gauge perceptions about water quality and watershed management issues. One survey will target lake residents and the second will target local governmental decision-makers throughout the watershed. The surveys will include a summary of findings regarding current water quality conditions in Spring Lake, and include information about pollution sources, causes, and corrective actions. Background information will also be provided regarding the roles various stakeholders are proposed to play in implementing the watershed management plan. The information obtained in the survey will be used to assess how to best tailor information to appeal to specific target audiences.

Press Releases

Press releases in local newspapers will be used to keep the local community abreast of project activities and specific actions being taken by the Spring Lake - Lake Board and its partners to implement the watershed plan. The press releases will be designed to increase public awareness and involvement in project activities.

Public Meetings and Presentations

During the course of plan implementation, public meetings and presentations will be conducted on a regular basis with local governmental decision-makers and area residents to garner support and an understanding of watershed management initiatives. Groups that will be targeted include the Spring Lake Area Residents Association, local planning commissions, and municipal bodies.

Slide Show

To facilitate an understanding of the scope and objectives of the watershed project, a slide presentation will be developed that provides an overview of the geographical characteristics of the watershed and the various issues and areas of concern. The slides will include both text and graphics and will be designed to be visually appealing and informative. Slide presentations will be given on an as-needed basis at public presentations and will be revised and updated periodically to reflect the current status of the project.

Website

A website will be developed for the project to provide ready access to pertinent information about both the scope and status of the project. The site would be designed so that key project publications could be readily downloaded.

Workshops

A series of workshops will be conducted, with assistance from Michigan State University Extension and local soil conservation districts, to provide landowners in the watershed with hands-on information about lakeside landscaping and other techniques to protect water quality.

Storm Sewer Stenciling

Approximately 70 storm sewers discharge directly into Spring Lake. To foster a better understanding of how activities on the land may directly impact water quality, a storm sewer stenciling program is proposed to be implemented with assistance from local residents. The stenciling program would be designed to promote a better understanding of the connection between land use and water quality and how people's actions (or inactions) may influence water quality.

Geographic Information System

To help protect critical land and water features in the Spring Lake watershed, information derived from the project's Geographic Information System (GIS) will be made available to interested property owners and local governmental units. The GIS will be used to identify, map, and analyze critical features such as area wetlands, steeply sloped forested lands, groundwater recharge zones, and other environmentally sensitive areas. Color maps at various scales will then be available to local regulatory agencies to facilitate identification and protection of these areas.

The I/E strategy will be implemented by the Spring Lake - Lake Board with support from its consultant and various partners. Copies of a brochure and newsletters that the lake board has disseminated to date are included in Appendix G. The lake board would track I/E activities to evaluate program effectiveness and to document the number of publications disseminated, workshops conducted, etc.

INSTITUTIONALIZATION

Reducing pollution and its impacts on Spring Lake will be a long-term process. Efforts that are begun today should incorporate methods to institutionalize the management of Spring Lake and its watershed in order to provide stakeholders, managers, and decision-makers with an infrastructure to expedite future achievements. Efforts to manage Spring Lake and its watershed will be institutionalized via two primary vehicles: the Spring Lake - Lake Board and local ordinances.

The Spring Lake - Lake Board is a form of local government established under provisions of Part 309 of Act 451 of 1994, the Natural Resources and Environmental Protection Act. Members of the lake board include representatives of all municipalities abutting Spring Lake, a lake resident, Muskegon and Ottawa County Commissioners, the Muskegon and Ottawa County Drain Commissioners, and a representative of the Department of Environmental Quality. Besides its strategic organizational structure, the lake board has the ability to finance improvement projects through special assessment, and can also be a recipient of most government-sponsored grant programs. Thus, lake and watershed management is institutionalized by having a decision-making body composed of individuals critical to the success of the project and a financing mechanism in place.

Watershed practices will be further institutionalized via the adoption of various local ordinances and water resource protection policies that are proposed as part of watershed management plan implementation. Institutionalization will help ensure that lessons learned are not forgotten; that management proceeds logically, rather than in a haphazard manner; and that when lake board members or consultants change, management efforts need not be reinvented.

PUBLIC PARTICIPATION PROCESS

Involving the public in decision-making is inherent in lake board projects. The Spring Lake - Lake Board was established by resolution of all five municipalities abutting Spring Lake. The Spring Lake Improvement Plan is being implemented pursuant to provisions of Part 309 of Act 451 of 1994, the Natural Resources and Environmental Protection Act. As required by Part 309, public hearings were held in which well over 100 lake residents and other interested parties attended. In addition, presentations were made to each of the municipalities surrounding Spring Lake to discuss the goals and objectives of the plan. As a public body, the lake board is subject to the Open Meetings Act, thus public access to decision-making is guaranteed. The Spring Lake - Lake Board meets regularly and strongly encourages public participation and input.

In addition to the Spring Lake - Lake Board, partners that have been involved with the development of the plan include the Natural Resources Conservation Service (NRCS), Timberland Resource Conservation and Development Area Council, and all Spring Lake municipalities.

TASKS AND PARTICIPATING PARTIES

Various parties that will participate in the implementation of the Spring Lake Watershed Management Plan are listed in Table 15.

TABLE 15
SPRING LAKE TASKS AND PARTICIPATING PARTIES

Task	Participating Party(ies)
Farmland Management	NRCS; Muskegon County Soil Conservation District
Road-stream Crossing	
C Engineering design	Ottawa County Road Commission; Muskegon County
C Permit acquisition	Road Commission; Progressive AE; Timberland RC&D
C Construction	
Streambank Stabilization	
C Engineering design	Progressive AE; Timberland RC&D
C Permit acquisition	
C Construction	
Storm Sewer Inserts and Retrofits	
C Engineering design	City of Ferrysburg DPW; Village of Spring Lake DPW;
C Administration	Spring Lake Township DPW; Village of Fruitport DPW;
C Construction	Fruitport Township DPW; Progressive AE
Lakeside Vegetative Buffers	Spring Lake - Lake Board; Progressive AE; Ottawa County Soil Conservation District; Muskegon County Soil Conservation District
Illicit Connection and Failed Septic Identification and Correction	Ottawa County Health Department; Muskegon County Health Department; Progressive AE
Stormwater Management Ordinances and Policies	
C Meetings	Spring Lake - Lake Board; Ottawa County Drain
C Draft ordinances	Commissioner; Muskegon County Drain Commissioner;
C Adopt ordinances	City of Ferrysburg Planning Commission and City Council; Village of Spring Lake Planning Commission and Village Council; Spring Lake Township Planning Commission and Township Board; Village of Fruitport Planning Commission and Village Council; Fruitport Township Planning Commission and Township Board; Progressive AE

TABLE 15
SPRING LAKE TASKS AND PARTICIPATING PARTIES

Task	Participating Party(ies)
Zoning and/or Conservation Easements	
C Meetings	Spring Lake - Lake Board; City of Ferrysburg Planning Commission and City Council; Village of Spring Lake Planning Commission and Village Council; Spring Lake Township Planning Commission and Township Board; Village of Fruitport Planning Commission and Village Council; Fruitport Township Planning Commission and Township Board; municipal planning consultants; Natural Areas Conservancy of West Michigan; Progressive AE
C Draft ordinances	
C Adopt ordinances	
Information and Education	Spring Lake - Lake Board; Spring Lake Area Residents Association; Michigan State University Extension; Muskegon County Soil Conservation District; Ottawa County Soil Conservation District; Progressive AE

PROJECT COSTS AND TASK SCHEDULE

An estimate of probable costs for each of the BMP's discussed herein along with a listing of possible funding sources are provided in Tables 16 and 17, respectively.

TABLE 16
SPRING LAKE WATERSHED MANAGEMENT PLAN COST ESTIMATE AND TASK SCHEDULE

Task	Sites	Cost/Site	Total Cost	Timeframe
Farmland Management			$20,000	Yrs. 1, 2, & 3
Road-stream Crossing	10	$15,000	$150,000	
Engineering design, permit acquisition				Yr. 1
Construction				Yrs. 2 & 3
Streambank Stabilization	4	$15,000	$60,000	
Engineering design, permit acquisition				Yr. 1
Construction				Yrs. 2 & 3
Storm Sewer Inserts and Retrofits	10	$22,000	$220,000	
Engineering design, administration				Yr. 1
Construction				Yrs. 2 & 3
Lakeside Vegetative Buffers	20	$1,000	$20,000	
Illicit Connection and Failed Septic Identification and Correction			$30,000	
Stormwater Management			$20,000	
Meetings, draft ordinances				Yr. 1 & 2
Adopt ordinances				Yr. 2 & 3
Zoning and/or Conservation Easements			$50,000	
Meetings, draft ordinances				Yr. 1 & 2
Adopt ordinances				Yr. 2 & 3
Acquire easements				Yr. 2 & 3
Information and Education			$40,000	
Engineering and Administration			$100,000	
Total			$710,000	

TABLE 17
SPRING LAKE WATERSHED MANAGEMENT PLAN POSSIBLE FUNDING SOURCES

Task	EPA 319	CMI Nonpoint	CMI Clean Water
Farmland Management	x	x	
Road-stream Crossing		x	
Streambank Stabilization		x	
Storm Sewer Inserts		x	
Lakeside Vegetative Buffers		x	
Illicit Connection and Failed Septic Identification and Correction			x
Stormwater Management	x		
Zoning and/or Conservation Easements	x		
Information and Education	x		

EVALUATION

Since this project is proposed to include both structural and nonstructural elements, a combination of methods is proposed to be utilized to evaluate the success of the project. For example, to gauge our effectiveness at educating property owners about proper shoreland management practices (i.e., lakeside landscaping, fertilizer management, and septic system maintenance) a survey of lake residents is proposed to be conducted. In addition, public comments and suggestions made during the course of plan implementation would be considered and adjustments would be made to enhance public participation and acceptance of the recommended management practices. The implementation of each structural best management practice would be documented as would the formal adoption of water resource protection ordinances and policies by watershed municipalities. Finally, water quality monitoring of Spring Lake will be an ongoing activity of the Spring Lake - Lake Board. Thus, depending on lake response time, it may be possible to document changes in lake water quality as the result of plan implementation. At a minimum, water quality monitoring will provide a baseline from which to gauge changes in the water quality of Spring Lake over the long term.

Appendix A

Spring Lake Improvement Plan

Spring Lake Improvement Plan

Prepared for:

Spring Lake - Lake Board
414 Washington Street, Room 107
Grand Haven, MI 49417

Prepared by:

Progressive AE
1811 4 Mile Road, NE
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January 2000

Project No: 54060101

Table of Contents

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Introduction

PROJECT BACKGROUND

Spring Lake is a drowned river mouth that empties into the Grand River, approximately 2 miles east of the Lake Michigan shoreline. A small portion of the lake is contained within Muskegon County and the remainder lies within Ottawa County. Spring Lake abuts five municipalities: Fruitport Township and the Village of Fruitport in Muskegon County; and Spring Lake Township, the Village of Spring Lake, and the City of Ferrysburg in Ottawa County (T8-9N, R16W; Figure 1).

Spring Lake is heavily used. Currently, approximately 900 homes and businesses border the lake, and approximately 350,000 people reside within about 20 miles of Spring Lake (Table 1). There are 2 state-owned public access sites on the lake. In addition, it is possible to navigate from Spring Lake to Lake Michigan via the Grand River. As such, Spring Lake harbors many large motorboats and sailboats for use on Lake Michigan, and the lake itself sustains heavy traffic for boating, fishing, water skiing and jet skiing.

TABLE 1
POPULATION IN THE VICINITY OF SPRING LAKE[1]

Fruitport Township	11,485
Village of Fruitport	1,090
Muskegon County	158,983
Spring Lake Township	10,751
Village of Spring Lake	2,537
City of Ferrysburg	2,919
Ottawa County	187,768

In recent years, lake residents expressed a desire to control nuisance aquatic plant growth and improve the water quality of Spring Lake. To address these issues, the Spring Lake Lake Board was formed in 1997 under the provisions of Part 309 of the Natural Resources and Environmental Protection Act, Act 451 of 1994. In April of 1999, Progressive AE was retained by the lake board to develop and define an improvement plan for Spring Lake. The purpose of this report is to discuss study findings and recommendations.

[1]U.S. Department of Commerce. 1990. Bureau of Census Data.

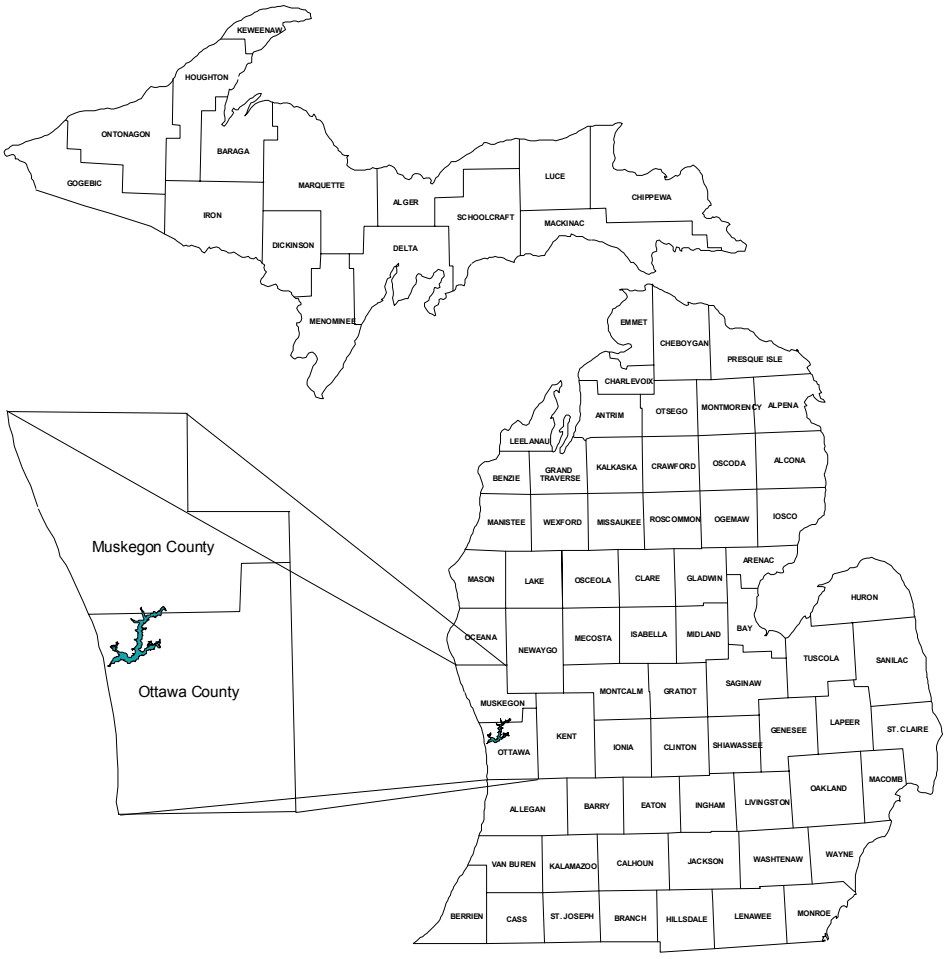


Figure 1. Project location map.

LAKE AND WATERSHED CHARACTERISTICS

A summary of the physical characteristics of Spring Lake and its watershed is provided in Table 2. A map depicting approximate depth contours in Spring Lake is shown in Figure 2. Spring Lake has a surface area of 1,298 acres and a maximum depth of 42 feet. At 19.7 feet, the mean or average depth of Spring Lake is greater than the maximum depth at which most plants can grow (15 feet).

The lake shoreline is 23 miles in length and the shoreline development factor is 5. The shoreline development factor indicates the degree of irregularity in the shape of the shoreline. That is, compared to a perfectly round lake with the same surface area as Spring Lake (i.e., 1,298 acres), the shoreline of Spring Lake is 5 times longer because of its irregular shape. Spring Lake's shoreline is highly irregular in shape because the lake is actually a drowned river mouth, much like an impoundment, although there is no artificial dam retaining water in Spring Lake. As such, Spring Lake has a long, narrow, convoluted configuration with several large bayous at the mouths of its tributaries. Despite the fact that Spring Lake is relatively deep, its long shoreline provides extensive area for rooted plant growth as well as residential development on shore.

TABLE 2
SPRING LAKE PHYSICAL CHARACTERISTICS[1]

Lake Surface Area	1,298	Acres
Maximum Depth	42	Feet
Mean Depth	19.7	Feet
Lake Volume	25,253	Acre-Feet
Shoreline Length	23	Miles
Shoreline Development Factor	5	
Lake Elevation	580	Feet
Watershed Area	31,986	Acres
Ratio of Lake Area to Watershed Area	1:24.6	

Watershed Land Uses	Acres	Percent of Total
Agriculture	4,718	15
Orchards	819	3
Residential Development	4,917	15
Commercial, Industrial	1,408	4
Forested	14,114	44
Open Field	4,029	13
Barren (sand dunes)	133	>1
Wetlands	1,848	6
Total	31,986	100

[1]From Lauber (1999) updated from 1978 Michigan Department of Natural Resources' Michigan Resource Information System to 1992 and 1997 aerial photography (for various areas within the watershed). Lauber reported a watershed area that included the area of Spring Lake itself which is excluded from the watershed area listed above. Additionally, Lauber categorized approximately 1,588 acres of lowland hardwoods and lowland conifers as forest land; in this report, these areas are classified as wetland.

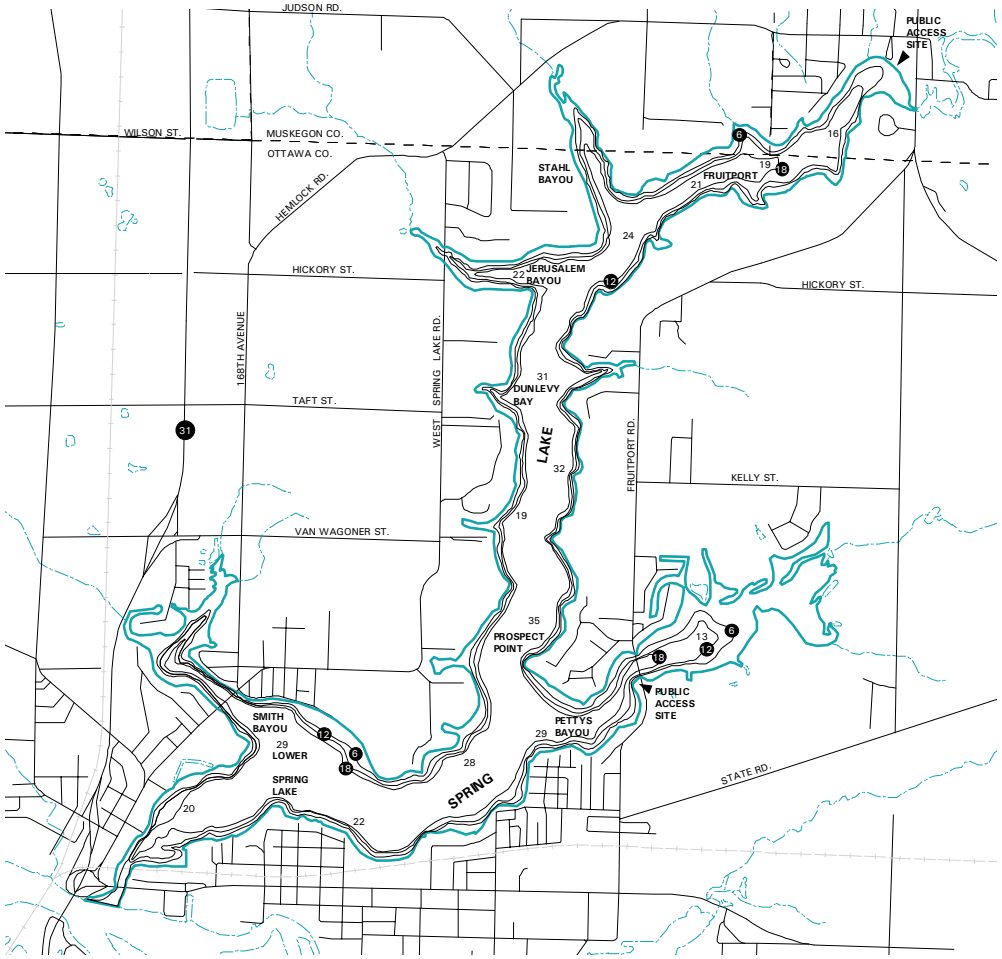


Figure 2. Spring Lake depth contour map.

The land area surrounding a lake that drains to the lake is called its watershed or drainage basin. The Spring Lake watershed comprises 31,986 acres (Figure 3), which is nearly 25 times larger than the lake itself, and includes 11 municipalities. Municipalities abutting the lake are shown in Figure 4. Water drains to Spring Lake via approximately 11 tributaries and 81 storm drains (Lauber 1999).

It is interesting to note that the predominant land use in the Spring Lake watershed is not agriculture but rather forested land (Figure 5). Intensive agriculture is precluded from much of the watershed because of poor soils. Most of the soils in the vicinity of the Norris Creek drainage area comprise the Rubicon-Au Gres-Roscommon soil association, which is referred to as "association 2" by the U.S. Department of Agriculture Soil Conservation Service (SCS) in its Soil Survey of Muskegon County (1968). According to SCS (1968), "the soils are poor for farming." SCS notes further:

> The soils in this association, like those in association 1, were cleared of trees and farmed, were severely damaged by soil blowing, and were abandoned. . . After the logging period, nearly all farms in association 2 consisted of a combination of Rubicon, Au Gres and Roscommon soils. The dry, sloping Rubicon soils were planted largely to grape vineyards and orchards, and the wetter Au Gres and Roscommon soils were used for general crops. The vineyards and orchards did not last long, because they could not withstand the frost, drought, erosion, and low fertility. Some of the worst wind-eroded areas in the county were those old vineyards and orchards and tracts of Rubicon soils. Blowouts, 5 to 10 feet deep, appeared on many of the dry sandy ridges. In Sullivan Township, a blowout area of 2,000 acres was widely known as Sullivan Sahara.
>
> The soils in this association are suited as woodland and for community developments, limited farming, and recreation.

Lauber (1999) recorded land use changes in the watershed since 1978. Residential lands have replaced agriculture as the second largest land use (after forest land). In fact, agriculture was the only land use to decrease between 1978 and the mid 1990's. While approximately 4,700 acres of agriculture remain, nearly 2,500 acres were converted to other land uses, including forest land (949 acres), residential land (773 acres), orchards (330 acres), commercial land (215 acres), and open field (180 acres).

In general, agricultural and residential lands tend to contain large quantities of nutrients and sediments in runoff, while forest land and wetland are considered beneficial land uses for protecting water quality. Urban land in the Spring Lake watershed is most problematic because of its proximity to the lake and the lack of detention or filtration of runoff prior to entering the lake. Indeed, some 81 stormwater outfalls discharge directly to the lake. Conversely, agricultural land in the watershed is situated far from the lake, and agricultural runoff tends to be filtered by watershed wetlands and forests. Although agricultural runoff in the Spring Lake watershed should be controlled to the extent possible, management of urban runoff should be a higher priority.

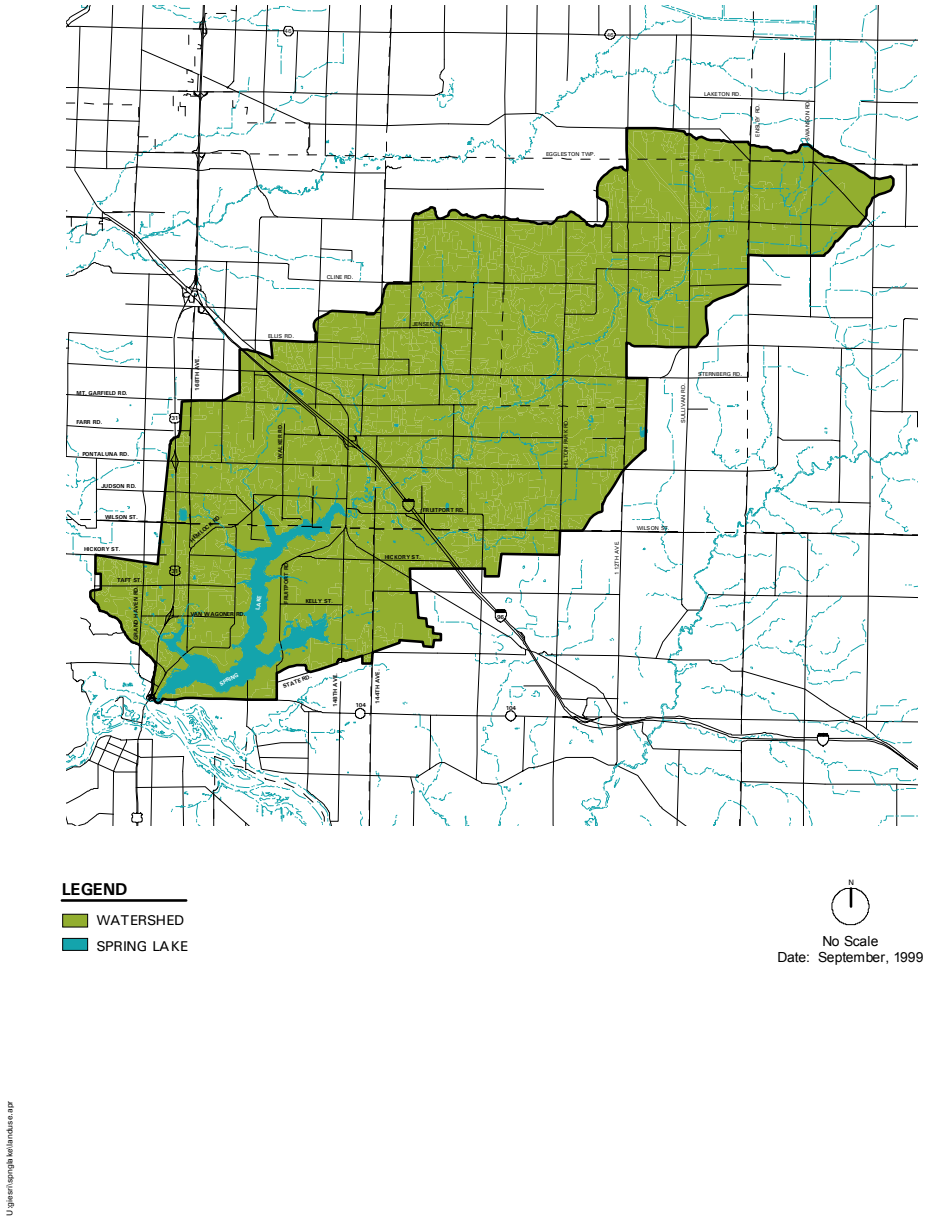


Figure 3. Spring Lake watershed map. Source: Lauber (1999).

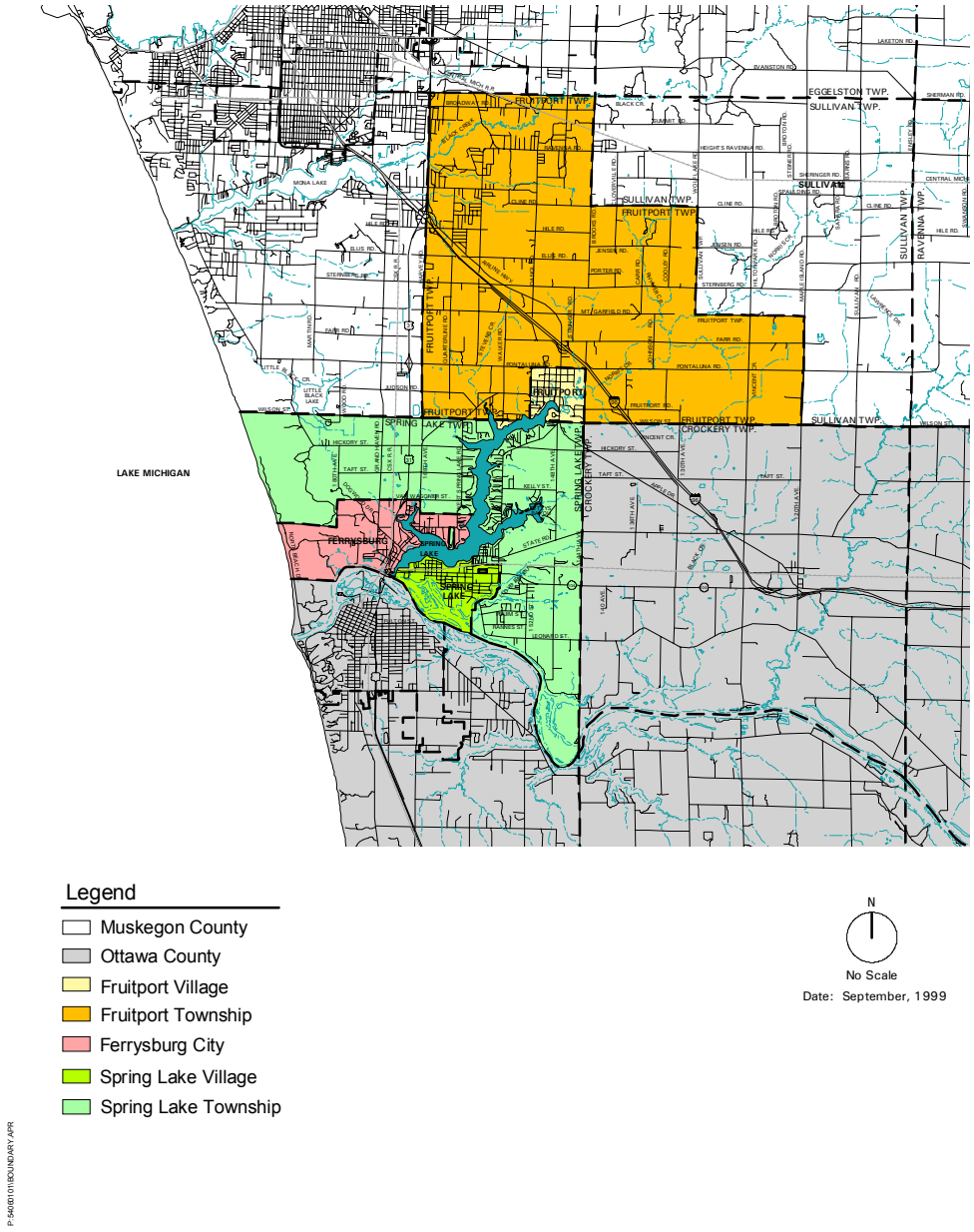


Figure 4. Spring Lake political jurisdiction map.

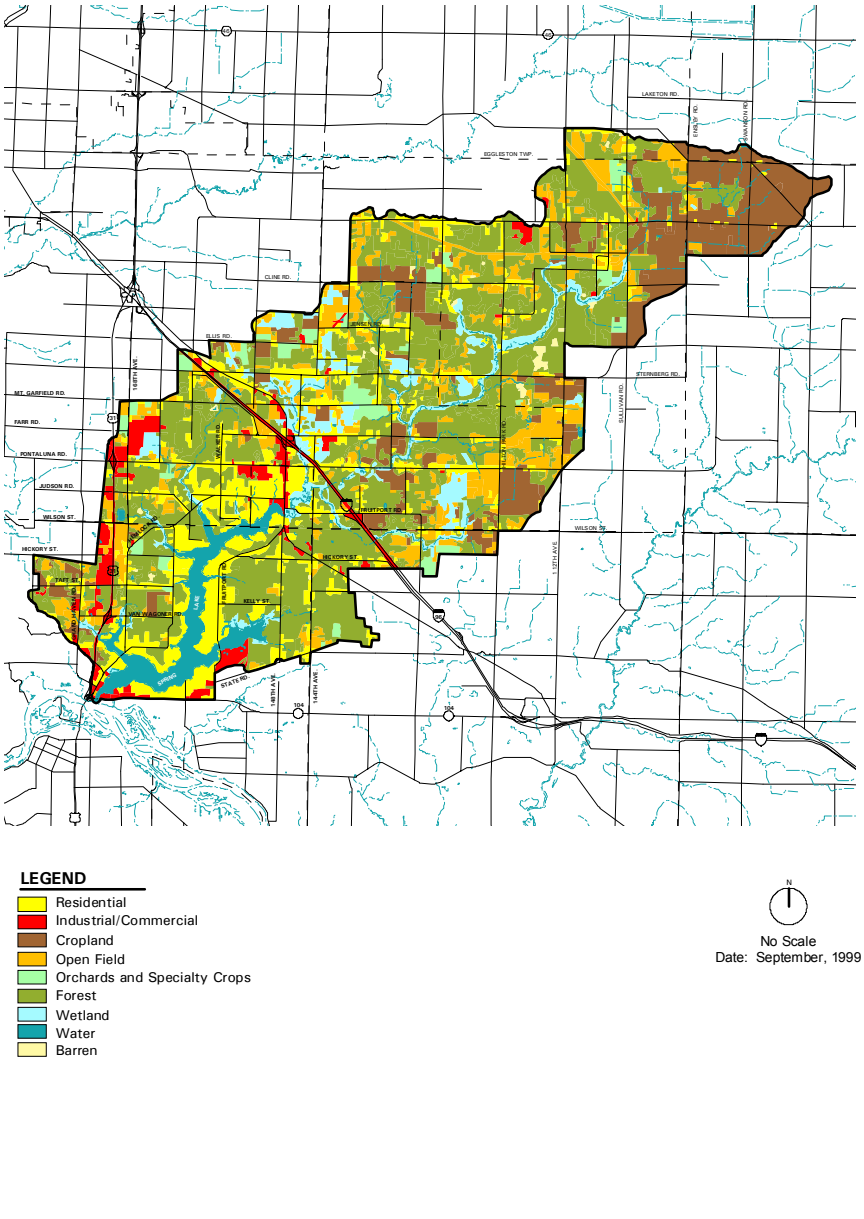
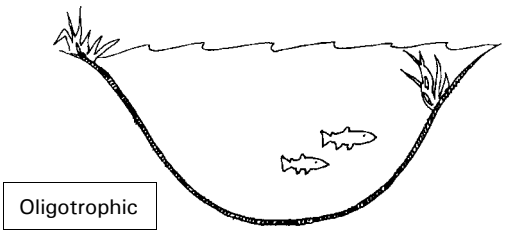


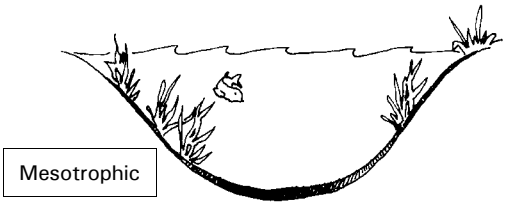
Figure 5. Spring Lake watershed land use map. Source: Lauber (1999).

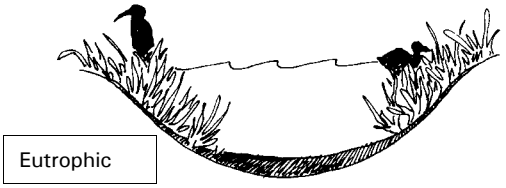
Lake Water Quality

INTRODUCTION

Lake water quality is determined by a unique combination of processes that occur both within and outside of the lake. In order to make sound management decisions, it is necessary to have an understanding of the current physical, chemical, and biological condition of the lake, and the potential impact of drainage from the surrounding watershed.







Lakes are commonly classified as **oligotrophic**, **mesotrophic**, or **eutrophic**. Oligotrophic lakes are generally deep and clear with little aquatic plant growth. These lakes maintain sufficient dissolved oxygen in the cool, deep bottom waters during late summer to support cold water fish such as trout and whitefish. By contrast, eutrophic lakes are generally shallow, turbid, and support abundant aquatic plant growth. In deep eutrophic lakes, the cool bottom waters usually contain little or no dissolved oxygen. Therefore, these lakes can only support warm water fish such as bass and pike. Lakes that fall between these two extremes are called mesotrophic lakes.

Under natural conditions, most lakes will ultimately evolve to a eutrophic state as they gradually fill with sediment and organic matter transported to the lake from the surrounding watershed. As the lake becomes shallower, the process accelerates. When aquatic plants become abundant, the lake slowly begins to fill in as sediment and decaying plant matter accumulate on the lake bottom. Eventually, terrestrial plants become established and the lake is transformed to a marshland. The aging process in lakes is called "**eutrophication**" and may take anywhere from a few hundred to several thousand years, generally depending on the size of the lake and its watershed. The natural lake aging process can be greatly accelerated if excessive amounts of sediment and nutrients (which stimulate aquatic plant growth) enter the lake from the surrounding watershed. Because these added inputs are usually associated with human activity, this accelerated lake aging process is often referred to as "**cultural eutrophication**." The problem of cultural eutrophication can be managed by identifying sources of sediment and nutrient loading (i.e., inputs) to the lake and developing strategies to halt or slow the inputs. Thus, in developing an improvement plan, it is necessary to determine the limnological (i.e., the physical, chemical, and biological) condition of the lake and the physical characteristics of the watershed as well.

Key parameters used to evaluate the limnological condition of a lake include temperature, dissolved oxygen, total phosphorus, chlorophyll-*a*, and Secchi transparency. A brief description of these water quality measurements is provided as an introduction for the reader. Particular attention should be given to the interrelationship of these water quality measurements.

TEMPERATURE

Temperature is important in determining the type of organisms that may live in a lake. For example, trout prefer temperatures below 68EF. Temperature also determines how water mixes in a lake. As the ice cover breaks up on a lake in the spring, the water temperature becomes uniform from the surface to the bottom. This period is referred to as "spring turnover" because water mixes throughout the entire water column. As the surface waters warm, they are underlain by a colder, more dense strata of water. This process is called thermal stratification. Once thermal stratification occurs, there is little mixing of the warm surface waters with the cooler bottom waters. The transition layer that separates these layers is referred to as the "thermocline." The thermocline is characterized as the zone where temperature drops rapidly with depth. As fall approaches, the warm surface waters begin to cool and become more dense. Eventually, the surface temperature drops to a point that allows the lake to undergo complete mixing. This period is referred to as "fall turnover." As the season progresses and ice begins to form on the lake, the lake may stratify again. However, during winter stratification, the surface waters (at or near 32EF) are underlain by slightly warmer water (about 39EF). This is sometimes referred to as "inverse stratification" and occurs because water is most dense at a temperature of about 39EF. As the lake ice melts in the spring, these stratification cycles are repeated. Shallow lakes do not stratify. Lakes that are 15 - 30 feet deep may stratify and destratify with storm events several times during the year.

DISSOLVED OXYGEN

An important factor influencing lake water quality is the quantity of **dissolved oxygen** in the water column. The major inputs of dissolved oxygen to lakes are the atmosphere and photosynthetic activity by aquatic plants. An oxygen level of about 5 mg/L (milligrams per liter, or parts per million) is required to support warm water fish. In lakes deep enough to exhibit thermal stratification, oxygen levels are often reduced or depleted below the thermocline once the lake has stratified. This is because deep water is cut off from plant photosynthesis and the atmosphere, and oxygen is consumed by bacteria that use oxygen as they decompose organic matter (plant and animal remains) at the bottom of the lake. Bottom-water oxygen depletion is a common occurrence in eutrophic and some mesotrophic lakes. Thus, eutrophic and most mesotrophic lakes cannot support cold water fish because the cool, deep water (that the fish require to live) does not contain sufficient oxygen.

PHOSPHORUS

The quantity of **phosphorus** present in the water column is especially important since phosphorus is the nutrient that most often controls aquatic plant growth and the rate at which a lake ages and becomes more eutrophic. In the presence of oxygen, lake sediments act as a phosphorus trap, retaining phosphorus and, thus, making it unavailable for aquatic plant growth. However, if bottom-water oxygen is depleted, phosphorus will be released from the sediments and may be available to promote aquatic plant growth. In some lakes, the internal release of phosphorus from the bottom sediments is the primary source of phosphorus loading (or input).

By reducing the amount of phosphorus in a lake, it may be possible to control the amount of aquatic plant growth. In general, lakes with a phosphorus concentration greater than 20 μg/L (micrograms per liter, or parts per billion) are able to support abundant plant growth and are classified as nutrient-enriched or eutrophic.

CHLOROPHYLL-*A*

Chlorophyll-*a* is a pigment that imparts the green color to plants and algae. A rough estimate of the quantity of algae present in lake water can be made by measuring the amount of chlorophyll-*a* in the water column. A chlorophyll-*a* concentration greater than 6 μg/L is considered characteristic of a eutrophic condition.

SECCHI TRANSPARENCY

A **Secchi disk** is often used to estimate water clarity. The measurement is made by fastening a round, black and white, 8-inch disk to a calibrated line. The disk is lowered over the deepest point of the lake until it is no longer visible, and the depth is noted. The disk is then raised until it reappears. The average between these two depths is the Secchi transparency. Generally, it has been found that aquatic plants can grow at a depth of approximately twice the Secchi transparency measurement. In eutrophic lakes, water clarity is often reduced by algae growth in the water column, and Secchi disk readings of 7.5 feet or less are common.

LAKE CLASSIFICATION CRITERIA

Ordinarily, as phosphorus inputs (both internal and external) to a lake increase, the amount of algae will also increase. Thus, the lake will exhibit increased chlorophyll-*a* levels and decreased transparency. A summary of lake classification criteria developed by the Michigan Department of Natural Resources (DNR) is shown in Table 3.

TABLE 3
LAKE CLASSIFICATION CRITERIA

Lake Classification	Total Phosphorus (μg/L)[1]	Chlorophyll-*a* (μg/L)	Secchi Transparency (feet)
Oligotrophic	Less than 10	Less than 2.2	Greater than 15.0
Mesotrophic	10 to 20	2.2 to 6.0	7.5 to 15.0
Eutrophic	Greater than 20	Greater than 6.0	Less than 7.5

AQUATIC PLANTS

Although an overabundance of undesirable plants can limit recreational use and enjoyment of a lake, it is important to realize that aquatic plants are a vital component of aquatic ecosystems. They produce oxygen during photosynthesis, provide food and habitat for fish and other organisms, and help stabilize shoreline and bottom sediments. The distribution and abundance of aquatic plants are dependent on several variables, including light penetration, bottom type, temperature, water levels, and the availability of plant nutrients. The term "aquatic plants" includes both the algae and the larger aquatic plants or macrophytes. The macrophytes can be categorized into four groups: the emergent, the floating-leaved, the submersed, and the free-floating.

In developing an effective aquatic plant control program, the type and distribution of nuisance plant growth must be evaluated so that a balanced, environmentally sound control strategy can be determined.

SAMPLING REGIME

For this report, water quality samples were collected on April 19, May 21, and July 7, 1999. On April 19, samples were collected from the surface, mid-depth, and bottom of three sites within the main body of Spring Lake (designated as Lower Spring Lake, Prospect Point, and Fruitport) and from four bayous (designated as Smith, Petty's, Jerusalem, and Stahl), shown in Figure 6. On May 21 and July 7, samples were collected only from the three sites within the main body of Spring Lake. To better discern stratification, temperature was measured at 5-foot intervals; dissolved oxygen, pH, and total alkalinity were measured at 10-foot intervals; and total phosphorus was measured at the surface, mid-depth, and bottom. For each sampling date and site, chlorophyll-*a* samples were collected as a composite throughout a depth equivalent to twice the Secchi transparency measurement. Aquatic plant surveys of Spring Lake were conducted on May 21 and July 7, 1999.

[1] μg/L = micrograms per liter = parts per billion.

Samples were collected by Lauber (1999) at the same seven in-lake sites periodically from May of 1997 until October of 1998. The DNR collected samples from a location between the lower Spring Lake and Prospect Point sites on April 4, 1967 and September 2, 1981.

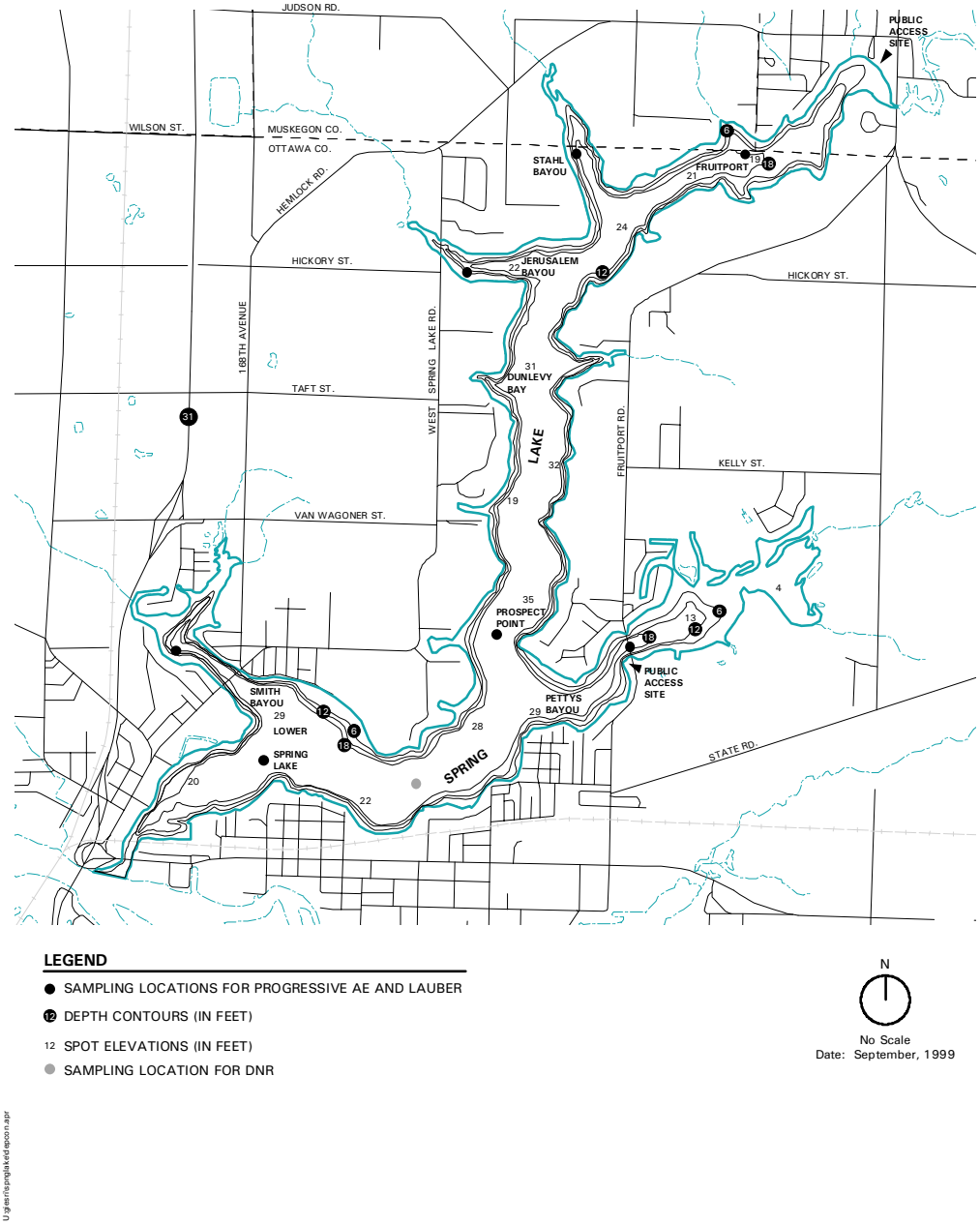


Figure 6. Sampling location map.

SAMPLING RESULTS

Deep basin water quality data is provided in Tables 4, 5, 6, and 7 for Lower Spring Lake, Prospect Point, Fruitport, and the bayous, respectively. Surface water quality data for all sites is shown in Table 8. Aquatic plant survey data is included in Table 9.

TABLE 4
SPRING LAKE DEEP BASIN WATER QUALITY DATA
LOWER SPRING LAKE

Date	Sample Depth (feet)	Temp. (EF)	Dissolv. Oxygen (mg/L)[1]	Total Phosph. (μg/L)[2]	pH (S.U.)[3]	Total Alkalin. (mg/L as $CaCO_3$)[4]
19-Apr-99	1	51.0	11.4	43	8.3	153
19-Apr-99	15	50.0	10.8	34	8.3	158
19-Apr-99	30	49.0	9.3	68	8.2	162
21-May-99	1	65.0	8.7	50	7.9	161
21-May-99	5	64.5				
21-May-99	10	63.0	7.5		7.8	144
21-May-99	15	62.0		35		
21-May-99	20	60.5	5.5		7.6	147
21-May-99	25	59.0				
21-May-99	30	58.0	4.1	73	7.6	147
7-Jul-99	1	79.0	12.6	35		156
7-Jul-99	5	78.0	12.3			159
7-Jul-99	10	77.0	8.4			151
7-Jul-99	15	74.0	8.2	39		152
7-Jul-99	20	63.0	6.9			153
7-Jul-99	25	63.0	1.4			152
7-Jul-99	30	63.0	0.5	631		169

[1] mg/L = milligrams per liter = parts per million.

[2] μg/L = micrograms per liter = parts per billion.

[3] S.U. = standard units.

[4] mg/L as $CaCO_3$ = milligrams per liter as calcium carbonate.

TABLE 5
SPRING LAKE DEEP BASIN WATER QUALITY DATA
PROSPECT POINT

Date	Sample Depth (feet)	Temp. (EF)	Dissolv. Oxygen (mg/L)[1]	Total Phosph. (μg/L)[2]	pH (S.U.)[3]	Total Alkalin. (mg/L as $CaCO_3$)[4]
19-Apr-99	1	51.5	12.7	30	8.6	149
19-Apr-99	18	50.5	11.6	46	8.4	153
19-Apr-99	35	49.5	10.8	30	8.3	141
21-May-99	1	65.5	10.4	30		140
21-May-99	5	65.5				
21-May-99	10	65.0	10.6		8.3	132
21-May-99	15	63.5		28		
21-May-99	20	61.0	6.1		7.8	140
21-May-99	25	60.0				
21-May-99	30	59.0	3.9		8.0	
21-May-99	35	57.0	3.8	46	7.8	142
07-Jul-99	1	79.5	9.1	35		101
07-Jul-99	5	79.0	7.8			131
07-Jul-99	10	79.0	6.8			134
07-Jul-99	15	78.0	6.5			143
07-Jul-99	20	76.5	5.0	52		143
07-Jul-99	25	72.0	3.0			146
07-Jul-99	30	64.0	0.7			161
07-Jul-99	37	64.0	0.4	465		159

[1] mg/L = milligrams per liter = parts per million.

[2] μg/L = micrograms per liter = parts per billion.

[3] S.U. = standard units.

[4] mg/L as $CaCO_3$ = milligrams per liter as calcium carbonate.

TABLE 6
SPRING LAKE DEEP BASIN WATER QUALITY DATA
FRUITPORT

Date	Sample Depth (feet)	Temp. (EF)	Dissolv. Oxygen (mg/L)[1]	Total Phosph. (μg/L)[2]	pH (S.U.)[3]	Total Alkalin. (mg/L as $CaCO_3$)[4]
19-Apr-99	1	51.5	12.6	19	8.2	130
19-Apr-99	9	50.0	10.9	41	8.2	138
19-Apr-99	17	49.5	10.9	32	8.1	131
21-May-99	1	68.0	10.4	35	8.1	123
21-May-99	5	67.0		28		
21-May-99	10	66.0	7.4		8.0	125
21-May-99	15	62.5	7.8	25	7.8	123
7-Jul-99	1	80.5	6.1	59		125
7-Jul-99	9	79.0	4.0	64		130
7-Jul-99	17	77.5	3.1	84		135

[1] mg/L = milligrams per liter = parts per million.

[2] μg/L = micrograms per liter = parts per billion.

[3] S.U. = standard units.

[4] mg/L as $CaCO_3$ = milligrams per liter as calcium carbonate.

TABLE 7
SPRING LAKE DEEP BASIN WATER QUALITY DATA
BAYOUS

Date	Bayou	Sample Depth (feet)	Temp. (EF)	Dissolv. Oxygen (mg/L)[1]	Total Phosph. (μg/L)[2]	pH (S.U.)[3]	Total Alkalin. (mg/L as $CaCO_3$)[4]
19-Apr-99	Smith	1	51.0	11.6	24	8.3	152
19-Apr-99	Smith	9	49.5	11.7	34	8.2	150
19-Apr-99	Smith	18	48.0	10.8	27	8.2	158
19-Apr-99	Petty's	1	51.5	12.2	35	8.5	146
19-Apr-99	Petty's	9	51.0	11.6	78	8.4	147
19-Apr-99	Petty's	18	50.5	11.3	32	8.3	153
19-Apr-99	Jerusalem	1	52.0	11.1	22	8.2	142
19-Apr-99	Jerusalem	9	50.0	11.5		8.2	149
19-Apr-99	Jerusalem	17	49.0	10.3	34	8.1	152
19-Apr-99	Stahl	1	52.0	11.7	39	8.2	147
19-Apr-99	Stahl	8	50.0	11.4	44	8.2	151
19-Apr-99	Stahl	15	49.0	11.1	32	8.1	149

[1] mg/L = milligrams per liter = parts per million.

[2] μg/L = micrograms per liter = parts per billion.

[3] S.U. = standard units.

[4] mg/L as $CaCO_3$ = milligrams per liter as calcium carbonate.

TABLE 8
SPRING LAKE SURFACE WATER QUALITY DATA

Date	Sample Location	Secchi Transparency (feet)	Chlorophyll-*a* (μg/L)[1]
19-Apr-99	Spring Lake	4.5	2
19-Apr-99	Prospect Point	5.0	7
19-Apr-99	Fruitport	4.5	10
19-Apr-99	Smith Bayou	6.5	5
19-Apr-99	Petty's Bayou	5.0	12
19-Apr-99	Jerusalem Bayou	6.0	7
19-Apr-99	Stahl Bayou	5.5	10
21-May-99	Spring Lake	4.0	2
21-May-99	Prospect Point	4.5	1
21-May-99	Fruitport	3.5	5
07-Jul-99	Spring Lake	3.0	46
07-Jul-99	Prospect Point	3.5	13
07-Jul-99	Fruitport	3.5	12

TABLE 9
SPRING LAKE AQUATIC PLANTS

Common Name	Scientific Name	Type	Density
Watershield	*Brasenia schreberi*	Floating-leaved	Common
Coontail	*Ceratophyllum demersum*	Submerged	Abundant
Water stargrass	*Heteranthera dubia*	Submerged	Common
Purple loosestrife	*Lythrum salicaria*	Emergent	Common
Eurasian milfoil	*Myriophyllum spicatum*	Submerged	Abundant
Naiad	*Najas flexilis*	Submerged	Common
Yellow waterlily	*Nuphar advena*	Floating-leaved	Common
Smartweed	*Polygonum sp.*	Emergent	Sparse
Curly-leaf pondweed	*Potamogeton crispus*	Submerged	Common
Sago pondweed	*Potamogeton pectinatus*	Submerged	Common
Richardson's pondweed	*Potamogeton richardsonii*	Submerged	Sparse
Thin-leaf pondweed	*Potamogeton sp.*	Submerged	Sparse
Arrowhead	*Sagittaria latifolia*	Emergent	Common
Bulrush	*Scirpus sp.*	Emergent	Sparse
Cattail	*Typha sp.*	Emergent	Common
Wild celery	*Vallisneria americana*	Submerged	Sparse

[1] μg/L = micrograms per liter = parts per billion.

DISCUSSION

Current and historical water quality data indicate Spring Lake is eutrophic (Table 10). Deep-water dissolved oxygen becomes depleted in late summer; levels of the plant nutrient phosphorus are very high; algae growth is excessive as reported by lake residents and as indicated by periodic high concentrations of chlorophyll-*a*; rooted plant growth is abundant; and water clarity is low. Spring Lake is nutrient-enriched and highly productive. Spring Lake contains excess levels of plant nutrients that support abundant rooted plants and algae, which form the base of a very productive food chain. Because the lake is so biologically active, plant and animal matter rapidly accumulates on the lake bottom, causing oxygen to be depleted relatively early in the summer in the course of decomposition. Water clarity is reduced by excessive algae growth, but may also be caused by sediments that are resuspended from the lake bottom or that wash into the lake from the shoreline, tributaries, and storm drains.

TABLE 10
SPRING LAKE 1999 WATER QUALITY DATA SUMMARY

	Total Phosphorus (Fg/L)	Chlorophyll-*a* (Fg/L)	Secchi Transparency (feet)
Median	35	7	5
Minimum	19	1	3
Maximum	631	46	7

Spring Lake stratified thermally and chemically at all sampling sites, although stratification occurred earlier and was sustained for longer periods at Lower Spring Lake and Prospect Point. Deep-water dissolved oxygen began to decrease as early as mid to late May, and was essentially depleted at the lake bottom by mid June at some sites. Oxygen depletions have been occurring since at least 1981 when the DNR measured levels as low as 0.1 parts per million at depths of 30 feet to the bottom.

Spring Lake contains high levels of the plant nutrient phosphorus. The lowest phosphorus concentration measured in 1999 was 19 parts per billion, which is only slightly below the eutrophic threshold concentration of 20 parts per billion. The median concentration was 35 and the highest was 631 parts per billion, measured at the bottom of the lower Spring Lake sampling site on July 7. Thus, phosphorus is released from the sediments when dissolved oxygen becomes depleted from the bottom waters through the process called internal loading. Phosphorus also enters Spring Lake from sources outside of the lake including the tributaries, stormwater outfalls, septic systems, lawn fertilizer, waterfowl droppings, and the atmosphere (Lauber 1999).

High phosphorus concentrations in Spring Lake have caused nuisance growth of both attached and free-floating algae. Lauber (1999) described the periphytic, or attached, algae that occurs in Spring Lake:

> *Vaucheria*, a blue-green felt-like algae occurs in most transects because it grows on shoreline rocks, whereas *Rhizoclonium* formed huge dense beds of horsehair-like algae weighing down other aquatic plants.

Dense growth of planktonic, or free-floating, algae is known as an algae "bloom." Depending on the type of algae in the bloom, a lake may become brown, bright green, or dark green in color, and tiny clumps of algae may even be visible to the naked eye. Algae blooms occur sporadically on Spring Lake as evidenced by the periodic high chlorophyll-*a* measurements (Table 8) which are consistent with measurements reported by Lauber (1999) and Michigan Sea Grant[1]. Lauber (1999) states "the algae that has caused the green cast on the lake during the summer for the past few years is due most likely to *Microcystis*." *Microcystis* blooms are very unsightly and are especially problematic because the algae is not a preferred food item for most organisms higher on the food chain, including zebra mussels.

Zebra mussels (*Dreissena polymorpha*) invaded Spring Lake in the mid 1990's (Lauber 1999) and were attached to aquatic plants in 90% of Lauber's (1999) aquatic plant transects. Zebra mussels filter lake water and ingest some types of algae while rejecting others. For example, research has shown that zebra mussels in Saginaw Bay reject *Microcystis*:

> These experiments have shown that the colonial *Microcystis* which dominates Saginaw Bay is not ingested or assimilated. Experiments with laboratory cultures of small algae showed that *Dreissena* can selectively remove small algae while leaving the *Microcystis* behind. This is strong evidence that *Dreissena* can, through its selective grazing, promote *Microcystis* blooms. [Vanderploeg et al. 1997]

Thus, zebra mussels often improve water clarity by actively filtering the water column. Conversely, water clarity may decrease if zebra mussels promote *Microcystis* blooms, which appears to be the case in Spring Lake. Water clarity, as measured by Secchi transparency, is consistently low in Spring Lake. (Table 8). All measurements were below the eutrophic threshold level of 7-1/2 feet.

Spring Lake also contains larger aquatic plants, known as macrophytes (Table 9). While most of the plants in Spring Lake are beneficial, Eurasian milfoil and coontail are nuisance plants. Eurasian milfoil is especially problematic in that it often becomes established early in the growing season and can grow at greater depths than most plants. Eurasian milfoil often forms a thick canopy at the lake surface that can degrade fish habitat and seriously hinder recreational activity (Figure 7). Eurasian milfoil spreads by a process known as vegetative propagation or fragmentation. Small pieces of the plant break off, float to new areas of the lake, sink to the bottom, take root, and grow. As such, Eurasian milfoil can quickly spread throughout a lake. Once introduced into a lake,

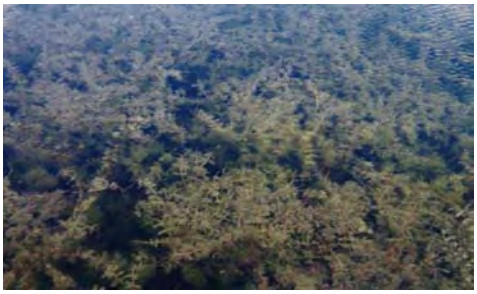


Figure 7. Eurasian milfoil canopy.

[1] Frank Drexler, Michigan Sea Grant College Program, 333 Clinton Street, Grand Haven, Michigan 49417-1492.

Eurasian milfoil may out-compete and displace more desirable plants and become the dominant species. Thus, Eurasian milfoil is considered a nuisance whenever it is present, whether sparse or abundant.

Although coontail is generally considered a beneficial plant, it has reached nuisance densities in Spring Lake and is interfering with recreational use of the lake. Nuisance growth of macrophytes is limited to a great extent, however, by the low water clarity; if clarity were to increase in Spring Lake, macrophyte growth may increase because of the abundance of nutrients to stimulate plant growth.

Overall, Spring Lake is a highly enriched, eutrophic lake. Spring Lake is impacted by both internal and external inputs of phosphorus, and perhaps sediment as well. Excessive nutrient levels are promoting nuisance growth of macrophytes and algae. In order to control plant growth over the long term, runoff from the watershed and nutrient recycling from the lake sediments must be reduced.

Lake Improvement Alternatives

INTRODUCTION

The primary objectives of the lake improvement plan for Spring Lake include reducing nuisance plant growth, increasing water clarity, and reducing pollution inputs to Spring Lake. Alternatives to accomplish these objectives are both short- and long-term, and involve implementation of measures in the lake itself and in the watershed.

AQUATIC PLANT CONTROL

The objective of a sound aquatic plant control program is to remove plants only from problem areas where nuisance growth is occurring. Under no circumstance should an attempt be made to remove all plants from the lake.

Mechanical harvesting (i.e., plant cutting and removal) and chemical herbicide treatments are methods commonly employed to control aquatic plant growth. For large-scale aquatic plant control, harvesting may be advantageous over herbicide treatments since plants removed from the lake will not sink to the lake bottom and add to the buildup of organic sediments. In addition, some nutrients contained within the plant tissues are removed with the harvested plants.

With the use of herbicides, treated plants die back and decompose on the lake bottom while bacteria consume dissolved oxygen reserves in the decomposition process. Since the plants are not removed from the lake, sediment buildup on the lake bottom continues, often creating a bottom substrate ideal for future aquatic plant growth. It should be noted however that attempts to control certain plant types by harvesting alone may not prove entirely effective. This is especially true with Eurasian milfoil (*Myriophyllum spicatum*) due to the fact that this plant may proliferate and spread via vegetative propagation (small pieces break off, take root, and grow) if the plant is cut. When Eurasian milfoil is present, it may be possible to control the growth and spread of the plant by treating the lake with a species-selective systemic herbicide. Also, since it is not economically feasible to mechanically harvest planktonic (i.e., free-floating) algae in a lake, herbicides, such as copper sulfate and chelated copper products, are often utilized to control nuisance algae growth. In Michigan, state law requires that a permit be acquired from the Department of Environmental Quality before any herbicides are applied to inland lakes.

In recent years, considerable research has been conducted on the biological control of Eurasian milfoil. This approach currently focuses on the introduction of a small weevil (*Euhrychiopsis lecontei*), commonly referred to as the milfoil weevil. This weevil has been found to selectively feed on Eurasian milfoil while ignoring other plants. In some cases, substantial reductions in Eurasian milfoil growth in lakes have been observed as a result of consumption by the milfoil weevil. The milfoil weevil is native to the

northeastern United States but apparently is not abundant in Michigan lakes. Research is currently underway in Michigan to evaluate the effectiveness of introducing the weevil for milfoil control.

Currently, Spring Lake contains approximately 100 acres of Eurasian milfoil and 100 acres of other nuisance plants, primarily coontail (Figure 8). If Eurasian milfoil can be treated early in the growing season with a herbicide, then other nuisance plants can be harvested later in the season. In addition, nuisance algae blooms occur throughout Spring Lake. Copper-based products are effective in controlling algae, but only for a short time period. Because the copper in algacides accumulates in the sediments, only minimal use of copper-based algacides is recommended.

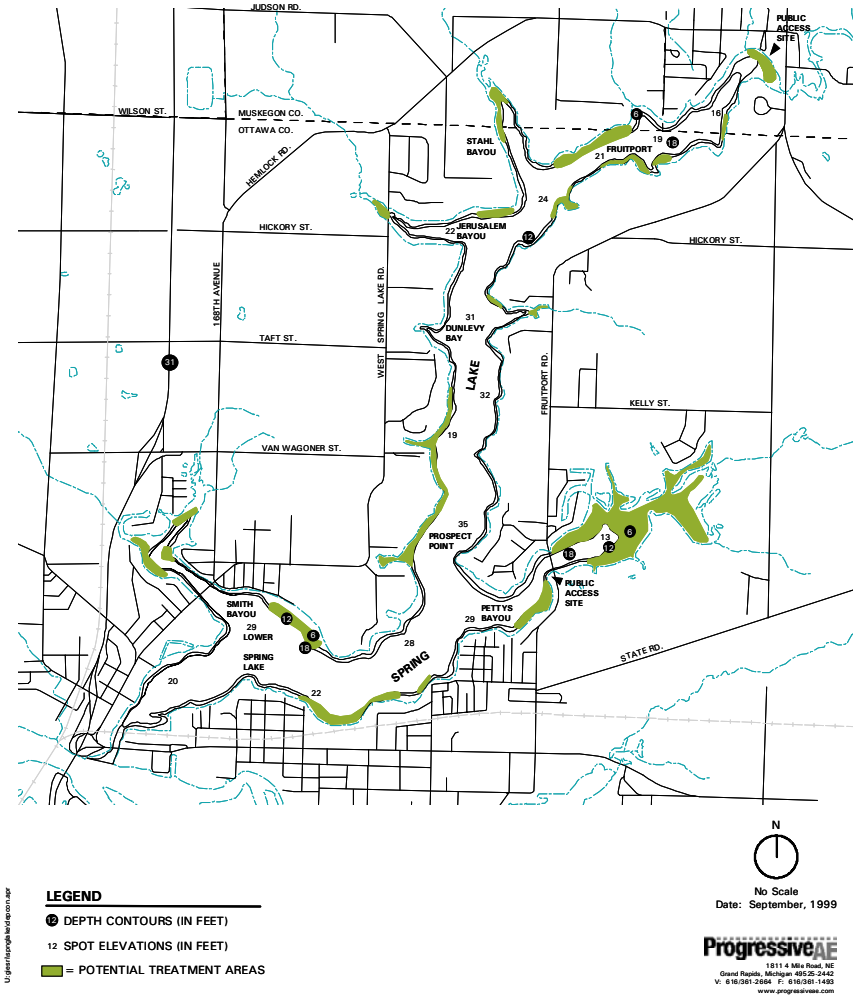


Figure 8. Milfoil distribution map.

LAKE ALUM TREATMENT

Phosphorus loading can be categorized into two sources: internal and external. Using the lake itself to delineate these two sources, phosphorus that enters the lake from beyond the shoreline or above the surface is considered external, and phosphorus recycled within the lake is considered internal. There are many external loading sources: surface runoff from agricultural, residential, and other land use types; groundwater seepage; rainfall and dry fall; and wastewater effluent are some examples. Some sources may be controlled (e.g., wastewater effluent), while others remain largely uncontrollable (e.g., rainfall). Internal loading sources are more difficult to see and define, and involve complex physical, chemical, and biological interactions within the lake. Also, it is not necessary for phosphorus to enter the lake via land runoff or other external sources in order for internal loading to occur. Therefore, if internal recycling of phosphorus is of major significance in a lake, removal of external loadings such as septic seepage or surface runoff may have very little effect on the eutrophic or fertilized, condition of the lake.

There are many pathways of phosphorus recycling within a lake. Algae withdraw phosphorus from the water into their cells during growth and release it when they die. Fish take up phosphorus during feeding as well and release it by excretion. Rooted aquatic plants are able to extract phosphorus from the bottom sediments and pump it to the leaves and other parts of the plant. Rooted plants often leak phosphorus through their leaves where it is then available for uptake by algae. Thus, one particle of phosphorus may be used over and over again within the aquatic system as it is released by one organism and taken up by another.

Phosphorus may also be transported internally through physical and chemical means. If the water lying just above the rich sediments is devoid of oxygen, phosphorus will be released (from the sediments) into the water column. From there, phosphorus can be taken up by aquatic organisms as discussed above, or it can be moved upward through a process called vertical entrainment. When a strong unidirectional wind blows across the lake for several days, water actually begins to pile up on the lee end of the lake. The accumulated water sinks to the stratified thermocline layer and slides back toward the opposite end of the lake. If the prevailing wind stops, the surface continues to rock back and forth for several days. This "see-saw" type of movement occurs not only on the surface but to an even greater extent in the thermally stratified waters beneath. Material from the bottom will be picked up on the down side of the see-saw, then is moved upward as the cool, dense bottom waters rock upward again. Phosphorus can be redistributed in this manner to the upper regions of the lake where it will be available for uptake by plants (Wetzel 1983).

There are many compounds that can bind with phosphorus and remove it from the water column. Alum, an aluminum sulfate and/or sodium aluminate compound, is optimal for use in lake treatments in that it continues to bind phosphorus under anaerobic conditions and under most pH ranges encountered in natural waters. Two methods may be used to reduce phosphorus availability with alum. One is to add it to the lake surface in a concentration that is only slightly higher than the ambient phosphorus concentration. The alum-phosphorus compound forms a heavy floc, which

sinks to the bottom; thus, the nutrient is no longer available for algal growth. The other technique involves adding alum just above the anaerobic sediments in very high concentrations to restrict phosphorus release from the sediments and, thus, reducing internal loading. Both techniques have been employed in many lakes across the country with good to excellent results (Cooke et al. 1986). However, it should be noted that, for long-term control of internal phosphorus recycling, the higher dose rate is required. It has been demonstrated that, at higher dose levels, up to 90 percent removal of phosphorus can be expected with continued low nutrient levels for up to 15 years after treatment (Cooke et al. 1986).

Not all lakes are good candidates for alum treatments, and individual lakes considered for treatment must be tested to ascertain correct dosage levels. While alum is stable in the pH range of most lakes, it may convert to the toxic dissolved aluminum form at pHs below 6.0 (Cooke et al. 1986; Cooke et al. 1978), which can be harmful to fish and other aquatic organisms. During the addition of alum to lake water and/or sediments, the pH will decrease as the water's buffering capacity (alkalinity) is used up. Water quality monitoring must be conducted during treatment to ensure the pH does not drop below 6.0. In addition, there may be an inherent trade-off in water quality with the use of alum. Because water clarity will improve, often dramatically, when phosphorus is removed, the increased light penetration can be a stimulus for increased macrophyte (large aquatic plant) growth. In other words, it may be possible to trade an algae problem for a macrophyte problem since rooted plants may still extract phosphorus from the sediments. Also, lakes receiving excessive phosphorus loadings from external (i.e., watershed) sources may not be good candidates for an alum treatment in that the longevity of the alum treatment may be greatly reduced.

In evaluating the feasibility and effectiveness of an alum treatment for phosphorus inactivation and aquatic plant control in Spring Lake, the following considerations are of primary importance:

- Water quality sampling conducted during the period of study indicates substantial bottom water phosphorus buildup occurs in Spring Lake during the period of summer stratification. Thus, internal recycling of phosphorus has the potential to contribute significantly to the total amount of phosphorus available to stimulate plant growth in the lake.

- Temperature profile data indicates Spring Lake has sufficient depth to achieve thermal stratification. Because the colder bottom water does not mix with the surface, the phosphorus-alum floc can be expected to remain bound to the deep water sediments for many years.

- Chemical conditions (i.e., alkalinity and pH) that exist are such that an alum dose rate sufficient to inactivate phosphorus on a long-term basis could be applied with due precautions without adversely impacting aquatic life.

- As discussed, alum is effective in controlling algae growth by removing phosphorus from the water column. However, rooted plants generally are not significantly impacted, in that they are able to draw the nutrients required for growth from the lake bottom sediments where phosphorus is still available. If

alum were effective in reducing algae growth in Spring Lake, water clarity would be expected to increase, and nuisance macrophyte growth may increase as well.

- Additional water quality monitoring is recommended to better evaluate the feasibility and effectiveness of an alum treatment for Spring Lake.

WATER QUALITY MONITORING AND TESTING

In order to determine the feasibility of an alum treatment as a means for controlling nuisance algae in Spring Lake, further monitoring is needed to establish the temporal and geographic extent of deep-water dissolved oxygen depletion, the concentration of phosphorus overlying the oxygen-depleted sediments, the rate of vertical transport or diffusion of phosphorus to the surface waters, potential alum dose rates, and a qualitative comparison of external versus internal loading rates. In order to discern temperature-oxygen-phosphorus gradients, more extensive mapping of the lake's bathymetry, or bottom contours, is required. This can be accomplished using a global positioning system (GPS) and a depth-sounder. To accomplish these sampling objectives, samples should be collected from the lake periodically from April to October from the surface to the bottom at the three in-lake sampling stations to measure temperature, dissolved oxygen, total phosphorus, pH, and total alkalinity. Additional temperature and dissolved measurements should be made at numerous points throughout the lake to determine the vertical and horizontal extent of dissolved oxygen consumption. Discharge and total phosphorus measurements should be made at the most downstream location possible for the major tributaries during major storm events and during base-flow conditions to evaluate storm and base-flow loadings. Water quality monitoring can be used to better document baseline water quality conditions and to gauge the effectiveness of ongoing management efforts.

WATERSHED MANAGEMENT

Nutrients and sediments which stimulate nuisance plant growth and reduce water clarity enter Spring Lake from the surrounding watershed. In order to improve conditions in Spring Lake, it will be necessary to reduce watershed inputs.

Watershed sources of phosphorus to Spring Lake include lawn fertilizers, septic systems, storm sewer outfalls, and agricultural runoff. By contrast, wetlands reduce runoff of nutrients and sediments by trapping and filtering runoff before it reaches the lake. Therefore, managing runoff from the watershed should include reducing phosphorus inputs and protecting wetlands. These watershed management practices are described in more detail as follows:

Shoreland Management

The portion of the watershed that directly abuts Spring Lake is known as the shoreland area, and is used primarily for residential or commercial purposes. Shoreland pollution inputs are caused by excessive fertilizer use, use of fertilizers that contain phosphorus, improper disposal of yard waste, and other improper lawn care practices. In addition, although most Spring Lake shoreland residences are serviced by a community sewer system, some residences use on-site septic systems which can leach nutrients to the

lake. In order to reduce shoreland nutrient and sediment inputs, residents should be informed of proper lawn care and septic system maintenance practices; shoreland soils should be tested for nutrient content prior to application of fertilizers; and, where appropriate, shoreline vegetative filter strips should be installed.

Stormwater Management

Spring Lake is also impacted by stormwater inputs from at least 81 outfalls that connect to the lake. In addition to sediments and nutrients, urban stormwater systems can contain illicit sanitary or industrial connections which further pollute receiving waters. With recent advancements in the technology for street sweeping–now more accurately described as street vacuuming–sediment and nutrient pollutants can be more effectively removed from stormwater. Illicit connections can only be addressed by painstaking investigation and correction.

Farmland Management

Although farming in the Spring Lake watershed is not intensive, agricultural runoff in general tends to be high in nutrients and sediments. Thus, reducing the concentration of nutrients and sediments in agricultural runoff to the extent possible will benefit downstream water quality. Agricultural improvements in the Spring Lake watershed will consist primarily of vegetative filter strips, streambank stabilization, and nutrient management (i.e., fertilizer and manure controls).

Critical Land Management

As discussed previously, wetlands protect water quality as well as reducing the severity of stormwater surges and providing fish and wildlife habitat. As such, lake residents and the lake board should be vigilant in wetland protection efforts. Currently, some wetlands are protected at the state level under the provisions of Part 303 of the Natural Resources and Environmental Protection Act, Act 451 of 1994, as amended. However, local governments can also adopt wetland protection ordinances to emphasize the local commitment to wetland protection. In some areas of the watershed, it may be appropriate to obtain a conservation easement over those lands that are particularly important in protecting the quality of Spring Lake. These critical lands may include wetlands, steeply sloped areas with unstable soils, or lands suitably located for future installation of water quality improvement facilities such as a sedimentation or stormwater detention/retention basins.

Grant Funding

Fortunately, there is state funding available to support watershed management efforts. In November of 1998, Michigan voters passed the Clean Michigan Initiative (CMI) bond. Of the $675 million in bond monies, $50 million is earmarked for nonpoint source pollution control, and $90 million for the Clean Water Fund. Before any grant funds can be expended, however, the Department of Environmental Quality (DEQ) must promulgate rules that describe how the grant funds may be used. The nonpoint source rules were promulgated in October of 1999, but at the time of this writing, promulgation of the Clean Water Fund rules was not completed. The nonpoint source rules and the draft Clean Water Fund rules state that in order to be eligible for either

fund, applicants must have a watershed management plan approved by the DEQ prior to submitting a grant application. At this time, both rules define the contents of an approved watershed management plan similarly. The promulgated nonpoint rules describe watershed management plans as follows:

> R 324.8810 Approvable watershed management plans.
> Rule 10. (1) A local unit of government or a not-for-profit entity may submit a watershed management plan to the department for approval under these rules.
> (2) A watershed management plan submitted to the department for approval under this section shall contain current information, be detailed, and identify all of the following:
>
> (a) The geographic scope of the watershed.
>
> (b) The designated uses and desired uses of the watershed.
>
> (c) The water quality threats or impairments in the watershed.
>
> (d) The causes of the impairments or threats, including pollutants.
>
> (e) A clear statement of the water quality improvement or protection goals of the watershed management plan.
>
> (f) The sources of the pollutants causing the impairments or threats and the sources that are critical to control in order to meet water quality standards or other water quality goals.
>
> (g) The tasks that need to be completed to prevent or control the critical sources of pollution or address causes of impairment, including, as appropriate, all of the following:
>
> (i) The best management practices needed.
>
> (ii) Revisions needed or proposed to local zoning ordinances and other land use management tools.
>
> (iii) Informational and educational activities.
>
> (iv) Activities needed to institutionalize watershed protection.
>
> (h) The estimated cost of implementing the best management practices needed.
>
> (i) A summary of the public participation process, including the opportunity for public comment, during watershed management plan development and the partners that were involved in the development of the watershed management plan.
>
> (j) The estimated periods of time needed to complete each task and the proposed sequence of task completion.
>
> (k) A description of the process that will be used to evaluate the effectiveness of implementing the plan and achieving its goals.
>
> (3) The department shall accept and review watershed management plans submitted for approval under this rule at any time throughout the year.
> (4) The department reserves 90 days to review and comment on watershed management plans submitted for approval.

In addition, grant recipients are required to match at least 25 percent of the project costs, either with currency or in-kind services. By providing a higher percentage of project costs, above and beyond the required 25 percent, applicants can increase their chance of receiving a grant. Thus, it will be necessary to prepare and receive approval

for a watershed management plan for the Spring Lake watershed, and to acquire funds or organize in-kind services to be used as a project cost-share.

Nonpoint source fund rules state that grant funds can be only be used for two purposes: "To implement the physical improvement portion of an approved watershed management plan," or "to reduce nonpoint source pollution from sources as identified by the department." "Physical improvements" are defined in the draft rules as "structural or vegetative practices used to control nonpoint source pollution."

The draft Clean Water Fund rules state that grant funds can be used for the following purposes that may be applicable to Spring Lake:

- Provide state match to establish and implement the conservation reserve enhancement program in Michigan. CMI funds will pay for the establishment cost of the riparian buffer strips, filter strips, field wind breaks, and grass waterway practices. They could also provide a one-time payment for voluntary, permanent easements for the same practices. This program will target agricultural lands within riparian corridors.
- Implement water quality protection or improvement activities in approved watershed management plans that are required under a National Pollutant Discharge Elimination System wastewater discharge permit for stormwater discharges from separate stormwater drainage systems and that are not otherwise required by federal law.
- Implement programs to identify and require the correction of illicit connections to separate storm sewer systems.
- Implement programs to do one or both of the following:
    - Identify failing on-site septic systems, determine the extent of failing on-site systems, and determine the impact of failing on-site systems on designated uses.
    - Implement corrective measures in areas where failing on-site septic systems have been determined to be threatening or impairing designated uses.

It should be emphasized that since the Clean Water Fund rules are in draft form, revisions are possible. Therefore, grant-eligible activities may ultimately differ from those stated above. At this time, it is recommended that a watershed management plan be prepared and than an application be submitted to the Department of Environmental Quality for grant funding. It is proposed that those activities that are not grant eligible be funded with local assessments. The proposed watershed management activities are outlined as follows:

TABLE 11
PROPOSED SPRING LAKE WATERSHED MANAGEMENT ACTIVITIES

Activity	Grant Eligible?
Shorelands Management	
Fertilizer controls	Yes - some activities
Shoreline buffer strips	Yes
Soil testing	Yes
Stormwater Management	
Street sweeping/vacuuming	Yes
Removal illicit stormwater connections	Yes
Stormwater ordinance	No
Protection of Environmentally Sensitive Land	
Wetland protection	Uncertain; ordinances: no
Conservation easements	Yes
Critical land purchases	Yes
Agricultural Land Management	
Filter strips	Yes
Erosion control	Yes
Nutrient management	Uncertain
Streambank Stabilization	Yes

INFORMATION AND EDUCATION

Much of the pollutant load that enters Spring Lake is from residential lands immediately adjacent to Spring Lake. In order to reduce fertilizer runoff and septic seepage, cooperation from lake residents will be critical to the success of the overall project. In order to obtain residents' cooperation, information regarding proper shorelands management should made available via annual newsletters and meetings. In addition, newsletters should be used to update all lake residents regarding lake water quality, boating safety, impacts of invader species, and project activities.

Recommended Improvement Plan

Current and historical water quality data indicate Spring Lake is eutrophic: deep-water dissolved oxygen becomes depleted in late summer; levels of the plant nutrient phosphorus are very high; rooted plant and algae growth is excessive; and water clarity is low. Spring Lake is nutrient-enriched and, biologically, is highly productive.

There are several sources of pollution to Spring Lake, including lake sediments which cause nutrients to be recycled within the lake itself, lawn fertilizers, septic systems, urban stormwater runoff, and runoff from agricultural lands. In order to protect and enhance the quality of Spring Lake over the long term, steps must be taken in conjunction with in-lake improvements to reduce pollution inputs from the watershed to the extent possible.

Improvement Plan Elements

The improvement plan for Spring Lake is proposed to include the control of nuisance plants via the select use of herbicides and aquatic plant harvesting, watershed management to reduce the input of pollutants to Spring Lake, information and education, and water quality monitoring. The improvement plan elements are described further as follows:

Aquatic Plant Control

- Eurasian Milfoil Control: The major nuisance rooted plant in Spring Lake is Eurasian milfoil, a plant which is not native to Michigan or the United States. Because Eurasian milfoil can spread rapidly by fragmentation, this plant is proposed to be controlled with the select use of herbicides. Herbicide treatments for milfoil control are most effective when conducted early in the growing season (May or early June).
- Mechanical Harvesting: Mechanical harvesting involves cutting and removing vegetation from the lake. Harvesting is proposed to be conducted along developed shoreline areas where nuisance aquatic plant growth (other than Eurasian milfoil) is inhibiting recreational use and enjoyment of the lake. To ensure optimum removal of plant biomass, harvesting is generally conducted in late June or July.
- Algae Control: Nuisance algae growth can be temporarily controlled with copper-based herbicides. The longevity and effectiveness of an algae treatment is dependent on weather, nutrient levels in the lake, and other conditions. Unlike most other aquatic herbicides that tend to rapidly break down, copper does not degrade and can accumulate in lake sediments. In light of these considerations, it is recommended that herbicide treatments for algae control be kept at a minimum. It is proposed that developed shoreline areas where nuisance plant growth is occurring be treated once annually at the peak of the summer growing season (July or August).

- Alum Treatment: Although not recommended at present, consideration should be given to the application of aluminum sulfate (alum) to the bottom waters of Spring Lake to reduce the internal recycling of phosphorus from the lake sediments. The effectiveness of an alum treatment would be enhanced if watershed management practices are implemented prior to the alum treatment.

Watershed Management:

The watershed management element of the Spring Lake Improvement Plan is proposed to focus on wetland protection and the reduction of pollution inputs from residential, urban, and agricultural lands in the watershed.

- Shoreland Management: Reduce phosphorus inputs from residential areas near Spring lake by:
  - Promoting policies to reduce the use of phosphorus-based lawn fertilizers near the lake.
  - Promotion of proper lakeside landscaping and lawncare practices.
  - Proper septic system maintenance.
- Wetland Protection: Wetlands in the Spring Lake watershed filter and purify runoff water and provide valuable habitat for fish and wildlife. In order to promote protection of wetlands, it is proposed that:
  - Detailed wetland maps be distributed to all governmental units in the watershed.
  - The lake board partner with the Natural Areas Conservancy of West Michigan and local governmental units to establish conservation easements over critical lands in the watershed.
- Urban Stormwater Management: In order to minimize the impact of new development, special stormwater regulations for Spring Lake watershed should be adopted that emphasize water quality protection.
- Clean Michigan Initiative Grant Program - Develop a watershed management plan for:
  - Agricultural best management practices (stream corridor filter strips, sedimentation basins, etc.).
  - Illicit stormwater connections.
  - An evaluation of imperviousness as a basis for implementation of periodic street cleaning with state-of-the-art street sweeping equipment.

Information and Education: Prepare and disseminate annual publications to all lake residents to provide information on shoreland management practices, lake water quality, boating safety, impacts of invader species, and updates on project activities.

Water Quality Monitoring: Expand water quality database to better discern: seasonal thermal stratification, dissolved oxygen, and total phosphorus dynamics; impacts of

invader species, and the magnitude and importance of internal phosphorus loading. Additional water quality data is needed to guide future management decisions.

The Spring Lake Improvement Plan is proposed to be implemented over a four-year period beginning in the year 2000 and continuing through 2003. Once the watershed management elements of the plan have been substantially implemented, consideration should be given to the application of aluminum sulfate (alum) to the bottom waters of Spring Lake to mitigate internal phosphorus recycling in the lake.

Project Implementation and Financing

Improvements for Spring Lake are being implemented in accordance with Part 309 (Inland Lake Improvements) of the Natural Resources and Environmental Protection Act (P.A. 451 of 1994). The budget for the Spring Lake Improvement Plan is presented in Table 11.

Pursuant to provisions of the Act, public hearings were held and a special assessment district has been established from which revenue is being generated to finance the improvements.

The Special Assessment District for Spring Lake includes all properties which border the lake and back lots which have deeded or dedicated lake access. Under this plan, developed lakefront properties are being assessed one unit of benefit and developed back lots with deeded or dedicated lake access are being assessed 1/2 unit of benefit. Undeveloped lakefront parcels are being assessed 1/2 unit of benefit, and undeveloped back lots are being assessed 1/4 unit of benefit. In addition, contiguous lots in common ownership are being assessed as one parcel provided only one house exists on the parcel. Businesses are being assessed, based on the number of boat slips installed on Spring Lake. Finally, it is proposed that Muskegon and Ottawa Counties each pay 5 percent of the total project cost.

The $150,250 annual cost of the project is being assessed for a four-year period (2000 to 2003). A breakdown of costs based on this approach is presented in Table 12.

TABLE 12
SPRING LAKE IMPROVEMENT PLAN PROPOSED BUDGET
2000 THROUGH 2003

Improvement	Annual Cost
Aquatic Plant Control[1] Eurasian milfoil: 100 acres @ $300/acre Harvesting: 100 acres @ $300/acre Algae control: 200 acres @ $50/acre Administration and Inspections @ $8,000/year	$78,000
Grant Application and Watershed Management Plan[2]	$6,250
Watershed Management Shorelands Wetlands Urban Agriculture	$25,000
Information and Education	$5,000
Water Quality Monitoring	$16,000
Project Administration[3]	$5,000
Contingencies[4]	$15,000
Total Annual Cost	$150,250

[1] The acreages shown for plant control are for budgeting purposes only. The actual amount of herbicides used or harvesting conducted in any given year will depend on the type and distribution of aquatic vegetation.

[2] This purpose of this project element is to pursue a grant under the recently approved Clean Michigan Initiative (CMI) environmental bond to supplement local funds. The watershed management elements of the Spring Lake project may be eligible for up to $300,000 in CMI grant funds.

[3] Project administration will include all costs incurred by the Spring Lake - Lake Board including postage, copies, mailings, notices, and legal.

[4] Part 309 of the Natural Resources and Environmental Protection Act, Act 451 of 1994, states that a lake board may add not less than 10% or more than 15% of the total project cost for contingent expenses.

TABLE 13
SPRING LAKE
COST BREAKDOWN

Parcel Type	Units of Benefit	Annual Assessment[1]
Developed Lakefront Parcels	1	$144
Undeveloped Lakefront Parcels	1/2	$72
Developed Backlot Parcels	1/2	$72
Undeveloped Backlot Parcels	1/4	$36
Business: Backlot (no slips)	1	$144
Businesses: <50 slips	4	$576
Businesses: 50 - 100 slips	8	$1,152
Businesses: 101 - 150 slips	12	$1,728
Businesses: >150 slips	16	$2,304
Muskegon County Contribution	5%	$7,500
Ottawa County Contribution	5%	$7,500

[1] Includes the cost of the feasibility study.

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Appendix B

Administrative Rules CMI Nonpoint Source Pollution Control

ADMINISTRATIVE RULES

CLEAN MICHIGAN INITIATIVE NONPOINT SOURCE POLLUTION CONTROL GRANTS

(Promulgated pursuant to Part 88 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended)

Effective: October 27, 1999

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

SURFACE WATER QUALITY DIVISION

Clean Michigan Initiative
Nonpoint Source Pollution Control Grants

Table of Contents

DEPARTMENT OF ENVIRONMENTAL QUALITY

SURFACE WATER QUALITY DIVISION

CLEAN MICHIGAN INITIATIVE NONPOINT SOURCE POLLUTION CONTROL GRANTS

Filed with the Secretary of State on October 11, 1999
These rules take effect 15 days after filing with the Secretary of State

(By authority conferred on the department of environmental quality by section 8808 of 1994 PA 451, MCL 324.8808)

R 324.8801 Purpose.

Rule 1. These rules establish a program of nonpoint source pollution prevention and control grants using funds available under the clean Michigan initiative. These rules establish requirements for all of the following:

(a) Approvable watershed plans.
(b) Eligible applicants.
(c) Selection criteria.
(d) Project design and maintenance.
(e) Reporting.

R 324.8802 Definitions.

Rule 2. As used in these rules:

(a) "Approved watershed management plan" means either of the following:
  (i) A watershed management plan that meets the criteria established in R 324.8810 and approved by the director.
  (ii) Remedial Action Plans and Lakewide Management Plans.
(b) "Best management practices" means structural, vegetative, or managerial practices that reduce or prevent the detachment, transport, and delivery of nonpoint source pollutants to the surface waters of the state or groundwater.
(c) "Department" means the department of environmental quality.
(d) "Designated use" or "designated uses" means a use or uses of the surface waters of the state as established by part 4 of 1994 PA 451, MCL 324.401 et seq.
(e) "Director" means the director of the department or his or her designee.
(f) "Environmental sample" means the collection or analysis of information about any of the following:
  (i) Vegetation.
  (ii) Soils.
  (iii) Fish.
  (iv) Biota.
  (v) Water
  (vi) Habitat.
(g) "Grant" means a nonpoint source pollution prevention and control project grant funded by the clean Michigan initiative bond.
(h) "In-kind services" means services provided by the grant applicant or its partners including any of the following:
  (i) Salaries and wages of project staff and others working on the project, including engineering services and volunteers.

(ii) Rent paid for office space, meeting rooms, or other indirect costs associated with the project.
(iii) The cost of renting or purchasing of equipment, materials, or supplies in excess of the costs paid for by the grant.
(iv) The costs of collecting and analyzing environmental samples or other environmental quality measurements to document improvement in water quality.
(v) The costs of installing best management practices or materials donated for the implementation of best management practices.
(vi) Other resources acceptable by the department.

(i) "Lakewide Management Plan" means a plan developed under the Great Lakes water quality agreement between Canada and the United States, as amended in 1987.

(j) "Local unit of government" means any of the following entities:
(i) A county, city, village, or township or an agency of a county, city, village, or township.
(ii) The office of a county drain commissioner.
(iii) A soil conservation district established under part 93 of 1994 PA 451, MCL 324.9301 et seq.
(iv) A watershed council.
(v) A local health department as defined in section 1105 of 1978 PA 368, MCL 333.1105.
(vi) An authority or any other public body created by or under state law.

(k) "Match" means the portion of the total project cost that is to be paid by the applicant or its partners from public or private funding sources, excluding clean Michigan initiative funds and federal clean water act funds awarded as grants by the state.

(l) "Nonpoint source pollution" means water pollution from diffuse sources, including any of the following:
(i) Runoff from precipitation or snowmelt contaminated through contact with pollutants in the soil or on other surfaces and either infiltrating into the groundwater or being discharged to surface waters of the State.
(ii) Runoff or wind that causes the erosion of soil into surface waters of the State.
(iii) Stream bank erosion resulting from unstable hydrologic flows.

(m) "Not-for-profit entity" means an entity that is exempt from taxation under section 501(c)(3) of the internal revenue code.

(n) "Physical improvements" means structural or vegetative best management practices used to control nonpoint source pollution.

(o) "Project contract" means the legally binding agreement between the department and a recipient of a grant that establishes the terms and conditions of the work to be conducted.

(p) "Remedial action plan" means a plan developed under the Great Lakes water quality agreement between Canada and the United States, as amended in 1987.

(q) "Request for proposals" means the document used by the department to solicit proposals for grant funding.

(r) "Site" means a block or contiguous blocks of land that constitute a viable management unit.

(s) "Surface waters of the state" means all of the following, but does not include drainageways and ponds used solely for wastewater conveyance, treatment, or control:
(i) The Great Lakes and their connecting waters.
(ii) All inland lakes.
(iii) Rivers.
(iv) Streams.
(v) Impoundments.
(vi) Open drains.

(vii)Other surface bodies of water within the confines of the state.

(t) "Water quality standards" means the part 4 water quality standards developed under part 31 of 1994 PA 451, MCL 324.3101 et seq.

(u) "Watershed" means a topographic area of the land that drains to a common point, such as a lake, pond, river, or stream.

(v) "Watershed management plan" means a water resource plan that sets forth management strategies for improving or protecting water quality or achieving water quality standards and designated uses in a watershed.

R 324.8803 Nonpoint source pollution prevention and control grants.

Rule 3. The director may award grants and enter into project contracts for either or both of the following purposes:

(a) To implement the physical improvement portion of an approved watershed management plan.

(b) To reduce nonpoint source pollution from sources as identified by the department.

R 324.8804 Application.

Rule 4. (1) The department shall seek applications for grants from local units of government and not-for-profit entities using a request for proposals. The request for proposals shall include all of the following information:

(a) The types of proposals being solicited.

(b) The application due date.

(c) Instructions and forms needed by the applicant.

(2) An applicant shall submit a grant application to the department in the format prescribed by the department and on forms provided by the department.

(3) A grant application shall include all of the following:

(a) Information about the applicant, including all of the following:

(i) The applicant’s name, address, telephone number, and other pertinent information.

(ii) The qualifications of the applicant’s key project staff.

(iii) A statement from a certified public accountant as to when an audit was last conducted, the scope and date of the audit, and a general statement as to the results of the audit.

(b) A description of the project, including, but not limited to all of the following information:

(i) The nature of the water quality concern to be addressed.

(ii) The project goals and objectives.

(iii) For projects implementing the physical improvement portion of an approved watershed management plan, a statement identifying the associated approved watershed management plan, a statement verifying that the plan is current, and a description of how the project is consistent with the tasks in R 324.8810(2)(g).

(c) Identification of the partners participating in the project and their roles.

(d) A work plan that identifies the tasks to be completed and the group or agency responsible for completing each task.

(e) A description of the measures the grantee has taken to identify potential land use conflicts with the proposed project.

(f) A timetable of significant milestones and deliverables.

(g) Steps to be taken to assure the long-term sustainability of the project, including both of the following:

(i) Steps to institutionalize the practices implemented in the project.

(ii) Commitments by appropriate partners to maintain the practices and the period of time over which the commitments are applicable.

(h) Budget information, including anticipated expenditures, local match and the sources of match, and the amount of the grant being applied for.
(i) An 8½-inch by 11-inch project location map.
(j) A statement that the proposed project is in compliance with all applicable state laws and rules or will result in compliance with state laws and rules.
(k) An evaluation component that describes how success in achieving the goals and objectives will be determined.
(l) For an application that proposes to implement physical improvements on sites where plans have been developed, an applicant shall submit all of the following information, unless the applicant demonstrates, in writing, that the information does not apply:
(i) Engineered drawings.
(ii) The basis of design.
(iii) A statement indicating the specifications that were used.
(iv) A statement verifying that all applicable permits will be obtained before implementation.
(v) A maintenance plan.
(m) For an application that proposes to implement physical improvements on sites where plans have not been developed, an applicant shall submit both of the following:
(i) An 8½-inch by 11-inch conceptual site plan showing the location of natural features and the proposed best management practices.
(ii) A statement indicating that final plans will be submitted to the department consistent with subrule (l) of this rule prior to construction. The department shall incorporate the commitment into the project contract.

(4) Plans and specifications submitted under subrule (l) of this rule for the project shall bear 1 or more seals of a registered professional engineer or registered landscape architect or equivalent, as appropriate for the proposed project and approved by the Department.
(5) The department reserves the right to review, request modifications of, approve, or reject a site plan submitted for grant funding.

R 324.8805 Eligible applicants.

Rule 5. (1) Only local units of government and not-for-profit entities are eligible to apply for grants.
(2) An applicant shall demonstrate the capability to carry out the proposed project.
(3) An applicant shall demonstrate that there is an identifiable source of funds for future maintenance and operation of the proposed project, if appropriate.
(4) An applicant shall have undergone a successful financial audit within the 24-month period immediately preceding the application for the grant.
(5) Within the 24-month period immediately preceding the application for the grant, an applicant shall not have demonstrated an inability to either manage a grant or meet the obligations in a project contract with the department.
(6) An applicant shall not have had a grant from any program within the department revoked or terminated within the 24-month period immediately preceding the application for the grant.
(7) An applicant shall submit all information included in the application requirements in R 324.8804 by the deadline identified in the request for proposals. The department shall not accept an application postmarked later than the deadline in the request for proposals. Eligible applicants may submit applications for more than 1 project.
(8) To be eligible for a grant under R 324.8803(a), an applicant shall have an approved watershed management plan. An applicant shall submit a watershed management plan to the department for approval not less than 90 days before the deadline identified in the request for proposals.

R 324.8806 Project selection factors.

Rule 6. In selecting projects for grant award, the department shall consider all of the following factors as they relate to a project:

(a) The anticipated water quality benefits of the project in relation to the costs.
(b) The ability of the applicant and the partners to carry out the project.
(c) A commitment on the part of the applicant to conduct an evaluation of the effectiveness of the project, including a commitment to provide monitoring data or other information that documents improvement in water quality or the reduction of pollutant loads.
(d) The expectation for long-term water quality improvement.
(e) The expectation for long-term protection of high-quality waters.
(f) The consistency of the project with remedial action plans and other regional water quality or watershed management plans approved by the department.
(g) The list of impaired waters under section 303(d) of title III of the federal water pollution control act, 33 U.S.C. §1313.
(h) Commitments for financial and technical assistance from the partners in the project.
(i) Financial and other resource contributions, including in-kind services, by project partners in excess of the contributions required in section 8802(4) of 1994 PA 451, MCL 324.8802(4).
(j) The length of time the applicant has committed to maintain the physical improvements.
(k) Whether the project provides benefits to sources of drinking water.
(l) Letters of support for the proposed project from affected stakeholders and local units of government.
(m) Other information the department considers relevant.

R 324.8807 Reporting and reimbursement.

Rule 7. (1) During the period of the grant, a grantee shall submit status reports to the department at least quarterly. The reports shall include all of the following information:

(a) A narrative description of the progress, including all of the following information:
  (i) The project name, the grantee name, and the reporting period.
  (ii) The value of the match earned during the quarter.
  (iii) The progress made during the reporting period for each task in the work plan.
  (iv) Accomplishments not anticipated in the work plan.
  (v) Products generated during the reporting period, if applicable.
  (vi) Barriers to progress that have caused delays.
  (vii)Activities scheduled for the following reporting period.
(b) A financial status report in a format consistent with the form provided by the department.
(c) A summary of the environmental benefits of the project, including the number of best management practices implemented and pollutant reduction information, if applicable.
(d) Other appropriate information requested by the department.

(2) The department shall reimburse expenditures incurred during the reporting period upon department approval of the status report.

(3) A grantee shall submit a final project report. The final project report shall include both of the following:

(a) A narrative description of the project, including all of the following information:
  (i) The project name and the grantee name.
  (ii) The project goals and objectives.
  (iii) An analysis of the extent to which the project achieved the goals and objectives.

(iv) A description of the environmental benefits of the project, including the best management practices implemented, pollutant reduction information, if applicable, and before and after pictures.
(v) A list of partners in the project and their individual contributions.
(vi) An analysis of which portions of the project were successful, which were not successful, and the barriers to success.

(b) A financial report in a format consistent with the form provided by the department.

(4) The department reserves the right to conduct site inspections to ensure consistency with the approved site plan.

(5) The department may withhold from reimbursement an amount equal to 10% of the grant until the grantee's final project report has been received and approved. If the department does not receive an approvable final project report within 12 months of the end of the project contract, then the grantee is in default of the contract and forfeits any claim to the unpaid balance of the grant. Forfeited funds are available only for commitment to future nonpoint source grants awarded consistent with these rules.

(6) All grants are subject to a postaudit.

(7) The department may revoke a grant made with money from the fund or withhold payment if the recipient fails to comply with the terms and conditions of the grant. If a grant is revoked, then the department may recover all funds awarded.

(8) If a grantee has committed to continuing maintenance of practices as the grantee's match, then the grantee or partner shall submit, in a format prescribed by the department, a report consistent with the maintenance schedule identified in the maintenance plan.

R 324.8808 Schedule of grants.

Rule 8. (1) The department shall issue the request for proposals each fiscal year in which clean Michigan initiative funding is available for grants.

(2) Following project selection, the department and a grantee shall enter into a project contract that establishes the work to be conducted and the commitment of funds.

(3) If a grantee satisfies the match requirement with a commitment to maintain the practices as allowed in R 324.8809, then the grantee shall enter into a separate contract that includes a maintenance plan describing the maintenance activities that will be accomplished and a schedule for each activity.

R 324.8809 Grantee contribution.

Rule 9. (1) Each grantee shall contribute not less than 25% of the project's total cost as match.

(2) The department may accept in-kind services to provide all or a portion of the required match.

(3) The department may accept as the match requirement a commitment, under terms acceptable to the department, that provides for the maintenance of the project or practices funded by the grant.

(a) The commitment shall be in the form of a contract between the grantee or a partner and the department. The department and the grantee shall sign the contract before the end of the grantee's project contract.

(b) The maintenance contract shall require the maintenance of the project or the practices for a minimum of 20 years after completion of the project.

(c) If a grantee fails to comply with the terms of the maintenance contract throughout the contract period, then the department may seek reimbursement of up to 25% of the project cost, plus interest, in an amount that is not more than 0.75% per month. Funds recovered under this rule are available only for commitment to future nonpoint source grants awarded consistent with these rules.

R 324.8810 Approvable watershed management plans.

Rule 10. (1) A local unit of government or a not-for-profit entity may submit a watershed management plan to the department for approval under these rules.

(2) A watershed management plan submitted to the department for approval under this section shall contain current information, be detailed, and identify all of the following:

(a) The geographic scope of the watershed.

(b) The designated uses and desired uses of the watershed.

(c) The water quality threats or impairments in the watershed.

(d) The causes of the impairments or threats, including pollutants.

(e) A clear statement of the water quality improvement or protection goals of the watershed management plan.

(f) The sources of the pollutants causing the impairments or threats and the sources that are critical to control in order to meet water quality standards or other water quality goals.

(g) The tasks that need to be completed to prevent or control the critical sources of pollution or address causes of impairment, including, as appropriate, all of the following:

(i) The best management practices needed.

(ii) Revisions needed or proposed to local zoning ordinances and other land use management tools.

(iii) Informational and educational activities.

(iv) Activities needed to institutionalize watershed protection.

(h) The estimated cost of implementing the best management practices needed.

(i) A summary of the public participation process, including the opportunity for public comment, during watershed management plan development and the partners that were involved in the development of the watershed management plan.

(j) The estimated periods of time needed to complete each task and the proposed sequence of task completion.

(k) A description of the process that will be used to evaluate the effectiveness of implementing the plan and achieving its goals.

(3) The department shall accept and review watershed management plans submitted for approval under this rule at any time throughout the year.

(4) The department reserves 90 days to review and comment on watershed management plans submitted for approval.

Appendix C

Administrative Rules CMI Clean Water Fund

ADMINISTRATIVE RULES

CLEAN WATER FUND

(Promulgated pursuant to Part 88 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended)

Effective: July 6, 2000
Latest revisions effective: February 1, 2001

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

SURFACE WATER QUALITY DIVISION

Clean Water Fund

Table of Contents

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

SURFACE WATER QUALITY DIVISION

CLEAN WATER FUND

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(By authority conferred on the department of environmental quality by section 8808 of 1994 PA 451, MCL 324.8808)

R 324.8901 Purpose.

Rule 1. These rules govern the establishment of contracts for the expenditure of money in the clean water fund to implement the programs described in the department's document entitled "A Strategic Environmental Quality Monitoring Program for Michigan's Surface Waters," dated January 1997; for water pollution control activities; for wellhead protection activities; for storm water treatment projects and activities; and to serve the purpose of section 8808 of 1994 PA 451, MCL 324.8808.

R 324.8902 Definitions; A to C.

Rule 2. As used in these rules:

(a) "Abandoned well" means any of the following which presents a threat to the groundwater resource and which no longer serves the purpose for which it was intended or has been taken out of service:
  (i) A water well.
  (ii) A monitoring well.
  (iii) A drainage well.
  (iv) A recharge well.
  (v) A test well.
  (vi) Other unplugged borings.

(b) "Abandoned well management grant" means a grant to protect community public water supplies by plugging abandoned wells within wellhead protection areas.

(c) "Abandoned well management team" means the wellhead protection team established under R 325.12804 or a team comprised of not less than 3 persons which includes a representative of the community public water supply, a representative of the municipality, village or township, and at least 1 of the following local entities:
  (i) County or district health department.
  (ii) Fire department.
  (iii) Business and industry.
  (iv) Agricultural sector.
  (v) Educational institution.
  (vi) Planning or zoning officials.
  (vii) Environmental groups.
  (viii) The general public.
  (ix) A representative of an adjoining community into which the wellhead protection area extends.

(d) "Applicant" means a nonprofit entity or local unit of government applying for grant funds awarded through the RFP process.

(e) "Approved watershed management plan" means either of the following:
  (i) A watershed management plan that meets the criteria established in R 324.8913 and is approved by the department.
  (ii) LaMPs and RAPs.

(f) "Best management practices" means structural, vegetative, or managerial practices that reduce or prevent the detachment, transport, and delivery of pollutants to surface waters or groundwater.

(g) "Clean water fund" or "fund" means the fund created in section 8807 of 1994 PA 451, MCL 324.8807.

(h) "Community public water supply" means a community supply as defined in section 2 of 1976 PA 399, MCL 325.1002.

(i) "Conservation reserve program (CRP)" means the program authorized by the food security act of 1985, as amended, P.L. 99-198, as amended, 7 U.S.C. 1281 et seq., administered by the United States department of agriculture farm service agency, under which the commodity credit corporation will enter into contracts with eligible participants to convert eligible agricultural land to a conserving use for a period of time of not less than 10 years nor more than 15 years in return for financial and technical assistance.

(j) "Conservation reserve enhancement program" means the program authorized under the food security act of 1985, as amended, P.L. 99-198, as amended, 7 U.S.C. 1281 et seq., under which a state may enter into agreement with the commodity credit corporation, to use the CRP to promote specific agricultural conservation and environmental objectives of Michigan and the nation.

(k) "Contract" means a legally binding agreement between the department and another entity, public or private, that establishes the terms and conditions of the work to be conducted, or the goods or services to be provided, whether acquired through a grant or through procurement.

(l) "Connecting waters" means any of the following:

(i) The St. Marys River.

(ii) The Keweenaw Waterway.

(iii) The Detroit River.

(iv) The St. Clair River.

(v) Lake St. Clair.

R 324.8903 Definitions; D to G.

Rule 3. As used in these rules:

(a) "Department" means the director of the department of environmental quality or his or her designee to whom the director delegates a power or duty by written instrument.

(b) "Designated uses" means a use of the waters of the state as established by part 4 of 1994 PA 451, MCL 323.1041 et seq., including use for any of the following:

(i) Industrial, agricultural, and public water supply.

(ii) Recreation.

(iii) Warmwater and coldwater fisheries, other aquatic life and wildlife.

(iv) Navigation.

(c) "Detroit consumer price index" means the most comprehensive index of consumer prices available for the Detroit area from the United States department of labor, bureau of labor statistics.

(d) "For-profit entity" means any entity that is subject to taxation in accordance with the internal revenue code.

(e) "Grant" means a grant awarded through the RFP process and funded by the clean water fund, being either an abandoned well management grant or a surface water grant.

(f) "Grantee" means the recipient of a grant.

(g) "Groundwater" means water beneath the surface of the earth that saturates the pore spaces associated with sand and gravel, rock fractures, and other subsurface geologic material.

R 324.8904 Definitions; H to N.

Rule 4. As used in these rules:

(a) "High quality waters" means any of the following:

(i) Wild and scenic rivers designated under the federal wild and scenic rivers act of 1991, Public Law 102-249, 16 U.S.C. 1271 et seq.

(ii) River reaches designated under part 305 of Act No. 451 of the Public Acts of 1994, as amended, MCL 324.30501 et seq.

(iii) All inland lakes identified in the publication entitled, "Coldwater Lakes of Michigan," as published in August 1976 by the department of natural resources, under the authority of part 411 of 1994 PA 451, MCL 324.41101 et seq., and which are designated for, and protected as, coldwater fisheries.

(iv) All lakes which have public access, which are greater than or equal to 40 acres in size, which are identified in the publication entitled, "Designated Trout Lakes and Regulations," dated September 10, 1998, by the director of the department of natural resources under the authority of part 411 of 1994 PA 451, MCL 324.41101 et seq., and which are designated, and protected as, coldwater fisheries.

(v) All streams identified in the publication entitled, "Designated Trout Streams for the State of Michigan," director's order no. DFI-101.97, by the director of the department of natural resources under the authority of section 48701(m) of 1994 PA 451, MCL 324.48701(m),and which are designated for, and protected as, coldwater fisheries.

(vi) Great lakes and connecting waters.

(vii) Other waterbodies that the applicant can demonstrate to the department contain an abundance, diversity and widespread distribution of members from each of the order plecoptera (stoneflies), ephemeroptera (mayflies), and trichoptera (caddisflies), which are indicators of high quality waters.

(b) "In-kind services" means direct services which are related to the project and which are provided by the applicant or its partner, including any of the following:

(i) Salaries and wages of project staff and others working on the project.

(ii) Time donated to the project, including media time related to the project.

(iii) Cost of rental or purchase of equipment, materials, or supplies.

(iv) Costs of collecting and analyzing water samples to document improvement in water quality.

(v) Costs of installing best management practices or materials donated for the implementation of best management practices.

(vi) Other resources acceptable to the department.

(c) "LaMP" means a lakewide management plan developed under the Great Lakes water quality agreement between Canada and the United States, as amended in 1987.

(d) "Local unit of government" means any of the following entities:

(i) A county, city, village, or township or an agency of a county, city, village, or township.

(ii) The office of a county drain commissioner.

(iii) A soil conservation district established under part 93, entitled "Soil Conservation Districts," of 1994 PA 451, MCL 324.9301 et seq.

(iv) A watershed council.

(v) A local health department as defined in section 1105 of 1978 PA 368, MCL 333.1105.

(vi) An authority or any other public body created by or under state law.

(e) "Low tritium public water supply" means a community supply that has had its well water sampled for tritium and had sample results of not more than 1.0 tritium unit.

(f) "Maintenance contract" means a contract for the long-term maintenance of best management practices.

(g) "Match" means that portion of the total project cost that is to be provided by the applicant or its partners from public or private funding sources other than clean Michigan initiative funds and federal clean water act funds awarded as grants by the state.

(h) "Monitoring activity or activities" means any activity or activities carried out to implement the surface water monitoring strategy or provide data to demonstrate water quality improvements as part of the clean water fund grant activities in R 324.8907(1)(c)to(h), including any of the following:

(i) Measuring the chemical character of surface waters of the state, including sediments, fish and wildlife, and measuring stream flow.

(ii) Monitoring the health and condition of associated aquatic communities and physical habitats of surface waters of the state.

(iii) Analyzing and reporting any associated environmental data.

(i) "Nonprofit entity" means an entity that is exempt from taxation under section 501(c)(3) of the internal revenue code.

(10) "NPDES" means the national pollutant discharge elimination system.

R 324.8905 Definitions; P to S.

Rule 5. As used in these rules:

(a) "Partner" means any individual or entity that participates in a project.

(b) "Procurement" means the acquisition of goods, services, or both by the department in accordance with procurement guidelines established by the state of Michigan, department of management and budget, and the office of purchasing.

(c) "Project" means work carried out under a grant.

(d) "QAPP" means a quality assurance project plan, which provides a framework for how environmental data will be collected to achieve specific project objectives, and which describes the procedures that will be implemented to obtain data of known and adequate quality.

(e) "RAP" means a remedial action plan developed under the Great Lakes water quality agreement between Canada and the United States, as amended in 1987.

(f) "Request for proposals" or "RFP" means the process used by the department to solicit proposals for grant funding and the document issued in conjunction with the process.

(g) "Site" is a defined area of land that constitutes a viable management unit.

(h) "Site plan" is an overall view of the site and includes all of the following:

(i) The construction proposed.

(ii) The best management practices proposed.

(iii) Existing structures and natural features.

(i) "The surface water monitoring strategy" means the report entitled "A Strategic Environmental Quality Monitoring Program for Michigan’s Surface Waters", (January 1997), as prepared by the department.

(j) "Surface waters of the state" means all of the following, but does not include drainageways and ponds used solely for wastewater conveyance, treatment, or control:

(i) The Great Lakes and their connecting waters.

(ii) All inland lakes.

(iii) Rivers.

(iv) Streams.

(v) Impoundments.

(vi) Open drains.

(vii) Other surface bodies of water within the confines of the state.

(k) "Surface water grant" means a grant to protect or improve surface waters of the state.

R 324.8906 Definitions; U to Z.

Rule 6. As used in these rules:

(a) "USDA" means the United States department of agriculture.

(b) "US EPA" means the United States environmental protection agency.

(c) "Vendor" means the recipient of funds made available by the department through procurement

(d) "Water quality standards" means the part 4 water quality standards developed under part 31 of 1994 PA 451, MCL 324.3101 to 324.3119.

(e) "Watershed" means a topographic area of land that drains to a common point, such as a lake, pond, river, or stream, including the surface waters within that topographic area.

(f) "Watershed management plan" means a water resource plan that sets forth management strategies for improving water quality or achieving water quality standards and designated uses in a watershed.

(g) "Wellhead protection area" means an area which has been approved by the department under the state of Michigan wellhead protection program, which represents the surface and subsurface area surrounding a water well or well field, which supplies a community public water supply, and through which contaminants are reasonably likely to move toward and reach the water well or well field within a 10-year time of travel or means a designated source water protection area surrounding a low-tritium public water supply well.

R 324.8907 Clean water fund activities.

Rule 7. (1) The director may award grants in accordance with R 324.8909 and enter into contracts for any of the following activities:

(a) Implementing portions of the surface water monitoring strategy.

(b) Providing state match to establish and implement the conservation reserve enhancement program in Michigan.

(c) Implementing water quality protection or improvement activities in approved watershed management plans that are required under a NPDES wastewater discharge permit for stormwater discharges from separate stormwater drainage systems and that are not otherwise required by federal law.

(d) Implementing water quality protection or improvement recommendations in approved watershed management plans that place a strong emphasis on protecting high quality waters.

(e) Implementing recommendations in LaMPs and RAPs that will directly protect or improve water quality, other than the recommendations that involve remediation of contaminated sediments.

(f) Implementing programs to identify and require the correction of illicit connections to separate storm sewer systems.

(g) Implementing programs to do one or both of the following:

(i) Identifying failing on-site septic systems, determining the extent of failing on-site systems, and determining the impact of failing on-site systems on designated uses.

(ii) Implementing corrective measures in areas where failing on-site septic systems have been determined to be threatening or impairing designated uses.

(h) Locating and plugging abandoned wells within wellhead protection areas.

(2) The activity identified under subrule (1)(b) of this rule shall be carried out in accordance with R 324.8915.

(3) The department shall implement the activity identified under subrule (1)(g) of this rule in accordance with R 324.8918.

(4) The department shall implement the activities identified under subrule (1)(h) of this rule, locating and plugging abandoned wells within wellhead protection areas, by

implementing R 324.8909(1), (2), (3), (4)(a), (b)(i and ii), (c) to (g), (j) and R 324.8910(a) to (b), and R 324.8911(7), R 324.8912, R 324.8916, and R 324.8917.

(5) Contracts shall be established with all recipients of money from the fund.

(6) The department shall not expend funds for removing inflow or infiltration from sanitary sewers.

R 324.8908 Eligibility for funds.

Rule 8. (1) For-profit entities, local units of government, and nonprofit entities are eligible to be selected as vendors.

(2) Only local units of government and nonprofit entities are eligible for grants.

(3) In addition to the requirement of subrule (2) of this rule, an applicant shall meet all of the following requirements to be eligible for a grant:

(a) The applicant shall demonstrate the capability to carry out the proposed project.

(b) The applicant shall demonstrate that there is an identifiable source of funds for future maintenance and operation of the proposed project, if appropriate.

(c) The applicant shall have undergone a successful financial audit within the 24-month period immediately preceding the application for a grant.

(d) Within the 24 months immediately preceding the application for a grant, the applicant shall not have demonstrated an inability to either manage a grant or meet the obligations in a contract with the department.

(e) Within the 24-month period immediately preceding the application for the grant, the applicant shall not have had a grant from any program within the department revoked or terminated due to the applicant's inability to meet the terms or condition of a grant.

(4) In addition to the requirements of subrules (2) and (3) of this rule, to be eligible for a grant, the applicant shall meet the application requirements set forth in R 324.8909(4) by the deadline identified in the request for proposals. The department shall not accept applications postmarked or hand delivered later than the deadline in the request for proposals. Eligible applicants may submit more than 1 application.

(5) Community public water supplies owned by the state or federal government are not eligible for abandoned well management grant assistance.

R 324.8909 Application and process for grants.

Rule 9. (1) The department shall issue a request for proposals each fiscal year in which clean water fund funding is available for grants.

(2) Requests for proposals shall include all of the following information:

(a) Instructions and forms needed by the applicant.

(b) The types of proposals being solicited.

(c) The application due date.

(3) An applicant shall submit an application to the department in the format prescribed by the department and on forms provided by the department.

(4) Applications for grants shall include all of the following information:

(a) Information about the applicant, including all of the following information:

(i) The applicant's name, address, telephone number, and other pertinent information.

(ii) The qualifications of the applicant's key project staff.

(iii) A statement from a certified public accountant as to when an audit was last conducted, the scope and date of the audit, and a general statement as to the results of the audit.

(b) A description of the project, including all of the following information:

(i) The nature of the surface water quality concern to be addressed, the abandoned well management project to be conducted, or the monitoring activity to be undertaken.

(ii) The project goals and objectives.

(iii) For projects implementing a portion of an approved watershed management plan, all of the following information:
(A) A statement identifying the associated approved watershed management plan.
(B) A statement verifying that the plan is current.
(C) A description of how the project is consistent with the tasks in R 324.8913(2)(g).

(c) Identification of the partners participating in the project and their roles.

(d) A work plan that includes all of the following information:
(i) Tasks to be completed.
(ii) The entity or individual responsible for completing each task.
(iii) A timetable of significant milestones and deliverables.

(e) Identification of any information and education activities.

(f) Budget information, including all of the following information:
(i) Anticipated expenditures.
(ii) Local match and the sources of match.
(iii) The amount of the grant being applied for.

(g) A statement that the proposed project is in compliance with state laws and rules or will result in compliance with state laws and rules.

(h) A statement verifying that all monitoring activities to be undertaken will be carried out in accordance with R 324.8914.

(i) A description of the steps to be taken to assure the long-term sustainability of the project, where appropriate, including both of the following:
(i) Steps to institutionalize the best management practices implemented in the project.
(ii) Commitments by appropriate entities or individuals to maintain the best management practices and the period of time over which the commitments are applicable.

(j) An 8½ inch by 11 inch project location map.

(k) In addition, applicants for abandoned well management grants under R 324.8907(1)(h), shall provide all of the following:
(i) A list of members of an abandoned well management team.
(ii) Verification that a representative of the county or district health department was requested by the applicant to participate in the abandoned well management team.
(iii) A description of the methods to be used to identify the owners of abandoned or temporarily abandoned wells.
(iv) A description of the methods to be used to locate abandoned wells, including identification of the persons responsible for conducting the abandoned well search activity.
(v) A description of the methods to be used to administer the abandoned well plugging activity.

(l) Applicants for abandoned well management grants under R 324.8907(1)(h) are exempt from subdivisions (h) to (i) and (m) to (q) of this subrule.

(m) For applications that propose to implement projects under R 324.8907(1)(c) to (e), an evaluation component that describes how success in achieving the goals and objectives will be determined.

(n) For applications that propose to implement structural best management practices under R 324.8907(1)(c) to (e), on sites where site plans have been developed, an applicant shall submit all of the following unless the applicant demonstrates, in writing, that the following do not apply:
(i) Engineered plans.
(ii) The basis of design.
(iii) A statement indicating the specifications that were used.

(iv) A statement verifying that all applicable permits will be obtained before implementation.

(v) A maintenance plan.

(o) For applications that propose to implement structural best management practices under R 324.8907(1)(c) to (e), on sites where site plans have not been developed, an applicant shall submit both of the following:

(i) An 8½ inch by 11 inch conceptual site plan showing the location of natural features and the proposed best management practices.

(ii) A statement indicating that final plans consistent with subdivision (n) of this subrule will be submitted to the department and approved by the department before construction. The department shall incorporate the commitment into the project contract.

(p) Plans and specifications submitted shall bear 1 or more seals of a registered professional engineer or registered landscape architect or equivalent as appropriate for the proposed project and approved by the department.

(q) The department reserves the right to review, require modification of, and approve all site plans submitted for grant funding.

R 324.8910 Project selection.

Rule 10. In selecting projects for grants awarded through a request for proposals process, the department shall consider all of the following as they relate to a project:

(a) The anticipated benefits of the project in relation to the costs.

(b) The ability of the applicant and the partners to carry out the project.

(c) A commitment on the part of the applicant to conduct an evaluation of the effectiveness of the project, including a commitment to document improvements in water quality or the reduction of pollutant loads, and document the success of proactive efforts such as pollution prevention controls and information and education activities.

(d) The expectation for long-term water quality improvement.

(e) The expectation for long-term protection of high quality waters.

(f) The consistency of the project with remedial action plans and other regional water quality or watershed management plans approved by the department.

(g) Waters that do not attain applicable water quality standards, or waters that presently attain water quality standards but are threatened, respectively, as identified in the publication "Clean Water Act Section 303(d) List Michigan Submittal for 1998," revised annually by the department, as directed by Public Law 92-500, as amended, 33 U.S.C. 1251 et seq.

(h) Commitments for financial and technical assistance from the partners in the project.

(i) Financial and other resource contributions by project participants in excess of that required in section 8802(4) of 1994 PA 451, MCL 324.8802(4).

(j) The commitment by the applicant and partners to institutionalize and enforce practices, using tools such as ordinances, to ensure water quality improves or is protected after the project ends.

(k) The length of time the applicant and partners have committed to maintain any structural best management practices.

(l) Whether the project provides benefits to sources of drinking water.

(m) Other information the department considers relevant.

R 324.8911 Grant reporting and reimbursement.

Rule 11. (1) During the period of the grant, surface water grantees shall submit status reports to the department at a frequency consistent with their contract and in a format specified by the department. A status report shall include all of the following information, as appropriate:

(a) A narrative description of the progress, including all of the following information:

(i) The project name, the grantee name, and the reporting period.
(ii) The value of the match earned during the reporting period.
(iii) The accomplishments achieved during the reporting period for each task in the work plan.
(iv) Other accomplishments not anticipated in the work plan.
(v) Products generated during the reporting period.
(vi) Barriers to progress that have caused delays.
(vii) Activities scheduled for the next reporting period.
(viii) In addition, for grantees implementing an abandoned well management grant under R 324.8907(1)(h), both of the following shall be submitted:
(A) A listing of locations of each abandoned well that was plugged during the reporting period.
(B) Copies of abandoned well plugging records.

(b) A financial status report in a format consistent with the form provided by the department.
(c) A summary of the environmental benefits of the project, including pollutant reduction information and the number and types of best management practices implemented.
(d) Other appropriate information requested by the department in the grant or contract.

(2) The department shall make reimbursement of expenditures incurred during the reporting period upon approval of the status report.

(3) A grantee shall submit a final project report. A grantee shall ensure that the final project report is consistent with the format provided by the department and includes all of the following information, as appropriate:
(a) A brief narrative description of the project, including all of the following information, as appropriate:
(i) The project name and the grantee name.
(ii) The project goals and objectives.
(iii) An analysis of the extent to which the project achieved the goals and objectives.
(iv) A description of environmental benefits of the project, including all of the following:
(A) The number and types of best management practices implemented.
(B) Pollutant reduction information.
(C) Before and after pictures.
(v) A list of partners in the project and their contributions.
(vi) A list of products resulting from the project.
(vi) A summary of the water quality data collected.
(viii) An analysis of which portions of the project were successful, which were not successful, and the barriers to success.
(b) A financial report in a format consistent with the form provided by the department.
(c) In addition, recipients of grants to implement the surface water monitoring strategy under R 324.8907(1)(a) shall submit a compilation of data collected.
(d) In addition, recipients of abandoned well management grants under R 324.8907(1)(h), shall submit both of the following:
(i) The number and location of all abandoned wells and temporarily abandoned wells located during the project.
(ii) A list of locations of all oil, gas, and mineral wells identified during grant-eligible search activities.
(e) Other appropriate information requested by the department in the grant or contract.

(4) For grantees implementing structural best management practices, the department may conduct site inspections to ensure consistency with the approved plan.

(5) The department may withhold from reimbursement an amount up to 10% of the grant until the grantee's final project report has been received and approved**,** and the financial records on file with the department have been audited by the department and any issues resolved. If the department does not receive an approvable final project report within 12 months of the end of the project contract, then the grantee is in default of the contract and forfeits claim to the unpaid balance of the grant. The recovered funds are available only for commitment to future grants awarded under these rules.

(6) All grants may be subject to a postaudit.

(7) The department may revoke a grant made with money from the fund or withhold payment if the recipient fails to comply with the terms and conditions of the grant. If a grant is revoked, then the department may recover all funds awarded.

(8) If the grantee satisfies the match requirement with a commitment to maintain the practices as allowed in R 324.8912(3), then the grantee's contract shall include a maintenance plan describing the maintenance activities that will be accomplished and a schedule for each activity. As part of the contract, the grantee shall submit, in a format prescribed by the department, a report consistent with the maintenance schedule identified in the maintenance plan. The plan shall describe the maintenance activities that will be accomplished and include a schedule for each activity.

R 324.8912 Match requirements for grants.

Rule 12. (1) A grantee shall contribute match funds according to the following:

(a) A grantee who receives grant funds under any of the following activities shall contribute not less than 25% of the project's total cost as match:

(i) R 324.8907(1)(a), implementing portions of the surface water monitoring strategy.

(ii) R 324.8907(1)(d), implementing water quality protection or improvement recommendations in approved watershed management plans that place a strong emphasis on protecting high quality waters.

(iii) R 324.8907(1)(e), implementing recommendations in LaMPs and RAPs that will directly protect or improve water quality, other than the recommendations that involve remediation of contaminated sediments.

(iv) R 324.8907(1)(f), implementing programs to identify and require the correction of illicit connections to separate storm sewer systems.

(v) R 324.8907(1)(g)(i), identifying failing septic systems, determining the extent of failing on-site systems, and determining the impact of failing on-site systems on designated uses.

(vi) R 324.8907(1)(h), locating and plugging abandoned wells within wellhead protection areas.

(b) A grantee who receives funding under R 324.8907(1)(c), implementing water quality protection or improvement activities in approved watershed management plans that are required under a NPDES wastewater discharge permit for stormwater discharges from separate stormwater drainage systems and that are not otherwise required by law, shall contribute not less than 50% of the project's total cost as match.

(c) A grantee who receives funding under R 324.8907(g)(ii), implementing corrective measures in areas where failing on-site septic systems have been determined to be threatening or impairing designated uses, shall contribute 66% of the project's total cost as match.

(2) The department may accept in-kind services to provide all or a portion of the required match.

(3) For all grants except those awarded under R 324.8907(1)(g)and (h), the department may accept as the match requirement a commitment, under terms acceptable to the

department, that provides for the maintenance of the project or practices funded by the grant.

(a) The commitment shall be incorporated into the contract between the grantee and the department.

(b) Any maintenance contracts between the grantee and a third party shall be subject to approval by the deparment.

(c) The maintenance of the project or the practices shall be for a minimum of 20 years after the completion of the project.

(d) If the grantee fails to comply with the maintenance terms of the contract throughout the 20-year period, then the department may seek reimbursement of funds equivalent to a proportional amount of the grant funding for which the defaulted maintenance activities were to be provided as match, plus interest in an amount not to exceed 0.75% per month from the date on which the department requests repayment**.** Funds recovered under this subrule shall be available only for commitment to future contracts awarded under these rules.

(4) A grantee implementing an abandoned well management grant under R 324.8907(1)(h) shall provide documentation of a local match to the grant assistance through 1 or more of the following:

(a) Identification of an item within a local budget dedicated to conducting abandoned well, temporarily abandoned well, or active well management activities in an amount not less than the local match. Activities acceptable as match may include any of the following:

(i) Implementation of ordinances that reduce or eliminate the creation of unplugged abandoned wells by any of the following:

(A) Promoting the plugging of abandoned wells when community public water service is provided.

(B) Requiring the plugging of abandoned wells before demolition of buildings.

(C) Requiring the plugging of abandoned wells before modifications of land use zoning classifications are granted.

(D) Other similar strategies.

(ii) Implementation of partnership agreements between townships, municipalities, villages, or local agencies for the purpose of abandoned well management.

(iii) Mapping the locations of active wells within a wellhead protection area using global positioning system/geographic information system technology.

(iv) Creation of geographic information system databases and the purchase of computer software to track the status of active wells inside wellhead protection areas.

(v) Grant-eligible activities defined in R 324.8916.

(b) A written agreement committing the applicant to an expenditure of funds in an amount not less than the local match.

(c) Evidence of previous local expenditures on abandoned well, temporarily abandoned well, and active well management and plugging activities within a wellhead protection area under 1978 PA 368, MCL 333.12701 et seq., that were completed after October 1, 1998.

(d) A combination of any of the items specified in subdivisions (a) to (c) of this subrule.

R 324.8913 Approvable watershed management plans.

Rule 13. (1) A local unit of government or a nonprofit entity may submit a watershed management plan to the department for approval under these rules.

(2) A watershed plan submitted to the department for approval under this rule shall be detailed, current, and identify all of the following:

(a) The geographic scope of the watershed.
(b) The designated uses and desired uses of the watershed.
(c) The water quality threats or impairments in the watershed.
(d) The causes of the impairments or threats, including pollutants.
(e) A clear statement of the water quality improvement or protection goals of the watershed plan.
(f) The sources of the pollutants causing the impairments or threats of impairments.
(g) The sources of the pollutants that are critical to control in order to meet water quality standards or other water quality goals.
(h) The tasks and their estimated costs that need to be completed to prevent or control the critical sources of pollution or address causes of impairment, including, as appropriate, all of the following:
(i) The best management practices needed.
(ii) Revisions needed or proposed to local zoning ordinances and other land use management tools.
(iii) Informational and educational activities needed.
(iv) Activities needed to institutionalize watershed protection.
(i) A summary of the public participation process, including the opportunity for public comment during watershed plan development and the partners that were involved in the development of the watershed plan.
(j) The estimated periods of time needed to complete each task and the proposed sequence of task completion.
(k) A description of the process that will be used to evaluate the effectiveness of implementing the plan and achieving its goals.

(3) The department shall accept and review watershed plans submitted for approval under this rule any time throughout the year.

(4) The department shall have 90 days to take action on watershed plans submitted for approval. Taking action may include approving, rejecting, or commenting.

R 324.8914 Quality assurance for monitoring activities.

Rule 14. (1) Before carrying out any monitoring activities, the grantee or vendor shall submit a QAPP for departmental approval.

(2) The QAPP shall address applicable objectives for environmental data accuracy, precision, completeness, representativeness, and comparability through coverage of the following elements, depending upon the monitoring activity or activities to be carried out:
(a) A description of the elements that make up the project and the person or persons responsible for carrying out the project.
(b) Quality assurance objectives for measurement data.
(c) Sampling procedures.
(d) Sample custody procedures.
(e) Equipment calibration procedures and frequency.
(f) Analytical procedures.
(g) Internal quality control checks.
(h) Data reduction, validation, and reporting.
(i) Performance and systems audits to verify adherence to quality assurance/quality control programs.
(j) Preventive maintenance on equipment and instrumentation.
(k) Data quality assessment.
(l) Corrective action for analytical and field equipment problems and quality assurance/quality control noncompliance problems.

(3) The grantee or vendor shall carry out monitoring activities in accordance with procedures outlined in 40 C.F.R. Section 136 (1998), or in accordance with other procedures approved by the department.

R 324.8915 Conservation reserve enhancement program.

Rule 15. (1) The department of environmental quality shall not use more than $5,000,000.00 from the fund to provide state contribution for the establishment and implementation of the conservation reserve enhancement program.

(2) Money from the fund can be used for any of the following:
- (a) Establishment of riparian buffer strips.
- (b) Filter strips.
- (c) Field windbreaks.
- (d) Grassed waterways.
- (e) Wetland restoration.
- (f) Wetland creation.
- (g) Other eligible practices related to water quality improvement specified in the conservation reserve enhancement program.

Fund money shall be used for onetime payment for voluntary permanent easements for the eligible practices. The department of environmental quality shall not use funds for rental incentive payments or for easements other than permanent easements.

(3) The department of environmental quality may enter into a memorandum of understanding with another state agency to provide the state contribution to the conservation reserve enhancement program.

(4) For the practices and activities identified in subrule (2)of this rule, the department of environmental quality and state agencies with whom the department enters into memorandums of understanding may provide direct payments to any of the following:
- (a) Landowners who enroll in the conservation reserve enhancement program.
- (b) Holders of the permanent easements.
- (c) Other third parties responsible for the establishment of the eligible practices or the permanent easements.

R 324.8916 Activities eligible for abandoned well management grants.

Rule 16. (1) The following abandoned well management activities are eligible for funding:
- (a) Preparation of proposals, narratives, financial statements, and reports related to abandoned well management, as requested by the department.
- (b) Conducting the following activities within wellhead protection areas:
  - (i) Identification of well and property owners.
  - (ii) On-site surveys, inspections, or other activities for finding abandoned wells.
  - (iii) A search for, and review of, records to identify abandoned well locations.
  - (iv) Creation of databases and the purchase of computer software to track the status of abandoned wells.
  - (v) The purchase or rental of magnetometers, metal detectors, or other appropriate geophysical instrumentation, and the excavation costs associated with locating buried abandoned wells.
  - (vi) The mapping of abandoned well locations**,** at a cost not to exceed 5% of the total grant amount.
  - (vii) Plugging of abandoned wells by water well drilling contractors registered under section 12704 of 1978 PA 368, MCL 333.12704.
    - (A) Where groundwater contamination problems have been identified inside the wellhead protection area, priority shall be given to plugging abandoned wells in the area of known contamination.
  - (viii) Well plugging verification activities.

(2) The following community public waterline extension activities conducted within wellhead protection areas are eligible for funding:
- (a) Identification of abandoned wells at structures where water service connection has been made.

(b) Plugging wells that have been taken out of service when new public water service connections are made.

(c) Wells that are required to be plugged under parts 201, 211, 213, or 615 of this act are not eligible for funding under this part.

(3) The applicant shall focus eligible public education and outreach activities on promoting wellhead protection concepts and the importance of plugging abandoned wells. Eligible activities include the following:

(a) Development and dissemination of brochures, pamphlets, billing statement attachments, news releases, videos, or similar materials through newspapers, radio, television, or other public communication media acceptable to the department.

R 324.8917 Abandoned well management grants.

Rule 17. (1) Each grant applicant is eligible for the following grant assistance to conduct activities within wellhead protection areas:

(a) Not more than the following amounts for conducting record searches and site surveys to locate abandoned or temporarily abandoned wells, conducting public outreach, and other related administrative activities approved by the department:

(i) $4,500 for the first square mile of wellhead protection area.

(ii) $2,500 for each additional square mile of wellhead protection area.

(b) Not more than the following amounts for plugging abandoned wells:

(i) A standard rate of $400 per well identified during the search activities.

(ii) Plugging costs that exceed $400 per well, if an itemized job estimate from 3 registered water well drilling contractors is provided, and if the amount is approved in writing by the department.

(iii) After locating abandoned wells in a wellhead protection area, to be eligible to receive grant assistance for plugging the identified abandoned wells, the grant applicant shall submit a listing of abandoned well locations to the department.

(2) A grant applicant shall not receive more than $100,000 for plugging abandoned wells in one fiscal year.

(3) A grantee that has received wellhead protection grant assistance authorized in section 12816 of 1976 PA 399, MCL 325.12816, shall not obtain funds under part 88 of 1994 PA 451, MCL 324.8808 et seq., for the same well location activity.

(4) The department shall annually assess grant amounts defined in R 324.8917 and shall increase the amounts by applying a percentage adjustment using the Detroit consumer price index.

R 324.8918 On-site septic systems grants.

Rule 18. (1) Corrective measures eligible for funding under R 324.8907(1)(g)(ii) include regional treatment alternatives or community treatment systems that provide adequate long-term protection of water quality.

(2) The department shall not award grants under R 324.8907(1)(g)(ii) to install individual septic systems.

(3) The department shall not award grants under R 324.8907(1)(g)(ii) to install conventional septic tank systems.

(4) All applications for projects under R 324.8907(1)(g)(ii) shall include verification that failing on-site septic systems are threatening or impairing designated uses.

(5) Grants awarded for projects under R 324.8907(1)(g)(i) shall not be more than $25,000.

(6) Grants awarded for projects under R 324.8907(1)(g)(ii) shall not be more than $1 million.

(7) The department shall give priority in awarding grants under R 324.8907(1)(g) to projects that provide alternatives to failed septic systems in small rural communities.

R 324.8919 Availability of documents.

Rule 19. The following documents are available for inspection electronically, and a single copy may be obtained at no cost, at the Lansing office of the department of environmental quality, P.O. Box 30273, Lansing, Michigan 48909-7773:

(a) "A Strategic Environmental Quality Monitoring Program for Michigan's Surface Waters," January 1997.
(b) "Michigan Natural Rivers Program, Designated Rivers and Tributaries."
(c) "Michigan Scenic Rivers Act of 1991."
(d) "Coldwater Lakes of Michigan," August 1976.
(e) "Designated Trout Lakes and Regulations," September 10, 1998.
(f) "Designated Trout Streams for the state of Michigan," January 8, 1997.
(g) "Clean Water Act Section 303(d) List, Michigan Submittal for 1998, revised May 1998."

R 324.8920 Adoption of standards by reference.

Rule 20. The following standards are adopted by reference in these rules and are available for inspection electronically, and at the Lansing office of the department of environmental quality, where they may be obtained as indicated:

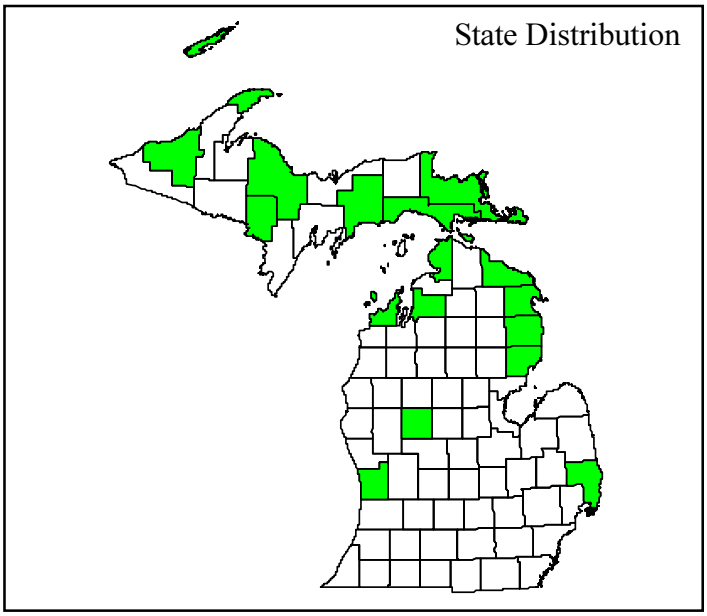
(a) "Guidelines for Establishing Test Procedures for Analysis of Pollutants," 40 C.F.R. section 136 (1998). Copies may be obtained from the Department of Environmental Quality, P.O. Box 30273, Lansing, Michigan 48909-7773, at a cost, as of the time of adoption of these rules of 5 cents per page at a labor rate of $18.10 per hour, or from the Superintendent of Documents, Government Printing Office, Washington, DC 20402, at a cost as of the time of adoption of these rules of $41.00.

Appendix D

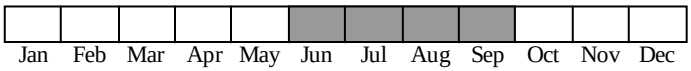
Selected Special Concern Species and Communities in the Spring Lake Watershed

Pterospora andromedea Nutt. pine-drops


Photo by Daniel C. Nepstad.



Best Survey Period



Status: State threatened

Global and state rank: G5/S2

Family: Monotropaceae (Indian-pipe)

Other common names: giant birds nest, Albany beech-drops

Synonyms: *Monotropa procera* Torr.

Taxonomy: *Pterospora andromeda* is the only species in its genus (monotypic). Sometimes included in the Pyrolaceae or Ericaceae under subfamily Pyrolaceae, *Pterospora* and other species of the Monotropaceae differ in their saprophytic (absorb nutrients from dead or decaying matter) habit (Voss 1996).

Total range: A species primarily of Western North America, pine drops is disjunct in the Great Lakes region from the Black Hills and mountains of the west, and is known in scattered, rare, and localized populations further east to Quebec and New England (Voss 1996).

State distribution: Forty three occurrences of this species have been reported from Michigan, 22 of which are post-1978 records. The majority of these are associated with forested dune communities ranging from Ottawa to Keeweenaw County, with concentrations in Keeweenaw, Emmet, and Leelanau counties. Additional occurrences are widely scattered from Ottawa and St. Clair counties in southern Lower Michigan and from Drummond Island to Ontonagon County in the western Upper Peninsula. All occurrences were reported in low numbers ranging from a single individual to 11 stems, or in many cases simply indicated as 'rare.' Seventeen occurrences occur on public lands or designated preserves. None of these occurrences, however, are under specific active protection.

Recognition: Pine-drop **lacks chlorophyll** and has one to several **simple, erect stems, from 3-10 dm tall**, bearing **numerous scale-like leaves** and a **terminal raceme of numerous nodding flowers**. The approx. 6-7 mm long , **bell-shaped corolla is white** while the **sepals and vegetative parts of the plant are reddish to maroon**. The **stem and sepals are glandular-hairy** giving the plant a **clammy-sticky** feel. The similar, but more widespread and common species *Monotropa uniflora* (Indian pipe) and *M. hypopithys* (pinesap), also lack chlorophyll, but are typically one half the size of *Pterospora* or smaller. In addition, the flowers of both Indian pipe and pinesap become erect in fruit, unlike the strongly nodding fruits of *Pterospora*. Indian pipe also differs in bearing only a single large flower on each stem.

Best survey time/phenology: Due to its distinctive habit and lack of chlorophyll, pine-drops should be recognizable during most of its aboveground life from June through early September, as long as the recognition characters are assessed carefully. The optimal time period, however, is when flowers and fruits are in their prime, typically from July through mid- to late August. It should be noted that pine drops is variable in its occurrence and may not appear aboveground each year.

Habitat: In Michigan, pine-drops is known from dry woods containing conifers such as pines, hemlock, spruce, balsam fir, or white cedar, and frequently including aspen or birch. Many occurrences are associated with dry to dry-

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mesic forests of sand dunes along the Great Lakes shorelines, while two occurrences have been reported from maple forests. This species typically occurs in forested habitats with a well-developed needle duff. Associated herbaceous species that have been noted include large leaved aster (*Aster macrophyllus*), Hepatica (*Hepatica* spp.), spotted coralroot (*Corallorhiza maculata*), wintergreen (*Gaultheria procumbens*), and various ferns.

Biology: Lacking chlorophyll, *Pterospora* is thought to be dependent upon a fungus that forms a mycorrhizal relationship (a mutually beneficial association of a fungus and plant root) with a forest tree (likely a conifer) and *Pterospora*, to obtain nutrients. The fungal mycelia (the thread-like stands that collectively form the underground body of a fungus individual) form a sheath around the roots, isolating the roots from direct contact with the soil. Because there is no evidence that it is directly parasitic on a forest tree, it is considered a saprophyte by some, or alternatively, a parasite on the fungus (Bakshi 1959, Voss 1996). Further study is necessary to resolve these alternative viewpoints. The stems arise from a tight ball of mycorrhizal roots, producing flowers at about 4 weeks, the first typically opening in June. New shoots and inflorescences, however, can be produced throughout the growing season. Fruiting usually occurs in late July and August. Depending upon the size of the plant, from 20-128 fruiting capsules are produced, each bearing up to 4800 short-lived (3-9 weeks), wind-dispersed seeds. Germination in the greenhouse or lab has been unsuccessful, as has transplantation, thus suggesting that pine drops is sensitive to disturbance. Apparently, it isn't easy to replicate the specific biological and ecological conditions required for germination and establishment. Michigan populations have all been reported to be small (the largest comprised of 11 stems), as was the case for populations studied by Bakshi (1959). However, some populations in the Great Lakes region have been reported "in great quantities" (Voss 1996). Populations have also been noted as sporadic, not appearing every year, although Garlitz observed one population consistently over a 16-year period (MNFI element occurrence record #038).

Conservation/management: Little is known regarding specific management strategies for this species with the exception of the need to maintain its mycorrhizal assocation. Any strategy that lacks an understanding of this relationship is doomed to failure. Until additional knowledge regarding the biology and ecology of this species is available, management strategies should focus on preservation of ecosystem function, with particular attention paid to the maintenance of soil microbe and mycorrhizal diversity.

Research needs: Further investigation of the mycorrhizal system of *Pterospora* is of critical importance for the protection of this species. Systematic surveys to provide a thorough assessment of its status in Michigan is also a high priority, since this will also help to define its habitat requirements.

Comments: Pine-drops derives its genus name *Pterospora* from the numerous winged (Ptero) seeds (spora) it produces (Bakshi 1959). Its species name comes from the flask-shaped flowers that resemble that of the Greek goddess Andromeda (Voss 1996).

Related abstracts: dry-mesic forest, dry northern forest

Selected references

Bakshi, T.S. 1959. Ecology and morphology of *Pterospora andromedea*. Bot. Gaz. 120:203-217.

Gleason, H.A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. 2nd ed. NY Bot. Garden, Bronx, NY. lxxv + 910 pp.

Voss, E.G. 1996. Michigan Flora: Part III, Dicots (Pyrolaceae-Compositae). Cranbrook Inst. of Sci. Bull. 61 and U. of Mich. Herbarium, Ann Arbor, MI.

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Abstract citation

Higman, P.J. and M.R. Penskar. 1999. Special plant abstract for *Pterospora andromeda* (pine-drops). Michigan Natural Features Inventory, Lansing, MI. 2 pp.

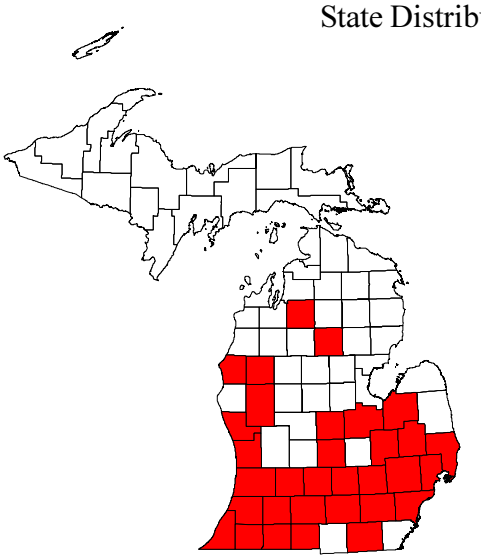
Funding for abstract provided by Michigan Department of Environmental Quality - Land and Water Management Division, Coastal Zone Management Program and Michigan Department of Natural Resources - Forest Management Division.

2-00/pjh

Clemmys guttata Schneider — Spotted turtle

Photo by James H. Harding

State Distribution



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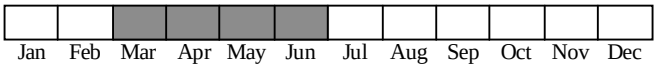

Status: State threatened

Global and state rank: G5/S2

Family: Emydidae (pond and box turtle family)

Range: Spotted turtles range from northeastern Illinois east through Michigan, northern Indiana, central Ohio, Pennsylvania and New York to southeastern Ontario and southern Maine, and south along the Atlantic coast to northern Florida (Ernst et al. 1994). Isolated populations occur in central Illinois, the western Carolinas, northern Vermont and southeastern Quebec (Harding 1997).

State distribution: Spotted turtles historically have been known from primarily the southern and western portions of Michigan's Lower Peninsula. Today, spotted turtles are uncommon to rare in Michigan, and tend to occur in isolated populations surrounded by unsuitable habitat (Harding 1997). Michigan Natural Features Inventory (2000) has compiled documentation of this species from 32 counties in the state, including isolated populations in north central Michigan in Roscommon County. This species has not been reconfirmed in Kalkaska, Lake, Clinton, Eaton, Ingham, Jackson and Branch counties within the last 20 years (Michigan Natural Features Inventory 2000). However, it is important to note that this species has not been systematically surveyed throughout the state, and may still occur in additional counties as well as those in which it has not been recently confirmed.

Recognition: The spotted turtle is a small turtle with adult carapace (i.e., top shell) lengths ranging from 3.5 to 5.4 inches. This turtle can be easily identified by the **round yellow spots** on its **broad, smooth, black or brownish black carapace.** Spots may fade in older individuals, and some individuals are spotless (Ernst et al. 1994). **The plastron (i.e., bottom shell) is hingeless,** and is usually **yellow or orange with a black blotch along the outer margin of each scute or scale;** in some males or older individuals, the black blotches cover the entire plastron. Their **heads are black** and typically have at least a few **spots on top and one or more irregular yellow or orange blotches on the sides near the eardrum.** Males have tan chins, brown eyes, and concave (i.e., curved inward) plastrons, with the vent or anal opening beyond the edge of the carapace when the tail is fully extended (Harding 1997). Females have yellow chins, orange eyes, broader, higher carapaces, and flat or convex (i.e., curved outward) plastrons, with the vent under the edge of the carapace when the tail is fully extended. Hatchlings average about 1.14 inches in carapace length, and usually have a single spot on each plate of their carapace. The plastron is yellowish orange with a central dark blotch.

Best survey time: The best time to survey for this species is early in the spring during the mating season, from March through May, before the vegetation gets too tall and dense (Conant 1951, Ernst 1976). In parts of its range, spotted turtles also are fairly visible in June during the nesting season when females will leave their drying pools to migrate to nest sites (Ernst 1976). The

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best way to survey for this species is to first search suitable habitat from a distance with binoculars or a spotting scope, scanning for individuals swimming in the water or basking in or along the river. This should be followed by slowly walking through the habitat, looking for turtles in the water or basking in the vegetation. Search efforts should concentrate on shallow pools of water or transitional areas from deeper water (Mauger pers. comm.). Optimal weather conditions for observing spotted turtles are sunny or partly sunny days above 60° F (Mauger pers. comm.). Spotted turtles are not very active on overcast or rainy days (Ernst 1976). Some studies have indicated a tendency for more observations during the morning hours from 7 am to 1 pm (Mauger pers. comm.), although this will vary with weather conditions.

Habitat: Spotted turtles require clean, shallow, slow-moving bodies of water with muddy or mucky bottoms and some aquatic and emergent vegetation (Ernst et al. 1994, Harding 1997). Spotted turtles utilize a variety of shallow wetlands including shallow ponds, wet meadows, tamarack swamps, bogs, fens, sedge meadows, wet prairies, shallow cattail marshes, sphagnum seepages, small woodland streams and roadside ditches (Ernst et al. 1994, Harding 1997, Mauger pers. comm.). Although spotted turtles are considered fairly aquatic, they are frequently found on land in parts of its range and during certain times of the year (i.e., during the mating and nesting seasons and during the summer) (Ward et al. 1976). Terrestrial habitats in which spotted turtles are found include open fields and woodlands and along roads.

Biology: Spotted turtles become active in early spring as soon as the ice and snow melt, usually in late March to mid-April. This species appears to tolerate and prefer cooler water and air temperatures than do other related turtles, initiating activity at water temperatures as low as 37°F (Ernst et al. 1994). In early spring, spotted turtles spend a great deal of time basking on logs, muskrat houses, and grass or sedge hummocks. Spotted turtles are generally difficult to find in the summer due to decreased activity levels and dense vegetation. Spotted turtle activity levels generally peak in May, or when mean monthly air temperatures are between 56 and 64°F, and start to decline in June, or when mean monthly air temperatures are between 64 and 72°F (Ernst et al. 1994). They become dormant or aestivate by late June or early July (Ernst 1982). In the spring, spotted turtles are active throughout the day, beginning at sunrise. At night, they burrow into the muddy bottoms of the wetland or crawl into mammal burrows or under vegetation (Ernst et al. 1994). In the summer, individuals are active primarily in the morning, and become dormant in the afternoon. Some individuals aestivate in muskrat burrows or lodges or dig into mud or submerged root systems, while others leave the water and burrow into soil or leaf litter (Harding 1997). Only nesting females are active in the evening.

Spotted turtles typically enter hibernation in mid-October (Harding 1997). They hibernate in shallow water in the mud or in muskrat burrows or lodges (Ernst et al. 1994). These sites are deep enough to not freeze completely, but are shallow enough to thaw quickly in the spring (Ernst 1982). Spotted turtles have been found to hibernate in congregations of up to 12 individuals (Bloomer 1978).

Spotted turtles reach sexual maturity at about 7 to 10 years of age (Ernst 1970). Mating occurs from March to May, and generally takes place in the water. Nesting usually occurs in the evening in early to mid-June in the Great Lakes region (Harding 1997). Nests are placed in well-drained areas with sandy or loamy soils exposed to full sunlight. Nest sites include grassy tussocks, hummocks of grass, sedge or sphagnum moss, marshy pastures and edges of roads (Hunter et al. 1992, Ernst et al. 1994). Females appear to nest near their core activity or foraging habitat (Mauger pers. comm.). The females dig a 2- to 2.5-inch deep flask-shaped cavity into which two to seven eggs are laid (Harding 1997). The hatchlings emerge in August or September, but may overwinter in the nest.

Spotted turtles have small home ranges of about 1.2 to 8.6 acres, although this may simply be an artifact of the amount of habitat available at many of the sites (Harding 1997). A study in Pennsylvania documented typical daily movements of less than 0.01 mile (65 feet); these mostly consisted of trips from evening retreats to daytime basking or foraging areas (Ernst 1976). Foraging turtles may move up to 0.03 mile. During the mating season, males in search of females may move up to 0.16 mile from water, while nesting females in search of a suitable nest site may travel up to 0.03 mile from water (Ernst 1976). In Maine, individuals readily travelled as much as 0.30 miles overland between wetlands to take advantage of available food sources (Hunter et al. 1992).

The spotted turtle is omnivorous, feeding primarily underwater. Their diet ranges from aquatic vegetation to larval amphibians, slugs, snails, crayfish, insects, worms and carrion (Harding 1997). Spotted turtles and their eggs are preyed upon by bald eagles, raccoons, skunks and muskrats (Ernst et al. 1994, Harding 1997). Wild spotted turtles have lived over 30 years, and can probably live up to 50 years (Hunter et al. 1992, Ernst et al. 1994).

Conservation/management: Similar to other turtle species, spotted turtles are characterized by relatively

late sexual maturity and low reproductive potential. These life history traits suggest that high annual survivorship of adults and juveniles is particularly crucial for maintaining a stable population. Mortality or removal of adults and juveniles at a rate faster than they can be replaced can lead to population declines and potential local extinctions over time. Small, fragmented populations also tend to be highly susceptible to extinction as a result of catastrophic or chance events.

The primary threats to this species are habitat destruction and degradation and illegal collection for the pet trade (Harding 1997). In the last few decades, much of the shallow wetlands preferred by the spotted turtle has been drained or filled and converted to agricultural, residential and commercial land uses (Harding 1997). Many of the remaining populations occupy small, isolated, remnant wetlands (i.e., <10 acres) that continue to be threatened by development and pollution. Spotted turtles are highly valued by reptile hobbyists because of their small size and bright coloration, and collectors have severely reduced or eliminated populations throughout the species' range (Harding 1997). Increased nest predation due to large small mammal predator populations, particularly raccoons, represents a substantial threat to spotted turtles and turtle populations in Michigan in general. Increased urbanization and associated increase in road density and traffic have resulted in higher road mortality of spotted turtles, and have further fragmented their habitat and isolated populations. Vandalistic shooting of spotted turtles also occurs (Harding 1997).

Protection of extant populations and suitable wetland and nesting habitats is crucial for conserving this species. Providing connectivity among populations to allow for genetic exchange also is vital for preserving the long-term viability of this species. Increased protection of small, wetland complexes is important for maintaining sufficient habitat. In general, implementing minimum development setback distances, leaving buffer zones during agricultural and land management operations, maintaining good water quality and hydrologic integrity, minimizing the delivery of pollutants into the wetlands, and minimizing the construction of roads in or near suitable wetlands would be beneficial to this species. Maintaining open upland nesting areas through woody vegetation management also would benefit this species. Altering the timing of land use activities (e.g., working in upland habitat during the winter from November through February when spotted turtles are hibernating in the water) could help minimize the potential for adversely impacting this species. Predator control and on-site protection of nest sites may be warranted in some instances. Stream channelization and water impoundments should be avoided in areas with suitable habitat.

This species has been given various levels of legal protection throughout its range, however, protection needs to be consistent across its range to completely eliminate commercial trade of this species (Harding 1997). In Michigan, the spotted turtle is listed as state threatened and is protected under the state's Endangered Species Act and the Director's Order No. DFI-166.98, Regulations on the Take of Reptiles and Amphibians. It is unlawful to take a spotted turtle from the wild except as authorized under an endangered species permit from the Michigan Department of Natural Resources. "Take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect or attempt to engage in any such conduct. Public land managers and the general public should be informed that this species is protected, and should not be collected or harmed. Any suspected illegal collection of spotted turtles should be reported to local authorities, conservation officers or wildlife biologists.

Research needs: An assessment of the species' current distribution and status throughout the state is needed. Spotted turtles have been documented from a fairly large number of sites in Michigan, but intensive surveys and monitoring are needed at these sites to determine whether they contain viable populations and to document population structure and trends. Nesting and wintering areas at these sites also need to be identified. Although the general life history and ecology of the spotted turtle are fairly well known, more information specific to spotted turtles in Michigan would be useful (e.g., movement and dispersal distances, home range, habitat use, reproductive success, long-term survivorship, potential carrying capacity). Impacts of various land uses and management activities on spotted turtle populations and habitat should be further investigated. The genetic diversity of extant populations needs to be examined. The impact of illegal collecting on spotted turtles in Michigan needs to documented and quanitified. Finally, effective strategies for ensuring the long-term viability of spotted turtles need to be investigated and developed.

Related abstracts: Prairie fen, mat muhly, prairie dropseed, prairie Indian plantain, small white lady's-slipper, Blanchard's cricket frog, Blanding's turtle, eastern box turtle, eastern massasauga, Kirtland's snakewood turtle, Mitchell's satyr butterfly.

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Hunter, M.L., J. Albright and J. Arbuckle (eds.). 1992. The amphibians and reptiles of Maine. Maine Agric. Exp. Sta. Bull. 838. 188 pp.

Mauger, D. Personal communication. Forest Preserve District of Will County, Joliet, IL.

Michigan Natural Features Inventory. 2000. Biological and Conservation Data System. Lansing, MI.

Ward, F.P., C.J. Hohmann, J.F. Ulrich, and S.E. Hill. 1976. Seasonal microhabitat selections of spotted turtles (*Clemmys guttata*) in Maryland elucidated by radioisotope tracking. Herpetologica 32:60-64.

Abstract citation:

Lee, Y. 2000. Special animal abstract for *Clemmys guttata* (spotted turtle). Michigan Natural Features Inventory. Lansing, MI. 4 pp.

Funding for abstract provided by Michigan Department of Natural Resources-Forest Management Division and Wildlife Division.

Natural processes: Present dry-mesic southern forests were probably oak openings prior to fire suppression, based on comparison of General Land Office survey reports and present vegetation in Oakland County.
Literature:
Disturbance effects:

DRY SOUTHERN FOREST [OAK FOREST]

Overview: An oak-dominated forest type of dry sites lying mostly south of the transition zone.
Physiography and geology: Occurring principally on glacial outwash, but also on sand ridges and elevations in sandy glacial lake plains and on sand dunes.
Soils: Loamy sand or sandy loam soils are strongly acid to medium acid.
Dominant plants: *Quercus velutina*, *Q. alba* (locally with *Carya glabra* and *C. ovalis*).
Associated species: Constant canopy species are *Acer rubrum*, *Prunus serotina*, and *Sassafras albidum*. *Q. ellipsoidalis* is present on the driest sites.
Characteristic plants: Typical shrub and herb species of the segment derived from oak barrens include *Ceanothus americanus*, *Corylus americana*, *Hackelia virginiana*, *Lysimachia quadrifolia*, and *Vitis aestivalis*. The groundlayer of the remaining segment is less distinct, but may be indicated (in conjunction with canopy composition) by *Hamamelis virginiana*, *Monotropa uniflora*, and *Vitis aestivalis*.
Variation: Toward the transition zone, *Pinus strobus* becomes a constant species.
Similar communities: oak barrens, dry-mesic southern forest, dry northern forest
Natural processes: Even-aged stands of *Q. velutina*, especially in southwest Lower Michigan, can represent former brushy prairies or oak barrens; even-aged stands of *Q. alba* may represent former oak openings. Based on General Land Office surveys, the sand ridges on the Maumee glacial lake plain and on the glacial lake plain of southwestern Michigan supported a black oak/white oak dominated, low productivity oak forest.
Literature:
Disturbance effects:

MESIC NORTHERN FOREST [NORTHERN HARDWOOD FOREST; HEMLOCK-HARDWOOD FOREST]

Overview: A forest type of moist to dry-mesic sites lying mostly north of the transition zone, characterized by the presence of northern hardwoods, hemlock and low levels of white pine.
Physiography and geology: Chiefly on coarse-textured ground and end moraines, but also common on silty/clayey lake plains, thin glacial till over bedrock; medium-textured moraines, kettle-kame topography, and sand dunes. Also occasionally on moderately well drained to well drained sandy lake plain.
Soils: Loamy sand to sandy loam (sometimes loam) soil ranges widely in pH, from extremely acid to medium acid.
Dominant plants: *Tsuga canadensis*, *Acer saccharum*, *Fagus grandifolia*, *Tilia americana*. *Acer* dominates most frequently.
Associated species: In *Acer* stands, *Tilia americana* is often important, along with *Betula allegheniensis*, *Quercus rubra*, and *Fagus grandifolia*. *Fagus* frequently codominates with *Acer saccharum* as well. In stands where *Tsuga* predominates or is accompanied by *A. saccharum*, the following are common: *Betula lutea* and, less frequently, *A. rubrum*, *Fagus grandifolia*, *Betula papyrifera*, *Quercus rubra*, and *Pinus strobus*. Extensive tracts of *A. saccharum* with *Thuja occidentalis* in dunes or over calcareous bedrock were known from the literature, but are found today only in dunes and on the drumlin fields of Menominee County.
Characteristic plants: Historical accounts portray this type as having a high shrub layer of *Taxus canadensis* (especially in *Tsuga* stands and along Great Lakes shorelines, where it is still found, as on

High Island in the Beaver Island group), which is now uncommon because so many deer herds north of the transition zone graze this plant excessively.
Variation: This community type breaks into two broad classes: northern hardwood forest and hemlock-hardwood forest.
Similar communities: mesic southern forest, dry-mesic northern forest, hardwood-conifer swamp
Natural processes:
Literature:
Disturbance effects: Stands dominated by *Populus tremuloides* are often on mesic sites formerly occupied--or succeeding to--mesic northern forest.

DRY-MESIC NORTHERN FOREST [PINE-HARDWOOD FOREST]

Overview: A pine-hardwood forest type of generally dry-mesic sites located mostly north of the transition zone.
Physiography and geology: Occurs principally on sandy glacial outwash, sandy glacial lake plains, and on thin glacial drift over bedrock; also on beach ridges on glacial lake plains.
Soils: Sand or loamy sand soils are extremely acid to very strongly acid.
Dominant plants: *Pinus strobus* is nearly always a dominant or important in the canopy. Hardwood dominants are *Quercus alba, Q. velutina, Q. ellipsoidalis, Q. rubra,* and *Acer rubrum*.
Associated species: *Pinus resinosa* and *Tsuga canadensis* are frequently present and occasionally codominant with *P. strobus*. *Abies balsamea* is often present in the subcanopy.
Characteristic plants: Shrub and groundlayer species found in dry northern forest overlaps in this forest type.
Variation:
Similar communities: dry northern forest, mesic northern forest
Natural processes: Fire and windthrow, with fire being more important for maintaining the community.
Literature:
Disturbance effects: Transition zone dry-mesic forests of *Pinus strobus* and *Quercus* spp. were converted to oak forest by lumbering and fire, which removed the seed source for pine. Present-day extensive oak forests in northern Lower Michigan formerly were pine-hardwood forest, not the southern oak forest community. A few of these oak forests now have understory or small overstory *P. strobus* and *P. resinosa* which are becoming the dominants as the mature oak forests are cut. Parts of "stump prairies" (see dry northern forest) such as Kingston Plains in north-central Upper Michigan, with *Populus tremuloides, Betula* spp., *Prunus pensylvanica, Pteridium aquilinum* and reindeer lichens, are lumbered and severely burned sites of former dry-mesic northern forest. Sites dominated almost exclusively by *Quercus rubra* and *Pinus strobus*, with an understory characteristic of mesic northern forest, were often mesic northern forest stands used by Indians for agricultural purposes.

DRY NORTHERN FOREST [PINE FOREST]

Overview: A pine dominated forest type on dry sites lying mostly north of the transition zone.
Physiography and geology: Occurs principally on sandy glacial outwash and sandy glacial lake plains, and also commonly on sand ridges within peatlands on glacial outwash or glacial lake plains.
Soils: Dry sand soils are extremely acid to very strongly acid.
Dominant plants: *P. banksiana* or *P. resinosa*.
Associated species: *Abies balsamea*, *Pinus resinosa*, and *P. strobus* are often in the subcanopy. *Quercus ellipsoidalis* usually accompanies *Pinus banksiana*; *Populus grandidentata*, *Acer rubrum*, and perhaps *Betula papyrifera* accompany *Pinus resinosa*. *Pteridium aquilinum*, *Vaccinium angustifolium*, with *Diervilla lonicera* and *Comptonia peregrina* form an open shrub layer. The groundlayer is dominated by *Carex pensylvanica,* with *Cladina rangifera*, *Dicranum*, and *Hypnum*

Appendix E

Erosion Sites

Mt. Garfield Road crossing.

Mt. Garfield Road crossing.

Hilton Park Road near power lines.

End of Sahara Road.

Roadside erosion, Farr Road.

Erosion around culvert, Farr Road.

Streamside erosion at Cooley Road.

Streamside erosion, Cooley Road.

Improper stabilization along paved recreational trail adjacent to Spring Lake.

Improper stabilization along paved recreational trail adjacent to Spring Lake.

Blowout downstream of culvert.

Blowout downstream of culvert.

Appendix F

Storm Sewer Inventory Data


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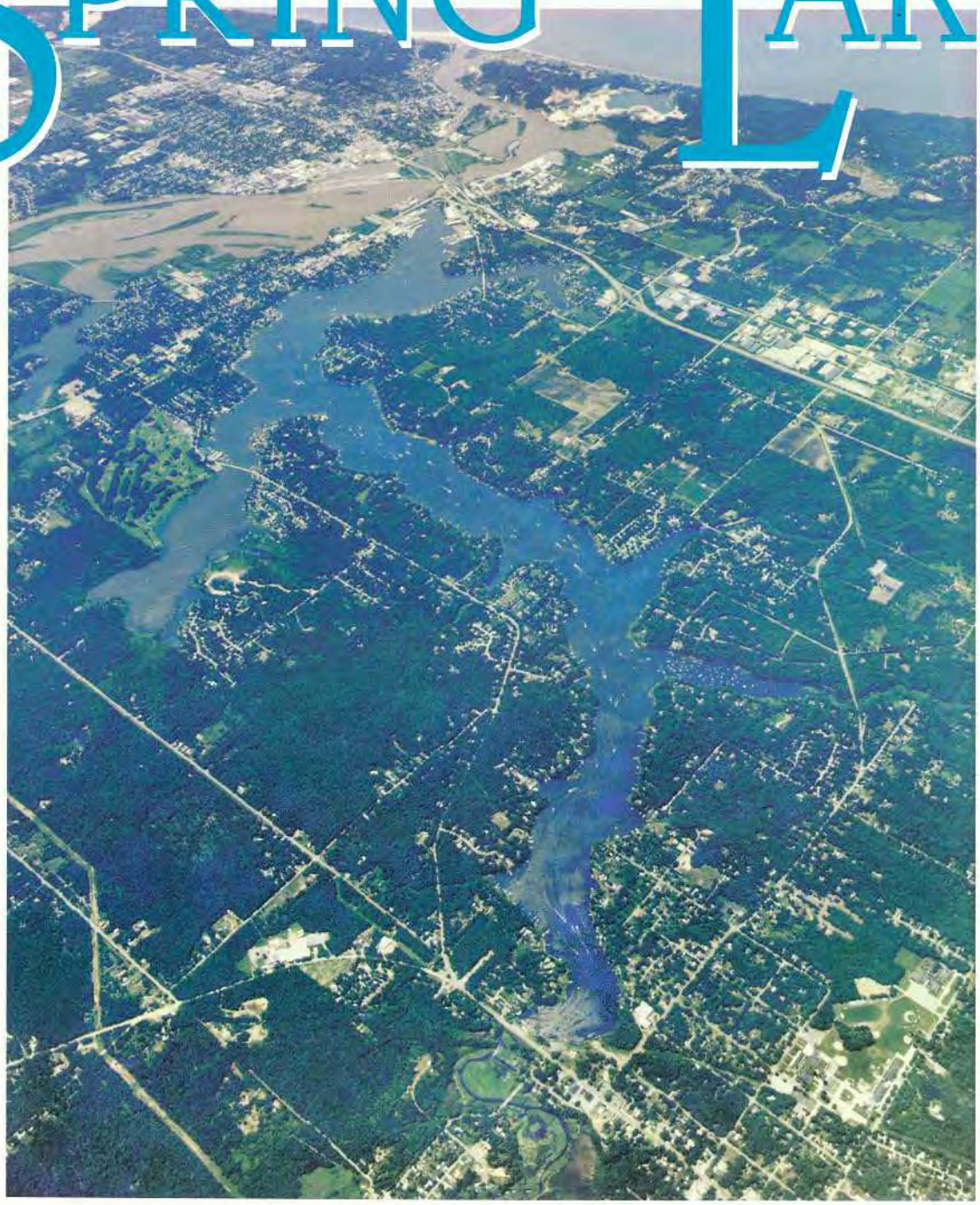
Appendix G

Spring Lake - Lake Board Publications

SPRING LAKE



WATERSHED GUIDEBOOK

What Landowners Can Do to Protect Spring Lake

Published by **Spring Lake - Lake Board**

Table of Contents

SPRING LAKE - LAKE BOARD MEMBERS (SL - LB)

Chairman, John Nash.....Spring Lake Township
Secretary, Jayne Austin.....The City of Ferrysburg
Diana Klemans.....MI Dept. of Environmental Quality
Tom Huizingh.....The Village of Spring Lake
Jan (John) Koens.....Muskegon County Treasurer
Co-Chairman, Kathy Przybytek.....The Village of Fruitport
Treasurer, Steve Van Hoeven.....Ottawa Drain Commissioner
David Split.....Fruitport Township
Leon Langeland (Deceased).....Ottawa County Commissioner
Martin Hulka.....Muskegon County Drain Commissioner

We, the members of the Spring Lake - Lake Board, would like to recognize the contributions that fellow lake board member Leon Langeland made to the writing of this information booklet. Leon was a friend and supporter of good Spring Lake lake stewardship and he will be dearly missed.

Cover Photograph by Marge Beaver, Photography Plus

Printed on Totally Chlorine Free paper

Mission Statement

To monitor and improve the water quality of Spring Lake and its watershed through stewardship and education.

GOALS AND OBJECTIVES

1. **Establish and Implement a Management Plan for the Spring Lake Watershed.**
   - A. Secure professional assistance to implement study recommendations.
   - B. Increase awareness of our water quality status and needs.
   - C. Support and continue LakeWatch and other watershed educational entities.
   - D. Support lake and watershed research.
   - E. Research and investigate storm sewer outfalls.
   - F. Initiate a stormwater management policy.
   - G. Monitor tributary erosion sites.
   - H. Archive all lake and watershed data.

2. **Provide Lake and Watershed Education to Improve Stewardship in the Watershed.**
   - A. Publish booklet to provide better water quality practices for watershed residents.
   - B. Install waterfowl stewardship signs.
   - C. Develop a presentation package.
   - D. Expand participation in watershed activities.
   - E. Expand public relations through local newspapers, bulletin boards and creation of a web site.

3. **Discover Sources of Possible Funding for the Above Activities.**
   - A. Investigate the desirability of the collection of money pursuant to the Inland Lake Improvement Act to improve Spring Lake water quality.
   - B. Coordinate grant writing efforts with all local units and agencies and obtain match monies for grants.
   - C. Expand business and industry sponsorships, fundraising events and encourage private donations.

The purpose of this booklet is to help educate the residents and promote stewardship within the Spring Lake Watershed. Spring Lake is one of, if not this area's most, valuable natural resources. Every property owner in the watershed will be sent a copy of this booklet so they can learn and practice good stewardship.

Recent History Concerning Water Quality

1950-55	Lake residents become concerned about water quality impacts from a large duck farm located at what is now Harbor Point.
1954	Residents commissioned a Wisconsin Chemical Firm to spray the lake for control of weeds and algae growth.
1955	Spring Lake Algae Control Committee was formed.
1956	The Spring Lake Improvement Association (SLIA) was formed. The purpose was to obtain donations from lakefront property owners to pay for algae treatments. It functioned until 1990 when the Michigan DNR instituted a rule requiring 80% of the lakefront property owners to annually approve lake treatments. With over 750 lakefront property owners, this ruling was too difficult for the SLIA volunteers.
1994	The Spring Lake Area Residents Association (SLARA) began. SLARA's primary concerns were identified as water safety and water quality.
1994-96	SLARA concentrated its efforts on water safety.
1996	SLARA hosted a Spring Lake Water Quality Seminar. Later the same year, the Ottawa County MSU Extension Office held a lake landscape informational meeting.
1997	SLARA organized a petition drive to establish a Spring Lake-Lake Board. Three months later, over two-thirds of the lakefront property owners had signed the petition. The lake board was authorized by resolution of riparian municipalities.
1998	In March, the Spring Lake-Lake Board held its first meeting.

The Spring Lake-Lake Board currently meets once a month.

For time and location of next meeting call:
Ottawa County Drain Commission
(616) 846-8220

Our Sponsors - The "Friends of the Lake"

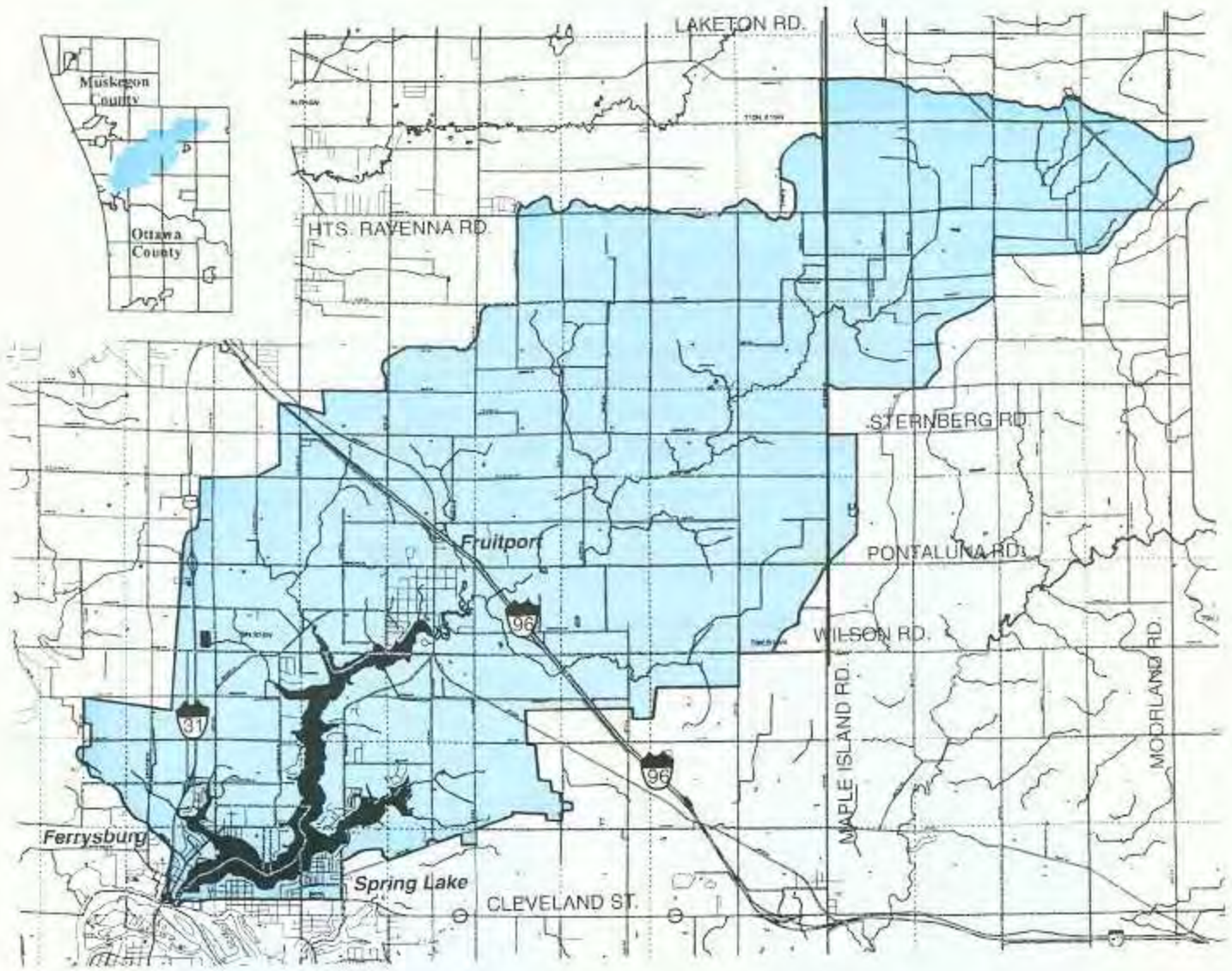
- Spring Lake Area Residents Association (SLARA)

- Shape Corp. - Vickie and Gary Verplank
- North Bank Communities Fund
- JSJ Foundation
- Grand Haven Area Community Foundation

- John and Nancy Carlyle
- Johnston Boiler Co.
- Kysor-Medallion Instruments
- Barrett Boat Works, Inc. - 821 W. Savidge Street, Spring Lake, MI (616-842-1202)

- Seaver Industrial Finishing Co.
- Scholten and Fant - 202 Old Kent Building, Grand Haven, MI (616-842-3030)
- Prince Bridge & Marine Ltd., 13844 172nd, Grand Haven, MI (616-846-0660)
- Dykstra Landscape Services, Inc. - Grand Haven, MI
- Lake Michigan Contractors, Inc. - 265 Kollen Park Dr., Holland, MI - (616-392-2958)
- Redeker Ford, Inc. - 1401 S. Beacon Blvd., Grand Haven, MI (616-842-0600)
- Harbor Industries
- Red Pony Antiques - (616-865-PONY [865-7669])
- Cook's Inc. - 1100 Washington, Grand Haven, MI (616-842-0180)
- Grand Transformers Inc.
- North Ottawa Community Hospital
- David C. Bos Homes - www.boshomes.com - (616-842-2248)
- NBD Bank
- Bil-Mar Restaurant - 1223 S. Harbor Ave., Grand Haven, MI (616-842-5920)
- Austin Sales Co., Inc.
- Dura Automotive Systems
- Interior Concepts
- Tru Green - ChemLawn, Grand Haven, MI (1-800-536-5296)

Spring Lake Watershed Map



A watershed is the entire land area that contributes water to a lake basin such as Spring Lake. The Spring Lake Watershed is about 52 square miles and the lake surface area is about 1300 acres.

There are approximately 6,000 property owners and about 17,300 people (1990 census) who live in the Spring Lake Watershed, of which 75% is in Muskegon County and 25% is in Ottawa County.

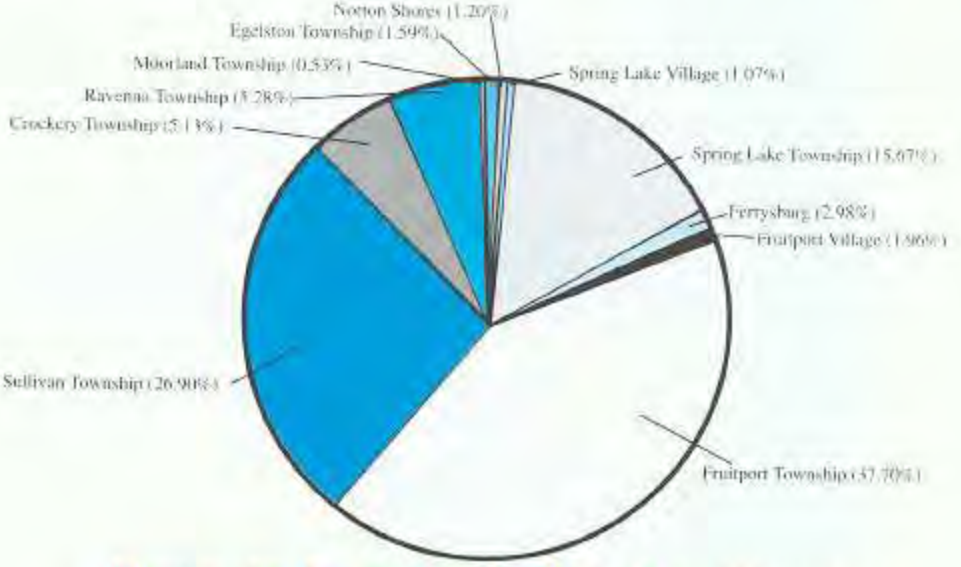
Spring Lake Watershed Facts

- The water of Spring Lake comes from springs, streams, precipitation, and stormwater runoff by storm drain outfalls and overland flow. Beginning in Sullivan Township, Norris Creek is the largest stream, flowing into Spring Lake just south of Fruitport Village. The lake is connected to Lake Michigan via the Grand River.

- Spring Lake is a drowned river-mouth lake with 23 miles of shoreline. It is a nutrient-rich lake with an abundance of both nitrogen and phosphorus, which has supported algae blooms of *Microcystis* the past few years.

- Most nutrients, soil, and pollutants get into the lake through streams, runoff, and inputs directly into the lake such as from leaching septic systems and lawn fertilizers. To reduce these unwanted substances, everyone in the watershed needs to learn how to minimize their potential impacts on water quality.

- The watershed includes portions of 11 different municipalities: Fruitport, Sullivan, Spring Lake, Moorland, Egelston, Crockery and Ravenna Townships, Fruitport and Spring Lake Villages, and the cities of Ferrysburg and Norton Shores. Five of the municipalities benefit directly from the shoreline uses of the lake and are riparian entities: Spring Lake Township, the Village of Spring Lake, Fruitport Township, the Village of Fruitport and the City of Ferrysburg.



Municipality Percentages in Spring Lake Watershed

Land uses within the watershed are reflected within the water quality of Spring Lake. Forested land is still the largest percentage of land use in the watershed (47%). Residential areas in the watershed are 15% and crop land is 14%. Large losses of forested land will impact the lake by degrading its water quality.

Information from: "Can the Big Bayou Be Saved? Water Quality Assessment and Management Recommendations for the Spring Lake Watershed, Ottawa and Muskegon Counties, MI." Lauber, T., 1999, Master's Degree Thesis, Michigan State University.

Lawn and Yard Stewardship

FERTILIZING

Most lawn fertilizers contain three minerals, nitrogen, phosphorus and potassium. The sandy soils in the **Spring Lake Watershed are generally phosphorus-rich, making phosphorus application unnecessary. Phosphorus *is* one of the key nutrients causing lake over-enrichment.** A sampling of your soil can be tested by MSU Extension at 333 Clinton, Grand Haven (616-846-8250) for a minimal fee. When fertilizer is necessary, consider using fertilizers with no soluble phosphorus and little nitrogen. For the past five years Spring Lake Country Club has been an example of quality turf with minimal phosphate use.

APPLYING CHEMICALS

Read pesticide and herbicide directions. Apply only the amount directed by the label and store pesticides far from wells, streams, wetlands or other water bodies. DO NOT apply when rain is expected. Take care not to apply pesticides and herbicides on sidewalks or driveways where it will be washed away with the surface water runoff into the storm drainage systems and then directly into our lakes and streams. If you use a lawn company, require that the company perform a soil test before applying fertilizers or pesticides, and use phosphorus-free fertilizers.

WATERING

Overwatering can leach nutrients from the soil and create runoff which can cause nutrients to migrate into water bodies.

BUFFERING

Keep the edge or banks of water bodies stabilized with plant growth, preferably native species which have the ability to protect waterways by filtering migrating pollutants, nutrients and soil. The more footage that can be reserved for the buffer area the better. A width of 10 to 30 feet will increase stabilization, improve bird and animal habitat, decrease Canada geese usage, and enhance aesthetics.

COMPOSTING

Dumping of yard wastes into water bodies is illegal according to state and local law. These wastes, including leaves, grass clippings and branches, when discarded in the water or along the banks of water bodies can cause two problems: 1) as these wastes decompose, oxygen in the water is depleted, diminishing the quality of fish and other aquatic life; 2) these wastes add nutrients to the water which can result in excessive growth of undesirable aquatic plants and algae blooms.

Compost away from the shoreline and direct runoff areas. If you rake nuisance aquatic weeds, the plants need to be placed on the compost pile. **Aquatic weeds if left on a dock or the shoreline will begin to decompose and leach nutrients back into the water.**

SEAWALL CONSTRUCTION

Seawalls should be constructed only at points of severe bank erosion. The type of seawall selected can have significant impacts on wave action, erosion control or wildlife habitat. Federal, state or local permits may be required for seawall installation or reconstruction.

Sanitary Sewer and Septic Systems

Many landowners within close proximity to Spring Lake have connected to an available public sanitary sewer, which transfers waste to a treatment facility. This is preferable to a septic system, which relies on soil filtration of the waste waters prior to entering into the ground water. **Homeowners who have sanitary sewer available and are not connected are encouraged to hook up.** If sanitary sewer is not available, it is the responsibility of homeowners to keep their septic system in optimum condition. Here are some recommendations to consider.

1. **Know the location and components of your system.** A copy of the original system diagram, if installed within the last twenty years, is available upon request by contacting the Environmental Health Division of your local health department.

2. **Keep drain fields clear.** Tree and other deeper root systems can disrupt and damage drain fields. Driving on a drain field can cause compaction, reducing effectiveness. Rainwater from gutters and runoff from paved areas can cause saturation of septic systems and should be directed away from these percolation-dependent systems.

3. **Look for signs of problems even if the system appears to be functioning properly.** Signs include: sewage odors, slow drains, soggy soil surrounding tank and drain field, or lush grass or excessive plant growth near drain field. Other indicators of possible problems are depressions in the surface of the ground in and around the drain field, *Cladophora* (an algae) growth in the water near your shoreline, and a slow flushing toilet after rainfall.

4. **Conserve water.** The more water that flows through the septic system, the faster the nutrients are released into the ground.

5. **Be careful of what goes down the drain.** Household chemicals and cleaners like bleach or drain cleaner should be avoided because they kill bacteria that are needed to break down waste. The following items should never be put down the drain because they will not break down in the system: grease, hair, cigarette butts, facial tissues, paper towel, personal hygiene supplies, bandages, paint, solvents, motor oil, or any other household hazardous waste.

6. **Beware of the "quick-fix."** Products that claim to clean septic tanks are no substitutes for proper maintenance. These quick fixes may accelerate the normal decay process from solid waste to liquid and can send much larger amounts of nutrients into the water system, which may contaminate the surface and groundwater.

7. **Routine maintenance is required.** Properly operating septic systems require sludge removal every **two or three years.**

For additional information on operation, maintenance or other questions regarding septic systems, please contact the Environmental Health Department of your county.

Boating Stewardship

On the water, every action a boater takes has an impact on other people as well as on aquatic life and its ecosystem. Clean water is the foundation of enjoyable boating and other water activities. The following are important suggestions:

1) Adhere to federal, state and local marine toilet rules and regulations. Use "Porta Potties" to keep sewage out of the water.

2) Know and use legally approved bottom paints.

3) Since wastewater runoff at car wash facilities is treated, use of these facilities is recommended. An alternative is to wash boats or other vehicles on the grass instead of in a driveway, minimizing soapy runoff. Use biodegradable cleaning agents.

4) Refrain from discarding any fishing line overboard. Numerous tackle shops maintain line recycling programs for your old line.

5) **Do Not Litter Spring Lake, its Streams or Storm Sewer Systems**
Litter not only ruins the natural beauty of Spring Lake, it can kill, or diminish aquatic life and habitat. The Marpol Treaty, a recently enacted international law, strictly forbids the dumping of any material or waste in lakes, rivers, or bays within three miles of shore. Plastics are prohibited from being thrown overboard **anywhere in the world.**

   a. Bring everything ashore, including beverage or food containers, biodegradable "food waste" and fish cleaning.

   b. Install a garbage can on your boat and use it.

   c. Switch to reusable cups and plates on your boat.

   d. When guests come aboard, inform them of your commitment to clean water and that you have a boat policy not to throw any trash overboard.

Waterfowl

Waterfowl are a natural part of the lake ecosystem. They eat lake plants and then excrete nutrients that support new plant growth. Feeding waterfowl increases waterfowl populations which encourages the lake plant growth through added nutrients. Waterfowl excretions may contribute to the cycle of organisms which cause swimmer's itch.

ONE DUCK EXCRETES ONE POUND OF PHOSPHORUS PER YEAR. ONE POUND OF PHOSPHORUS IS ENOUGH TO GROW 750 POUNDS OF ALGAE IN THE LAKE. HIGH PHOSPHORUS LEVELS INCREASE WEED AND ALGAE GROWTH IN SPRING LAKE.

The artificial feeding of waterfowl is not beneficial for the waterfowl, or for the people who enjoy Spring Lake.

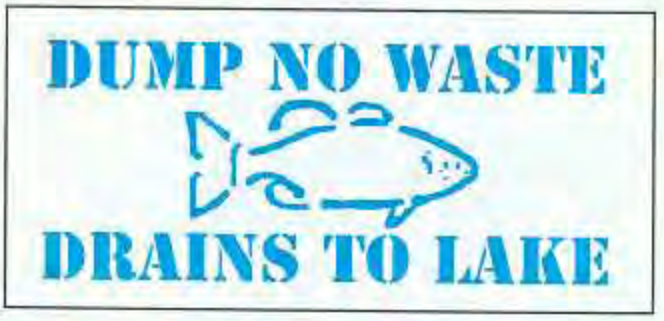
Signs like this will be posted around Spring Lake by the SL - LB to help remind people that feeding the waterfowl may lead to an increase of algae growth in the lake.

Storm Drains

The purpose of storm drain stenciling is to alert people to the fact that stormwater runoff from your street, sidewalk, and driveways flows directly through storm drains into SPRING LAKE or a tributary. This runoff washes pollutants into the water and harms SPRING LAKE'S water quality. Fertilizer runoff provides the nutrients which cause algae blooms.

Improper disposal of hazardous wastes leads to the poisoning of our lake's fish and harms the water quality. This contamination can also endanger human use by polluting our lake for swimmers, boaters, and other recreational users. Polluted runoff occurs when water runs over land or pavement, picks up pollutants and then deposits them in Spring Lake.

This stenciling program is sponsored by the Spring Lake - Lake Board.



Please prevent the following things from going into storm drains and POLLUTING SPRING LAKE:

Motor Oil, Gasoline, Antifreeze, Paint, Pesticides, Herbicides, Fertilizers, Other Hazardous Chemicals, Animal Wastes, All Litter, Grass, Leaves, and Branches.

Sweep driveways and dispose of debris instead of washing it down the storm drains.

Conservatively use salt to melt snow and ice on driveways, use sand or chip the ice off when possible.

Water Quality Protection Programs

The Michigan Groundwater Stewardship Program (MGSP) offers public service educational programs that can help Spring Lake Watershed residents protect water quality. These programs are voluntary, confidential, and free.

HOME*A*SYST

Home*A*Syst (H*A*S) is a self-assessment program you can use to evaluate your home and property for pollution and health risks. It is designed to provide homeowners and/or renters with the information and tools they need to take action. H*A*S can help you:

1. **Safeguard the health of you and your family.** Preventing or eliminating dangers in the water you drink or from hazardous chemicals in your home is important to avoid potential health risks.
2. **Prevent contamination of water supplies and other natural resources.** Protecting groundwater and surface water quality is essential to you and your neighbors and to others downstream. This is important whether your drinking water comes from a private well or municipal system.
3. **Protect your financial investment.** Your home is often your most valuable investment. Knowing about potential risks or problems can help you prevent costly cleanups, repairs, and legal troubles. And it pays not only to take care of your own property but also to make sure others around you are using good management practices. Property values can also be affected by pollution problems on your property, in your neighborhood, or in your lake.

H*A*S SUPPLEMENTS

These supplements offer additional information specific to certain issues.

Managing Shoreline Property to Protect Water Quality - examines the special role shoreline property owners have in preventing contamination of their lake or stream.

Lawn*A*Syst - An environmental risk assessment guide for lawn care practices, providing information for different seasons of the year.

PROGRAM CONTACT INFORMATION

Ottawa County Residents - Contact the Ottawa MSU Extension office at (616) 846-8250.

Muskegon County Residents - Contact the Muskegon Conservation District at (616) 773-0008

The MGSP is a statewide environmental program administered by the Michigan Department of Agriculture under the authority of the Groundwater and Freshwater Protection Act (P.A. 247) of 1993. Cooperating agencies include the USDA Natural Resources Conservation Service, Michigan State University Extension, Soil Conservation Districts, and AmeriCorps. Continued funding for this program is subject to periodic review by the state legislature.

Information Sources

MUSKEGON COUNTY

- Marty Hulka, Drain Commissioner, SL-LB member.....(231) 724-6219
- Environmental Health Department.....(231) 724-6208
- Office of Public Works.....(231) 724-6411
- Soil Erosion and Sedimentation Control Agency.....(231) 724-6411
- Soil and Water Conservation District.....(231) 773-0008
- Jan (John) Koens, Muskegon County Treasurer, SL-LB member.....(231) 724-6261

Watershed Municipalities

- Fruitport Township.....(231) 865-3151
- Fruitport Village.....(231) 865-3577
- Sullivan Township.....(231) 853-6900

OTTAWA COUNTY

- Steve Van Hoeven, Drain Commissioner, SL-LB member.....(616) 846-8220
- Environmental Health Department.....(616) 393-5645
- Michigan State University Extension Office.....(616) 846-8250
- Road Commission.....(616) 842-5400
- Sgt. David Loree, SL Sheriff's Patrol.....(616) 846-9170 ext. 1
- Sheriff Gary Rosema.....(616) 846-9170 ext. 1
- Soil Erosion and Sedimentation Control Agency.....(616) 846-8222
- Soil and Water Conservation District.....(616) 846-8770

Watershed Municipalities

- The City of Ferrysburg .....(616) 842-5950
- Spring Lake Township.....(616) 842-1340
- Spring Lake Village.....(616) 842-3430

FEDERAL AND STATE

- Army Corps of Engineers Office G.H.....(616) 842-5510
- DEQ Regional Field Office.....(616) 456-5071
- Grand Haven Coast Guard Office.....(616) 847-1755
- Michigan Lake and Stream Association.....(616) 273-8200
- State of Michigan Department of Environmental Quality (DEQ)
- Diana Klemans, Director of Inland Lakes Unit.....(517) 373-8000

State Senator..... Leon Stille.....(800) 378-4553
State Representative..... Jon Jellema.....(800) 535-5362
State Representative..... Gerald VanWoerkom.....(877) 633-0331

Spring Lake Area Residents Association (SLARA)

SLARA is proud to be the major financial sponsor of this informative booklet. We feel good lake stewardship is a necessity for the improvement of the Spring Lake water quality.

SLARA has developed a **"Good Steward of Spring Lake"** award. The requirements for the awards are the following:

1. Own or drive quiet watercrafts.
2. Keep watercraft speed below 55 mph.
3. Use only non-phosphorus lawn fertilizers.
4. Do not dump any yard waste (leaves, grass clippings, and/or branches) into the lake.
5. Avoid feeding the waterfowl.
6. Allow no wastes to flow into storm sewers.
7. Connect to the public sanitary sewer if at all possible; if not, maintain septic system in excellent condition.
8. Do not dump anything into the lake off any watercraft.
9. Encourage others to be good lake stewards.
10. Become a member of SLARA.

news

Spring Lake - Lake Board Newsletter

May 2000

In this Issue:

Spring Lake - Lake Board
414 Washington St., Room 107
Grand Haven, Michigan 49417
616-846-8220

Thanks to you, we're on our way!

This is the first of a four-year improvement plan for Spring Lake being implemented under the direction of the Spring Lake - Lake Board. In this newsletter, we will explain who we are (and who we're not), what we're doing now, what we have planned for the future, and provide you with other Spring Lake news and information.

First, who and what is the Spring Lake - Lake Board? The lake board is comprised of a lake resident, a representative from each municipality that abuts Spring Lake, a county commissioner from Ottawa and Muskegon Counties, the drain commissioners from Ottawa and Muskegon Counties, and a representative from the Department of Environmental Quality. The lake board was formed in 1998 under the authority of Part 309 of Act 451 of 1994, the Natural Resources and Environmental Protection Act. By following procedures outlined in Act 451, the lake board has the ability to levy assessments to pay for lake improvements. The lake board is a separate entity from the Spring Lake Area Residents Association, or SLARA, which has continued to exist along with the lake board.

WebLink
To read a copy of the lake board legislation on the Internet, follow the link for Part 309 at www.deq.state.mi.us/lwm/lwmacts.htm

The lake board's mission is to monitor and improve the water quality of Spring Lake and its watershed through stewardship and education. In order to accomplish this mission, about one year ago the lake board hired an environmental consulting firm, Progressive Architecture Engineering, to conduct a lake improvement feasibility study. Progressive provided the lake board with the Spring Lake Improvement Plan which is a strategy for improving conditions in the lake. The plan is being implemented over a 4-year period and includes the following elements:

- Nuisance plant control
- Watershed management
- Information and education
- Water quality monitoring

This is the first in a series of newsletters that the Spring Lake - Lake Board will mail annually to all lake residents. Each newsletter will contain specific information about the Spring Lake Improvement Plan. If you have questions or comments about the project, please feel free to write the lake board or contact a lake board representative.

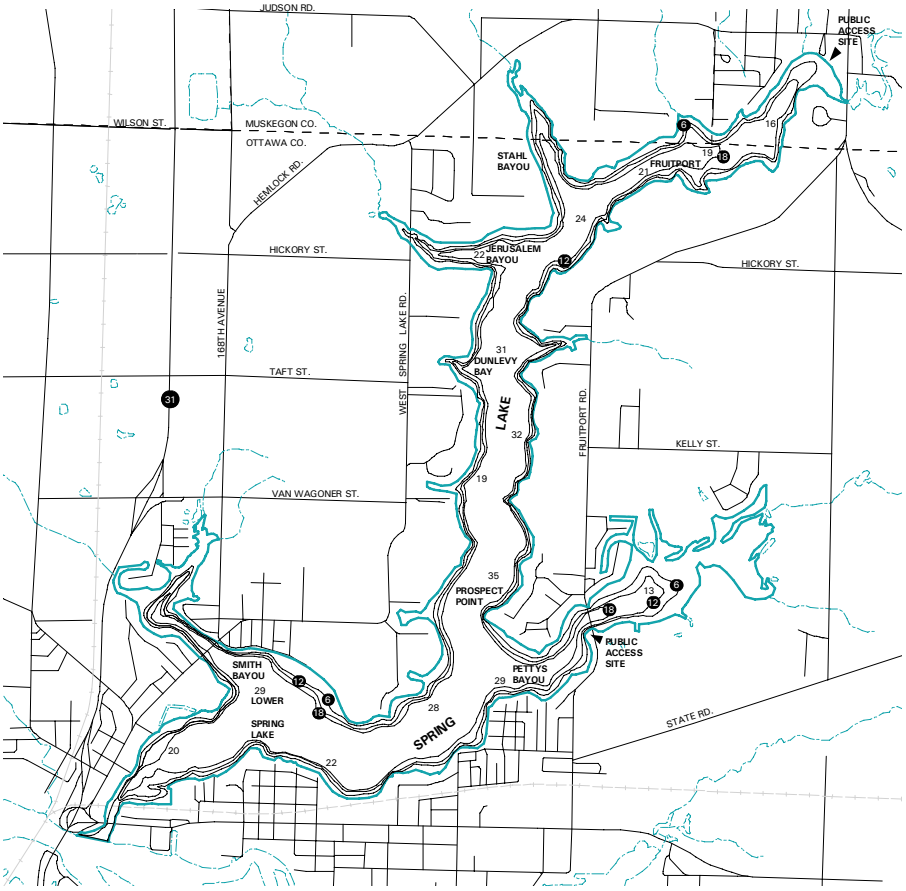
Spring Lake - Lake Board
414 Washington St., Room 107
Grand Haven, Michigan 49417

Lake Facts

2

Lake Surface Area: 1,097 acres
Maximum Depth: 42 feet
Approx. Average Depth: 20 feet
Shoreline Length: 24.6 miles
Shoreline Development Factor: 5.3

Spring Lake has a surface area of 1,097 acres and a maximum depth of 42 feet. At about 20 feet, the mean or average depth of Spring Lake is greater than the maximum depth at which most plants can grow (15 feet). The lake shoreline is over 24 miles in length and the shoreline development factor is 5.3. The shoreline development factor indicates the degree of irregularity in the shape of the shoreline. That is, compared to a perfectly round lake with the same surface area as Spring Lake (i.e., 1,097 acres), the shoreline of Spring Lake is 5.3 times longer because of its irregular shape. Spring Lake's shoreline is highly irregular in shape because the lake is actually a drowned river mouth, much like an impoundment, although there is no artificial dam retaining water in Spring Lake. As such, Spring Lake has a long, narrow, convoluted configuration with several large bayous at the mouths of its tributaries. Despite the fact that Spring Lake is relatively deep, its long shoreline provides extensive area for rooted plant growth as well as residential development on shore. Currently, approximately 900 homes and businesses border the lake.



Spring Lake Watershed

Agricultural Land
4,644 acres
15% of watershed area

Orchards
750 acres
2% of watershed area

Urban Development
5,392 acres
18% of watershed area

Forested Land
13,570 acres
45% of watershed area

Undeveloped Open Land
3,860 acres
13% of watershed area

Wetland Areas
1,778 acres
6% of watershed area

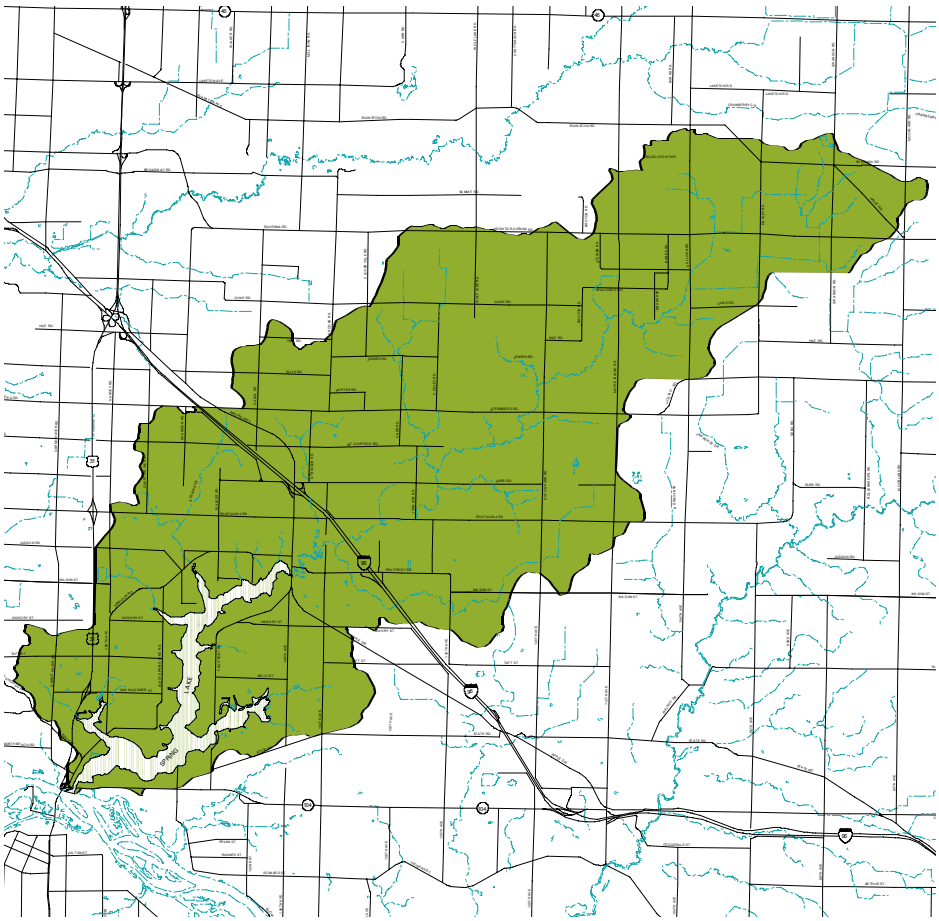
Barren Land
124 acres
<1% of watershed area

Total Watershed Area
30,118 Acres

The land surrounding the lake, from which water drains to the lake, is called the watershed or drainage basin. At over 30,000 acres, the Spring Lake watershed is over 27 times the size of the lake. Water flows from Spring Lake into the Grand River and Lake Michigan.

Land use activities in a lake's watershed have a direct impact on lake water quality. Nutrient-enriched runoff water and septic seepage from residential land adversely impact water quality while wetlands and forested areas can actually trap pollutants and protect the lake.

As with most lakes, residential development in the Spring Lake watershed is concentrated near the lake, thus, proper management of these lands is critical to long-term water quality protection.



Plants Are Part of a Healthy Lake

Although an overabundance of undesirable plants can limit recreational use and enjoyment of a lake, it is important to realize that aquatic plants are a vital component of aquatic ecosystems. They produce oxygen during photosynthesis, provide food and habitat for fish and other organisms, and help stabilize shoreline and bottom sediments.

The objective of a sound aquatic plant control program is to remove plants only from problem areas where nuisance growth is occurring. Under no circumstance should an attempt be made to remove all plants from the lake.

Plant Control

Mechanical harvesting (i.e., plant cutting and removal) and chemical herbicide treatments are methods commonly employed to control aquatic plant growth. For large-scale aquatic plant control, harvesting may be advantageous over herbicide treatments since plants removed from the lake will not sink to the lake bottom and add to the buildup of organic sediments. In addition, some nutrients contained within the plant tissues are removed with the harvested plants. With the use of herbicides, treated plants die back and decompose on the lake bottom while bacteria consume dissolved oxygen reserves in the decomposition process.

Since the plants are not removed from the lake, sediment buildup on the lake bottom continues, often creating a bottom substrate ideal for future aquatic plant growth.

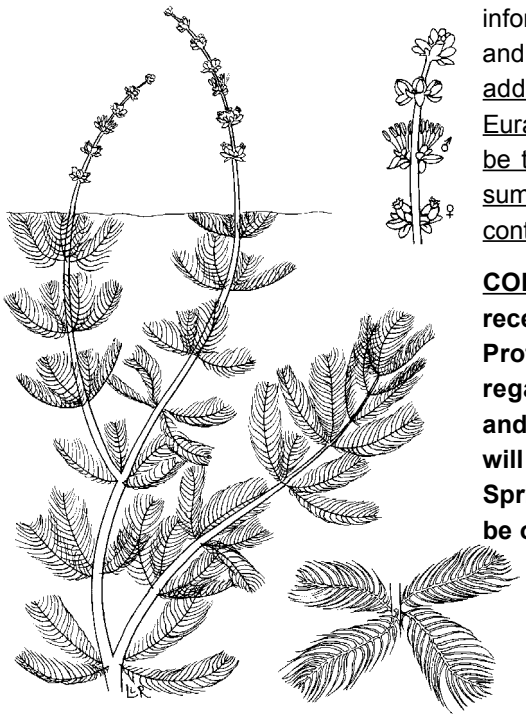
It should be noted, however, that attempts to control certain plant types by harvesting alone may not prove entirely effective. This is especially true with Eurasian milfoil (*Myriophyllum spicatum*) due to the fact that this plant may proliferate and spread via vegetative propagation (small pieces break off, take root, and grow) if the plant is cut. Eurasian milfoil is especially problematic in that it often becomes established early in the growing season and can grow at greater depths than most plants. Eurasian milfoil often forms a thick canopy at the lake surface that can degrade fish habitat and seriously hinder recreational activity. Once introduced into a lake system, Eurasian milfoil may out-compete and displace more desirable plants and become the dominant species. When Eurasian milfoil is present, it may be possible to control the growth and spread of the plant by treating the lake with a species-selective systemic herbicide.

Also, it is not economically feasible to mechanically harvest planktonic (i.e., free-floating) algae in a lake, therefore herbicides, such as copper sulfate and chelated copper products, are often used to control nuisance algae growth. The longevity and effectiveness of an algae treatment is dependent on weather, nutrient levels in the lake, and other conditions. Unlike most other aquatic herbicides that tend to rapidly break down, copper does not degrade and can accumulate in lake sediments.

Herbicide Use Requires a Permit

In Michigan, Act 368 of 1978 (the Public Health Code) requires that a permit be acquired from the DEQ before any herbicides are applied to inland lakes. The permit will include a list of herbicides that are approved for use in the lake, respective dose rates, use restrictions, and will show specific areas in the lake where treatments are allowed.

Eurasian milfoil
Myriophyllum spicatum



The plant control program for Spring Lake will include the limited use of herbicides and mechanical harvesting. The herbicide treatments will focus primarily on the control of Eurasian milfoil and nuisance algae growth. This spring and early summer, biologists from Progressive Architecture Engineering will conduct surveys of the lake and the location of Eurasian milfoil beds will be identified using a Global Positioning System (GPS). Up to 100 acres of Eurasian milfoil will be treated early in the growing season (i.e., May or early June). The exact timing of the treatment depends on weather conditions and the extent of plant growth in the lake. All lake residents will receive a written notice of the pending treatment in the mail and, on the day of treatment, the lakeshore near treated areas will be posted with bright yellow signs informing you of the herbicides used and any restrictions on water use. In addition to the treatment for Eurasian milfoil control, the lake will be treated once at the peak of the summer growing season for algae control.

CORRECTION: Information you recently received in the mail from Professional Lake Management regarding herbicide treatments and dates was incorrect. There will NOT be 3 algae treatments of Spring Lake this year; there will be only 1 algae treatment.

Mechanical harvesting of up to 100 acres of Spring Lake is scheduled for July. Harvesting efforts will be concentrated along developed shoreline areas where nuisance aquatic plant growth (other than Eurasian milfoil) is inhibiting recreational use and enjoyment of the lake. Harvesting is typically conducted parallel to shore away from docks and boats in four to five feet of water to clear navigation channels to open water areas. However, please be aware that the low water level in the lake this year may limit the scope of the harvest since harvesting machines cannot operate efficiently in water less than about 3 feet deep.

The Role of the Consultant

The lake board's consultant, Progressive Architecture Engineering, is responsible for preparing bid documents for the plant control program, assisting the lake board with the selection of plant control contractors, conducting surveys of the lake to determine the scope of work to be performed by plant control contractors, and perform follow-up inspections to ensure work proceeds in a satisfactory manner. The consultant reports to the lake board regarding the performance of the plant control contractors and makes recommendations to the lake board regarding payments to the contractor.

The Contractor

Professional Lake Management of Caledonia has been awarded the aquatic plant control contract for the 2000 season.

Although herbicides and mechanical harvesting are useful for quickly controlling nuisance plant growth, these techniques are effective only temporarily because they merely address the symptom instead of the underlying problem. Plants grow because a lake is very fertile; removing nuisance plants with herbicides or harvesting does very little to reduce a lake's fertility, and therefore nuisance plant growth will return year after year. In order to reduce plant growth over the long term, the amount of nutrients entering a lake must be reduced. Developing and implementing strategies to reduce pollution inputs from a watershed is called **watershed management**.

Nutrients enter Spring Lake from three general areas within the watershed: the urbanized land immediately surrounding the lake; the corridors immediately adjacent to the tributary streams, and the farmland far upstream of Spring Lake.

Within the urban area, lawn fertilizers wash into the lake promoting nuisance plant and algae growth. In addition, storm sewers carry fertilizers from those lawns that are located away from the lake's edge. Finally, a small portion of the lake is not sewered, and septic drainfields eventually leach nutrients into the lake, as well. Along tributaries such as Norris Creek and Stevens Creek, eroding streambanks carry nutrients and sediment that are deposited in Spring Lake. Farmland also contributes nutrients and sediment to Spring Lake, primarily from fertilizers, manure, and eroding drainage ditches. In order to improve conditions in Spring Lake, these watershed sources of pollution must be eliminated or mitigated to the extent possible.

Fortunately, there are state grant funds available for watershed management. As you may recall, Michigan voters approved the Clean Michigan Initiative (CMI) referendum in November of 1998 which included, among other things, $90 million for the Clean Water Fund and $50 million for nonpoint source pollution clean-up projects. It is likely that some of the elements of the Spring Lake Improvement Plan will be grant eligible.

There is not a maximum dollar amount (per grant) limit, but the grants require a minimum 25% local match. That means for every $1 that the Spring Lake - Lake Board puts into the grant eligible portion of the project, that it can receive $3 in state grant funds. The Spring Lake Improvement Plan includes an annual assessment of $25,000 for the watershed management portion of the project. Therefore, over the four-year project timeframe, a total of $100,000 in local assessments will be collected for watershed management making the project eligible for up to an additional $300,000 in state grant funds.

In order to apply for grant funds, a watershed management plan which details pollution sources and corrective actions must be approved by the Department of Environmental Quality. Staff from Progressive Architecture Engineering are working to complete the watershed management plan. Details of the plan will be presented in upcoming newsletters.

At the moment, one of the most obvious features of Spring Lake is its low water level. Of course, one of the big concerns this year is whether the level will continue to go down and how boating will be affected by the low levels. Some long-term perspective might be useful.

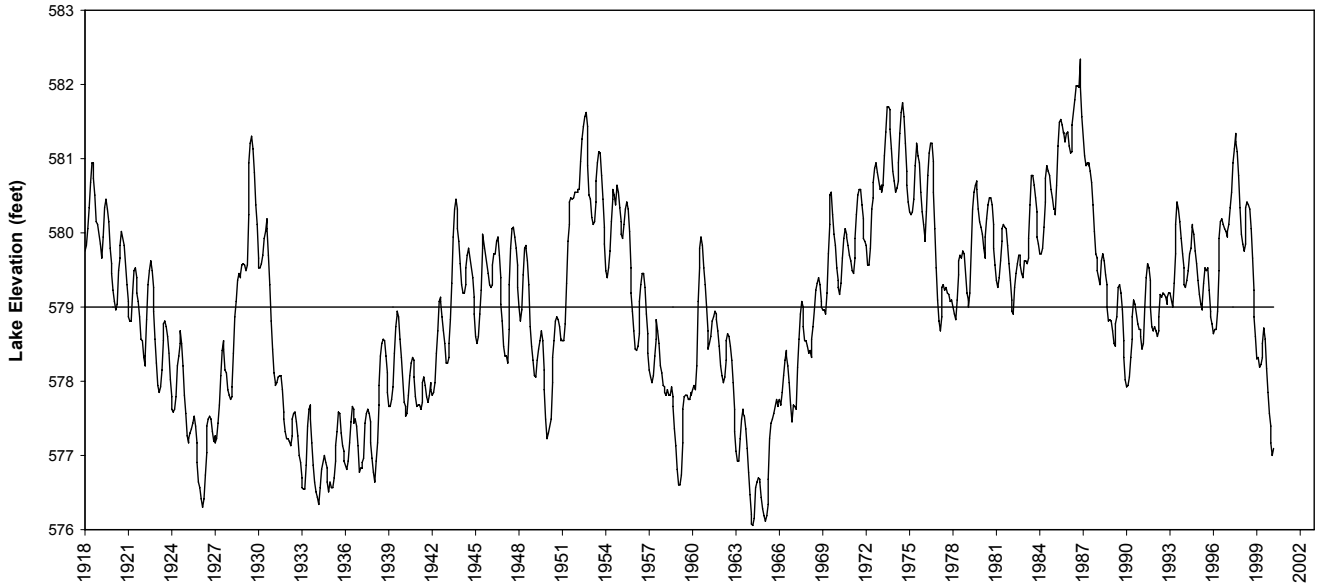
As you might suspect, the level of Spring Lake and Lake Michigan are nearly identical. Fortunately, the U.S. Army Corps of Engineers has a record of Lake Michigan's level dating back to 1918. Thus, we can see how the level of the lakes has behaved historically for nearly a hundred years.

	Level	Year
Average	579	
Minimum	576	1964
Maximum	582	1986

It is worth noting that,

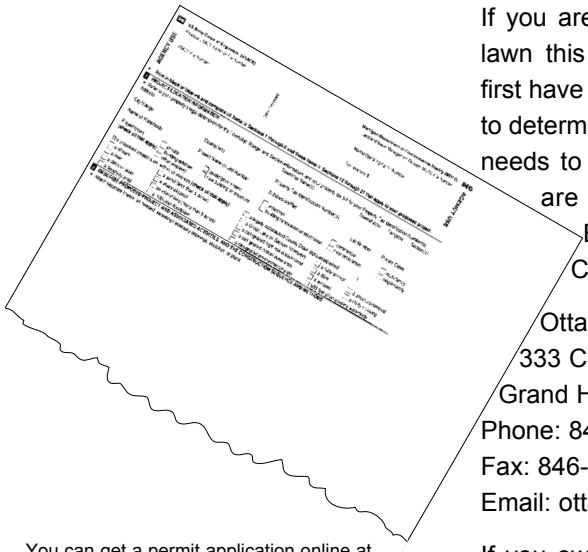
- Lake Michigan undergoes annual cycles of summer highs and winter low levels.
- The lake level has cycled over a period of years with low levels in the mid 1920's, the 1930's, the mid 1960's, and again in 1999-2000.
- For the last 30 years, the lake level has generally been higher than the overall average since 1918.
- It appears that, given the mild weather and lack of snow melt this past winter, the level of Lake Michigan and Spring Lake may decline further this summer.
- There are several reasons that lake levels have decreased including increased evaporation, lack of snowmelt, and warmer air temperatures which increase evaporative water losses.
- Low water levels in Spring Lake will likely cause an increase in rooted aquatic plant growth since sunlight will penetrate to more of the lake bottom.
- If history is any indication, the levels of Lake Michigan and Spring Lake will eventually return to normal.

Lake Michigan Lake Elevation (in feet), 1918 - the Present



From: U.S. Army Corps of Engineers Michigan-Huron Hydrograph web page at http://huron.lre.usace.army.mil/levels/hlevmh.html
Note that 1999 and 2000 data are approximate.

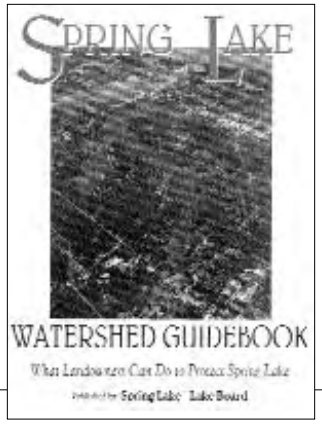
Be aware that if you are considering doing work on the lakeshore--including newly-exposed shoreline--that you will need to acquire a permit from the DEQ. This work can include dredging, filling, seawall construction, permanent docks, etc.

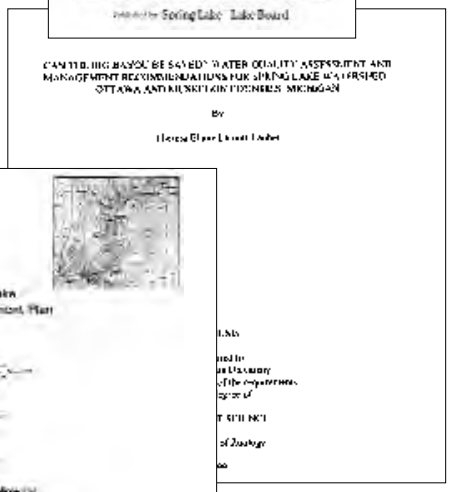


You can get a permit application online at www.deq.state.mi.us/lwm/grt_lakes/pcu/pcu.html or call the Grand Rapids DEQ office at 616-356-0500.

Reports on Spring Lake that may interest you include Theresa Lauber's 1999 Master's thesis, the lake board's Spring Lake Watershed Guidebook, and Progressive's feasibility study. All are available for you to review at the following locations:

- Ottawa Co. Drain Commissioner's Office
  Room 107 County Building
  414 Washington St.
  Grand Haven, MI 49417
  616-846-8220
- Fruitport District Library
  47 West Park
  Fruitport, MI 49415
  231-865-3461
- Warner Baird District Library
  123 East Exchange St.
  Spring Lake, MI 49456
  616-846-5770
- Loutit Library
  407 Columbus
  Grand Haven, MI 49417
  616-842-5560





If you are planning to fertilize your lawn this year: **WAIT!** You should first have the soil in your yard tested to determine whether the lawn really needs to be fertilized. Soil test kits are available through MSU Extension in Ottawa County:

Ottawa County Extension
333 Clinton Street
Grand Haven, MI 49417
Phone: 846-8250
Fax: 846-0655
Email: ottawa@msue.msu.edu

If you own lakeshore property, you need this book! ***Lakescaping for Wildlife and Water Quality*** provides hands-on information for landscaping your property to protect water quality. Produced by the Minnesota Department of Natural Resources, this book is chock full of information that will apply equally as well to Michigan lakeshores. To order or to inquire about dealer rates, please contact Minnesota's Bookstore, 117 University Avenue, Saint Paul, MN 55155, or call 1-800-657-3757.

news

Spring Lake - Lake Board Newsletter

October 2000

In this Issue:

Spring Lake - Lake Board
414 Washington St., Room 107
Grand Haven, Michigan 49417
616-846-8220

Off to a good start!

This year marks the first year of the Spring Lake Improvement Plan being implemented by the Spring Lake - Lake Board. The Plan is being implemented over a four-year period and includes:

- Nuisance plant control
- Watershed management
- Information and education
- Water quality monitoring

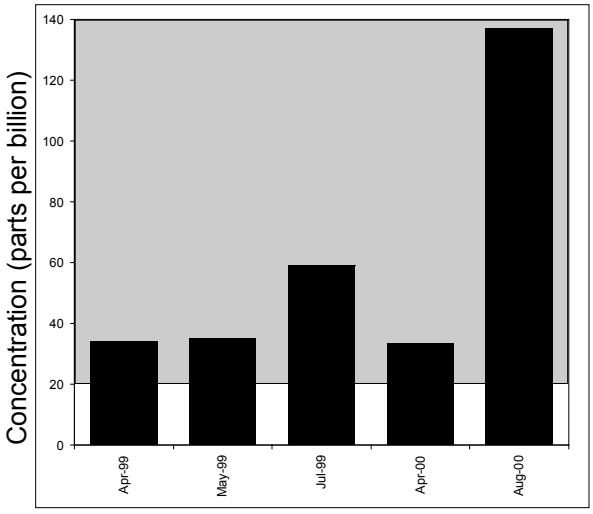
This is the second in a series of newsletters being mailed to lake residents to keep you informed of project activities.

Why All the Algae?

This year, there was very little rooted plant growth in Spring Lake. As a result, less than 100 acres of the lake was treated with herbicides for rooted plant control, and no mechanical harvesting was needed.

On the other hand, there was a bumper crop of algae this year and there were 4 separate treatments totalling about 300 acres for algae control. There are a couple of reasons why that occurred. First, Spring Lake is very rich in the nutrients that plants and algae need to grow, especially the nutrient "phosphorus." Phosphorus is the nutrient of primary concern in that it accelerates the lake eutrophication or aging process. The more phosphorus available in the lake, the more algae growth. Based on extensive monitoring of temperature, dissolved oxygen concentrations, and phosphorus levels in the lake, it appears that phosphorus-rich water from the bottom of the lake was brought to the surface where it was available to cause algae blooms.

Spring Lake Median Total Phosphorus Concentrations, 1999-2000



The bar graph at left shows the median phosphorus concentrations measured in Spring Lake from April of 1999 through August of 2000. "Median" is a type of average measurement.

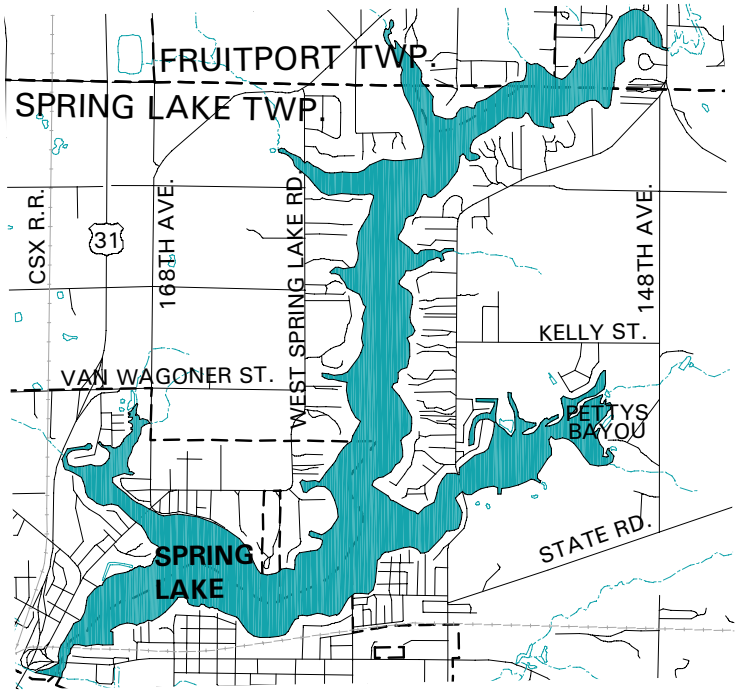
The grey shaded area covering most of the graph is the concentration of phosphorus at which abundant plant growth can be expected; less plant growth occurs when concentrations remain in the white area at the bottom of the graph.

For the past two years, total phosphorus concentrations in Spring Lake have been very high, especially in August of this year when phosphorus-laden bottom waters mixed with surface waters. A primary objective of the watershed management plan currently being developed by the lake board is to reduce all sources of phosphorus input to Spring Lake.

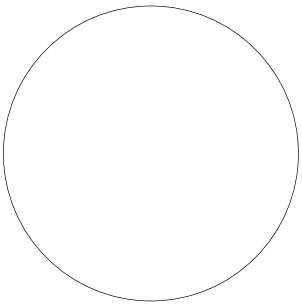
2

Spring Lake has a long shoreline, but do you know just how long it is? The length of the Spring Lake shoreline is about 25 miles, but besides being long, it is also very irregular in its shape. As you know, Spring Lake is not what you'd call a very round lake. All the coves and points and bayous cause the shoreline to take a very zig-zagged path around the lake. This is important because it means that compared to a round lake with the same surface area as Spring Lake (about 1,000 acres), the Spring Lake shoreline is much longer because of its convoluted shape. In fact, Spring Lake's shoreline is over 5 times longer than a perfectly circular 1,000-acre lake.

With all that extra shoreline, Spring Lake has a much greater potential for plant growth along the shore, and for houses or other development to occur as well. With the potential for perhaps as many as 5 times the number of houses on shore, then the potential also increases for things like phosphorus fertilizers and septic seepage to migrate into the lake. With a long shoreline, it is more important than ever that everyone be a good steward of the lake. YOU *CAN* MAKE A DIFFERENCE!



Spring Lake is 1,097 acres with 24.6 miles of shoreline.



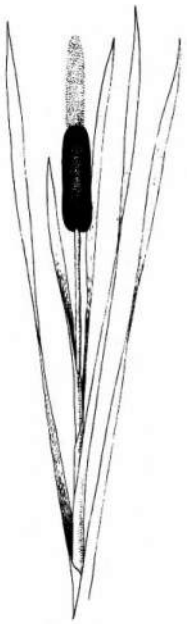
A perfectly circular 1,097-acre lake would have only 4.6 miles of shoreline. This circle is shown at the same scale as the Spring Lake map, above. The circle and Spring Lake both cover an area of 1,097 acres.

Please do not feed the waterfowl!

Have you seen this sign? The Spring Lake Area Residents Association (SLARA) has been busy putting up these signs all around the lake, and they have now been installed in all 5 municipalities.

Geese, ducks, and swans very efficiently recycle phosphorus in the lake by consuming plants at one end and releasing them at the other end--usually on your lawn! If you feed the waterfowl, you're only adding more phosphorus into the whole system, and encouraging the birds to stay around Spring Lake. While they're nice to see, we'd like the birds to take their droppings elsewhere!

If you would like a sign for your dock or property, they can be obtained from John Nash for $5 each. Contact John at 842-7318.



Municipalities Just Say "No" to Phosphorus Fertilizers

On August 21, the Ferrysburg City Council adopted a resolution calling upon residents to eliminate the use of phosphorus fertilizers in order to help improve the water quality of Spring Lake. Thank you Ferrysburg!

Now, both the Village of Spring Lake and Spring Lake Township have done the same. The Village of Fruitport and Fruitport Township will be considering similar resolutions in the near future.

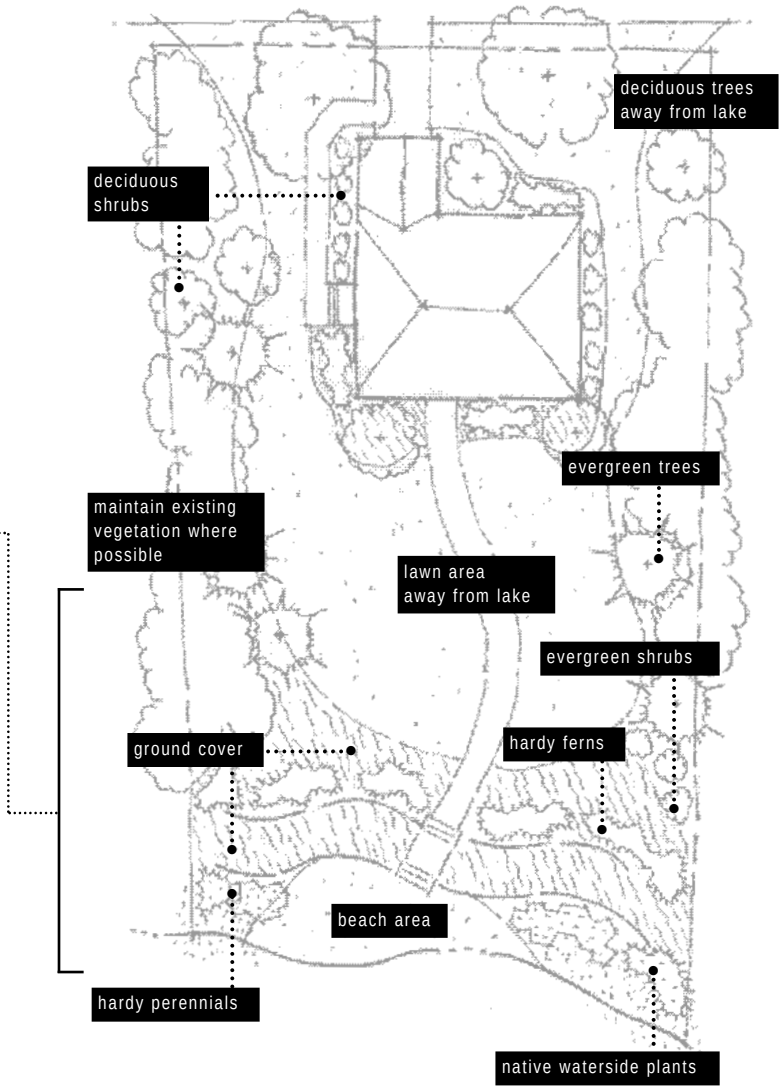
Although the municipalities have not issued an outright ban on phosporus (that would be difficult to enforce), the Spring Lake - Lake Board asks you to join in the spirit of these resolutions to "just say 'no' to phosphorus fertilizers." In most cases, you don't need the extra phosphorus because your lawn already will have all that it can use. So, don't throw your money away on fertilizer you don't need. If you feel you must use fertilizer, please use one that is phosphorus-free, and be sure to follow the label rates for application. Above all, be sure you don't overfertilize!

Wetlands: Going, Going . . .

Before they're gone, we're taking steps to protect what little wetland remains around Spring Lake by commenting on pending permit applications to the Department of Environmental Quality. Why? Because wetlands are critical to Spring Lake's water quality. Among other things, wetlands provide flood control; habitat and cover for fish and wildlife; ground water recharge; pollution treatment; and erosion control. Wetlands aren't formed overnight! What takes hours or days to destroy took years to evolve. To help protect remaining wetlands, the Spring Lake - Lake Board is preparing maps of wetland locations throughout the Spring Lake watershed.

4

1. Apply lawn fertilizer sparingly, if at all. If you must apply fertilizer, request and use a phosphorus-free fertilizer. If you irrigate from the lake, you probably won't need to apply fertilizer at all.
2. Don't feed the ducks, geese, swans, or any waterfowl.
3. Dump no yard waste in the lake, including leaves, sticks, and grass clippings.
4. Plant shrubs or ground covers along the shoreline (i.e., a greenbelt) to prevent nutrients from entering the lake.
5. Don't place fill in area wetlands.
6. Connect to the public sewer, if possible.
7. Thank your municipal leaders that are passing good lake stewardship proposals.
8. Encourage municipal leaders to do everything possible to protect water quality.
9. Encourage your neighbors and everyone that uses the lake to be good stewards.
10. Don't be complacent – don't assume someone else will solve the problem.



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Progressive Architecture Engineering. 2000. Spring Lake Improvement Plan. Spring Lake - Lake Board, 414 Washington Street, Grand Haven, MI 49417.

Sayles, B. 1996. "Designated Uses for Michigan Waterbodies." *Michigan's Nonpoint Source News*. Michigan Department of Environmental Quality.