Hooker Lake
Planning Grant Project

February 1995

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HOOKER LAKE PLANNING GRANT
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HOOKER LAKE PLANNING GRANT

Background

In August 1991, the Hooker Lake Management District applied for a Lake Management Planning Grant from the Wisconsin Department of Natural Resources. The Planning Grant program was established in 1989 to help local communities manage and improve their lakes. In October of 1991, Hooker Lake received a commitment for a $10,000 planning grant from the state.

The Hooker Lake planning grant addresses three primary concerns:

- water quality--how clean is the water
- plants in the lake--changes were being seen by residents as a sign of possible problems
- the opinions of the residents and landowners--what they see, and what they would like to see

Water Quality Monitoring

The U.S. Geological Survey (USGS) was contracted by the Hooker Lake Management District to conduct water quality monitoring. Monitoring was conducted from October 1991 through September 1993. The annual reports from USGS are included in the Appendix. The results were presented by Steve Field, USGS, to the local residents at the annual meeting August, 1994.

The USGS monitoring was complemented by volunteer efforts. A local resident sampled clarity on Hooker Lake weekly.

Aquatic Plant Survey

Hooker Lake is a small, 87 acre eutrophic lake with nuisance levels of aquatic vegetation. Approximately 68 homes surround the lake. There is a large conservancy area on the north shore of Hooker Lake. The aquatic plant community in Hooker Lake is not very diverse. The aquatic plant community is dominated by Eurasian Water Milfoil and Coontail. The lake attracts anglers looking for Largemouth Bass, Panfish and Northern Pike.

The information obtained by conducting aquatic plant surveys may be used by future investigators to further document changes in the aquatic plant community and evaluate the impact of plant management, lake management, and watershed activities upon the plant communities. This information can be used to guide future lake management decisions on Hooker Lake.

In June and August 1992, Aron & Associates (A&A) conducted detailed aquatic plant surveys on Hooker Lake. The diversity, density and frequency of the plants in Hooker Lake were determined. Plant specimens were collected, analyzed, pressed, and mounted. The Hooker Lake Management District has been given a collection of the plants found in the lake, for their permanent record. A collection of the plants found was also sent to the University of Wisconsin Milwaukee Herbarium.

Throughout the project period Hooker Lake exhibited rather poor plant diversity--a total of eighteen different species were found. Two exotic species, curly-leaf pondweed (Potamogeton crispus) and eurasian water milfoil (Myriophyllum spicatum) were found in the lake in nuisance quantities.

Hooker Lake is located in Kenosha County, Wisconsin. Hydrographic and morphological information are presented in Table 1 and Map 1.

Table 1. Hydrographic and Morphologic Data of Hooker Lake.

Surface Area	87 acres
Total Drainage Area	1133 acres
Volume	983 acre feet
Shoreline Length	1.9 miles
Maximum Depth	24 feet
Mean Depth	11.3 feet

Source: USGS, DNR, SEWRPC

METHODOLOGY

General Survey

A preliminary survey of the lake was made by boat. An attempt was made to locate all plant communities in the lake by region. All plant species found were collected and identified. Specimens were pressed, dried, and mounted for a permanent record. Nomenclature follows Fassett (1956) and Helquist and Crow (1980). Additional species located during the transect survey were also pressed, dried, and mounted. The 1992 maximum rooting depth in Hooker Lake was determined to be twelve feet.

Transect Survey

The methodology for the transect survey follows the methods used by the Wisconsin Department of Natural Resources (WDNR) in their Long Term Trend Monitoring Program. Twenty-five transects were established along the lake perimeter (Map 2). Each transect was identified by a landmark, compass bearing, and way point. Transects extended from shore to the maximum rooting depth (twelve feet) or to a point approximately half way to the opposite shore (way point). Photographs were taken of each transect shore location to facilitate duplication in future surveys (Appendix).

Four sampling locations along each transect were established at water depths of 1.5, 4, 7-8, and 10-11 feet. At each sampling point an imaginary six foot diameter circle was divided into four quadrants. Sampling of aquatic vegetation took place once within each quadrant producing a total of four samples for each sample point. A rake with a telescoping handle was used to collect plant samples. Samples were collected by casting the rake into each of the four quadrants and pulling the rake to the center of each sampling point. Each plant species retrieved was recorded and given a density rating in accordance with the following criteria:

Rake Recovery of Aquatic Plant	Density Rating	Descriptive Term
Rake teeth full, all 4 casts	5	Heavy
Teeth partly full, all 4 casts	4	Dense
Plants taken on 3 casts	3	Moderate
Plants taken on 2 casts	2	Scattered
Plants taken on 1 cast	1	Sparse

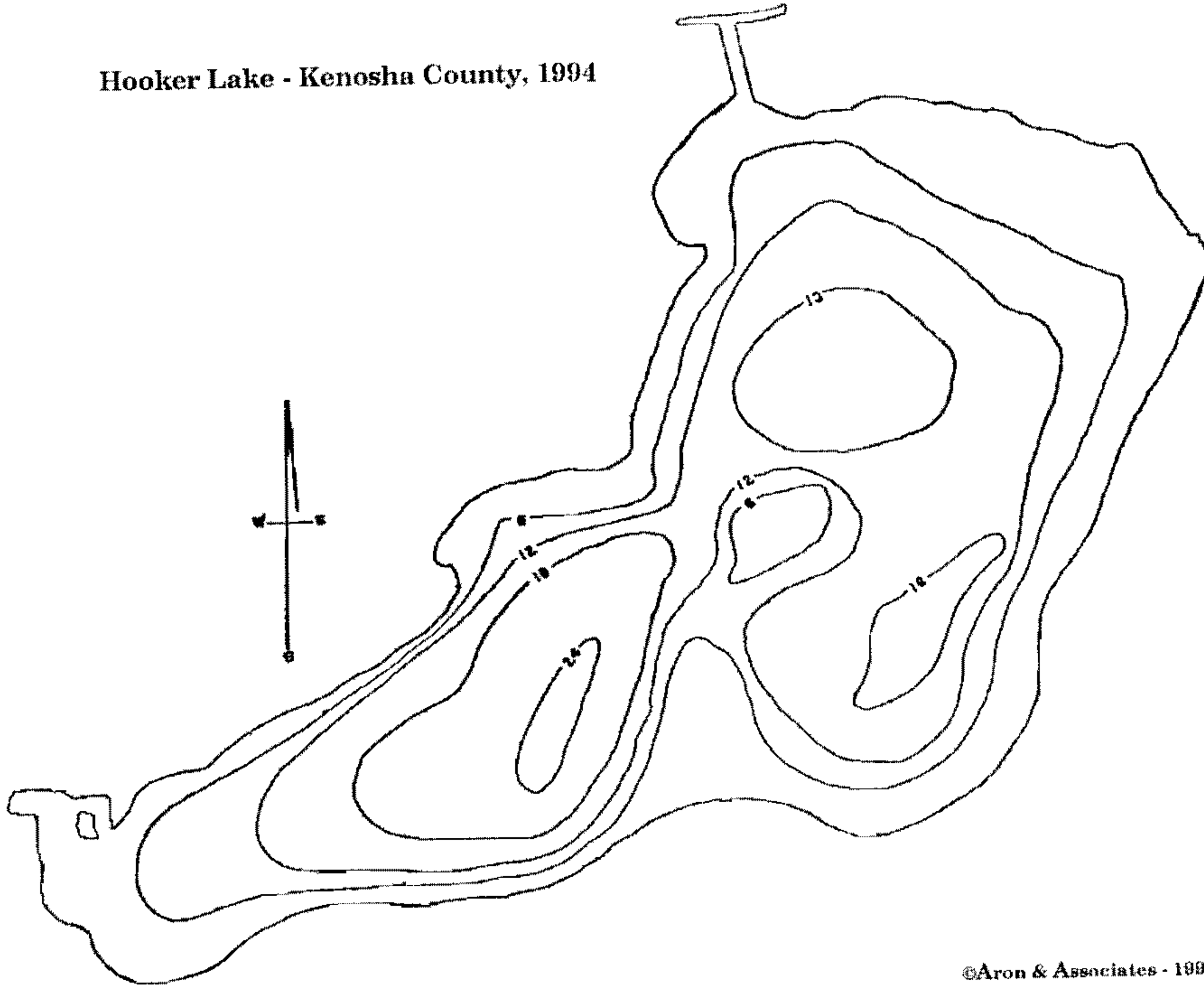
The data collected were then used to calculate frequency of occurrence, and density ratings for each species along each transect at each sample depth.

The abundance of each species was determined using four estimates:

1) The **frequency** is an estimate of how often a species occurs in the sample points.
2) The **average density** rating, or the average density of a species in the sample point where it occurred.
3) The **relative density** rating, or the average density of a species averaged over all sample points whether or not any species were present.
4) The **relative density** rating averaged over all sample points in which any species occurred.

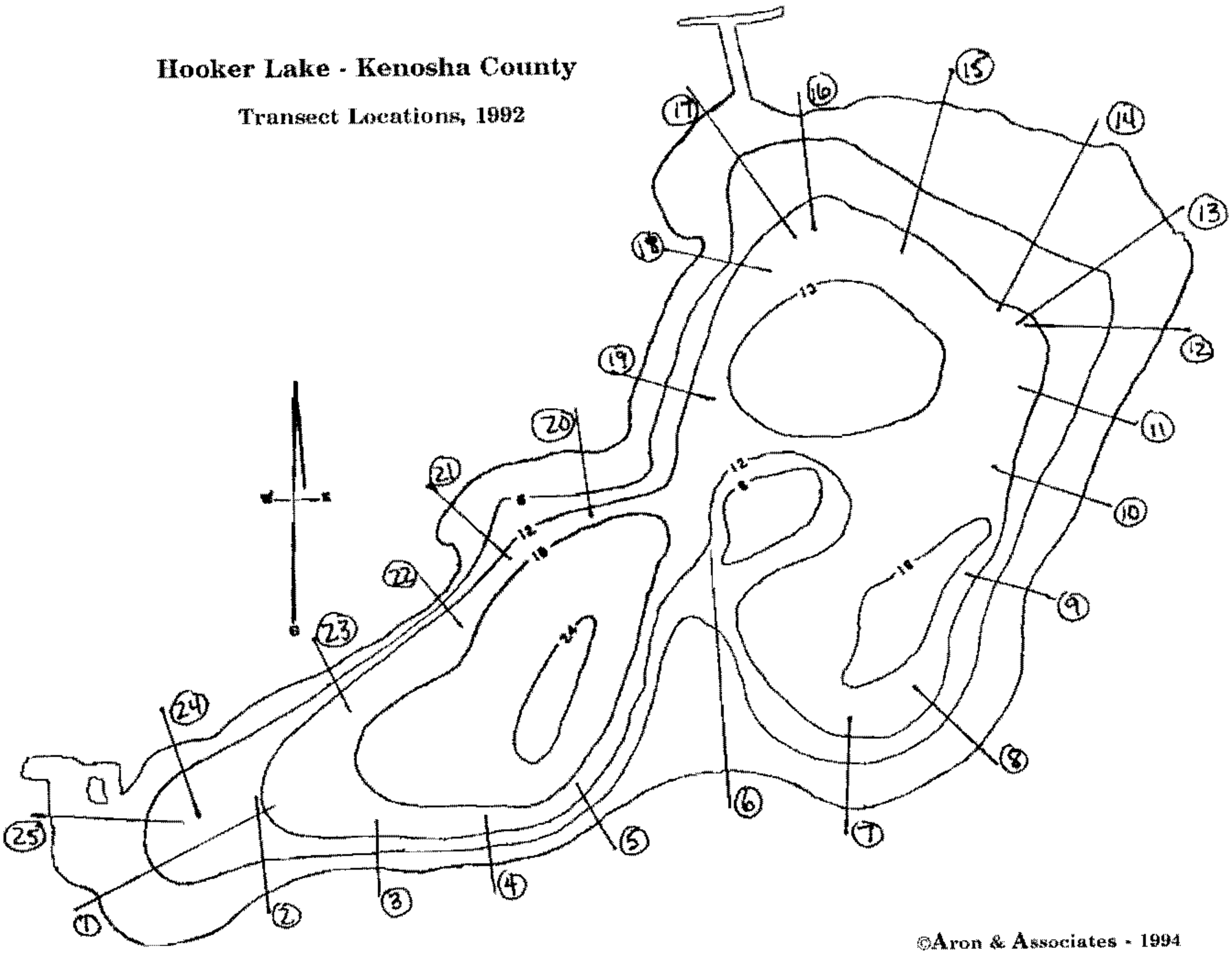
A Sitek strip chart recorder was used to obtain a permanent record of the depth profile and plant distribution along each transect.

Hooker Lake - Kenosha County, 1994



Hooker Lake - Kenosha County

Transect Locations, 1992



RESULTS

The first of two surveys was conducted in June 1992. A total of eleven plant species were found. Two of the plants found, eurasian water milfoil (Myriophyllum spicatum) and curly-leaf pondweed (Potamogeton crispus), are not native to Hooker Lake and were found at nuisance levels. Seven plant species were found in all depth categories. These included coontail (Ceratophyllum demersum), muskgrass (Chara sp.), waterweed (Elodea canadensis), eurasian water milfoil, curly-leaf pondweed, sago pondweed (P. pectinatus) and flat-stem pondweed (P. zosterformis). Illinois pondweed (P. illinoensis) was found in the 1.5, 4 and 7 foot depths. Cattail (Typha sp.) and yellow water lily (Nuphar sp.) was found only in the 1.5 foot depth.

The sediments along the eastern shoreline consist of firm sandy soils in depths up to four feet. This area had good stands of muskgrass. Eurasian water milfoil was found growing in a band along the 5 to 7 foot depth contours on the northern cattail fringe and the eastern shoreline. The western end of the lake, including the boat launch, was dominated by eurasian water milfoil, curly-leaf pondweed and coontail. A shallow peninsula that extends north from the southern shore contained mixed stands of eurasian water milfoil and Illinois pondweed. The steeper southern shoreline contained fewer plants, primarily muskgrass, curly-leaf pondweed and waterweed.

During the August survey there was more diversity, a total of eighteen aquatic plant species were observed. However, densities were much lower than found in June. Two (2) species were observed only during the general survey, and sixteen (16) species were observed in the transect survey (Table 2). Coontail was dominant, especially in the west end of the lake. Eurasian water milfoil was still present but had declined significantly. Native pondweeds had also declined. The large stand of Illinois pondweed on the peninsula was almost entirely gone. Flat-stem pondweed (P. zosterformis) was found sporadically on the peninsula. Figure 1 compares the results of the two surveys.

The distribution of plants by water depth is summarized in Table 3. Of those species found during the transect surveys, two species were found at all sample depths during both surveys : coontail and eurasian water milfoil. Waterweed (Elodea canadensis) was found at all sample depths during the June survey. Slender naiad (Najas flexilis) was found at all sample depths during the August survey.

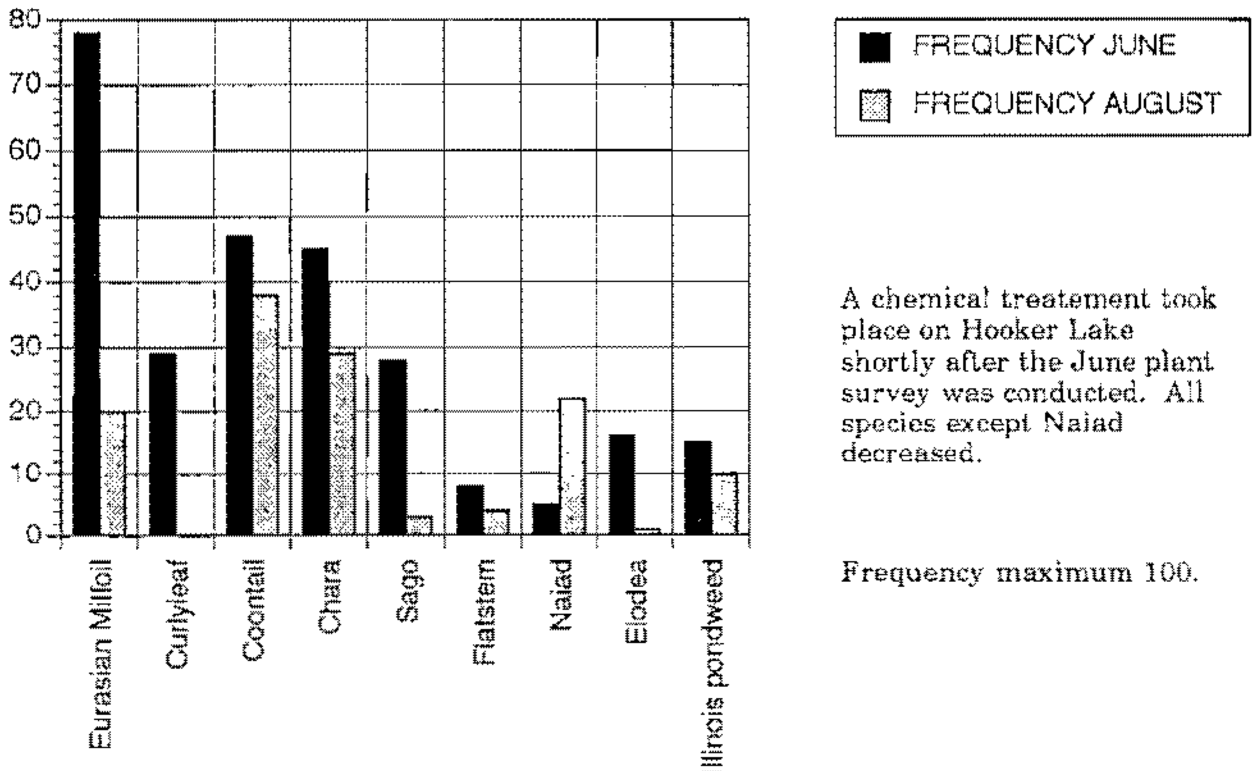
A chemical treatment for nuisance aquatic vegetation was conducted soon after the June survey. This treatment had a decided impact on the vegetation found in the lake. The target nuisances were eurasian water milfoil, coontail and curly-leaf pondweed. Diquat, Cutrine Plus and 2,4-D were the chemicals used. Chemical fact sheets that provide information on the chemicals are included in the Appendix. Although treatment was intended to only target those nuisances mentioned above, it was apparent from the August survey that more plants were affected. Aquatic plant densities declined throughout the lake. At the same time, clarity in Hooker Lake declined significantly as algae increased. Water clarity in June was measured at seven feet. Water clarity in August was down to only three feet. In June

Muskgrass (Chara sp.) was the most dominant at the 4 foot depths; Eurasian Water Milfoil was dominant at the 1.5 and 7 foot depths; and Coontail was most dominant at the 10 foot depth. In August, Muskgrass was dominant at 1.5 foot depth and Coontail was dominant at all depths greater than 1.5 feet. Actual survey data are provided in the Appendix.

Figure 1 - Comparison of Aquatic Plant Densities from June & August 1992.

Source: Aron & Associates

HOOKER LAKE PLANTS - 1992



A chemical treatement took place on Hooker Lake shortly after the June plant survey was conducted. All species except Naiad decreased.

Frequency maximum 100.

Hooker Lake - Kenosha County

Area Available for Aquatic Plant Growth, 1992

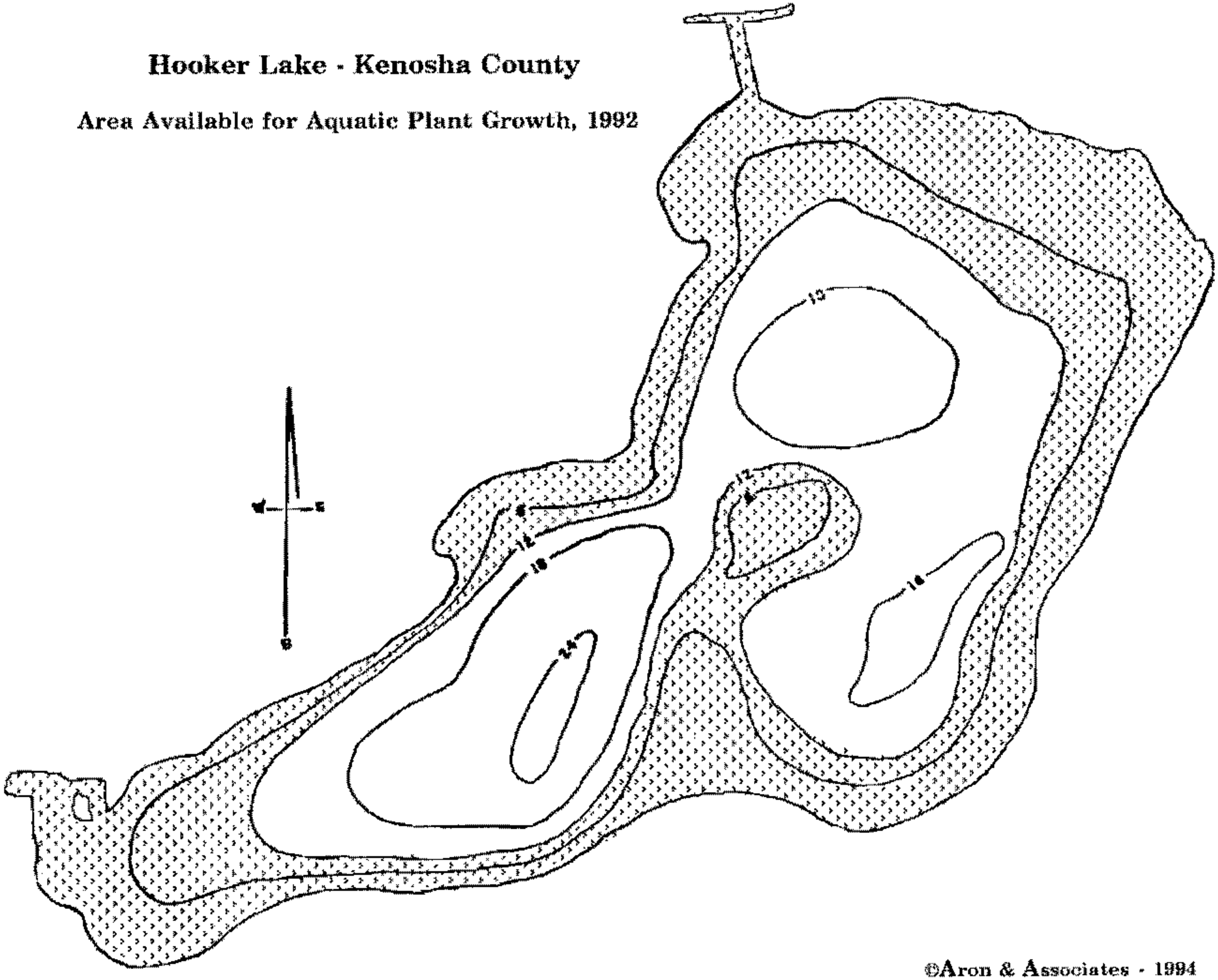


Table 2 -Aquatic Vegetation - 1992
Hooker Lake - Kenosha County, Wisconsin

Scientific Names	Common Names
Ceratophyllum demersum	coontail
Chara sp.	muskgrass
Elodea canadensis	common waterweed
Heteranthera dubia	water star grass
Lemna minor[1]	small duckweed
Myriophyllum spicatum	eurasian water milfoil
Najas flexilis	slender naiad
N. marina	spiny naiad
Nuphar sp. [2]	yellow water lily
Nymphaea sp. [2]	white water lily
Potamogeton. crispus	curly-leaf pondweed
P. illinoensis	Illinois pondweed
P. pectinatus	sago pondweed
P. Richardsonii	clasping-leaf pondweed
P. zosterformis	flat-stem pondweed
Typha sp.[2]	cattail
Utricularia vulgaris	great bladderwort
Vallisneria americana	water celery

1 Found during general survey
2 No specimen collected

Table 3 -Distribution of Aquatic Plants by Depth
Hooker Lake - Kenosha County, Wisconsin

Scientific Names	Common Names	Depths in feet 1.5	4	7-8	10-11
Ceratophyllum demersum	coontail	X	X	X	X
Chara sp.	muskgrass	X	X	X	J
Elodea canadensis	common waterweed	J	J	J	J
Heteranthera dubia	water star grass		A	A	A
Lemna minor[1]	small duckweed				
Myriophyllum spicatum	eurasian water milfoil	X	X	X	X
Najas flexilis	slender naiad	A	A	A	A
N. marina	spiny naiad	X	X		J
Nuphar sp. [3]	yellow water lily	J			
Nymphaea sp. [3]	white water lily	A	A		
Potamogeton. crispus[4]	curly-leaf pondweed	J	J	J	J
P. illinoensis	Illinois pondweed	X	X	X	
P. pectinatus	sago pondweed	X	X	J	J
P. Richardsonii	clasping-leaf pondweed		A		
P. zosterformis	flat-stem pondweed	X	X	X	J
Typha sp.[3]	cattail	J			
Utricularia vulgaris	great bladderwort	A			
Vallisneria americana[2]	water celery	A			

J indicates plant was found during June 1992 survey
A indicates plant was found during August 1992 survey
X indicates plant was found during both June and August surveys

1 Found during general survey
2 Also found during general survey in June
3 No specimen collected
4 Also found during general survey in August

After learning of the marked changes in the plant communities in 1992 following the chemical treatment, the District wanted to avoid the damage to the native plant communities with future treatments. Prior to the 1993 chemical treatment, a general survey of the lake was conducted. Overall, densities remained lower than that found in June 1992. Native pondweeds had rebounded and were found at levels similar to June 1992. Eurasian water milfoil was found only sporadically along the eastern shoreline and growth along the western end appeared much slower than 1992. The District made the decision to restrict treatment to eurasian water milfoil and coontail. It was decided that curly-leaf pondweed was not going to be treated since it usually dies off by mid summer. Because it is more selective, 2,4-

D was the only chemical used in 1993. During the actual treatment, some areas were not allowed to be treated because eurasian water milfoil was not yet to the surface. Those areas reached the surface within a week to ten days. Almost all of the areas that were not treated in 1993 and that had a history of eurasian water milfoil problems had reached nuisance conditions by August. The western shoreline was treated entirely and the treatment significantly reduced the nuisance conditions without harming the native pondweeds.

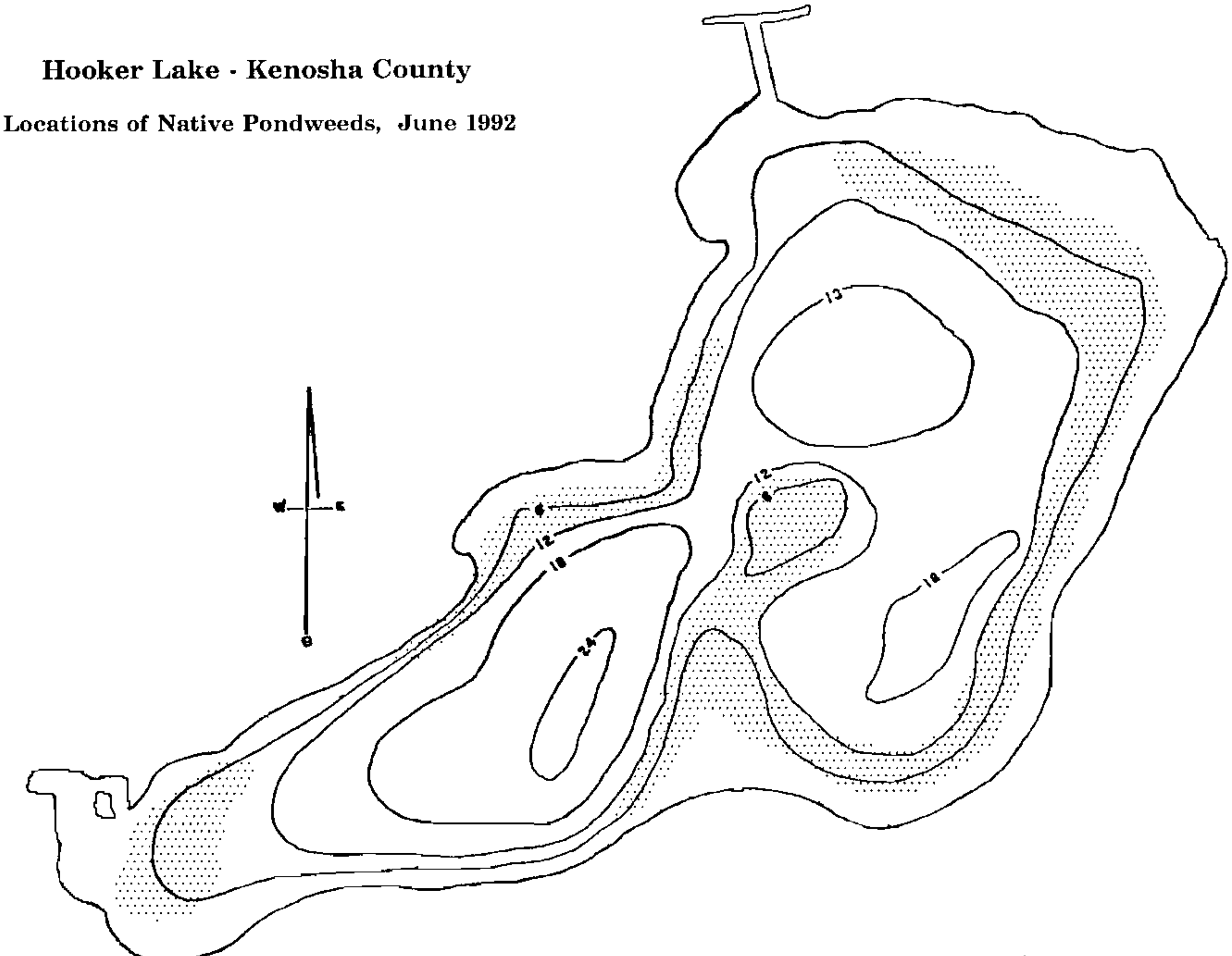
If chemical treatment continues to be the desired management option by the community, care should be taken to protect the native pondweeds. Native plants usually do not grow to and lay on the surface of the lake. Nor do they grow as densely as eurasian water milfoil. Well-established communities of native plants will help reduce the problems from eurasian water milfoil. Muskgrass beds should not be chemically treated as they too help prevent invasions from less desirable plants. Another option to consider may be the use of a new chemical such as Sonar. This chemical can be used in much colder temperatures before native plants begin to grow. It has been found to be an effective treatment against eurasian water milfoil (Pullman 1992). The District should consult with experienced professionals prior to consideration of this approach. As with any chemical treatment, a permit is needed from the DNR prior to treatment.

One additional component of the plant survey project was to use aerial photography to document plant beds. It was initially intended to have photos taken on a calm day in June near the survey day, and then another in August. The two sets of photos would be compared to further document the changes that occur over the summer, including the affect of the chemical treatment.

The first set of photos were taken within one week of the survey and are provided in the Appendix. The eurasian water milfoil 'fringe' is apparent along the 4 to 7 foot contour and on the western shoreline. The second set of photos were not able to be taken. Weather conditions, very poor water clarity conditions and increased cost prevented the second set of photos from being taken.

Hooker Lake - Kenosha County

Locations of Native Pondweeds, June 1992



Hooker Lake - Kenosha County

Locations of Native Pondweeds, August 1992

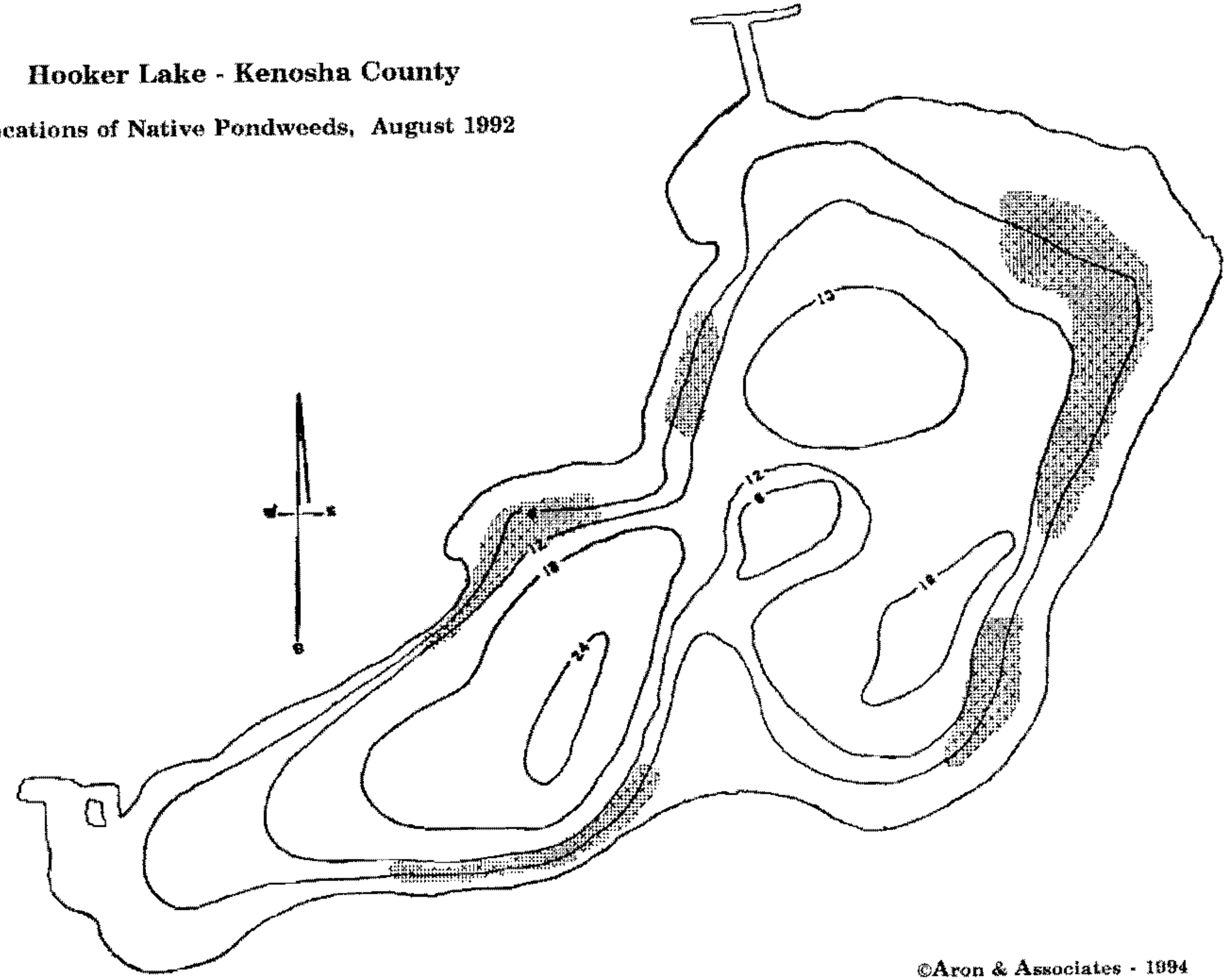


Table 4 - Mean Density of Aquatic Plants, June 1992

SPECIES	SPECIE CODE	% OF OCCURRENCE	SPECIE MEAN DENSITY	sum density
Eurasian water milfoil	MYRSPI	78	3.04	237
Coontail	CERDE	47	2.79	131
Muskgrass	CHASP	45	2.51	113
Spiny naiad	NAJMA	53	2.47	131
Curly-leaf pondweed	POTPC	29	2.24	65
Illinois pondweed	POTIL	15	1.80	27
Sago pondweed	POTPE	28	1.79	50
Common waterweed	ELOCA	16	1.50	24
Flat-stem pondweed	POTZO	8	1.13	9
Yellow waterlily	NUPHA	4	1.00	4
Cattail	TYPSP	1	1.00	1

Table 5 - Mean Density of Aquatic Plants, August 1992

SPECIES	SPECIE CODE	% OF OCCURRENCE	SPECIE MEAN DENSITY	sum density
Common waterweed	ELOCA	1	5.00	5
Coontail	CERDE	38	2.82	107
Muskgrass	CHASP	29	2.59	75
Slender naiad	NAJFL	22	2.27	50
Richardson's pondweed	POTRI	1	2.00	2
Sago pondweed	POTPE	3	2.00	6
Great bladderwort	UTRVU	1	2.00	2
Illinois pondweed	POTIL	10	1.80	18
Spiny naiad	NAJMA	8	1.75	14
Flat-stem pondweed	POTZO	4	1.25	5
White water lily	NYMSP	4	1.25	5
Water stargrass	HETDU	8	1.25	10
Eurasian water milfoil	MYRSPI	20	1.20	24
Wild celery	VALAM	1	1.00	1

Table 6-Transect Density June 1992

TRANSECT	1.5 FT	4 FT	7 FT	10 FT	SUM DENSITY
		DEPTHS			
1	8	14	14	8	44
2	8	8	12	9	37
3	*	8	8	6	22
4	2	5	8	4	19
5	7	9	10	6	32
6	5	10	9	6	30
7	7	5	12	5	29
8	7	9	6	2	24
9	7	5	7	3	22
10	2	5	4	1	12
11	2	9	5	1	17
12	4	12	8	8	32
13	1	11	9	3	24
14	1	10	6	3	20
15	4	8	5	5	22
16	7	4	7	4	22
17	*	8	9	8	25
18	*	10	5	5	20
19	*	7	5	7	19
20	*	12	9	3	24
21	*	12	9	1	22
22	17	6	5	7	35
23	10	12	8	11	41
24	12	13	11	0	36
25	10	10	15	9	44

Table 7-Transect Density August 1992					
		DEPTHS			SUM
TRANSECT	1.5 FT	4 FT	8 FT	11 FT	DENSITY
1	1	4	5	1	11
2	3	3	5	0	11
3	*	10	9	3	22
4	5	7	1	2	15
5	1	7	4	1	13
6	0	8	4	1	13
7	0	5	3	1	9
8	9	0	3	3	15
9	6	6	4	0	16
10	9	2	2	0	13
11	6	5	0	0	11
12	10	5	3	0	18
13	0	8	4	0	12
14	12	6	3	0	21
15	4	2	0	0	6
16	3	4	4	0	11
17	*	5	4	0	9
18	*	0	5	0	5
19	*	2	3	0	5
20	*	5	0	0	5
21	*	11	1	0	12
22	0	3	0	0	3
23	10	5	3	4	22
24	2	3	5	0	10
25	1	5	5	0	11

Watershed

A watershed consists of all the land that contributes water to a lake. To outline a watershed boundary, connect the points of highest elevation around a lake on a topographic map. Water falling within this bowl flows by gravity in streams and ground water to the lake.

A watershed can extend for miles. So, lake protection efforts must extend to the entire watershed. Because watersheds almost always extend beyond municipal boundaries, solutions may be difficult to implement.

Picture a drop of rainwater landing in your yard 1 mile from Hooker Lake. It washes onto the driveway and down to the roadside ditch where it flows into a culvert under the road, which then empties into a stream that feeds Hooker Lake.

That drop of water might contain lawn fertilizer, motor oil from the road, cow manure from the farm upstream, or dirt from the new development across the road. It all ends up in Hooker Lake. And it is probably loaded with phosphorus. Water entering Hooker Lake may have actually come from much farther away. So you can see, the potential for problems can be great.

A lake is a reflection of its watershed. It's not just a large tub of water. Take a clear jar and scoop up some lake water. At first glance it doesn't look like much. But if you look real close you'll see a jar teeming with life. Tiny whitish specks are swimming throughout the water. Those are zooplankton. They consume the tiny green algae cells in the water. The zooplankton become food for small fish, who are food for big fish, etc. That huge food chain begins with those tiny critters in the jar. Disrupting one element in that chain has a domino effect on the rest of the system.

The Hooker Lake watershed is 1133 acres (SEWRPC , 1979). The ratio of watershed area to lake size is 13:1. Lakes with ratios greater than 10:1 tend to develop water quality problems (Uttermark, 1978). The greater the land area the more opportunities there are for land changes that may lead to soil erosion, nutrient, fertilizers and pesticide use that may wash into lakes.

Map 6 illustrates the boundary of the Hooker Lake watershed as identified by SEWRPC. Map 7 shows the land uses found during field inspections by Aron & Associates staff. Open space and agriculture are the dominant land uses (37%) followed closely by wetlands and woodlands that comprise 31% of the watershed (Table 8).

Estimates of potential development rates and the sources phosphorus loading in the Hooker Lake watershed were provided by SEWRPC in 1979. At that time, SEWRPC estimated that the major sources of phosphorus were from livestock operations, runoff from construction activities, and runoff from rural land. In 1994 the major sources of phosphorus were runoff from construction activities, runoff from rural land, and runoff from urban lands (Table 9). Livestock operations were reduced significantly since 1979. The contribution from onsite sewage systems was also eliminated with the construction of the sewer system.

Table 8- Land Use within the Hooker Lake Drainage Area, 1994

Land Use	Area-Percent	Area-Acres
Open space and Agriculture	37%	415
Urban	24%	275
Surface water	8%	87
Wetlands/woodlands	31%	356
Total	100 %	1133

Source: Aron & Associates

It should also be noted that the rate of urban development in the Hooker Lake watershed is significantly lower than that anticipated in 1979. Instead of a five acre per year predicted agriculture to urban conversion rate, the actual rate has been about 1.5 acre per year.

Wetlands and woodlands are an important component of the natural resource value of Hooker Lake. Most of the wetlands in the Hooker Lake watershed found north of the lake are protected by a conservancy. The largest area of woodlands is also located north of the lake and is adjacent to the conservancy area. This woodland has been designated as primary environmental corridor (SEWRPC 1986). This designation would limit development to one unit per five acres. Any development that occurs in this woodland should be very carefully planned to preserve this important habitat. This woodland area would be a good candidate for protection by the community. Development that occurs adjacent to wetlands should also be monitored to protect the wetlands. Excessive sedimentation from construction sites can significantly alter the balance in wetlands, affecting its functional value.

Acquisition of lands to protect the degradation of a natural resource can be funded with the support of a number of grant programs. The Wisconsin Stewardship Grant Program and the Wisconsin Lake Protection Grant Program are two that may assist with funds for acquisition. Purchase of land or easements are options under the funding programs. The Department of Natural Resource Community Assistance staff will assist with applications for such projects.

Construction site erosion during urban development can pose a significant problem for the lake should development pressures in the area increase. State requirements for prevention of construction erosion should be followed carefully, and enforced, during any shoreline construction. Landowners should be encouraged to minimize disruption of the steep slopes.

No ms

Table 9 - Estimated Direct Tributary Phosphorus Loads to Hooker Lake 1975 to 2000

Source: SEWRPC and Aron & Associates

	1975		1995		2000	
Land Use	Acres	Loading*	Acres	Loading*	Acres	Loading*
URBAN	242	106	270	120	391	191
CONSTRUCTION	5	236	5	236	5	236
ONSITE SEWAGE	14	40			0	0
RURAL	799	224	771	217	650	181
LIVESTOCK (units)	49	323	5	33	0	0
ATMOSPHERE	87	44	87	44	87	44
SURFACE WATER	87		87		87	
TOTAL		973		650		652

* Pounds of phosphorus per year

** Table assumes no additional non-point source control

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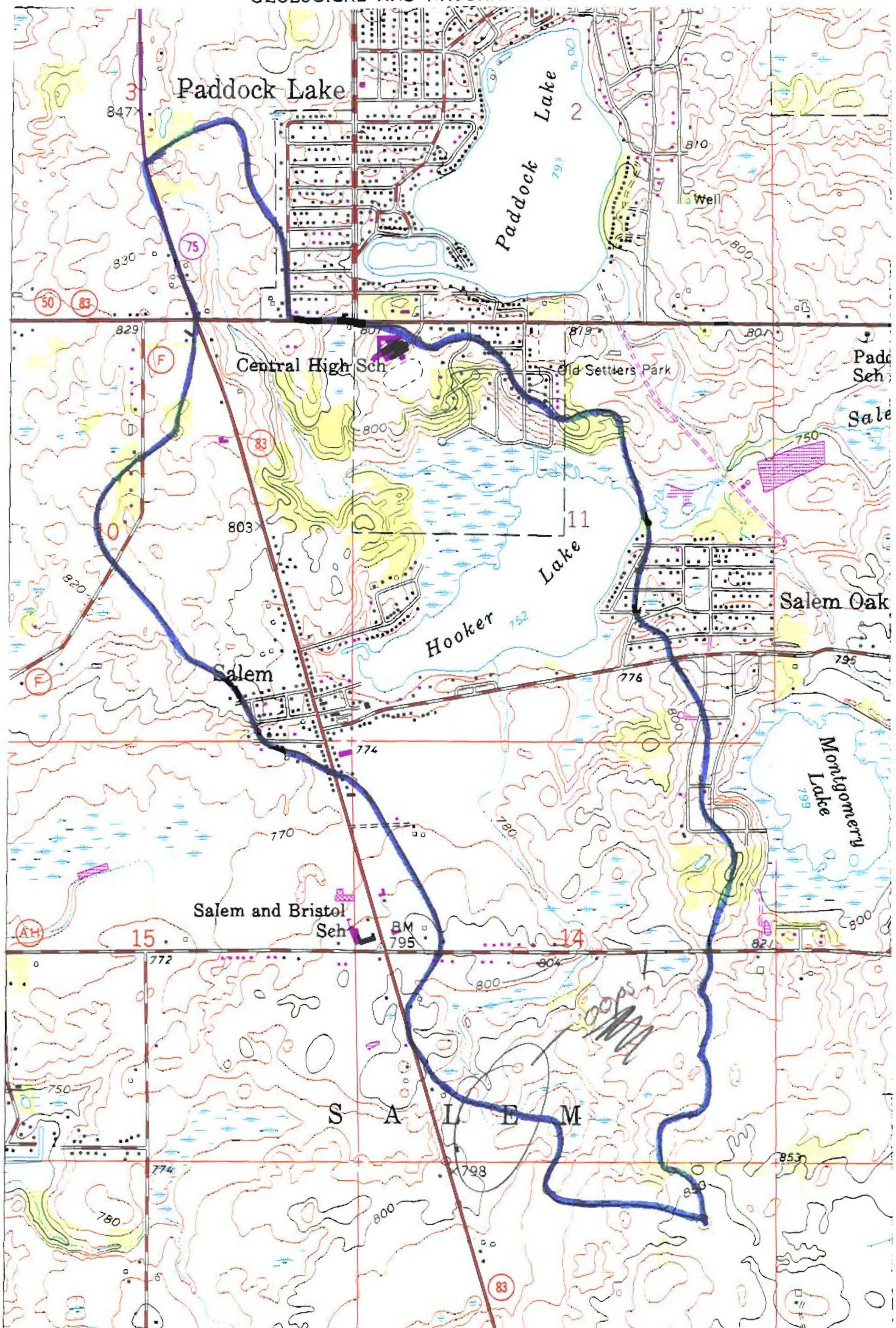
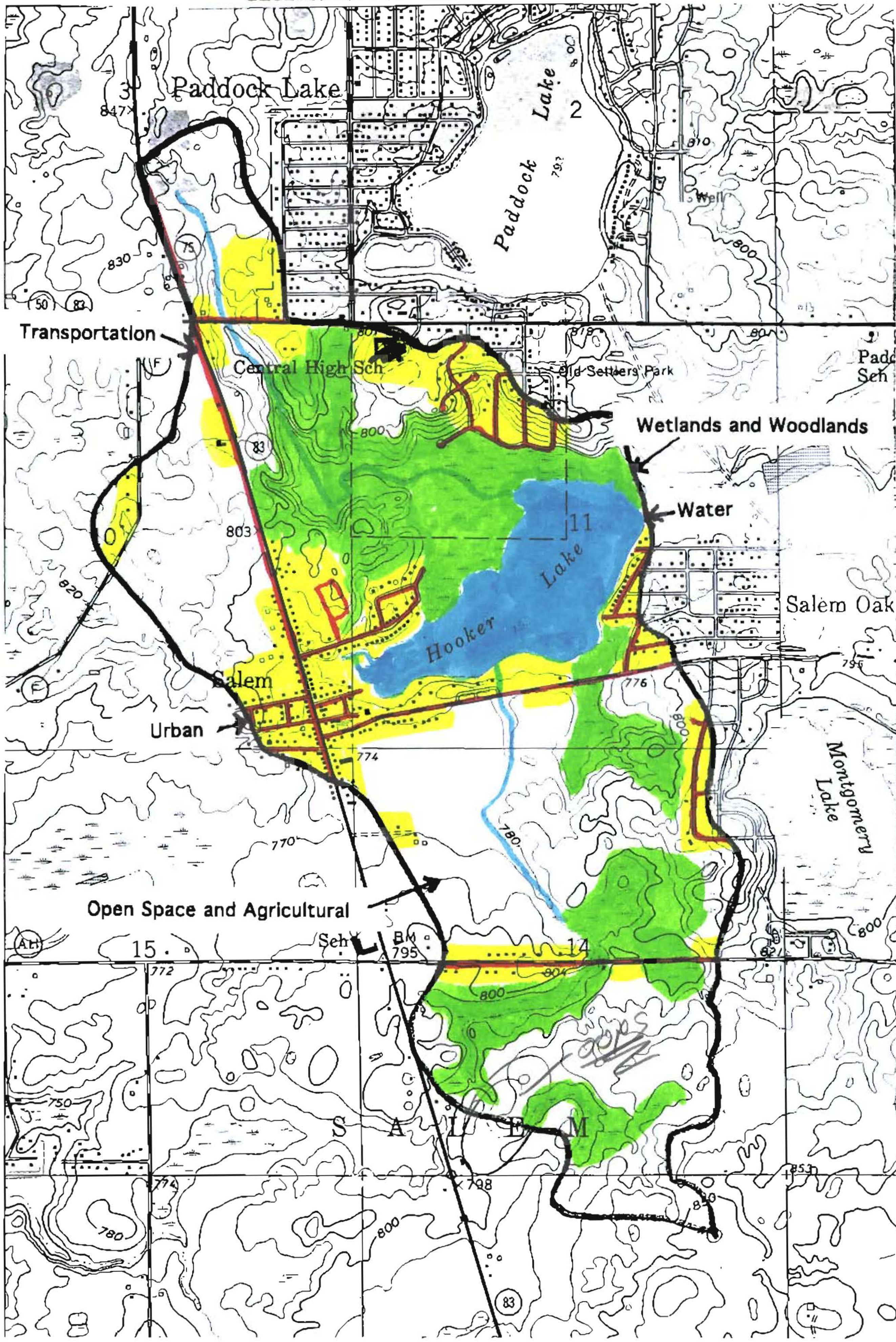
SCALE?

STATE OF WISCONSIN
STATE HIGHWAY COMMISSION
GEOLOGICAL AND NATURAL HISTORY SURVEY



STATE OF WISCONSIN
STATE HIGHWAY COMMISSION
GEOLOGICAL AND NATURAL HISTORY SURVEY



STATE OF WISCONSIN
STATE HIGHWAY COMMISSION
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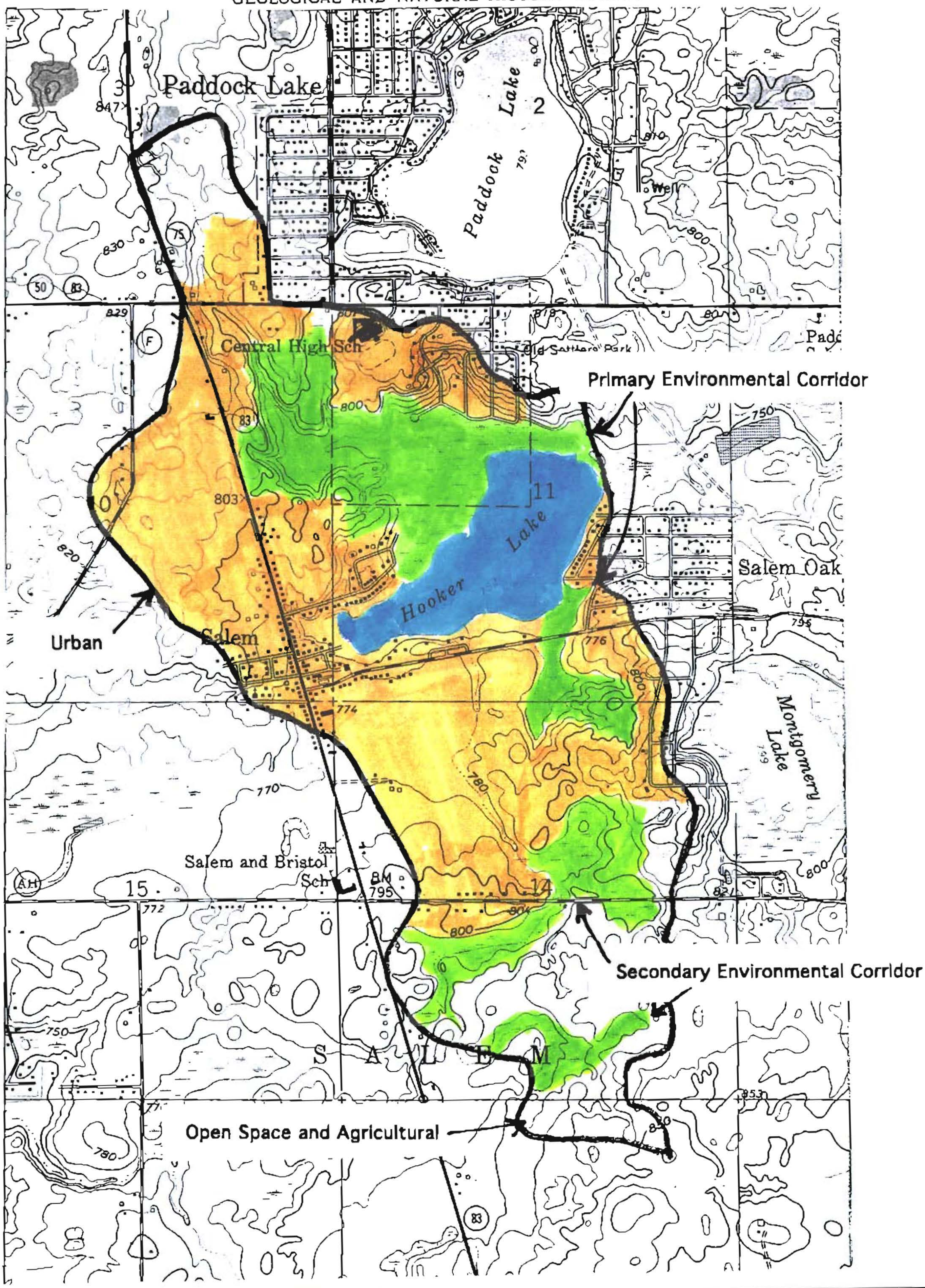

Recreational Use

A community survey of residents and landowners was conducted by the District in 1991. The survey was designed to assess opinions, concerns, issues and desires that were important to those responding. This basis of understanding is crucial to the successful implementation of lake management efforts. If lake users don't fish, they will not understand the need for vegetation in the lake. If lake users don't swim, they will likely not understand the frustration with vegetation that is too dense. If lake users enjoy wildlife and fish, they will not enjoy hearing ski boats all day and evening.

The Hooker Lake Community Survey brought to light a concern that some residents had with respect to lake use. Some believe that lake use, that is, speed boating and skiing, were causing reduced water clarity, damaging aquatic plant communities and eroding cattail stands. Four actions were undertaken to assess the validity of the concern. 1) a volunteer would begin taking water clarity readings (Secchi disk); 2) a boat count would be taken; 3) high use periods would be monitored occasionally to assess traffic; and 4) historical records would be reviewed to determine if the cattail fringe had changed significantly.

The initial plan for monitoring water clarity was to test the clarity on Mondays and Thursdays to see if the lake became more cloudy after heavy weekend use. Although a volunteer monitored as much as possible, choppy lake conditions and scheduling conflicts did not allow more than once a week sampling. Although clarity declined during summer months, the greatest decline followed the die-off of plants from the chemical treatment. Algae, instead of plants, dominated the lake.

The riparian boat count proved more successful. A total of 77 boats were moored at 68 homes on the lake. The largest number of watercraft were fishing boats. Thirty-three were noted on the survey. Speed boats were second with a total of 13 on the lake; all with motors larger than 50 horsepower. Twelve pontoon boats and ten paddleboats were moored on the lake. There were seven canoes and two personal watercraft (jetskiis). The lake area to boat ratio was just under one per acre.

Weekend and holidays were checked five times during 1992. On each occasion, the maximum number of boaters using the lake never exceeded seven. Fishing boats averaged 2.2 per visit; ski boats averaged 1.6; and other watercraft such as canoes and jetskiis averaged 0.6 per visit. The maximum numbers indicated a boat to lake ratio of 1:12.

Crowded conditions, or more appropriately, the perception of crowding, is a correlation of the type of use. More canoes can safely use an 87 acre lake than can ski boats. Another factor is the individual's frame of reference. Someone used to the weekend use levels found on Hooker Lake would feel very crowded on Brown's Lake in Racine County. Yet if they were used to the quiet solitude found on some northern lakes, they might feel quite crowded on Hooker Lake. Finding a safe balance among competing lake users should be addressed with an educational program.

To review the size and configuration of the cattail marsh, 1963 and 1990 aerial photographs were obtained from the Southeastern Wisconsin Regional Planning Commission. The cattail fringe of the 1963 map was traced onto a mylar which was then placed over the 1990 map. The perimeter of the cattail fringe was virtually identical between the two maps.

Management Recommendations

The Hooker Lake Association and the area residents are to be commended for their efforts during this planning project and for the amount of time and energy spent working to improve their public resource. Based on this planning effort, a number of items are presented for further consideration.

Aquatic Plants

The diversity of the aquatic plant community could be better. A couple of factors are likely restricting the diversity, including the density of nuisance vegetation, the historical chemical treatments with non-selective herbicides. More selective treatments that protect native vegetation may lead to a rebound of the native plants, possibly producing conditions more acceptable to residents. Supplementing existing plant communities may also be done by planting natives. Consult with DNR staff or a qualified professional to prior to planting to be sure the planned activity conforms to the existing vegetation.

Education of lake users can also help re-establish native plant communities. One way to minimize problems with nuisance plants is to protect the native plants. Eurasian Water Milfoil will rarely move into an already inhabited area. Minimize boating in the shoreline areas and large shallow bays. Confine high speed boating activities to the deep water zones of the lake. Educate lake users to keep jet-skiers in the deep water zones as well.

Changes in aquatic plant communities can signal problems with water quality. An aquatic plant survey should be conducted every three to five years and should repeat the transects established through this planning effort.

It is not likely that aquatic vegetation will ever be scarce on Hooker Lake, especially in the western end of the lake. The nutrient rich sediments will continue to support a healthy plant community. It is also interesting to note that a postcard from 1940 showed rather extensive beds of lily pads covering the west end (a photocopy is provided in this report and the original given to the District).

Water Quality

Water quality data is extremely important to lake management. Without actual, long term data, it is very difficult and often impossible to make good management decisions. Lake organizations have at times spent lots of time, energy and money and failed to produce their desired results, usually because not enough information was acquired on which to base their decisions.

It is recommended that the Hooker Lake Management District consider water quality sampling every two to three years. This would minimize the costs to the District while at the same time developing the very important database. Also, volunteers should continue to measure water clarity and should be sure to send the information regularly to Madison DNR. Volunteers should also take notes to document the results to other factors such as relationship to chemical treatments, heavy lake use days, etc.

Information - Education

The local community is very concerned with their water resource. Many hours are spent on projects such as measuring water clarity and providing additional public access to the lake. Bringing new volunteers into the District activities can go a long way towards minimizing volunteer burnout. A well-educated, informed public will be more inclined to contribute time and effort towards protecting something important to them. The District should consider developing a newsletter for the residents and the community. Even when distributed once or twice a year, a newsletter can give people a valuable link to their lake, especially important in areas with high numbers of seasonal homes. Local University Extension agents, DNR staff or private consultants can assist with articles for a newsletter and can help provide ideas for layout and design. Funding is also available from the DNR to assist with the cost of educational materials and distribution.

The District should consider the results of the Community Survey when planning projects or developing informational programs. Careful consideration of the information provided may point to specific needs the community may wish to focus on. Conflicting desires by lake residents amplify the need for education. Many understand the need for aquatic plants for a healthy fishery, but also want to swim and ski without weeds. Finding a balance for the various lake user's desires will need to consider heavily the impact to the water resource.

Watershed

The regional plan for development of the Hooker Lake watershed through the year 2010 anticipates a significant increase in the urban density. This would have an impact on all aspects of life in the community, including traffic, schools, safety, and crowding. Residents should begin to get involved in land use planning decisions for lands within the watershed immediately to ensure the community continues to reflect the goals and needs of the residents. Attending Town and County meetings will alert residents to potential problems that may be forthcoming. Maintain regular contact with Town officials and County representatives (through the new newsletter) to improve their understanding of how to protect the valuable natural resource. The public officials can also provide information about who is the best person to contact to solve particular concerns.

The District should consider forming a "Watershed Watch" program. Such a program would educate the community about the lake and ways to protect it; and it would ensure that activities taking place within the watershed are reviewed and permitted. Volunteers could watch for construction site erosion, earth moving activities, chemical spills, burning in ditches, etc, anything that could prove harmful to the lake. A contact person or committee could be set up to review complaints, determine means to handle and work correct the problems. This should be coordinated with the Town, County and DNR.

Exotics

Watch for invasions of purple loosestrife and take immediate steps to control it. Once sold in nurseries as a landscape plant, purple loosestrife is now destroying our wetlands. The plant invades marshes and lake shores, replacing cattails and other more beneficial wetland plants. The plant can form dense stands which are unsuitable as cover, food or nesting sites for animals and waterfowl. The plant is a prolific seed producer: one plant can disperse 2 million seeds annually. The plant can also resprout from roots and broken stems that fall to the ground or into the water. The best way to control loosestrife is to catch it in the early stages, before it takes over an area. Handpulling young plants, taking care to contain the flower stalks and seeds, and burning the plants will help prevent its spreading.

Zebra mussels are another invader the District should watch for. Zebra mussels began clogging up pipes in waste water treatment plants along the Great Lakes in 1988. The mussels have been found in the Milwaukee River, the Wisconsin shoreline of Lake Michigan and more recently, a couple of inland lakes. Female mussels can produce 30,000 to 300,000 eggs per year. An adult mussel can attach to virtually any solid underwater surface. In its larvae form (called veligers) they can be spread by scuba divers, waterfowl and boat motors. Because mussels filter one or more liters of water per day, there is a significant potential for a negative impact on aquatic food chains. They may also impact fish spawning areas by colonizing rocky bottom areas used for spawning. Zebra mussels can be very costly for recreational boaters. Extensive engine damage can occur from veligers and mussels. If you find evidence of zebra mussels, do not throw it back into the water. Store it in rubbing alcohol if possible, and immediately contact the DNR and the Lake District and the University of Wisconsin Sea Grant Institute.

There are things people can do to minimize the threat of exotics. Thoroughly rinse any equipment used in the Great Lakes or other infested waters. Water of 110° F will kill the veligers (young mussels), 140° F will kill the adult mussels and water fleas. Thoroughly drain and rinse all boat compartments, cooling systems, livewells, bilge water and transom wells. Empty your bait bucket on land, never into the water. Never dip your bait or minnow bucket into one lake, if it has water in it from another. And let everything dry for three days before transporting your boat to another body of water. For more information contact the Wisconsin Sea Grant Institute.

Wetlands and Woodlands

Another valuable activity revolves around wetlands. Protection is critical to the long term health of Hooker Lake. The District can help residents and property owners understand their importance:

- Wetlands are important water storage areas. They release water slowly and help prevent flooding downstream.
- Wetlands trap sediment that may be eroding from upland areas. Too much polluted runoff can be damaging. Without wetlands, our lakes fill in more rapidly.
- They also trap the nutrients and chemicals that are carried with the silt. Too many nutrients in our lakes produce aquatic plant and algae problems.
- Wetlands serve as natural sponges, holding excess water, and recharging ground water systems that provide water for people's wells.
- Wetlands provide cover, food and water for hundreds of species of wildlife year-round. The decline in waterfowl, that many depend on for hunting, has been directly attributed to the lack of wetlands for waterfowl migration patterns.
- Wetlands provide breeding and nursery areas for fish. Game fish spawn in wetland areas. Larger fish depend on food produced in and near wetlands.
- Many people depend on wetlands for their recreation: hunters, anglers, photographers, bird-watchers, and others.
- In-lake wetland areas protect shorelines against wave action and erosion.

The District should consider acquiring the large woodland north of the lake. Protection of this area would significantly improve the value and long term protection of the primary environmental corridor. As these woodlots are eliminated because of development, wildlife that depend on the area are also eliminated. The entire ecosystem of a region depends in part on the variety and habitat afforded by woodlands. The proximity of this woodland to the lake and wetland conservancy also increases its importance. Acquisition would prevent potentially unsuitable development from damaging the wetland and ultimately, the lake.

Final Report

Public meetings have been held to present the results of this planning project. The District held annual meetings in 1992, 1993, and 1994. At the 1992 and 1993 annual meetings the results of the plant surveys were presented. Mounted plant specimens and live plants, were available for the residents to review. The USGS presented the results of their water quality sampling at the 1994 annual meeting. A summary of the planning project including review of the watershed also was conducted during the 1994 meeting. The District notified landowners and residents of the meetings by direct mail.

Table 10 - Public Involvement in Hooker Lake Planning Grant Project

August 1991	Annual Meeting - discuss the Planning Grant process, needs and wants.
August 1992	Annual Meeting - discuss the Grant award and present the results of the aquatic plant survey conducted in 1992.
August 1993	Annual Meeting - discuss data on water quality monitoring, and aquatic plant survey for 1993 and chemical treatment.
August 1994	Annual Meeting - USGS presents the water quality monitoring results; present summary of planning project.

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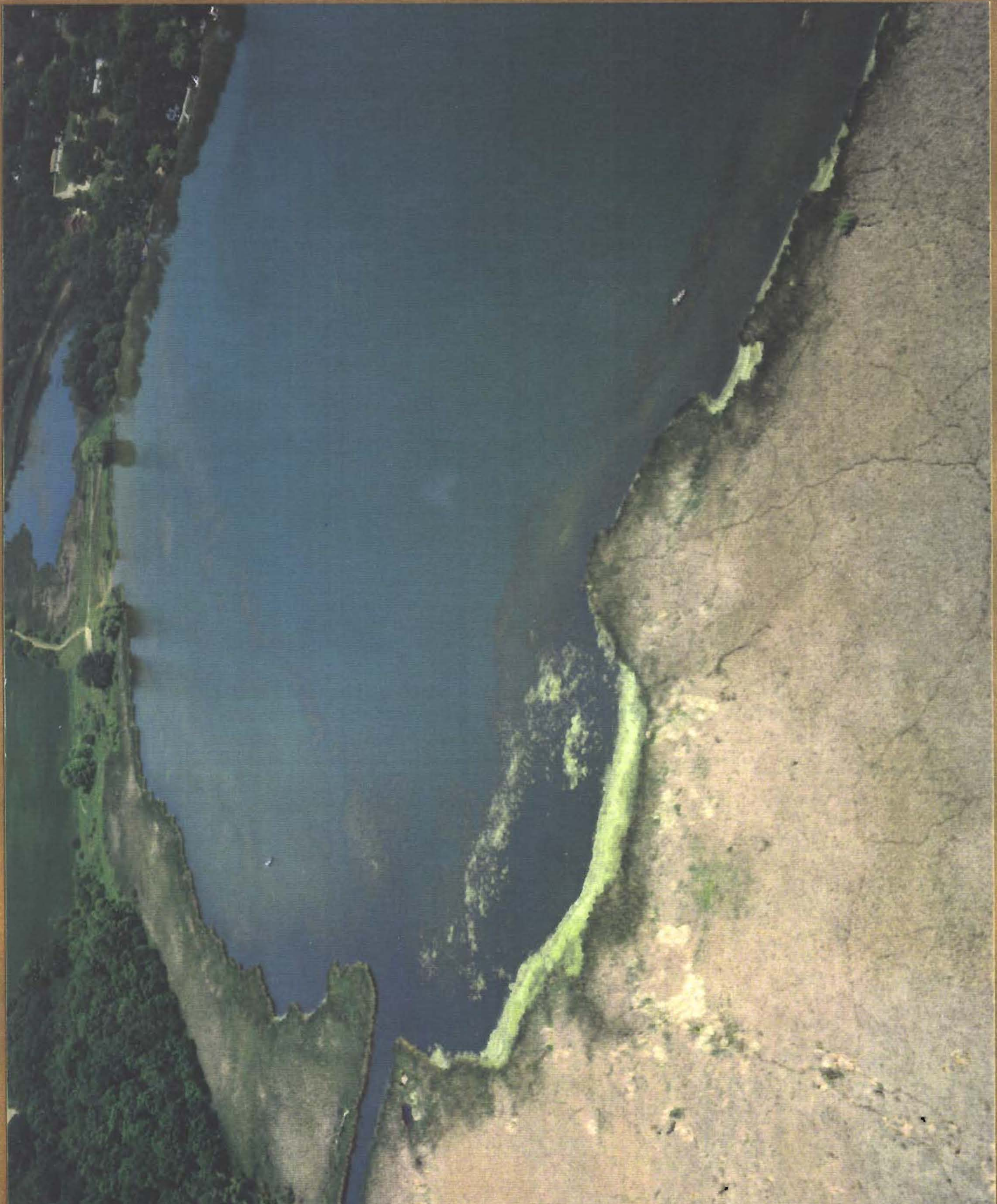

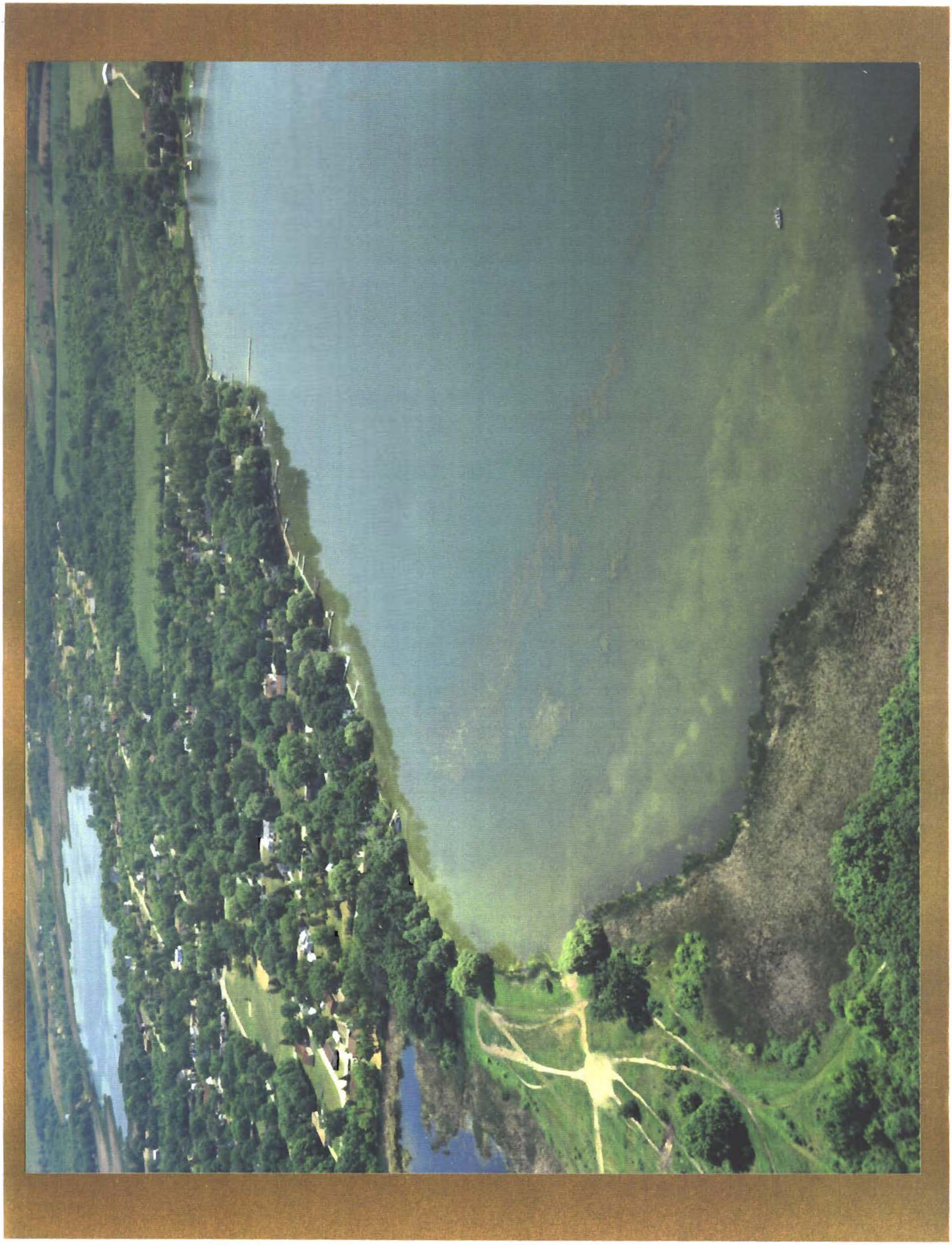

United States Department of the Interior

GEOLOGICAL SURVEY

Water Resources Division
6417 Normandy Lane
Madison, Wisconsin 53719-1133
608 274-3535 (Fax 608 276-3817)

June 24, 1993

Mr. Geoffrey L. Wheeler, President
Hooker Lake Management District
P.O. Box 287
Salem, Wisconsin 53168

Dear Mr. Wheeler:

This letter describes the progress on the evaluation of the water quality of Hooker Lake according to the data collected from October 1991 to September 1992 as stated in our agreement. Please read the enclosure, "U.S. Geological Survey Lake Monitoring Program in Wisconsin", before proceeding with this letter.

In a brief summary, based on the 1992 data:

- The water quality of Hooker Lake, based on chlorophyll a and total phosphorus data, is fair to good and can be classified as a lower eutrophic lake or one with many nutrients
- Algal growth appears to be dependent upon the amount of available phosphorus rather than nitrogen.
- In July and August, during summer stratification, oxygen disappears from a small portion of the lake bottom which is then unable to support a fish population.
- During the summer anoxic (devoid of oxygen) period, there are minor amounts of phosphorus being released from the bottom sediments.
- The data enclosed herein are provisional until published.

Hooker Lake has a surface area of 87 acres (0.14 square miles). One site was sampled in Hooker Lake. It was located approximately at the deepest spot in the lake at a depth of about 25 feet and is shown in figure 1.

The data for this report are found in the following tables and figures:

Table 1. Lake-depth profiles for Hooker Lake at Salem, Wisconsin, 1992 water year

Table 2. Water clarity and water-quality analyses and their associated Trophic State Indices (TSI) for Hooker Lake at Salem, Wisconsin, 1992 water year

Figure 1. Location of sampling site and staff gage on Hooker Lake at Salem, Wisconsin

Figure 2. Lake water-quality data for Hooker Lake at Salem, Wisconsin, 1992 water year

Figure 3. Trophic State Indices for Hooker Lake at Salem, Wisconsin

All the water-quality samples collected were analyzed by the Wisconsin State Laboratory of Hygiene at Madison, Wisconsin. The water-quality data is published in our annual publication, "Water Resources Data for Wisconsin, 1992".

LAKE-STAGE FLUCTUATIONS

Lake stages were read from a staff gage at the boat landing off 83rd Street by Ken Paull. Lake-stage data are listed in figure 2. Lake stages fluctuated 0.58 feet and ranged from 10.44 feet on August 17 to 11.02 feet on April 2. More lake-stage readings should be obtained by the lake district.

LAKE-DEPTH PROFILES

Profiles of water temperature, dissolved oxygen, pH, and specific conductance at the deep hole are listed in table 1 and shown in figure 2. No abnormalities in the data are apparent. Among our sampling dates, complete water-column mixing was observed on April 2. The remainder of the profile data show incomplete mixing. The lake thermally stratifies during summer. During July and August, the bottom 6 feet of water became anoxic (devoid of oxygen) and were unable to support fish. The levels of pH are within acceptable limits to support aquatic life. Because of the high buffering capacity of the lake water, Hooker Lake is not susceptible to the effects of acid rain.

SELECTED ANALYSES

Analyses of selected constituents for April 2 for samples collected at 1.5 and 24-foot depths are listed in figure 2. The water-quality values for color, chlorophyll a, calcium, magnesium, pH, alkalinity, total nitrogen and total phosphorus are within regional values for this area as described by Lillie and Mason in "Limnological Characteristics of Wisconsin Lakes," 1983, Technical Bulletin No. 138, Department of Natural Resources.

To compute the nitrogen-phosphorus ratio, only the sample collected from the 1.5-foot sampling depth for April was used. This depth was used because algae grow in the upper part of the lake rather than at the bottom. The ratio of total nitrogen to phosphorus was calculated as approximately 54:1 and suggests the lake is phosphorus-limited. This means algal growth appears to be dependent on the amount of available phosphorus rather than nitrogen.

APRIL, JUNE, JULY AND AUGUST WATER QUALITY

The data for total phosphorus, chlorophyll a, and Secchi-depth readings, are listed in table 2 and on figure 2.

Total phosphorus: Total phosphorus concentrations sampled at a 1.5-foot depth range from 0.020 mg/L in June to 0.037 mg/L in April. All values fall within the regional values previously referenced.

Concentration of total phosphorus 1.5 feet above the lake bottom ranged from 0.023 mg/L in June to 0.184 mg/L in August. These concentrations are indicative of minor phosphorus release from the bottom sediments during anoxic (absence of oxygen) periods.

Chlorophyll a: Chlorophyll a concentrations, which indicate algal biomass, ranged from 9 µg/L in June to 19 µg/L in April. These data are within the regional values.

Secchi disc: Secchi-disc depths, which indicate water clarity, ranged from 2.6 feet in August to 7.2 feet in June. These data are within the regional values.

TROPHIC STATUS

Lillie and Mason (1983) classified Wisconsin lakes using a random data set (summer, July and August) according to total phosphorus and chlorophyll a concentrations, and Secchi-disc depth. This evaluation is shown below:

Water quality index	Approximate total phosphorus equivalent (mg/L)	Approximate chlorophyll a equivalent (µg/L)	Approximate water clarity equivalent (Secchi-disc depth in ft)
Excellent	<0.001	<1	<19.7
Very good	.001-.010	1-5	9.8-19.7
Good	.010-.030	5-10	6.6-9.8
Fair	.030-.050	10-15	4.9-6.6
Poor	.050-.150	15-30	3.3-4.9
Very poor	>.150	>30	<3.3

Using the above criteria to evaluate the mean summer (July-August) 1992 data shown in table 2 for Hooker Lake, surface total phosphorus concentrations indicate good water quality, chlorophyll a concentrations indicate fair water quality, and Secchi-disc depths indicate very poor water quality. The Secchi-disc depths for July and August may, however, misrepresent the lake's water quality as discussed under Carlson's Trophic State Index.

Using the data from "Limnological Characteristics of Wisconsin Lakes," 1983, by Lillie and Mason, a comparison of the 1992 mean summer data (July and August) for total phosphorus, chlorophyll a, and Secchi depths for Hooker Lake to other lakes in southeast Wisconsin are shown below:

	Parameter	Percentage of distribution of lakes in southeast Wisconsin within these concentrations	
	Total phosphorus (mg/L)		
	<.010	Best condition	7
	.010-.020	↓	21
Hooker Lake values →	.020-.030		15
	.030-.050		21
	.050-.100		21
	.100-.150		3
	>.150	Worst condition	12
	Chlorophyll a (μg/L)		
	0- 5	Best condition	22
	5-10	↓	31
Hooker Lake values →	10-15		14
	15-30		12
	>30	Worst condition	22
	Secchi depth (in feet)		
	>19.7	Best condition	1
	9.8-19.7	↓	9
	6.6- 9.8		26
	3.3- 6.6		31
Hooker Lake values →	<3.3	Worst condition	33

Comparing other lakes in southeast Wisconsin to the 1992 data for Hooker Lake, the above data show, during the period 1966 to 1979, 28 percent had lower total phosphorous concentrations, 53 percent had lower chlorophyll a concentrations, and 67 percent had better water clarity.

A second approach to assessing the "health" or trophic status of a lake is to use Carlson's Trophic State Index (TSI). A graphic illustration of the Trophic State Index for Hooker Lake is shown on figure 3. The data from 1992 show Hooker Lake to be lower eutrophic or one with many nutrients.

The July and August TSI values for Secchi depth plot considerably higher than those for chlorophyll a. This suggests that turbidity caused by fish, motorboats, winds, etc., may be the reason for the higher TSI. Therefore, chlorophyll a concentrations may better represent the lake's water quality than Secchi depth.

The data that has been collected for Hooker Lake from 1992 is extremely important for understanding the lake's water quality and managing the lake. To continue with the monitoring will help to build a very valuable data base.

If you have any questions regarding this evaluation, please contact me at 608/276-3842.

Sincerely,

Stephen J. Field
Biologist

Enclosures

cc: Bob Wakeman, DNR, Milwaukee

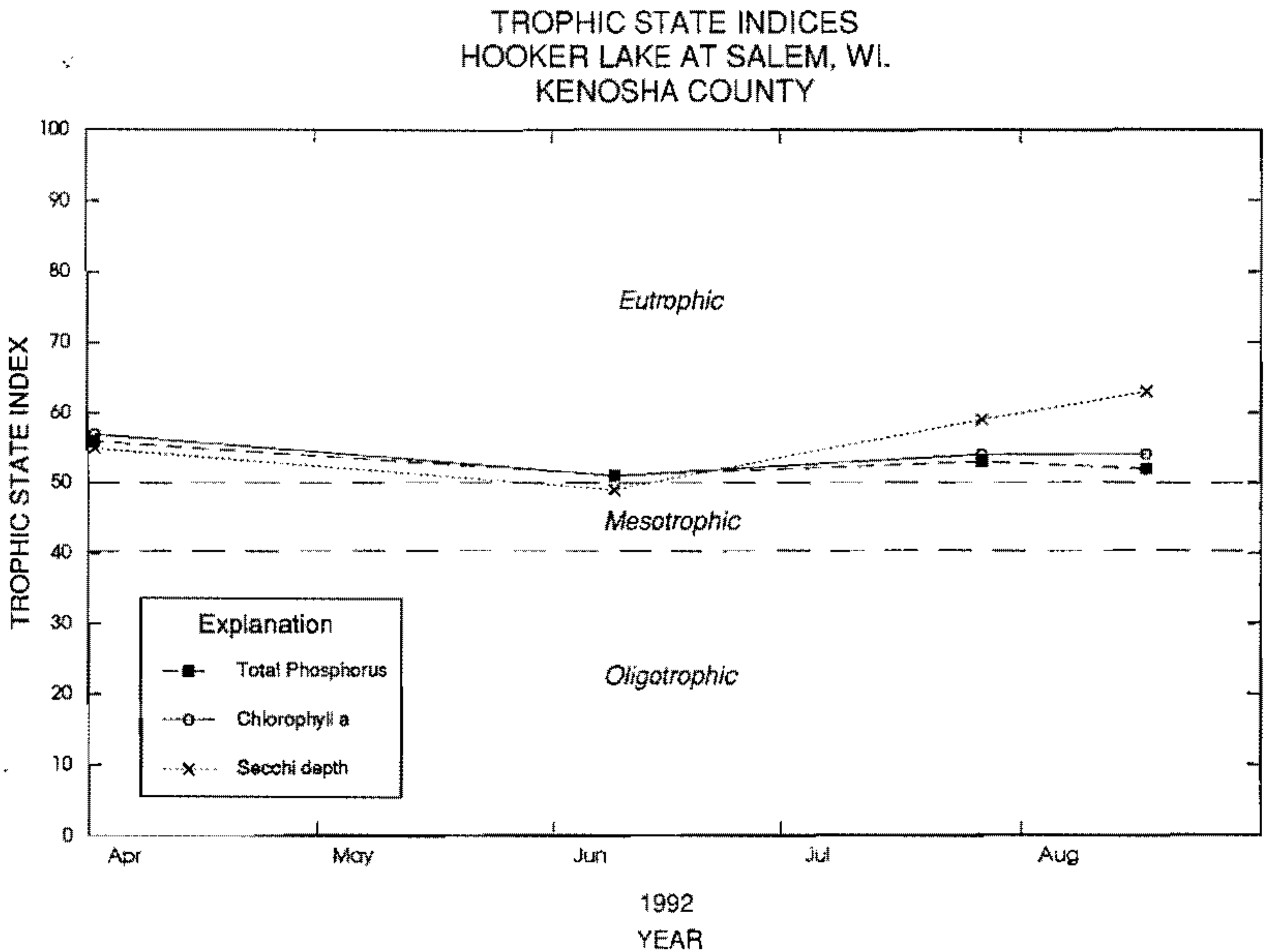

Figure 3. Trophic State Indices for Hooker Lake at Salem, Wisconsin

United States Department of the Interior

GEOLOGICAL SURVEY
Water Resources Division
6417 Normandy Lane
Madison, Wisconsin 53719-1133
608 274-3535 (Fax 608 276-3817)

April 12, 1994

Mr. Geoffrey L. Wheeler, President
Hooker Lake Management District
P.O. Box 287
Salem, Wisconsin 53168

Dear Mr. Wheeler:

This letter describes the progress on the evaluation of the water quality of Hooker Lake according to the data collected from October 1992 to September 1993 as stated in our agreement. Please read the "U.S. Geological Survey Lake Monitoring Program in Wisconsin", sent to you last year, before proceeding with this letter.

In a brief summary, based on the 1993 data:

- The water quality of Hooker Lake is fair and can be classified as a lower eutrophic lake or one with many nutrients.
- Algal growth appears to be dependent upon the amount of available phosphorus rather than nitrogen.
- In July and August, during summer stratification, oxygen disappears from the bottom portion of the lake which is then unable to support a fish population.
- During the summer anoxic (devoid of oxygen) period, there are moderate amounts of phosphorus being released from the bottom sediments.
- The data enclosed herein are provisional until published.

Hooker Lake has a surface area of 87 acres (0.14 square miles). One site was sampled in the lake. It was located approximately at the deepest spot in the lake at a depth of about 25 feet and is shown in figure 1.

The data for this report are found in the following tables and figures:

Table 1. Lake-depth profiles for Hooker Lake at Salem, Wisconsin, 1993 water year

Table 2. Water clarity and water-quality analyses and their associated Trophic State Indices (TSI) for Hooker Lake at Salem, Wisconsin, 1993 water year

Figure 1. Location of sampling site and staff gage on Hooker Lake at Salem, Wisconsin

Figure 2. Lake water-quality data for Hooker Lake at Salem, Wisconsin, 1993 water year

Figure 3. Trophic State Indices for Hooker Lake at Salem, Wisconsin

All the water-quality samples collected were analyzed by the Wisconsin State Laboratory of Hygiene at Madison, Wisconsin. The water-quality data is published in our annual publication, "Water Resources Data for Wisconsin, 1993".

LAKE-STAGE FLUCTUATIONS

Lake stages were read from a staff gage at the boat landing off 83rd Street by the U.S. Geological Survey at the time of sampling. Lake-stage data are listed in figure 2. Lake stages fluctuated 1.18 feet and ranged from 10.62 feet on August 23 to 11.81 feet on April 22.

LAKE-DEPTH PROFILES

Profiles of water temperature, dissolved oxygen, pH, and specific conductance at the deep hole are listed in table 1 and shown in figure 2. No abnormalities in the data are apparent. Among our sampling dates, complete water-column mixing was observed on April 22. The remainder of the profile data show incomplete mixing. The lake thermally stratifies during summer. During June, July and August, the bottom 9 feet of water became anoxic (devoid of oxygen) and were unable to support fish. The levels of pH are within acceptable limits to support aquatic life. Because of the high buffering capacity of the lake water, Hooker Lake is not susceptible to the effects of acid rain.

SELECTED ANALYSES

Analyses of selected constituents for April 22 for samples collected at 1.5 and 23-foot depths are listed in figure 2. The water-quality values for color, chlorophyll a, calcium, magnesium, pH, alkalinity, total nitrogen and total phosphorus are within regional values for this area as described by Lillie and Mason in "Limnological Characteristics of Wisconsin Lakes," 1983, Technical Bulletin No. 138, Department of Natural Resources.

To compute the nitrogen-phosphorus ratio, only the sample collected from the 1.5-foot sampling depth for April was used. This depth was used because algae grow in the upper part of the lake rather than at the bottom. The ratio of total nitrogen to phosphorus was calculated as 32:1 and suggests the lake is phosphorus-limited and is consistent with previous data. This means algal growth appears to be dependent on the amount of available phosphorus rather than nitrogen.

APRIL, JUNE, JULY AND AUGUST WATER QUALITY

The data for total phosphorus, chlorophyll a, and Secchi-depth readings, are listed in table 2 and on figure 2.

Total phosphorus: Total phosphorus concentrations sampled at a 1.5-foot depth range from 0.018 mg/L in August to 0.066 mg/L in April. All values fall within the regional values previously referenced.

Concentration of total phosphorus 1.5 feet above the lake bottom ranged from 0.060 mg/L in July to 0.262 mg/L in August. These concentrations are indicative of moderate phosphorus release from the bottom sediments during anoxic (absence of oxygen) periods.

Chlorophyll a: Chlorophyll a concentrations, which indicate algal biomass, ranged from 7.82 µg/L in June to 36.4 µg/L in April. These data are within the regional values.

Secchi disc: Secchi-disc depths, which indicate water clarity, ranged from 1.3 feet in April to 3.9 feet in June and July. These data are within the regional values.

TROPHIC STATUS

Lillie and Mason (1983) classified Wisconsin lakes using a random data set (summer, July and August) according to total phosphorus and chlorophyll a concentrations, and Secchi-disc depth. This evaluation is shown below:

Water quality index	Approximate total phosphorus equivalent (mg/L)	Approximate chlorophyll a equivalent (µg/L)	Approximate water clarity equivalent (Secchi-disc depth in ft)
Excellent	<0.001	<1	<19.7
Very good	.001-.010	1-5	9.8-19.7
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Fair	.030-.050	10-15	4.9-6.6
Poor	.050-.150	15-30	3.3-4.9
Very poor	>.150	>30	<3.3

Using the above criteria to evaluate the mean summer (July-August) 1993 data shown in table 2 for Hooker Lake, surface total phosphorus concentrations indicate good water quality, chlorophyll a concentrations indicate fair water quality, and Secchi-disc depths indicate poor water quality. The Secchi-disc depths for August may, however, misrepresent the lake's water quality as discussed under Carlson's Trophic State Index.

Using the data from "Limnological Characteristics of Wisconsin Lakes," 1983, by Lillie and Mason, a comparison of the 1993 mean summer data (July and August) for total phosphorus, chlorophyll a, and Secchi depths for Hooker Lake to other lakes in southeast Wisconsin are shown below:

	Parameter	Percentage of distribution of lakes in southeast Wisconsin within these concentrations	
	Total phosphorus (mg/L)		
	<.010	Best condition	7
	.010-.020	↓	21
Hooker Lake values →	.020-.030	↓	15
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	.050-.100	↓	21
	.100-.150	↓	3
	>.150	Worst condition	12
	Chlorophyll a (µg/L)		
	0- 5	Best condition	22
	5-10	↓	31
Hooker Lake values →	10-15	↓	14
	15-30	↓	12
	>30	Worst condition	22
	Secchi depth (in feet)		
	>19.7	Best condition	1
	9.8-19.7	↓	9
	6.6- 9.8	↓	26
Hooker Lake values →	3.3- 6.6	↓	31
	<3.3	Worst condition	33

Comparing other lakes in southeast Wisconsin to the 1993 data for Hooker Lake, the above data show, during the period 1966 to 1979, 28 percent had lower total phosphorous concentrations, 53 percent had lower chlorophyll a concentrations, and 36 percent had better water clarity.

A second approach to assessing the "health" or trophic status of a lake is to use Carlson's Trophic State Index (TSI). A graphic illustration of the Trophic State Index for Hooker Lake is shown on figure 3. The data from 1993 show Hooker Lake to be lower eutrophic or one with many nutrients. The 1992-93 data show little change in water quality.

The August TSI values for Secchi depth plot considerably higher than those for chlorophyll a. This suggests that turbidity caused by fish, motorboats, winds, etc., may be the reason for the higher TSI. Therefore, chlorophyll a concentrations may better represent the lake's water quality than Secchi depth.

The data that has been collected for Hooker Lake from 1992 and 1993 is extremely important for understanding the lake's water quality and managing the lake. This is the last report on the lake you will receive unless you continue with the monitoring as in the past to build on this very valuable data base.

If you have any questions regarding this evaluation, please contact me at 608/276-3842.

Sincerely,

Stephen J. Field
Biologist

Enclosures

cc: Bob Wakeman, DNR, Milwaukee

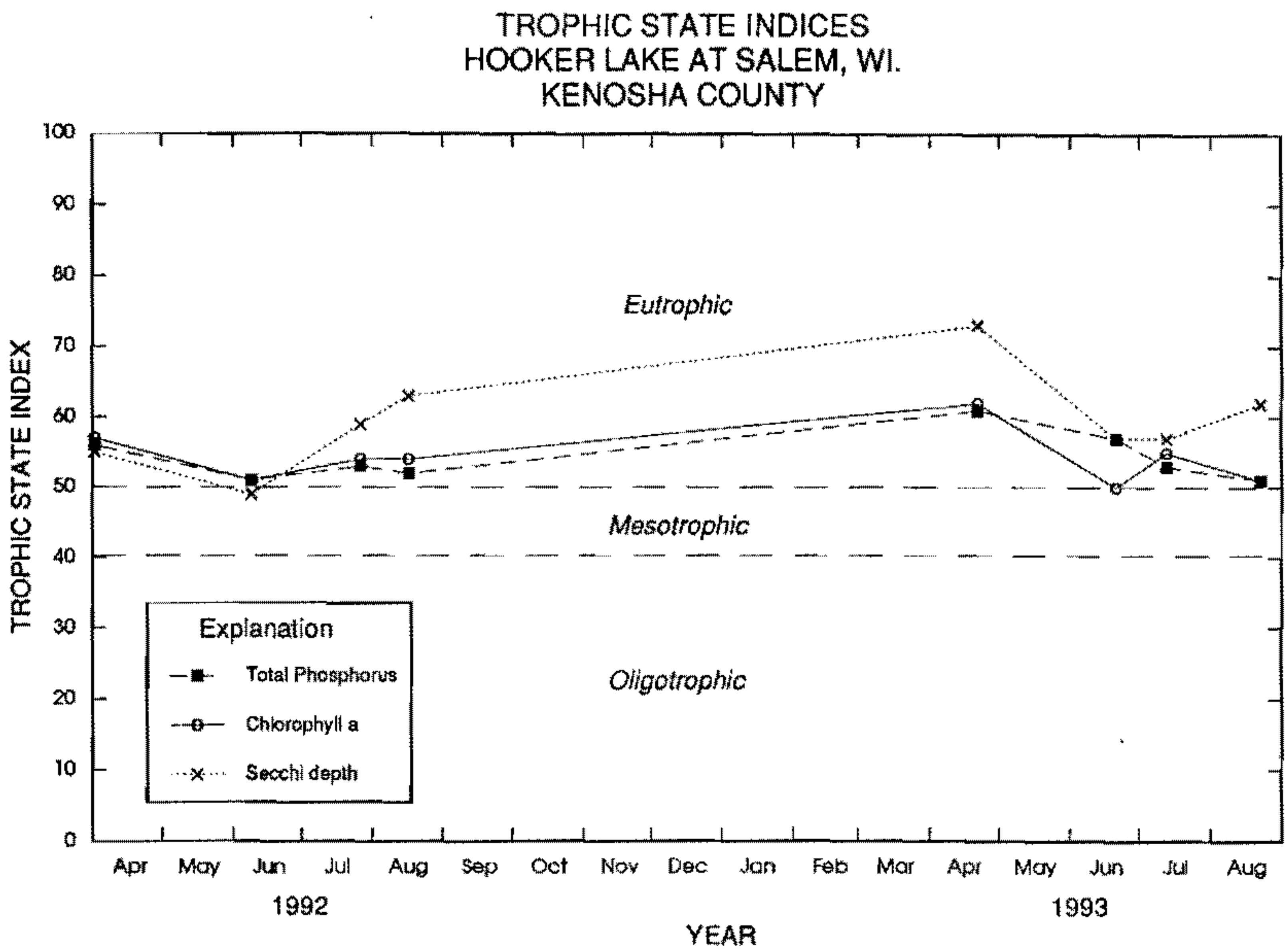

Figure 3. Trophic State Indices for Hooker Lake at Salem, Wisconsin