Asher B. Durand: *Kindred Spirits*, 1849

Water Quality Report and Lake Management Plan for White Mound Lake, Sauk County, Wisconsin

May 1996

Prepared for:
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-- A Wisconsin DNR Lake Management Planning Grant Project --

DRAFT

--Contents--

SUMMARY

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White Mound Lake is located in Sauk County, Wisconsin.

Goals

The goals of this project were:

- to examine existing lake conditions
- to develop a lake management plan that protects, maintains, and enhances the lakes water quality.

Watershed Characteristics

The White Mound Lake watershed is 4474 acres in size. The land use break down is open land\pasture\forest\wetlands: 1855 acres (41%), park: 1100 acres (25%), hay: 845 acres (19), corn: 370 acres (8%), CRP land: 281 acres (6%) and soybean: 20 acres (1%).

Water Quality and Quantity Monitoring Methods

- Sampling was conducted monthly in the summer of 1995.
- Streams were measured at base flow in June, July, and August and on tow storm events.
- The lake was sampled in June, July and August.
- Chemical analysis was conducted by the Wisconsin Laboratory of Hygiene.

The following parameters were analyzed:
Chl a
Dissolved Oxygen
Conductivity
Nitrate plus Nitrite
Total Kjeldahl Nitrogen
Total Phosphorus
Ammonia
Secchi disc readings were taken in June, July, and August.

Dissolved Oxygen and Temperature

Dissolved oxygen/temperature profiles were collected on a monthly basis during the summer. The profiles were taken at one location in June, two locations in July, and three locations in August. Site 1 was located by the dam in approximately 25 feet of water, site 2 was located in the north end of the lake in approximately 12 feet of water, and site 3 is located in the southwest corner of White Mound Lake near an incoming stream. In June the dissolved oxygen levels were low after a depth of 20 feet. Site 1 was near depletion of dissolved oxygen at 15 feet in July and 6 feet in August. Site 2 was found to have dissolved oxygen down to the bottom in both July and August. Site 3 had dissolved oxygen throughout the lake column in August.

Nutrients

Nutrient levels for White Mound Lake indicate that the lake is productive eutrophic lake. Summer averaged concentrations were:

total phosphorus (ug/l):	top-station 1	50
	bottom-station 1	123
	top-station 2	42
secchi disc (feet):	top-station 1	7.3
	top-station 2	7.0
chlorophyll a (ug/l): (only one sample)	top-station 1	77.4

Macrophyte Status

White Mound Lake has a variety of native plants as well as having both curlyleaf pondweed and Eurasian water milfoil. Both of these plants are exotics from Europe and grow to nuisance densities in White Mound Lake.

Lake Sedimentation Rates

Lake sedimentation rates are normal to low. Only a few inches of muck have accumulated in deep water. Deltas located at mouths of incoming streams have formed.

Lake Modeling

- ► The Wisconsin Lake Model Spreadsheet was used to model phosphorus in White Mound Lake.
- ► For White Mound Lake, the model predicted a concentration of 69 ppb of phosphorus, and the actual lake phosphorus level was 46 ppb.

How Close Are Lakes to the Danger Zone?

The Trophic State Index (TSI) rates a lake from 1 to 100, with low numbers being the best. White Mound Lake is currently rated as an eutrophic lake. The current average TSI for White Mound is 59 (TSI ratings are based on the chlorophyll a level, total phosphorus concentrations, and secchi disk transparency).

Recommended Lake Management Projects

Watershed Projects

- ► Install buffer strips along gullies with erosional problems.
- ► Review nutrient management and manure management plans with farmers in the northwest subwatershed.
- ► Reshape to a gentler slope the shoreline banks along the northeast shoreline. Plant with adult bulrush and burred. If necessary, use riprap and cover with 4"-6" of topsoil and plant.

Lake Nutrient Manipulation/Nuisance Algae Reductions

- Monitor impact of bottom withdrawal on lake thermal structure . . . does it cause dialyze . . . does it reduce hypolimnetic phosphorus buildup . . . what happens downstream after hypolimnetic water is discharged.
- An alum treatment over the bottom area greater than 10 feet deep could reduce sediment phosphorus release. May be needed if bottom withdrawal is ineffective.
- Experiment with an alum treatment in the mouth of stream 3 for filamentous algae reduction.

Using Lake Drawdown as a Management Tool

- Check impacts from the 1996 winter drawdown -- curlyleaf regrowth, EWM regrowth, could deltas be removed.

Aquatic Plant Management Projects

- Run experiments to check aquatic plant seedbank.
- Modify weed harvestor to cut curlyleaf pondweed (permit needed by WDNR).
- Continue EWM harvesting . . . closely monitor material removed.
- Consider establishing test plots and use herbicide spot treatment followed by transplanting submersed plants.
- Consider participating in a biological control program.

Recreational Projects

- Beach cleaning options: use modified serve to pick up plant fragments . . . install a curtain at 9-foot depth and treat inside with herbicides . . . purchase a beach cleaner and share with other Dame County parks.
- Use larger size sand particles for beach nourishment. May slow the loss of beach sand.
- Remove existing diving platform and replace with a raft.

Information and Education Projects

- Develop and maintain a series of lake-related Nature Guides. We produced several as part of this project.
- Clean-up and highlight the artisan spring near the swimming beach. Use signs to describe the spring and why it is unique.
- Develop a promotional brochure on University of Wisconsin research on White Mound Lake. It will be good public relations for the University as well.

1. Introduction and Project Setting

White Mound Lake is a 104 acre impoundment located in Sauk County, Wisconsin (Figure 1). The dam was built in 1969 and filled in 1972. White Mound Lake is eutrophic with phosphorus levels (around 45 $\mu g/l$) and a secchi disc transparency range of 3 to 7 feet in summer. The maximum lake depth is about 26 feet (Figure 2). The drainage area to the lake is approximately 4,500 acres (Figure 3) and is dominated by rolling hills of agricultural and forested acreage.

The goals of this project were to examine existing lake conditions and to develop lake management plans to protect, maintain, and enhance lake water quality for the short term and long term.

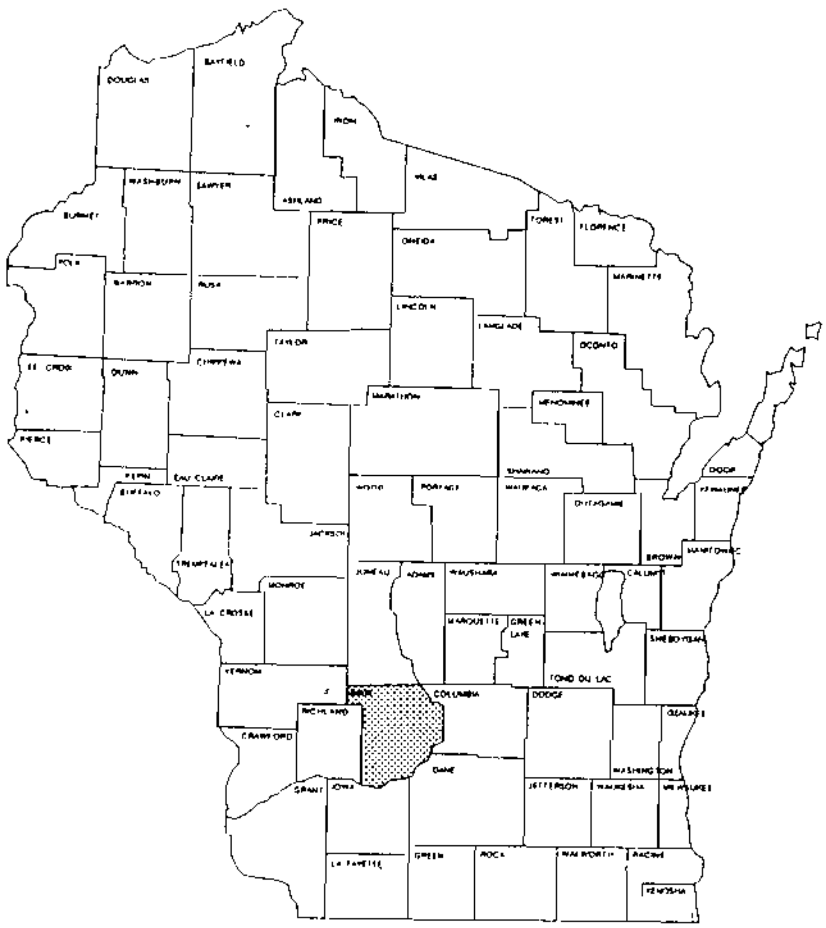


Figure 1. White Mound Lake is in Sauk County, Wisconsin.

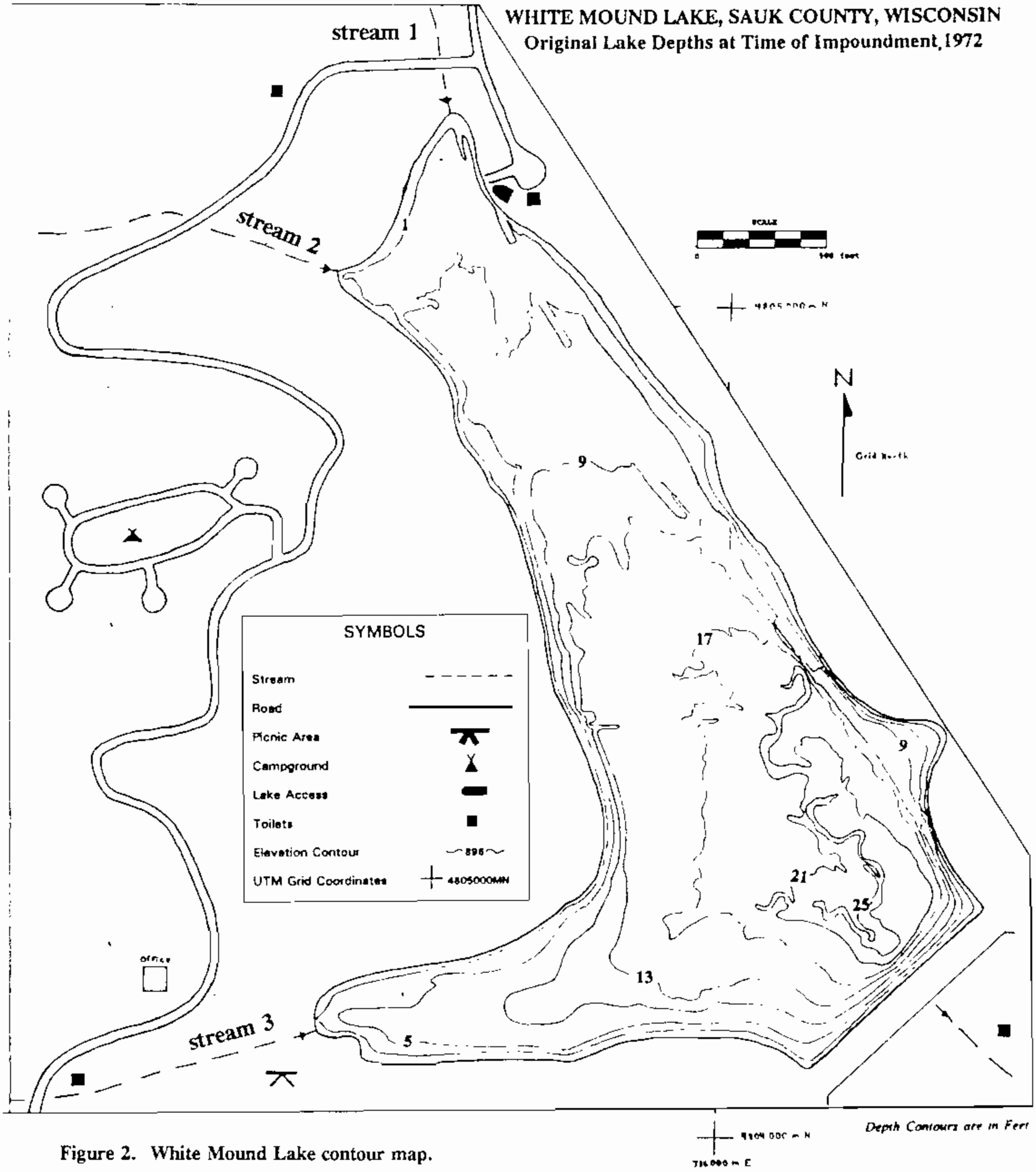


Figure 2. White Mound Lake contour map.

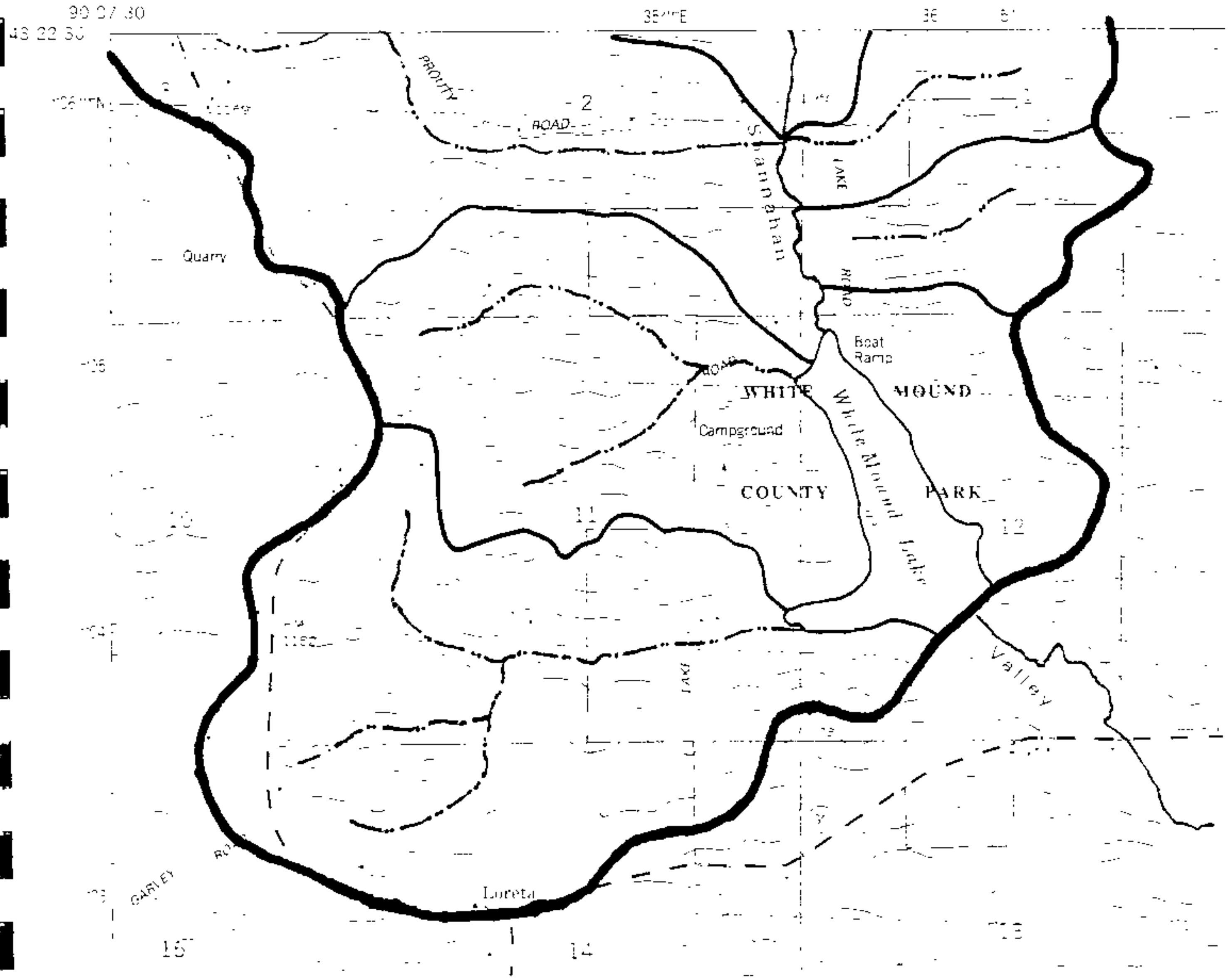


Figure 3. The majority of the White Mound Lake watershed is shown above. A number of tributaries drain the rolling countryside. The watershed area is about 4,500 acres.

2. History of White Mound Lake Area and Projects

To attempt to control the frequent and sometimes severe flooding in the Plain-Honey Creek Watershed and also to provide a public, water recreational resource for the area. The Sauk County Soil & Water Conservation District in 1965 sponsored in a program to implement land conjuration practices and floodwater control structures within the watershed.

The lake itself was created by damming Honey Creek. The dam was built in 1969 and the impoundment of 104 acres was filled in 1972.

The Sauk County LCD also purchased five farms surrounding the lake to create a 1,100 acre county park.

The park has camping facilities and, over the years, have added various natural restoration sites that include prairies, wetlands, and aspen woodlands.

3. Geologic Setting and Soils

(Section prepared by Brian Cunningham, student, UW-Stevens Point)

It is important to know the context of the land that the lakes reside in, because it has ramifications for water quality.

White Mound Lake is located in the "Driftless Area" of Wisconsin. This area was not touched by the latest glaciation. The area is characterized by many hills and valleys which were not "smoothed out" by the glaciers. A typical geologic cross section is shown in Figure 4. The name "White Mound" refers to the mound-like outcrops of whitish rock in the area.

Driftless area of Wisconsin was not touched by the latest glaciation.

<u>Soils</u>

Soils in the watershed are predominantly gray-brown silt loams. These soils originate from the weathering of the underlying limestone and sandstone bedrock, windblown silt and alluvial deposits.

Soils in the White Mound Lake watershed are classified as La Forge-Norden-Gale Association. These soils are generally well drained and moderately permeable.

The top soils are mostly loam formed in loess and cherty clay residuum from dolomite. The Shannahan Valley contains fertile clay loam soils.

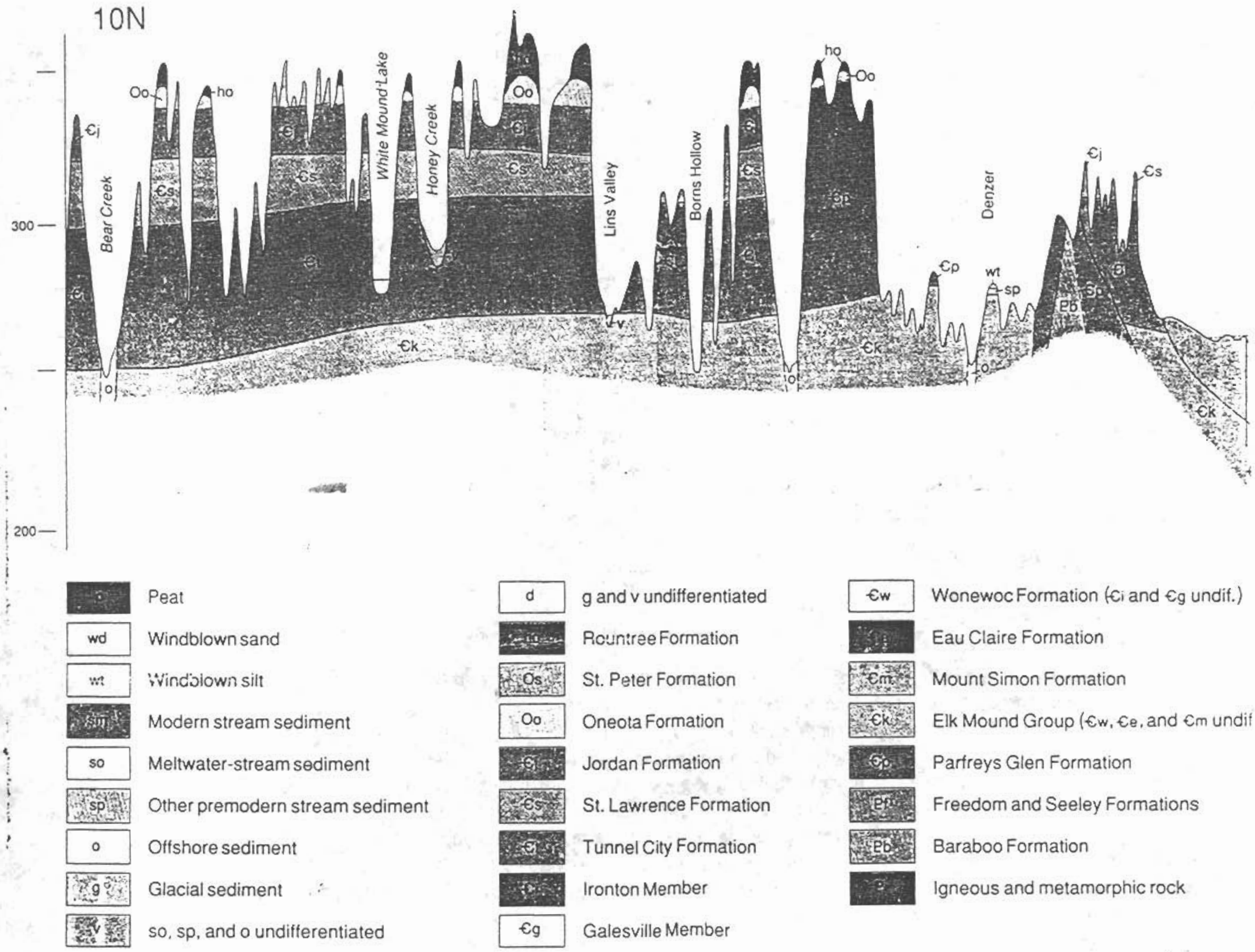


Figure 4. Cross section of surficial geology in a transect through the White Mound Lake area (Clayton and Attig, 1990)

4. Watershed Characteristics

(This section also was prepared by Brian Cunningham, student, UW-Stevens Point.)

Land Use

General land use in the watershed is shown in Figure 5. The White Mound Lake watershed encompass approximately 4,500 acres. Of that 4,500 acres, undeveloped park (takes up 1,100 acres, while the reminder is predominantly agricultural)(Table 1).

White Mound Lake's watershed is dominated by open land\pasture\forest\ wetlands land use.

White Mound Lake is located in an area of Wisconsin that is dominated by open land\pasture\forest\wetlands. The White Mound Lake watershed is 41% open land\pasture\forest\ wetlands (1,855 acres), 25% park (1100 acres), and 34% agricultural use [19% hay (845 acres), 8% corn (370 acres), 6% CRP (281 acres) and 1% soybean (20 acres)].

Table 1. Land use in the White Mound Lake watershed. Areas presented are in acres. Numbers shown in parentheses are the percent of land use.

	Land Use	
	Acres	Percentage
Open Land/Pasture/Forest/Wetlands	1858	41
Park	1100	25
Agricultural:	(1516)	(34)
Hay	845	19
Corn	370	8
CRP	281	6
Soybean	20	1
Total Watershed Acreage	4,474	

According to the Agriculture Stabilization and Conservation Service office in Baraboo, 95 percent of the farmland in the watershed is classified under highly erodible land. However, this doesn't seem to be a problem because all of the farmers use contour plowing and strip cropping to minimize erosion. To show that farmers have been doing a good job on controlling erosion it is valuable to look at the transections of the lake. The results show lake depths close to the original depths of the lake. Much more of a concern is nutrient overloading of the lake caused by the farmers. However, by working together to limit fertilizer use and fixing up a couple of barnyards much of the problem can be solved.

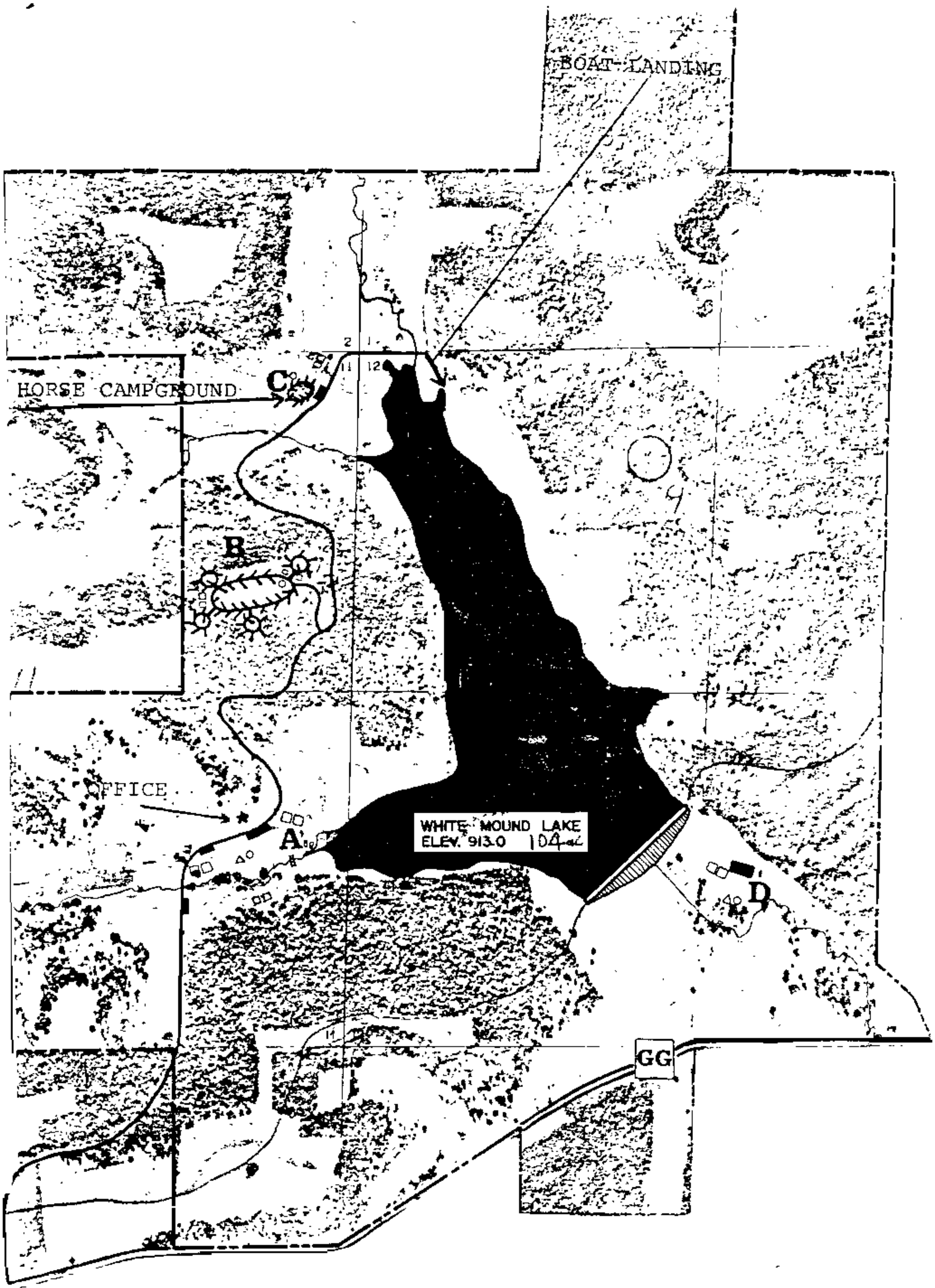


Figure 5. General land use of the White Mound Lake watershed. In the vicinity of White Mound Lake. Forested acreage is important in the immediate watershed area.

5. Watershed Monitoring Results

Three streams were sampled over the summer of 1995, and sampling locations are shown in Figure 6. Stream samples were checked for the total phosphorus and suspended solids and results are shown in Table 2.

Stream Sampling Results

Table 2. Summer (1995) sampling monthly data. TP = total phosphorus; SS = suspended solids.

Date	Stream Location	TP (ppb)	SS (ppm)	Flow (cfs)	Rainfall Summary
6.14.95	1	48		1.75	
	2	97		0.10	
	3	62		0.80	
7.14.95	1	52	8		
	2	77	10		
	3	77	10		
7.19.95	1			2.56	
	2			0.12	
	3			0.71	
	Spillway			3.21	
7.24.95	1			2.43	
	2			0.08	
	3			1.09	
7.25.95	1	163	51		
	2	1260	213		
	3	440	243		
7.27.95	1			2.80	
	2			0.04	
	3			0.85	
	Spillway			5.40	

Date	Stream Location	TP (ppb)	SS (ppm)	Flow (cfs)	Rainfall Summary
8.3.95	1			2.84	
	2			0.18	
	3			1.06	
	Beach Spring			0.01	
	Spillway			4.88	
8.13.95	1			1.88	
	2			0.15	
	3			1.16	
	Beach Spring			0.02	
	Spillway			4.71	
8.16.95	1			1.71	
	2			0.12	
	3			0.98	
	Beach Spring			0.02	
	Spillway			4.82	
8.19.95	1	170	57		
	2	2240	890		
	3	827	708		
8.24.95	1	52	7		
	2	67	--		
	3	52	8		

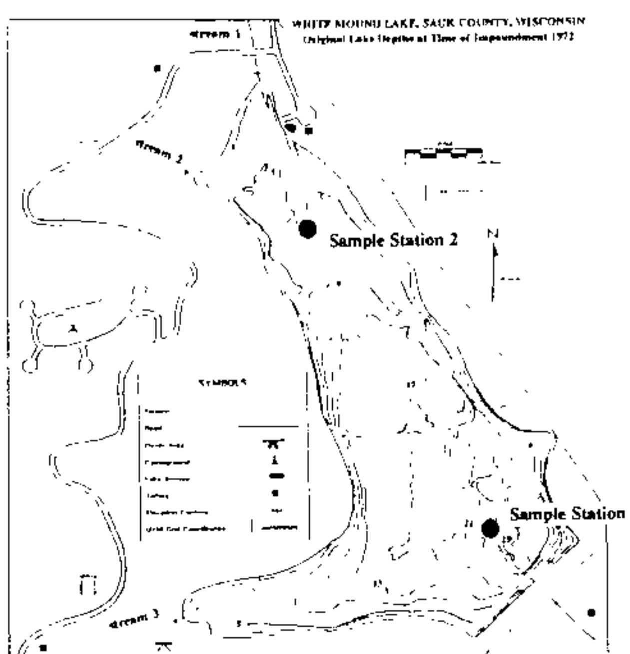


Figure 6. Location map of sampling locations.

Table 3. White Mound Lake and stream bacteria colonies.

	MFFCC Colonies (#/100 ml)	Fecal Strep (#/100 ml)	Ratio FC/FS	Date
White Mound Lake 1	250	100	2.5	7.17.95
Stream 1	870	2500	0.35	7.17.95
Stream 2	1500	5200	0.29	7.17.95
Stream 3	320	3000	0.11	7.17.95

Fecal coliform to fecal streptococcus ratios for human waste and for several mammals.

SOURCE	FFECAL COLIFORM: FECAL STREPTOCOCCUS RATIO
Human	4.4[a]
Domestic sewage	< 4.0[b]
Anaerobic septic tank effluent	100[b]
Aerobic septic tank effluent	10[b]
Drainfield trench	> 3.5[b]
Mound system (liquid collected at base)	7[b]
Cat	0.29[a]
Rat	0.04[a]
Chipmunk	0.03[a]
Dog	0.02[a]
Rabbit	0.004[a]
Ag tile drains (no manure)	1.0[c]
Spring applied cow manure	0.4[c]
Autumn applied cow manure	2.2[c]

Sources: (a) E.E. Geldreich, et al. 1968. The bacteriological aspects of stormwater pollution. Journal Water Pollution Control Federation 40:1861-1872. (b) W.A. Ziebell, et al. 1975. Use of bacteria in assessing waste treatment and soil disposal systems. Pages 58-63 in Proceedings. National Home Sewage Disposal Symposium. American Society of Agricultural Engineers. St. Joseph, Michigan. (c) N.K. Patni, et al. 1984. Bacteria quality of tile drainage water from manured and fertilized cropland. Water Research 18:127-132.

6. Lake Monitoring Results

Dissolved Oxygen, Temperature, and Secchi Disc Results
White Mound Lake is 104 acres in size, with a watershed of 4,474 acres. The average depth of White Mound Lake is 3.4 meters (11 feet) with a maximum depth of 7.9 meters (26 feet) (Table 4). A lake contour map is shown in Figure 2.

Secchi disc average summer transparency for 1995 was 2.2 meters (7.2 feet).

The secchi disc transparency had an average summer depth of 2.2 meters (7.2 feet) in 1995.

The summer dissolved oxygen (DO) and temperature profiles are shown in Figure 7.

Table 4. White Mound Lake Characteristics

Area (Lake): 104 acres (42 ha)
Mean depth: 11 feet (3.4 m)
Maximum depth: 26 feet (7.9 m)
Volume: 1,144 acre-feet (143 Ha-M)
Fetch: 1.2 miles (1.9 km)
Watershed area: 4,474 acres (1811 ha)
Watershed: Lake surface ratio 43:1

Public accesses (#): 1
Inlets: 3 Outlets: 1

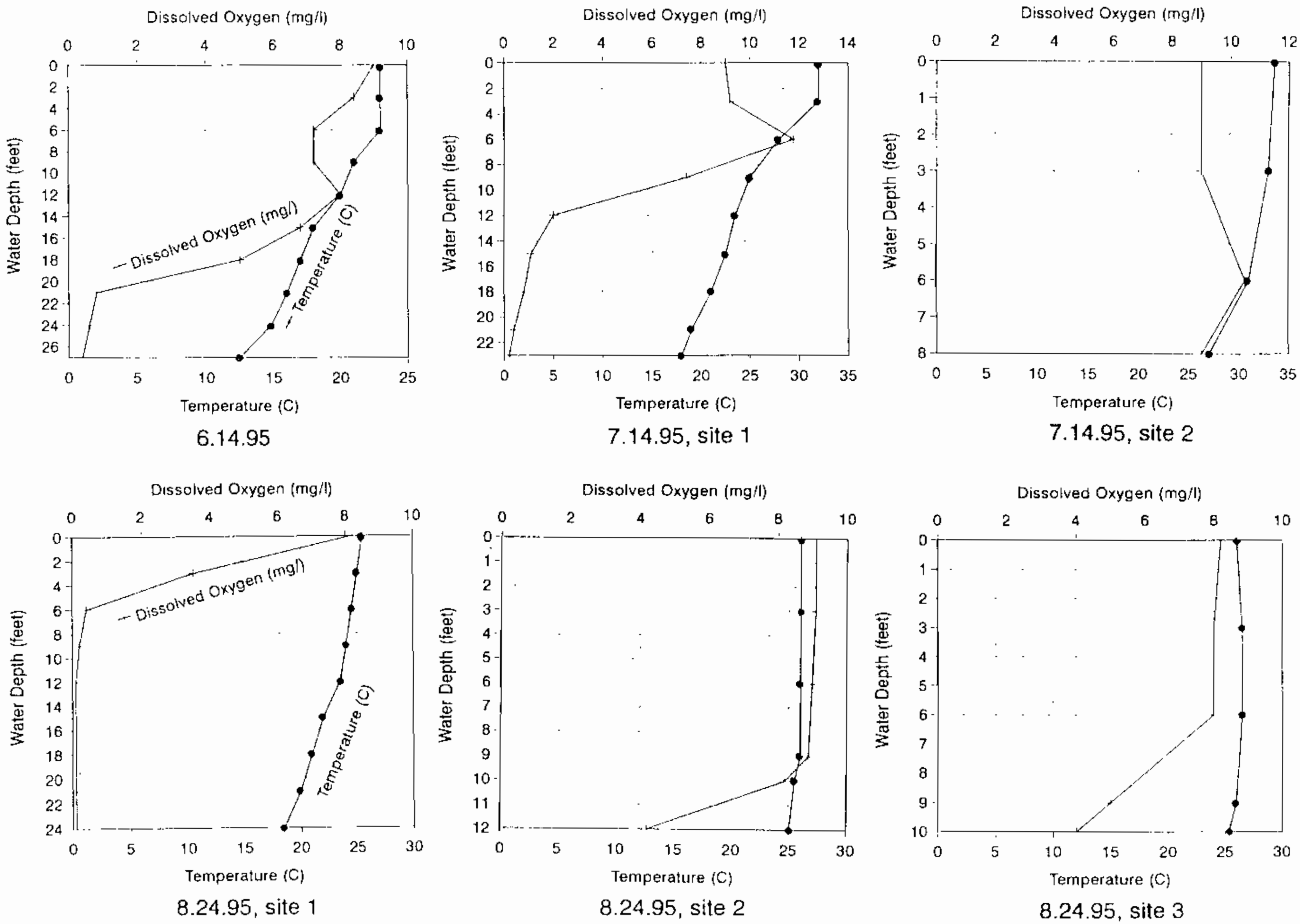


Figure 7. Dissolved oxygen/temperature profiles from 1995.

Lake Water Chemistry

Summer water chemistry data collected during 1995 included secchi disc, total phosphorus (TP), chlorophyll a (Chl a), total kjeldahl nitrogen (TKN), ammonia (NH_3), nitrate (NO_3), and conductivity (Cond) (Table 5). Samples were collected at the surface and two feet off the bottom in the deepest area of White Mound Lake. Total phosphorus was higher in the bottom water than the top water indicating some phosphorus release from the bottom material (sediments or plants) may be occurring.

Table 5. Summer (1995) monthly sampling data. T=top, B=bottom. Station 1 is in 25 feet of water near the dam and station 2 is in 8 feet of water near the boat landing.

Date	Lake Station	TP (μg/l)	Secchi Disc (ft)	SS (ppm)	Chl a (μg/l)	TKN (μg/l)	Alk (ppm)
6.14.95	T - 1		14.5				
	B - 1	28					
	T - 2	13					
7.14.95	T - 1	19	5.5	6			
	B - 1	69					
	T - 2	22	7.0				
8.24.95	T - 1	30	2.0	12	77.4	1.9	130
	B - 1	273					
	T - 2	91					
Summer Averages	T - 1	50	7.3	9	77.4	1.9	130
	B - 1	123					
	T - 2	42	7.0				

Trophic State Index
The Trophic State Index (TSI) was calculated for water chemistry results and is shown in Table 6. Results indicate White Mound Lake is an eutrophic lake. Although there was some variability within a lake for phosphorus, chlorophyll, and transparency values, they are fairly close.

Table 6. Summary of Trophic State Index Values for phosphorus (TSIP), chlorophyll a (TSIC), and secchi disc (TSIS).

	White Mound Lake
TSIP (TP)	62
TSIC (Chl a)	66
TSIS (Secchi disc)	49
TSI (mean)	59

TSI = Trophic State Index

$TSI(Chl\ a)(ppb\ or\ ug/L) = 36.25 + 15.5 \log_{10} [Chl\ a]$
$TSI(TP)(ppb\ or\ ug/L) = 60 - 33.2 \log_{10} (40.5/TP)$
$TSI(Secchi)(meters) = 60-(SD \log_{10} \times 33.2)$

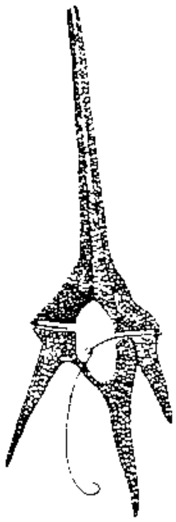
Table 7. Zooplankton counts for the summer of 1995, results are shown in numbers per liter.

	6.15.95	7.14.95
Daphnids	17	8
Big	6	6
Little	11	2
Copepods	9	10
Calonoids	3	4
Cyclopoids	4	1
Nauplii	2	5
Rotifers	0	1
Keratell sp		1

Total phosphorus results from 6.14.95.

Location	TP (ppb)
White Mound stream 1	48
White Mound stream 2	97
White Mound stream 3	62
White Mound Lake - top (station 2)	13
White Mound Lake - bottom (station 1)	28

An example of a Daphnia found in White Mound Lake during the summer of 1995.



Ceratium, a common phytoplankton found in White Mound Lake.

Macrophytes

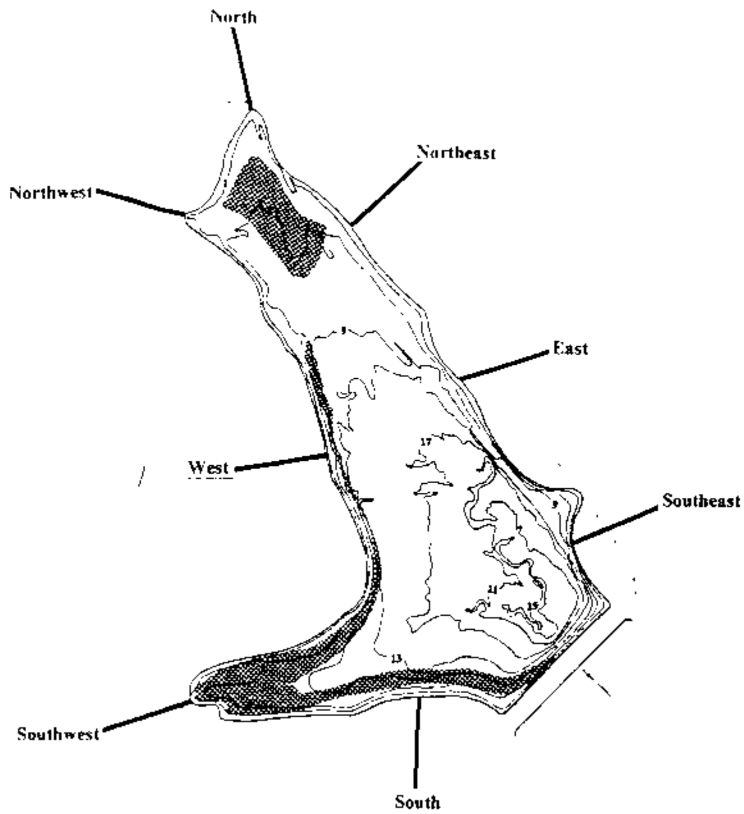
An aquatic plant survey was conducted on White Mound Lake on July 20, 1995.

Eight transects, perpendicular to shore were run with sample points at 1 meter, 2 meters, 3 meters, 4 meters, and 5 meters. Rooted plants were found in water to a depth of 5 meters. A list of plant species found in White Mound Lake is shown in Table 8. The most common plant was curlyleaf pondweed as indicated in Table 9. A plant map of White Mound Lake is shown in Figure 8.

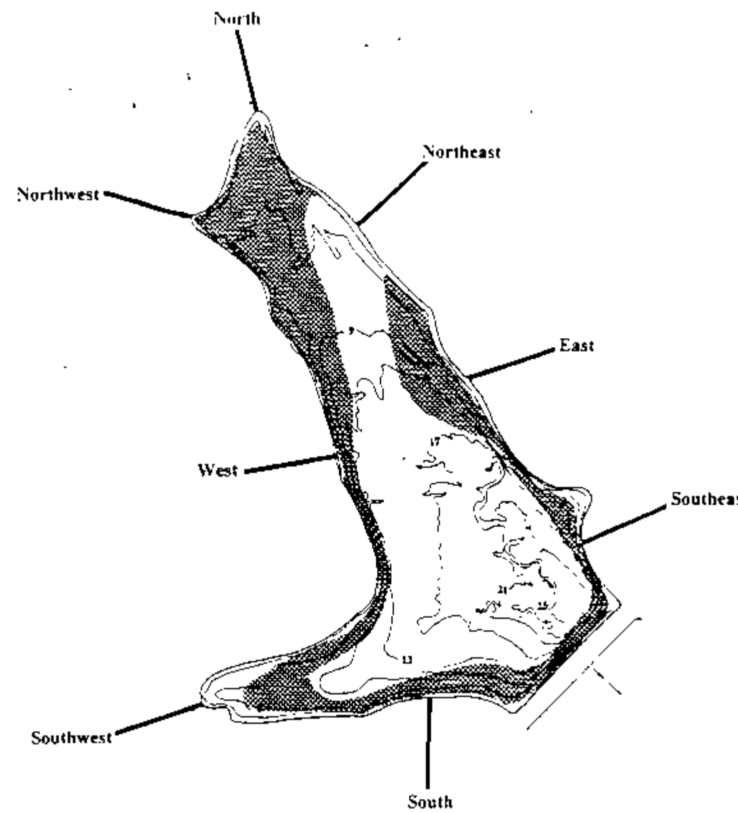
Ten different aquatic plant species were found on July 20, 1995.

Table 8. Species list of the aquatic plants found in White Mound lake.

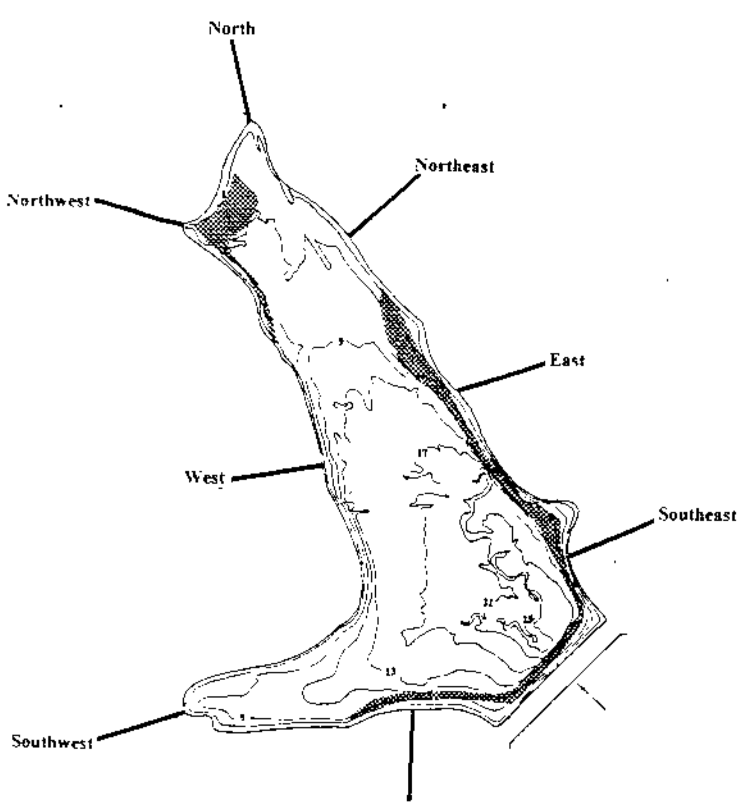
Common Name	Scientific Name
Eurasian watermilfoil	*Myriophyllum spicatum*
Curlyleaf pondweed	*Potamogeton crispus*
Naiads	*Najas flexilis*
Muskgrass	*Chara sp.*
Coontail	*Ceratophyllum demersum*
Common waterweed	*Elodea canadensis*
Leafy pondweed	*P. foliosus*
Mud plantain	*Heteranthera dubia*
Sago pondweed	*P. pectinatus*
Flatstem pondweed	*P. zosteriformus*



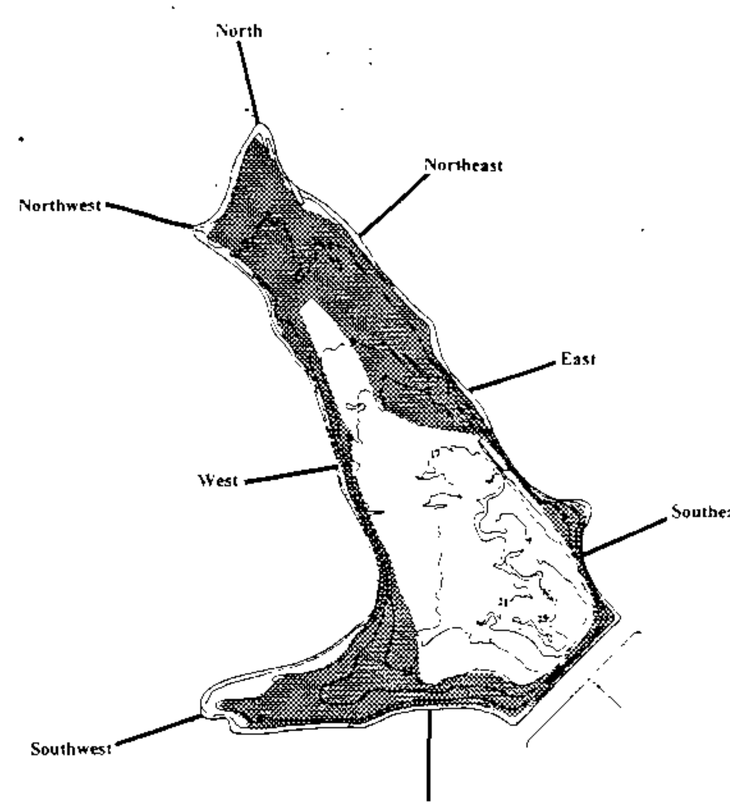
Eurasian watermilfoil (*Myriophyllum spicatum*)



Curlyleaf Pondweed (*Potamogeton crispus*)



Naiads (*Najas flexilis*)



Other Pondweeds (*Potamogeton sp*)

Figure 8. White Mound Lake plant coverage.

7. White Mound Lake Phosphorus Model

Lake modeling is a tool that aids in predicting what phosphorus concentrations should be in a lake based on the amount of nutrients that comes into a lake on an annual basis. A lake model can also be used to predict what future conditions could be if changes occur in the watershed that bring in more phosphorus.

Before the models could be run, nutrient and water budget for White Mound Lake was needed. To estimate the nutrient budget, phosphorus concentrations were assigned for various land use delineations and then assuming a certain amount of runoff per year we estimated phosphorus inputs from various land uses. The nutrient input table shows that open land is the major nutrient contributor to White Mound Lake followed by agriculture (Table 10).

The phosphorus model predictions and the actual observed phosphorus load are shown in Table 11.

Table 10. Data used to run the Wisconsin Lake Model Spreadsheet.

<u>Hydrologic and Morphometric Module Data</u>

Trib. drainage area	4,474.0 ac
Total unit runoff	8.0 in
Annual runoff volume	2,982.7 ac-ft
Lake surface area	104.0 ac
Lake volume	1,144.0 ac-ft
Lake mean depth	11.0 ft
Lake net annual precip	1.6 in
Hydraulic loading	2,996.5 ac-ft/yr
Areal water load	2.88E+0.1 ft/yr
Lake flushing rate	2.62/yr

<u>Phosphorus Loading Module Data</u>

Land Use	Area (ac)	Loading Percent
Agriculture	1,516	44.9
Open grassland	2,958	52.6
Precipitation	104	1.9

Table 11. Total phosphorus observed and calculated model predictions

	Total phosphorus
Actual summer White Mound Lake TP	46 ppb
Model prediction (Canfield-Bachmann artificial lake)	69 ppb

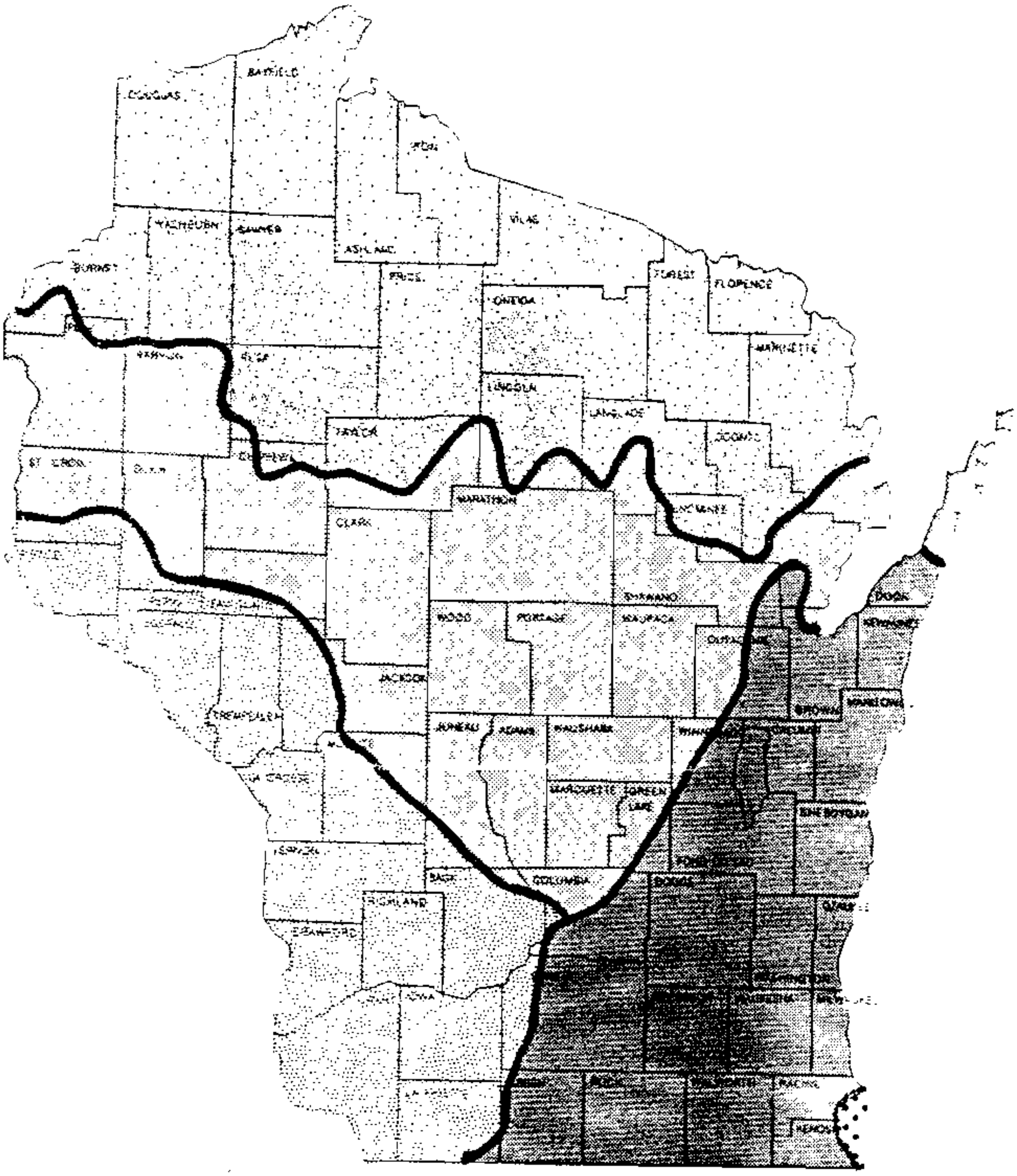
8. Lake Status

The status of stream tributary to White Mound Lake compared to other streams in the driftless area is shown in Table 12.

A map showing the ecoregion area and the White Mound Lake location is displayed in Figure 9. There are few natural lakes in the driftless area.

Table 12. Ecoregion stream values for 1980-1985. White Mound Lake values are from 1995 data.

	Driftless Area		White Mound Streams		
	Average for year	Summer only	1	2	3
Temperature (°C)	11.8	16.2	--	--	--
pH	7.7	7.8	--	--	--
Conductivity (umhos)	421	415	490	370	460
TSS (mg/l)	172	130	31	501	242
Turbidity (NTU)	80.2	62.3	--	--	--
$NO_2 + NO_3$ (μg/l)	2.16	2.08	--	--	--
NH_3 (μg/l)	0.24	0.16	--	--	--
TP (μg/l)	400	315	89	640	253
BOD_5 (μg/l)	2.87	2.79	--	--	--
Fecal coliform (number/100 ml)	4187	7878	870	1500	320



Omernik, J.M. and A.L. Gallant. 1988. Ecoregions of The Upper Midwest States. U.S. EPA 600/3-88/037, Corvallis, OR.

Legend

- Northern Lakes and Forests
- North Central Hardwood Forests
- Driftless Area
- Southeastern Wisconsin Till Plains
- Central Corn Belt Plains

Figure 9. Ecoregions of Wisconsin.

9. Management Plan for White Mound Lake

A list of projects has been prepared that are intended to protect the water quality of the White Mound Lake.

Watershed Projects

- Install buffer strips along gullies with erosional problems.
- Review nutrient management and manure management plans with farmers in the northwest subwatershed.
- Reshape to a gentler slope the shoreline banks along the northeast shoreline. Plant with adult bulrush and burred. If necessary, use riprap and cover with 4"-6" of topsoil and plant.

Lake Nutrient Manipulation/Nuisance Algae Reductions

- Monitor impact of bottom withdrawal on lake thermal structure . . . does it cause dialyze . . . does it reduce hypolimnetic phosphorus buildup . . . what happens downstream after hypolimnetic water is discharged.
- An alum treatment over the bottom area greater than 10 feet deep could reduce sediment phosphorus release. May be needed if bottom withdrawal is ineffective.
- Experiment with an alum treatment in the mouth of stream 3 for filamentous algae reduction.

Using Lake Drawdown as a Management Tool

- Check impacts from the 1996 winter drawdown -- curlyleaf regrowth, EWM regrowth, deltas could be removed.

Aquatic Plant Management Projects

- Run experiments to check aquatic plant seedbank.
- Modify weed harvestor to cut curlyleaf pondweed (permit needed by WDNR).
- Continue EWM harvesting . . . closely monitor material removed.
- Consider establishing test plots and use herbicide spot treatment followed by transplanting submersed plants.
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Recreational Projects

- Beach cleaning options: use modified serve to pick up plant fragments . . . install a curtain at 9-foot depth and treat inside with herbicides . . . purchase a beach cleaner and share with other Dame County parks.
- Use larger size sand particles for beach nourishment. May slow the loss of beach sand.
- Remove existing diving platform and replace with a raft.

Information and Education Projects

- Develop and maintain a series of lake-related Nature Guides. We produced several as part of this project.
- Clean-up and highlight the artisan spring near the swimming

beach. Use signs to describe the spring and why it is unique.

► Develop a promotional brochure on University of Wisconsin research on White Mound Lake. It will be good public relations for the University as well.

Details of the projects are given below and on the following pages.

<u>Eurasian Watermilfoil Control</u>

Eurasian watermilfoil (EWM), is present in White Mound Lake at this time. A fact sheet on EWM has been prepared for White Mound Lake, that describes its basic ecology as well as some control approaches.

<u>Continue a lake monitoring program.</u>

To evaluate White Mound Lake, a monitoring program should be ongoing. This program will address the issues of:

o Effectiveness of watershed projects in regard to phosphorus in runoff

o Changes in lake quality as measured by total phosphorus, secchi disc, algae and macrophyte distribution.

Improvement Project Details

1. Watershed Projects

Review Nutrient Management in Agriculture Areas
The rolling hills in the White Mound Lake watershed have the potential for producing erosion. However, because of the steep slopes, much of the acreage is grazed and not cropped. It appears that erosion problems are minor. One area that could be explored is manure and nutrient management associated with beef and airy cattle operations. Several farms with cattle operate in the watershed (Figure 10). The objective of this project component is to have a County Park technician or intern contact the Sauk County Land Conservation Department and together, review existing nutrient management plans for farms in the watershed. Farmers would be visited if there were any questions about to answer.

Buffer Strips
Buffer strips could be maintained around cropland on erodible slopes or especially along tributary streams so pollutants in runoff could be filtered and removed. The buffer strip should be 15-30 feet in width. The buffer strip could consist of any vegetation, such as existing grass that is not cut, or native wildflowers or other grasses that could be planted. The Sauk County Land Conservation Department would be a good contact for details.

Reshape Shoreline
The White Mound Lake shoreline and bank on the northeast side is steep, is eroding and could use some reshaping (Figure 11). The slope could be cut down to a gentler angle. In shallow water, up to one foot deep, bulrush and burreed plants could be planted. One the upland slopes shrub species such as willow and red osier dogwood could be planted, or other ground cover, with specific species that could be determined by County Park personnel and the Land Conservation Department. A backhoe or small front end loader (like a "bobcat") would be needed to reshape a bank. A 3 to 1 or 4 to 1 slope would be adequate. Work could be done over winter and equipment could work on the ice.

2. Lake Nutrient Manipulation and Algae Reduction

Monitor Bottom Withdrawal

Internal phosphorus loading appears to be a factor in mid-summer algae blooms in White Mound Lake. Internal loading can be reduced several ways, but two of th most popular are by aerating the bottom water to keep phosphorus tied up with iron hydroxides or be adding alum which will tie up phosphorus after it is released from the iron dissolution and keep it from being used by algae.

It is worth exploring if manipulating bottom water withdrawal from White Mound Lake can destratify the lake and bring about reoxygenation or possibly, bottom withdrawal may expel enough phosphorus to help reduce nuisance algae blooms.

Changes were made in the outlet structure (Figure 12)(Appendix B) over the 1995-1996 winter to increase the amount of bottom water removal. The objective of this project component is to evaluate the impact of the withdrawal on the temperature/oxygen profile of White Mound Lake and determine if it is affecting the internal phosphorus loading.

To do this, summer staff at the Park could monitor temperature and dissolved oxygen on a weekly basis as well as taking phosphorus samples from the top and bottom water. After a summer monitoirng, the impacts of the withdrawal could be evaluated. If destratification is not occurring, maybe an aeration system could be installed, and because of bottom withdrawal, the aeration system could be sized smaller (and cheaper) than an aeration system in a lake without bottom water withdrawals. It may take less power to destratify a lake with a bottom draw.

The cost of an aeration system for White Mound Lake would be around $40,000 with a summer operating cost of $1,000-$2,000/summer depending on electrical rates.

Alum Treatment for White Mound Lake

If the bottom withdrawal approach is not effective, an alum treatment for water depths over 10 feet should be looked at. The alum treatment will help control phosphorus release from the sediments. Alum is applied from a floating barge in liquid form (Figure 13) at between 150 to 300 gallons per acre.

For White Mound Lake, about 80% of the lake surface area would be treated or about 90 acres, at a cost of about $325/acre which would total $29,250. Alum treatments can last up to 10 years or more in some cases. The effectiveness of an alum treatment in White Mound Lake would be dependent on how well watershed phosphorus loading was reduced. A whole lake alum treatment is a project that would be implemented after watershed and in-lake projects were completed.

At the present time, state and federal lake grants programs probably would not fund this. If the county is not able
fund an alum application, then another option may be a partial alum treatment.

Experiment with Alum Treatment for Incoming Streams

If a whole lake alum treatment is not financially feasible, an alternative may be to apply alum only to the areas producing filamentous algae at the tributary mouths (Figure 14). This would greatly reduce alum costs and may reduce the growth of filamentous algae in these areas. In addition, it appears that in shallow water, a sediment alum treatment may work to remove phosphorus from the water column, and in this case could possibly remove phosphorus from incoming tributary flows. In a project in Eagan, Minnesota, an alum treatment in a shallow lake reduced water column phosphorus and filamentous algae for two summers (Rich Brasch, City of Eagan, MN, pers. comm.). The downside of a partial alum treatment is that it is not long lasting (up to three years), and may not reduce nuisance planktonic (open water) algae blooms in White Mound Lake.

I estimate that about 10 acres could be treated at a cost of $450 per acre for a total cost of $4,500.

3. Aquatic Plant Management Projects

Using Lake Drawdown as Management Tool

Lake drawdown can be used as a tool to control some species of aquatic plants. The idea is to lower the lake level over winter which exposes lake sediments and freeze them. Eurasian watermilfoil and curlyleaf pondweed are susceptible to winter drawdowns (Cooke et al 1986). White Mound Lake has the capability to draw the lake level down, even if a siphon has to be used. A partial drawdown was conducted over the 1995-1996 winter. Impacts to plants in shallow water should evaluated in the summer of 1996. If there is an indication of curlyleaf or milfoil reduction, a larger-scale drawdown around 10 feet or so, could be implemented in the future.

Before a drawdown would occur, fishery impacts have to be considered. A small water volume associated with a drawdown could cause a winterkill. One or two winters of dissolved oxygen monitoring should be conducted to seed if oxygen depletion is a potential problem. If it looks like it is, then a stand by (mobile) aeration system would be needed on site. Another consideration is winter ice fishermen. The lake may have to be closed to winter fishing. Public meetings would be needed to see how this idea would go over.

If drawdown looks like it is acceptable technically and politically, it is probably a very economical plant control technique for White Mound Lake.

Check the Seedbank

White Mound Lake sediments should be checked to determine the extent of a native seedbank in the lake especially in the Eurasian watermilfoil beds. The testing can be conducted by putting White Mound Lake sediments, approximately the first 6 inches of near shore sediments, in three gallon buckets and then watching to see is anything grows. Observe the buckets over the summer to determine if there is a viable seedbank and also to determine what the species may be.

Modify the Weed Harvestor for Curlyleaf Pondweed Control

The existing Aquarius Weed Harvestor is still harvesting and is adequate for cutting channels through Eurasian watermilfoil. However curlyleaf pondweed is another story. It is a nuisance in early summer (Figure 15). Unlike milfoil, curlyleaf is an annual and almost all its new growth comes from turions produced at the end of its summer peak. Curlyleaf pondweed has the potential to be controlled by modifying the existing harvestor to allow it to cut at a faster rate. Recent work on French Lake in Rice County, Minnesota (McComas and Stuckert, 1994) indicates if curlyleaf pondweed is cut before it produces turions, it does not grow back, and in fact, it dies. For White Mound Lake, I would suggest that if the front screen is removed, then the harvestor becomes a cutter only, weeds would be cut but not transported up the front conveyor to be off loaded. The advantage to this approach is the machine could cover much more acreage as a cutter than as a harvestor. The disadvantage is that a special WDNR permit or variance would be needed since it is policy that cut weeds need to be removed from the lake.

Continue Eurasian Watermilfoil Harvesting

Eurasian watermilfoil will be a factor in White Mound Lake for some time to come. Managing milfoil with a mechanical harvester is a solid approach and should be continued. Cutting channels through milfoil beds allows boats to get to open water. Cutting additional channels perpendicular and parallel to shore creates crusing lanes for fish and allows anglers access to fish.

Consider Establishing Test Plots for Herbicide Treatments

Using herbicides on a limited basis is an option for milfoil management. The herbicide 2,4-D is somewhat selective for dicotyledons and milfoil is in that group. Many of the pondweed are monocots and are hardly effected by this herbicide. One way to use 2,4-D may be to use a low dose in the main boating channels after they have been cut with a harvestor. Sometimes an injured plant is susceptible to low doses of herbicides and this approach may provide milfoil control for an entire summer. Small test areas could be set up, and if successful, these could be scaled up to treat the major channels.

Consider Participating in a Biological Control Program

Eurasian watermilfoil may be vulnerable to biological control by snails, weavels, aquatic insects or other biota. The proximity of White Mound Lake to UW-Madison as well as the relative control of shoreline areas and plant management approaches, may make the lake a good candidate for a research or demonstration site for milfoil control by biological means. Some work has been done in the last couple of years by Dr. Carpenter's group from Madison. This may be a good place to initiate a contact for checking the possible use of White Mound Lake as a project site.

4. Recreational Projects

Beach Cleaning Options

The swimming area of White Mound Lake is a special attraction and is used by many park visitors. However, floating aquatic weeds tend to accumulate in the beach area. As they decompose, they give off an odor and also leave a black mucky residue behind. Several options are described here that could improve the situation.

1. Move the beach: The swimming area was cut out of the former hillside when the lake was made. This cut now acts as a dead end bay. Moving the beach to the norht side of the bay would proabably improve the beach conditions (Figure 16). The drawbacks are that the changing facilities are close to the existing beach and may be to be moved. Also, a new area would have to be leveled and beach sand brought in.

2. Use a curtain to isolate the beach area: A submerged vinyl curtain could be deployed across the bay to isolate the swimming area. The curtain would be supported by a floating collar and anchored at the bottom. This would prevent aquatic plants from drifting into the area and onto the beach. If algae or weed conditions get to a nuisance level within the curtained area, herbicides could be used to reduce the plant growth. The curtain would have to be set-up and taken down every summer.

3. Use a modified fish seine to clean the beach: This is probably the lowest cost option and involves using a fish seine to work along the shoreline to remove plants that drift in. Park technicians could handle the seines. The seine would only need to be about 20 feet long, about 3 feet deep and have extra lead on the lead line which would help to pick up the weeds. The collected weeds could be pitched into a truck and hauled to a compost pile.

4. Buy a Cherrington Beach Cleaner and share it with the other county parks: A fancy way to keepthe beach clean would be to buy a machine designed for cleaning beaches. The Cherrington Beach Cleaner (Fairmont, MN) is an example. The machine works in shallow water and actually will pick up a couple inches of sand and sift it, keeping the plants and debris and returning the clean sand to the beach. A machine costs about $50,000 and it would be hard to justify the cost if only used for White Mound Lake. However, if three or four other lakes in the area could use it, and help defray the cost, this option may be plausible.

Use Larger Size Sand Particles for Beach Nourishment

Based on research done in this study, it appears that the water is shallower by the diving platform today compared to 15 years ago due to the beach sand being transported to this area. The sediment build-up does not appear to be silt coming from the inflowing stream in this area. We found that the beach sand is a fine-grain size sand. The sand used for a mortar mix in conrete and stucco work would be an improvement and still provide a pleasant beach. Sand of a larger grain-size may stay in the beach area longer than a finer-grain sand.

Remove Existing Diving Platform and Replace with a Raft

The existing diving platform is not as functional as it used to be. The sediment accumulation in the area has decreased the water depth prompting the removal of the higher diving board. Also, the platform has tilted to one side (Figure 16). It should be removed in the near future. Divers may be needed to either cut the metal posts holding up the platform or use a cutting torch. A floating diving raft would serve as an adequate replacement to the diving platform.

5. Information and Education

Develop and Maintain a Series of Lake-Related Nature Guides

As a service to park visitors, it would be appropriate to maintain a series of lake-related nature guides to complement the wetland and upland brochures. We developed several lake guides as part of this study. In the future, park personnel can update these and develop thier own.

Clean-up and Highlight the Artesan Spring

Spring action is active in the White Mound Lake watershed. As luck would have it, there is a spring right near the swimming beach area (Figure 17). As a special feature for the park, this area could be cleaned up (weeds trimmed, etc.), roped off (to give it the look of something special) and then interpretive signs could explain what is happening and how the spring woks.

Develop a Promotional Brochure on the University of Wisconsin Research

Another area to make public is the research that the University of Wisconsin and the WDNR have been conducting on White Mound Lake. One current project deals with young-of-the-year fish, but other work has been done as well. A one or two page summary would be good public relations for the University and for the park.

6. Lake Monitoring for Water Quality Evaluation

A monitoring program would help to track water quality trends in White Mound Lake. Secchi Disc transparencies should be taken through the summer on a monthly basis, and twice a month if possible.

Surface water samples from the lake should also be collected in June, July, and August, and analyzed for the total phosphorus, and chlorophyll a.

Another option is the University of Wisconsin-Stevens Point which has a very good lake testing program. Lakes are sampled in the spring and the fall and costs are about $120 per lake per year. County Park personnel can take the water samples. The UW-Stevens Point contact is Byron Shaw.

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