RIB LAKE

MANAGEMENT PLAN

VILLAGE OF RIB LAKE

TAYLOR COUNTY, WISCONSIN

PHASE 1

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SUMMARY

Rib Lake is a 324 acre, drainage lake that is located within the village limits of Rib Lake, Taylor County, Wisconsin. It is a natural lake of glacial origin which formed 10,000 to 15,000 years ago. Past industrial and limited agricultural activities have degraded the water quality and biological integrity of the lake ecosystem.

Major impacts to Rib Lake's water quality date back to the village's development in 1882 when the Rib Lake Saw Mill and Tannery Lane Company were established. After industrial activities along the lake shore closed in 1948, the aesthetic and natural values of Rib Lake began to be appreciated. However, years of neglect and pollution had contributed to excess weed growth and fish kills.

In response, the Rib Lake Protection and Rehabilitation District was formed in 1976 to improve the water quality and fishery of the lake. In cooperation with the Wisconsin Department of Natural Resources, the district took action to control and correct some of the problems. As a result, the water quality and fishery have improved, but the district wanted to further improve the lake ecosystem.

The objectives of this study are part of an on-going lake management program developed by the Rib Lake District and the Village of Rib Lake. The project centers on identifying potential pollutants that may be discharging to Rib Lake and determining pollutant concentrations that are currently in the lake. Surveys were also done to determine if the water quality is degrading the biological communities. A lake management plan will report the results of the study.

Investigations included analysis of water chemistry, bottom sediment, benthic macroinvertebrate and fishery surveys, plankton analysis, aquatic plant (macrophyte) surveys, and a watershed appraisal. The lake management plan will analyze the data and make recommendations for strategies to improve the water quality and biological communities of Rib Lake.

The Phase 1 report includes an introduction to the project, information on the materials and methods that were used to conduct the study, and the results of the study in table form. The Phase 2 study will include analysis of the data and recommended strategies and alternatives for best management practices that will improve the biological integrity of Rib Lake.

INTRODUCTION

Rib Lake is a 324 acre lake located totally within the village limits of Rib Lake, Taylor County, Wisconsin. It is a natural lake of glacial origin that was formed 10,000 to 15,000 years ago. The lake has been subjected to significant deterioration in water quality since the early days of the village's development in 1882 when it was used for industrial purposes for the Rib Lake Saw Mill and Tannery Lane Company. After the sawmill closed (1948) the lake began to be used and appreciated for its aesthetic and natural value.

This appreciation came after 60 years of saw dust, bark, slabs and tannery sludge were deposited in the lake in addition to large quantities of nutrients and sediments eroding from the cleared forest land. The lake experienced significant algal blooms, weed growth and fish kills in the 1960's and 1970's promoting the community to form the Rib Lake Public Inland Lake and Protection and Rehabilitation District in 1976 and a conservation club to improve the lake quality and its fishery.

A comprehensive lake study was conducted in 1977-80 by the Wisconsin Department of Natural Resources (WDNR) indicating:

- The 3.7 square mile watershed includes the Village of Rib Lake, a small amount of agricultural land and extensive marsh and woodland areas.
- The soils of the watershed originate from acid drift from granite source materials. The drainage basin is mainly hilly loams formed from sandy loams, acid glacial till and sand and gravel outwash.
- The major drainage to the lake occurs through two tributary streams. Land use in the watershed consists of approximately 10% urban residential, 60% forested and wetland, and 30% abandoned agricultural.
- Surface runoff, groundwater, and atmospheric fallout contribute approximately 1070 pounds of phosphorus per year. The acid soils and high background phosphorus levels in the soil are the most likely cause of this higher than expected nutrient loading.
- The lake's present volume is 1,977 acre-feet. The lake's original volume was 7,600 acre-feet.
- In certain areas the soft sediment is over 40 feet deep. The organic content of the sediment is 40%-to-50% and the water content is 85%-to-95% indicating that internal production of algae and macrophytes is the major cause of lake infilling.

The 1979 lake study indicated that the water quality of the two tributaries and their appropriate watersheds were minimally affected by human activities and development. At that time their were three active farming operations in the watershed. Agricultural land use is currently limited to two hobby farms. The study suggests that Rib Lake was recycling its nutrients in a cyclical fashion with the excessive weed growth that resulted in seasonal fish kills.

The Rib Lake District took recommended action to control and correct some of the problems. Under supervision and direction of the WDNR the outlet dike was reconstructed elevating the water level approximately two feet. A weed harvesting program was implemented but later abandoned when weeds appeared to be under control. A fish stocking program was developed under WDNR supervision and is expanding. A bullhead/rough fish removal effort has been implemented. A rock reef was also constructed and the Lake District is into it's 13th year of aeration.

All of the above practices have improved the lake and its fishery, but citizens want to do more. In 1995, the village conducted a long range planning program. Through it, residents identified the lake as a major asset to their culture and economy. Also, citizens want to further improve the water quality, fishery, aesthetics, and provide better public access (i.e. swimming beach, fishing peer, improved boat landings).

Watershed management and man induced phosphorus control does not appear to be the key issue affecting Rib Lake's current water quality. Controlling non-point pollution by implementing best management practices in the watershed will not rehabilitate the lake. This is a unique opportunity to restore a local and state resource that was degraded by activities 100 years ago. This investment will allow the current stewards of Rib Lake to correct the errors of a past generation and enact practices that will protect this resource for future generations.

The objectives for this study are part of an on-going program of lake management activities by the Rib Lake District and the Village of Rib Lake. A comprehensive lake management and rehabilitation plan will provide data and suggest recommendations for best management practices that will improve the water quality and biological integrity of Rib Lake.

MATERIALS AND METHODS

Field Analysis

To determine the current health of the Rib Lake's ecosystem, numerous categories of the lake were reviewed and analyzed. These included reviewing the history of Rib Lake and its land use; reviewing and interpreting past sampling data; water quality and sediment analysis; phytoplankton and zooplankton analysis; benthic macroinvertebrate and macrophyte surveys; analysis of WDNR fishery surveys; and a current watershed and land use appraisal.

Water Chemistry

Water chemistry samples were collected at three strategic locations that best represented the lake's morphology and drainage patterns. These three locations are the deepest area of the lake, the littoral zone near the major inlet on the northwest side of the lake, and the outlet on the south end of the lake.

One sample was collected at each site, one meter below the surface. Samples were collected at different times throughout 1996 and 1997. The samples were collected with a ALPHA water sampling bottle, and WDNR quality assurance procedures. Samples were placed on ice and mailed to the State Laboratory of Hygiene in Madison, Wisconsin for chemical analysis.

Chemical analysis included biochemical oxygen demand (5-day), chloride, conductivity, acidity, alkalinity, hardness, calcium, magnesium, ammonia nitrogen, nitrate and nitrite nitrogen, total kjeldahl nitrogen, total phosphorus and dissolved ortho phosphorus. These parameters were only analyzed in June of 1996 and 1997. The remaining samples were only tested for total phosphorus and dissolved ortho phosphorus. All analyses were done using U.S. Environmental Protection Agency (EPA) approved methods.

Bottom Sediment

Two sediment samples were collected in July, 1996 using an Ekman Bottom Grab sampler that was six inches in length and six inches wide. Samples were collected at an approximate depth of four-to-six inches at the northwest and southern ends of the lake. Samples were placed on ice and delivered to the University of Wisconsin - Stevens Point Environmental Task Force Laboratory for chemical analysis.

Analysis included total cadmium, chromium, copper, lead, mercury, and zinc; oil and grease; total phosphorus; total organic carbon; alpha-BHC; beta-BHC; gamma-BHC; delta-BHC; heptachlor; aldrin; heptachlor epoxide; endosulfan I; p,p'-DDE; dieldrin; endrin; endosulfan II; p,p'-DDD; endrin aldehyde; endosulfan sulfate; p,p'-DDT; endrin ketone; and methoxychlor. All analyses were done using U.S. EPA approved methods.

Benthic Macroinvertebrate Surveys

Three replicate sediment samples were collected in May and September of 1996 and 1997, adjacent to the two bottom sediment sites, for a total of 24 benthic macroinvertebrate samples. Samples were collected with an Ekman Bottom Grab sampler at an approximate depth of four-to-six inches. Invertebrates were separated from the sediment using a WILDCO Wash Bucket with a #30 (600 um) sieve bottom.

Invertebrate samples were preserved with 70 percent ethanol and identified to family level using a dissecting microscope. Data was tabulated and compared to sediment chemistry to determine if chemical concentrations were affecting the benthic macroinvertebrate populations.

Fish Community Surveys

WDNR staff has monitored the fish community surveys of Rib Lake on an annual basis since 1984. Surveys have been conducted using electroshocking equipment and fyke nets. This data was reviewed and compiled to determine the current health and status of the fishery.

Phytoplankton and Zooplankton Analysis

Three phytoplankton and zooplankton samples were collected in June and August of 1996 and 1997. A total of 12 phytoplankton and 12 zooplankton samples were collected. Samples locations were the same as the three water chemistry sites. Phytoplankton samples were collected at a depth of one meter, placed in 120 ml, glass, amber, bottles, and were preserved with 1 mL of iodine.

The zooplankton samples were collected by a vertical net haul (lake bottom to surface), using a 'Wisconsin Plankton Net', and placed in clear, 120mL, glass bottles. Samples were preserved

with 10 mL of ethanol. Phytoplankton and zooplankton samples were identified to species level, when possible, using the standard inverted microscope analysis method (American Public Health Association et al., 1995).

Aquatic Plant Surveys

Macrophyte surveys were conducted using a modification of the grid sampling method of Jessen and Lound (1962) in August of 1996 and 1997. Permanent reference points were established along shore using Capree Scout Loran C receiver. Six transacts were established from shore to the open water along a straight line. Four stations were recorded in each transact according to water depth for a total of 24 sample stations. Direction was maintained using a compass.

Observations of abundance and diversity of aquatic vegetation was made using a 14 inch wide, double-sided, thatch rack head attached to a rope. Rake teeth are spaced 3/4 inch apart. Observations were made at precise depths along the transacts and reported. The width and distance across each station where observations were made along the transacts were six feet or 1.8 meters.

Watershed Appraisal

A visual survey of the existing conditions of the drainage basin for Rib Lake was done to determine potential sources of point source and nonpoint source pollution. Point sources of pollution are those that have discrete discharges, usually from a pipe or outfall. Nonpoint source pollution is that which cannot be traced to a single point such as a municipal or industrial wastewater treatment plant discharge pipe. Nonpoint sources include eroding farmland and construction sites, urban streets, and barnyards. Pollutants from these sources reach water bodies in runoff, which can best be controlled by proper land management.

Sediment Criteria

The use of one standardized set of sediment criteria is not a luxury that is available at this time. Several sediment pollutant concentration guidelines or criteria are commonly used when assessing sediment quality. Criteria is typically derived using information from background concentrations, toxicity tests, bioassessments, and chemical and physical properties.

Sediment guidelines that are commonly used, but are not limited to, include criteria developed by the Wisconsin Department of Natural Resources (WDNR) for maximum allowable concentrations in Great Lakes sediments for beach nourishment and in-water disposal; U.S. EPA 1977 guidelines for the pollutional classification of Great Lakes Harbor sediments; National Oceanic and Atmospheric Administration guidelines for biological effects; Ontario Ministry of the Environmental Provincial sediment quality guidelines based on biological effects; and an Equilibrium Partitioning Approach to develop sediment quality assessment values for nonpolar hydrophobic organic compounds.

For the purposes of this report the U.S. EPA and WDNR sediment guidelines will be used to interpret the chemical data. This is because both sets of criteria address dredging, beach nourishment, and in-water disposal of sediment (Tables 31 & 32). The other standards are primarily applied to potential biological impacts from contaminated sediment (Tables 33 & 34).

REFERENCES

American Public Health Association, American Water Works Association and Water Environment Federation, 1995. Standard Methods for the Examination of Water and Wastewater. Edited by Eaton, A.D., Clesceri, L.S. and Arnold E. Greenberg.

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Wisconsin Department of Natural Resources, 1980. Office of Inland Lake Renewal. Rib Lake, Taylor County, Feasibility Study Results and Management Alternatives. 28 pp.

Wisconsin Department of Natural Resources, 1991. Lake Habitat Evaluations, Rib Lake, Taylor County. Park Falls Office. 35 pp.

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Table 1. Water chemistry data for Rib Lake samples collected during 1996. All values in mg/L unless otherwise noted.

Collection Date	06/28/96	06/28/96	06/28/96	07/31/96	07/31/96	07/31/96
Sample Site	**RB-SO**	**RB-C**	**RB-NW**	**RB-SO**	**RB-C**	**RB-NW**
Parameters						
BOD^5	4.6	3.8	4.8	NA	NA	NA
Chloride	4.8	4.7	4.7	NA	NA	NA
Conductivity (umhos/cm)	84	84	84	NA	NA	NA
pH	7.66	7.65	7.95	NA	NA	NA
Alkalinity	32	32	32	NA	NA	NA
Hardness	35	35	35	NA	NA	NA
Calcium	9.3	9.4	9.2	NA	NA	NA
Magnesium	2.8	2.9	2.8	NA	NA	NA
Ammonia-Nitrogen	< 0.027	0.031	<0.027	NA	NA	NA
Nitrate+Nitrite-Nitrogen	<0.01	<0.01	<0.01	NA	NA	NA
Total Kjeldahl Nitrogen	1.0	0.8	0.9	NA	NA	NA
Total Phosphorus	0.061	0.065	0.065	0.112	0.131	0.123
Diss. Ortho-Phosphorus	0.003	0.003	0.003	0.007	0.002	0.002
Field Parameters						
Sample Depth (m)	1.5	1.5	1.5	1.0	1.0	1.0
Ambient Air Temp. (F)	90	90	90	70	70	70
pH	8.1	8.3	8.1	8.2	7.9	7.8
Cloud Cover (%)	0	0	0	100	100	100

Collection Date	08/28/96	08/28/96	08/28/96	10/29/96	10/29/96	10/29/96
Sample Site	**RB-SO**	**RB-C**	**RB-NW**	**RB-SO**	**RB-C**	**RB-NW**
Parameters						
Total Phosphorus	0.111	0.134	0.111	0.073	0.069	0.056
Diss. Ortho-Phosphorus	0.003	<0.002	0.004	0.022	0.020	0.020
Field Parameters						
Sample Depth (m)	1.0	1.0	1.0	1.0	1.0	1.0
Ambient Air Temp. (F)	80	80	80	45	45	45
pH	7.7	7.8	7.9	8.0	7.8	7.8
Cloud Cover (%)	0	0	0	100	100	100

NA = Not included in laboratory analysis.

Table 2. Water chemistry data for Rib Lake samples collected during 1997. All values in mg/L unless otherwise noted.

Collection Date	02/19/97	02/19/97	02/19/97	05/27/97	05/27/97	05/27/97
Sample Site	**RB-SO**	**RB-C**	**RB-NW**	**RB-SO**	**RB-C**	**RB-NW**
Parameters						
Total Phosphorus	0.065	0.069	0.068	0.059	0.059	0.064
Diss. Ortho-Phosphorus	0.035	0.045	0.043	0.006	0.008	0.007
Field Parameters						
Sample Depth (m)	1.0	1.0	1.0	1.0	1.0	1.0
Ambient Air Temp. (F)	30	30	30	65	65	65
pH	NA	NA	NA	7.7	7.5	7.0
Cloud Cover (%)	0	0	0	0	0	0

Collection Date	06/25/97	06/25/97	06/25/97	07/31/97	07/31/97	07/31/97
Sample Site	**RB-SO**	**RB-C**	**RB-NW**	**RB-SO**	**RB-C**	**RB-NW**
Parameters						
BOD^5	NA	6.21	8.85	NA	NA	NA
Chloride	5.8	5.8	5.7	NA	NA	NA
Conductivity (umhos/cm)	88	88	87	NA	NA	NA
pH	7.73	7.87	7.97	NA	NA	NA
Alkalinity	33	33	32	NA	NA	NA
Hardness	33	34	33	NA	NA	NA
Calcium	8.6	8.9	8.6	NA	NA	NA
Magnesium	2.8	2.9	2.8	NA	NA	NA
Ammonia-Nitrogen	0.027	0.028	<0.013	NA	NA	NA
Nitrate+Nitrite-Nitrogen	0.015	0.017	<0.01	NA	NA	NA
Total Kjeldahl Nitrogen	1.1	1.8	2.4	NA	NA	NA
Total Phosphorus	0.076	0.095	0.140	0.294	0.164	0.147
Diss. Ortho-Phosphorus	0.007	0.002	0.004	0.018	0.016	0.013
Field Parameters						
Sample Depth (m)	1.0	1.0	1.0	1.0	1.0	1.0
Ambient Air Temp. (F)	80	80	80	80	80	80
pH	NA	NA	NA	NA	NA	NA
Cloud Cover (%)	30	30	30	20	20	20

NA = Not included in laboratory analysis.

Table 2 (Cont.). Water chemistry data for Rib Lake samples collected during 1997. All values in mg/L unless otherwise noted.

Collection Date	08/25/97	08/25/97	08/25/97	11/12/97	11/12/97	11/12/97
Sample Site	**RB-SO**	**RB-C**	**RB-NW**	**RB-SO**	**RB-C**	**RB-NW**
Parameters						
Total Phosphorus	0.162	0.133	0.138	0.034	0.034	0.030
Diss. Ortho-Phosphorus	0.029	0.027	0.027	0.002	0.003	0.003
Field Parameters						
Sample Depth (m)	1.0	1.0	1.0	1.0	1.0	1.0
Ambient Air Temp. (F)	70	70	70	35	35	35
pH	NA	NA	NA	NA	NA	NA
Cloud Cover (%)	50	50	50	20	20	20

NA = Not included in laboratory analysis.

Table 3. Secchi disc data collected near center of Rib Lake in 1996 and 1997. Data collected by the Rib Lake Protection and Rehabilitation District.

Date	Secchi Depth (ft)	Water Color
06/08/96	5	Clear
07/01/96	2.25	Green
07/19/96	2.75	Green
08/16/96	1.25	Green
10/03/96	5	Clear
10/28/96	7	Clear
06/14/97	3	Green
07/07/97	1.5	Green
07/14/97	1.5	Green
07/24/97	1.5	Green
08/18/97	2.5	Brown
09/19/97	2	Brown

Table 4. Water temperature (T) and dissolved oxygen (DO) profiles from Rib Lake in 1996. Temperature units in degrees Celsius and dissolved oxygen in mg/L. ( ) indicates sample locations. Data collected by the Rib lake Protection and Rehabilitation District. Depths vary due to thickness of ice or lake bottom.

	Day/Month										
Depth (ft)	01/20	01/20	01/31	02/11	02/11	02/24	02/24	03/07	03/07	04/10	04/10
	(A)*	(M)	(A)	(A)	(BB)	(A)	(M)	(A)	(OB)	(FI)	(A)
	DO	DO	T/DO	DO	DO	DO	DO	DO	DO	DO	DO
Surface											
1											
2			0.9/4.4					3.6	2.7		
3			1.3/4.3					3.4	2.6	4.6	6.0
4	4.8	6.1	1.7/4.2	4.3	4.2	3.4	3.8	3.4	2.4	3.0	4.7
5			1.9/3.7		3.7	3.2	3.3	2.9	2.2	2.2	4.5
6	3.4	3.7	2.3/3.1	3.6	1.6	2.2	2.8	2.6	1.8	1.6	4.3
7		1.4	4.0/0.3		0.8	0.1	1.2	Bottom	Bottom	1.0	
8			Bottom				0.4				

* A = Aerator
BB = Back Bay
FI = Front of Island
M = Middle
OB = Outlet of Bay

Table 5. Water temperature (T) and dissolved oxygen (DO) profiles from Rib Lake in 1997. Temperature units in degrees Celsius and dissolved oxygen in mg/L. ( ) indicates sample locations. Data collected by the Rib Lake Protection and Rehabilitation District. Depths vary due to thickness of ice or lake bottom.

	Day/Month									
Depth (ft)	01/15	01/15	02/01	02/01	02/01	02/17	02/17	02/17	03/03	03/03
	(A)*	(FI)	(A)	(FI)	(BB)	(A)	(M)	(BB)	(A)	(BB)
	T/DO	T/DO	T/DO	T/DO	T/DO	T/DO	T/DO	T/DO	T/DO	T/DO
Surface										
1										
2	0.9/4.8	0.9/5.2	1.4/4.7	0.3/5.1	0.6/4.7	1.2/5.0	0.8/5.1	0.3/4.3		
3	1.8/4.8	1.4/4.8	1.6/4.5	0.6/4.9	0.7/4.6	1.5/4.7	0.8/5.0	0.5/4.1	1.0/4.8	0.9/3.4
4	2.0/4.7	1.8/4.6	1.6/4.5	1.4/4.4	1.3/4.4	1.6/4.6	1.5/4.2	1.3/3.7	1.4/4.8	1.0/3.4
5	2.0/4.5	2.0/4.4	1.7/4.4	1.9/4.1	1.8/3.9	1.6/4.6	1.7/3.6	1.9/2.8	1.7/4.9	1.4/3.4
6	2.1/4.4	2.5/3.9	1.8/4.2	2.2/3.4	2.1/3.0	2.2/3.4	2.0/2.6	2.2/2.1	2.1/2.6	2.0/2.0
7	2.5/3.6	3.1/2.6	2.7/2.6	3.0/1.9	2.5/1.5		2.6/1.3		3.0/1.1	
8										

* A = Aerator
FI = Front of Island
M = Middle
BB = Back Bay

Table 6. Chemical data for two grab sediment samples from Rib Lake. All values in mg/kg (dry weight).

Parameter	RB-SO	RB-NW	Criteria
Cadmium	1.5	1.3	1
Chromium	21	20	100
Copper	55.3	43.4	100
Lead	56.1	43.8	50
Mercury	1.78	1.213	0.1
Zinc	162	175	100
Oil & Grease	0.6	0.7	1000
Total Phosphorus	1563	1221	NA
Total Organic Carbon (%)	23.8	15.6	NA
Pesticides			
alpha-BHC	ND	ND	NA
beta-BHC	ND	ND	NA
gamma-BHC	ND	ND	NA
delta-BHC	ND	ND	NA
Heptachlor	ND	ND	50
Aldrin	ND	ND	10
Heptachlor epoxide	ND	ND	NA
Endosulfan I	ND	ND	NA
p,p'-DDE	ND	ND	10
Dieldrin	ND	ND	10
Endrin	ND	ND	50
Endosulfan II	ND	ND	NA
p,p'-DDD	ND	ND	NA
Endrin aldehyde	ND	ND	NA
Endosulfan sulfate	ND	ND	NA
p,p'-DDT	ND	ND	10
Endrin ketone	ND	ND	NA
Methoxychlor	ND	ND	NA

ND=Not Detected
NA=Not Available

Table 7. Benthic macroinvetebrate abundance and diversity of samples collected in May and September of 1996 and 1997. Numbers represent averages of triplicate samples.

	RB-SO		RB-NW	
Date	**Chironomidae**	**Tubificidae**	**Chironomidae**	**Tubificidae**
May 5, 1996	64	308	18	280
September 15, 1996	12	240	44	134
May 4, 1997	0	594	108	76
September 20, 1997	24	126	9	612

Table 8. Summary of fish species observed in Rib Lake from 1984 through 1997 by the Wisconsin Department of Natural Resources. Surveys done with boom shockers and/or fyke net lifts.

Species	1984	1985	1986	1987	1988	1989	1990*	1991	1992	1993	1994	1995	1996*	1997*
Walleye	x	x	x	x	x	x		x	x	x	x	x	x	x
Musky	x	x		x	x	x		x	x	x	x	x	x	x
Northern Pike	x	x	x		x	x			x	x	x	x		x
Largemouth Bass	x	x				x		x	x		x	x	x	x
White Sucker	x	x	x		x	x		x	x		x	x		x
Bluegill								x	x	x	x	x		x
Pumpkinseed								x	x	x	x	x		
Hybrid BG x PS											x			
Black Crappie								x	x	x	x	x		x
Yellow Perch						x		x	x	x	x	x		x
Bullhead sp.								x	x	x	x	x		
Common Shiner					x			x						
Golden Shiner					x									

*1990 - No data available.
1996 - Incomplete data.
1997 - Incomplete data.

Table 9. Phytoplankton analysis of three samples collected from Rib Lake on June 25, 1996. Values in units/mL.

DIVISION	TAXON	SO	C	NW
CHLOROPHYTA (Green Algae)	*Ankistrodesmus fractus*	0	48	130
	Botryococcus sudeticus	29	77	0
	Chlamydomonas globosa	80	438	203
	Chlorococcum humicola	168	0	400
	Oocystis parva	316	145	0
	Pandorina morum	76	486	48
	Pediastrum duplex	0	56	348
	Scenedesmus armatus	69	146	210
	Scenedesmus quadricauda	480	290	0
	Scenedesmus sp.	89	376	0
	Selenastrum Westii	0	15	154
	CHLOROPHYTA TOTAL	**1,307**	**2,077**	**1,493**
CYANOPHYTA (Blue-Green Algae)	*Anabaena circinalis*	0	210	0
	Aphanizomenon flos-aquae	1,459	3,075	846
	Gleotrichia sp.	0	76	130
	Microcystis incerta	0	0	372
	CYANOPHYTA TOTAL	**1,459**	**3,361**	**1,348**
CHRYSOPHYTA (Diatoms)	*Asterionella formosa*	140	320	280
	Cyclotella Meneghiniana	390	1,256	450
	Dinobryon calciformis	0	27	420
	Fragilaria crotonensis	523	390	0
	Gomphonema olivaceum	54	0	129
	Melosira granulata	380	54	560
	Melosira ambigua	0	310	89
	Stephanodiscus niagarae	28	305	0
	Synedra tabulata	0	60	158
	CHRYSOPHYTA TOTAL	**1,515**	**2,722**	**2,086**
CRYPTOPHYTA (Cryptomonads)	*Cryptomonas erosa*	1,030	480	928
	CRYPTOPHYTA TOTAL	**1,030**	**480**	**928**
	TOTALS	**5,311**	**8,640**	**5,855**

Table 10. Zooplankton analysis of three samples collected from Rib Lake on June 25, 1996. Values in numbers/m^2.

DIVISION	TAXON	SO	C	NW
CLADOCERA	*Bosmina longirostris*	1,036	4,048	847
	Ceriodaphnia sp.	24,944	160,637	200,783
	Chydorus sphaericus	100,783	40,859	140,637
	Daphnia pulex	3,960	0	289
	CLADOCERA TOTAL	**130,723**	**205,544**	**342,556**
COPEPODA	*Cyclops sp.*	30,893	2,057	48,059
	Diaptomus sp.	0	5,904	16,478
	Nauplii	3,095	148,849	28,647
	COPEPODA TOTAL	**33,988**	**156,810**	**93,184**
ROTIFERA	*Keratella cochlearis*	30,467	168,938	156,790
	Polyarthra vulgaris	3,960	0	2,622
	Trichocerca cylindrica	0	7,893	948
	ROTIFERA TOTAL	**34,427**	**176,831**	**160,360**
	TOTALS	**199,138**	**539,185**	**596,100**

Table 11. Phytoplankton analysis of three samples collected from Rib Lake on August 28, 1996. Values in units/mL.

DIVISION	TAXON	SO	C	NW
CHLOROPHYTA (Green Algae)	*Botryococcus sudeticus*	0	0	70
	Chlamydomonas globosa	77	638	210
	Oocystis parva	309	91	838
	Pandorina morum	0	91	70
	Pediastrum duplex	154	455	0
	Scenedesmus quadricauda	463	0	210
	Scenedesmus sp.	77	182	140
	CHLOROPHYTA TOTAL	**1,080**	**1,457**	**1,538**
CYANOPHYTA (Blue-Green Algae)	*Anabaena circinalis*	309	455	419
	Aphanizomenon flos-aquae	34,986	40,536	26,480
	Coelosphaerium Naegelianum	232	0	210
	Microcystis aeruginosa	927	547	908
	Microcystis incerta	1,390	1,457	1,327
	Oscillatoria sp.	0	0	419
	CYANOPHYTA TOTAL	**37,844**	**42,995**	**29,763**
CHRYSOPHYTA (Diatoms)	*Fragilaria crotonensis*	154	182	0
	Melosira granulata	0	182	559
	Stephanodiscus sp.	0	0	140
	CHRYSOPHYTA TOTAL	**154**	**364**	**699**
CRYPTOPHYTA (Cryptomonads)	*Cryptomonas erosa*	772	1,640	1,537
	CRYPTOPHYTA TOTAL	**772**	**1,640**	**1,537**
	TOTALS	**39,850**	**46,456**	**33,537**

Table 12. Zooplankton analysis of three samples collected from Rib Lake on August 28, 1996. Values in numbers/m^2.

DIVISION	TAXON	SO	C	NW
CLADOCERA	*Bosmina longirostris*	6,189	25,465	48,189
	Ceriodaphnia sp.	61,894	186,742	568,625
	Chydorus sphaericus	259,953	203,718	202,392
	Daphnia galeata mendotae	12,379	0	0
	Daphnia pulex	0	8,488	0
	Diaphanosoma leuchtenbergianum	0	0	28,913
	Immature Cladocera	0	33,953	57,826
	CLADOCERA TOTAL	**340,415**	**458,366**	**905,945**
COPEPODA	*Copepodid*	0	0	9,638
	Cyclops sp.	37,136	84,883	96,377
	Diaptomus sp.	6,189	0	38,551
	Nauplii	136,166	229,183	106,015
	COPEPODA TOTAL	**179,491**	**314,066**	**250,581**
ROTIFERA	*Keratella cochlearis*	80,462	288,601	269,856
	Keratella quadrata	0	8,488	8,488
	Polyarthra vulgaris	18,568	25,465	57,826
	Trichocerca cylindrica	12,379	42,441	28,913
	ROTIFERA TOTAL	**111,408**	**364,995**	**365,084**
	TOTALS	**631,315**	**1,137,427**	**1,521,610**

Table 13. Phytoplankton analysis of three samples collected from Rib Lake on June 20, 1997. Values in units/mL.

DIVISION	TAXON	SO	C	NW
CHLOROPHYTA	*Chlamydomonas globosa*	387	0	785
(Green Algae)	*Chlorococcum humicola*	284	389	73
	Chorella ellipsoidea	743	238	197
	Oocystis parva	890	75	1,309
	Pandorina morum	0	492	0
	Pediastrum duplex	84	338	298
	Scenedesmus quadricauda	0	0	528
	CHLOROPHYTA TOTAL	**2,388**	**1,532**	**3,190**
CYANOPHYTA	*Anabaena circinalis*	134	278	0
(Blue-Green Algae)	*Aphanizomenon flos-aquae*	10,748	4,832	15,905
	CYANOPHYTA TOTAL	**10,882**	**5,110**	**15,905**
CHRYSOPHYTA	*Asterionella formosa*	0	394	237
(Diatoms)	*Cyclotella Meneghiniana*	810	297	126
	Dinobryon calciformis	48	160	0
	Fragilaria crotonensis	0	0	204
	Gomphonema angustatum	86	293	129
	Melosira granulata	484	38	85
	Nitzschia sigmoidea	34	182	0
	Stephanodiscus dubius	0	16	65
	Stephanodiscus niagarae	0	0	173
	Synedra tabulata	538	69	310
	CHRYSOPHYTA TOTAL	**2,000**	**1,449**	**1,329**
	TOTALS	**10,882**	**8,091**	**20,424**

Table 14. Zooplankton analysis of three samples collected from Rib Lake on June 20, 1997. Values in numbers/m^2.

DIVISION	TAXON	SO	C	NW
CLADOCERA	*Ceriodaphnia sp.*	95,374	34,845	123,439
	Chydorus sphaericus	283,478	129,639	39,402
	Daphnia galeata mendotae	0	64,309	12,940
	Daphnia pulex	3,904	5,928	2,934
	Diaphanosoma leuchtenbergianum	8,340	19,468	0
	CLADOCERA TOTAL	**391,096**	**254,189**	**178,715**
COPEPODA	*Copepodid*	836	13,934	0
	Cyclops sp.	128,374	36,480	85,382
	Nauplii	180,479	100,383	36,047
	COPEPODA TOTAL	**309,689**	**150,797**	**121,429**
ROTIFERA	*Keratella cochlearis*	121,938	320,782	190,384
	Keratella quadrata	4,948	0	783
	Polyarthra vulgaris	34,839	25,389	9,283
	ROTIFERA TOTAL	**161,725**	**346,171**	**200,450**
	TOTALS	**862,510**	**751,157**	**500,594**

Table 15. Phytoplankton analysis of three samples collected from Rib Lake on August 25, 1997. Values in units/mL.

DIVISION	TAXON	SO	C	NW
CHLOROPHYTA (Green Algae)	*Ankistrodesmus fractus*	104	32	0
	Chlamydomonas globosa	320	729	48
	Oocystis parva	110	290	1,038
	Pandorina morum	290	0	39
	Pediastrum duplex	320	193	410
	Scenedesmus quadricauda	0	325	43
	CHLOROPHYTA TOTAL	**1,144**	**1,569**	**1,578**
CYANOPHYTA (Blue-Green Algae)	*Anabaena circinalis*	210	0	539
	Aphanizomenon flos-aquae	29,930	56,378	13,629
	Coelosphaerium Naegelianum	1034	547	92
	Microcystis aeruginosa	0	389	893
	Microcystis incerta	537	1,387	238
	CYANOPHYTA TOTAL	**31,711**	**58,701**	**15,391**
CHRYSOPHYTA (Diatoms)	*Asterionella formosa*	48	132	0
	Fragilaria crotonensis	58	283	185
	Melosira granulata	372	0	0
	Synedra tabulata	0	629	163
	CHRYSOPHYTA TOTAL	**478**	**1,044**	**348**
CRYPTOPHYTA (Cryptomonads)	*Cryptomonas erosa*	38	940	549
	CRYPTOPHYTA TOTAL	**38**	**940**	**549**
	TOTALS	**33,371**	**62,254**	**17,866**

Table 16. Zooplankton analysis of three samples collected from Rib Lake on August 25, 1997. Values in numbers/m^2.

DIVISION	TAXON	SO	C	NW
CLADOCERA	*Bosmina longirostris*	26,934	8,398	58,562
	Ceriodaphnia sp.	396,629	48,289	198,389
	Chydorus sphaericus	300,827	230,480	180,384
	Daphnia galeata mendotae	3,948	0	5,389
	Daphnia pulex	3,898	2,839	0
	Immature Cladocera	28,390	9, 589	49,378
	CLADOCERA TOTAL	**760,626**	**299,595**	**492,102**
COPEPODA	*Copepodid*	5,438	0	938
	Cyclops sp.	48,932	18,468	92,389
	Diaptomus sp.	2,389	728	32,405
	Nauplii	0	44,839	101,289
	COPEPODA TOTAL	**56,759**	**64,035**	**227,021**
ROTIFERA	*Keratella cochlearis*	239,489	97,378	139,321
	Polyarthra vulgaris	20,378	59,303	19,937
	Trichocerca cylindrica	38,489	8,948	26,319
	ROTIFERA TOTAL	**298,356**	**165,629**	**185,577**
	TOTALS	**1,115,741**	**529,259**	**904,700**

Table 17. Location information for Macrophyte Transacts on Rib Lake in 1996 and 1997.

Transact Number	Latitude/Longitude	Transact Length (ft)	Bearing (Degrees)	Depth Range*
1	45^0 19.180' / 90^0 11.609'	50	20	1/2/3/4
2	45^0 18.965' / 90^0 11.425'	55	75	1/2/3/4
3	45^0 18.605' / 90^0 11.709'	87	190	1/2/3/4
4	45^0 18.615' / 90^0 12.431'	160	220	1/2/3/4
5	45^0 18.834' / 90^0 12.448'	100	300	1/2/3/4
6	45^0 19.096' / 90^0 12.065'	125	325	1/2/3/4

1 = 0.0 - 0.5 m (0.0 - 1.7 ft)
2 = 0.5 - 1.0 m (1.7 - 3.4 ft)
3 = 1.0 - 1.5 m (3.4 - 5.0 ft)
4 = 1.5 - 3.0 m (5.0 - 10.0 ft)

Table 18. Aquatic Plant Species Observed in Rib Lake, 1996 and 1997.

Scientific Name	Common Name	Code
Lemna minor	Lesser Duckweed	LEMMI
Lemna trisulca	Star Duckweed	LEMTR
Spirodela polyrhiza	Greater Duckweed	SPIRP
Ceratophyllum demersum	Coontail	CERAD
Elodea canadensis	Elodea	ELODC
Potamogeton Richardsonii	Richardson's Pondweed	POTAR
Potamogeton pectinatus	Sago Pondweed	POTAP
Typha latifolia	Broad-leaved Cattail	TYPHL
Sagitarria latifolia	Broad-leaved Arrowhead	SAGIL
Polygonum natans	Water Smartweed	POLYN
Nuphar variegata	Yellow Water-Lily	NUPHV
Sparganium eurycarpum	Giant Bur-reed	SPARG
Cladophora sp.	Cladophora	CHADO

Table 19. Occurrence and Abundance of Aquatic Plants by Depth for Transact 1, Rib Lake, August, 1996. Occurrence in Percent (%) and Rake Head Abundance Ranges are (1) low to (5) high.

Code	Depth 1	Depth 2	Depth 3	Depth 4
LEMMI				
LEMST				
SPIRP				
CERAD				
ELODC	40	100	50	100
POTAR			50	
POTAP				
TYPHL	60			
SAGIL				
POLYN				
NUPHV				
SPARG				
CLADO				
Abundance	5	4	1	1

Table 20. Occurrence and Abundance of Aquatic Plants by Depth for Transact 2, Rib Lake, August, 1996. Occurrence in Percent (%) and Rake Head Abundance Ranges are (1) low to (5) high.

Code	Depth 1	Depth 2	Depth 3	Depth 4
LEMMI				
LEMST				
SPIRP				
CERAD				
ELODC		100	5	100
POTAR			95	
POTAP				
TYPHL	95			
SAGIL				
POLYN				
NUPHV				
SPARG	5			
CLADO				
Abundance	4	1	3	1

Table 21. Occurrence and Abundance of Aquatic Plants by Depth for Transact 3, Rib Lake, August, 1996. Occurrence in Percent (%) and Rake Head Abundance Ranges are (1) low to (5) high.

Code	Depth 1	Depth 2	Depth 3	Depth 4
LEMMI	1			
LEMST	4	2	2	
SPIRP	5	3	3	5
CERAD		20		
ELODC	80	70	90	90
POTAR				
POTAP				
TYPHL				
SAGIL				
POLYN				
NUPHV				
SPARG				
CLADO	10	5	5	5
Abundance	5	5	5	5

Table 22. Occurrence and Abundance of Aquatic Plants by Depth for Transact 4, Rib Lake, August, 1996. Occurrence in Percent (%) and Rake Head Abundance Ranges are (1) low to (5) high.

Code	Depth 1	Depth 2	Depth 3	Depth 4
LEMMI	1			
LEMST				
SPIRP	3			
CERAD	40	30	30	40
ELODC	50	60	60	60
POTAR				
POTAP				
TYPHL				
SAGIL				
POLYN	1			
NUPHV				
SPARG				
CLADO	5	10	10	
Abundance	5	5	5	3

Table 23. Occurrence and Abundance of Aquatic Plants by Depth for Transact 5, Rib Lake, August, 1996. Occurrence in Percent (%) and Rake Head Abundance Ranges are (1) low to (5) high.

Code	Depth 1	Depth 2	Depth 3	Depth 4
LEMMI				
LEMST				
SPIRP				
CERAD		10		
ELODC	30	60	50	65
POTAR				
POTAP				5
TYPHL	50			
SAGIL				
POLYN				
NUPHV	20	30	50	30
SPARG				
CLADO				
Abundance	5	3	3	5

Table 24. Occurrence and Abundance of Aquatic Plants by Depth for Transact 6, Rib Lake, August, 1996. Occurrence in Percent (%) and Rake Head Abundance Ranges are (1) low to (5) high.

Code	Depth 1	Depth 2	Depth 3	Depth 4
LEMMI				
LEMST				
SPIRP	2			
CERAD	40	5	5	5
ELODC	50	90	90	90
POTAR				
POTAP				
TYPHL	3			
SAGIL	1			
POLYN				
NUPHV	4	5	5	5
SPARG				
CLADO				
Abundance	5	5	5	5

Table 25. Occurrence and Abundance of Aquatic Plants by Depth for Transact 1, Rib Lake, August, 1997. Occurrence in Percent (%) and Rake Head Abundance Ranges are (1) low to (5) high.

Code	Depth 1	Depth 2	Depth 3	Depth 4
LEMMI	5			
LEMST	5			
SPIRP				
CERAD		10	30	20
ELODC	30	90	50	80
POTAR			20	
POTAP				
TYPHL	50			
SAGIL				
POLYN				
NUPHV				
SPARG	5			
CLADO	5			
Abundance	5	3	1	1

Table 26. Occurrence and Abundance of Aquatic Plants by Depth for Transact 2, Rib Lake, August, 1997. Occurrence in Percent (%) and Rake Head Abundance Ranges are (1) low to (5) high.

Code	Depth 1	Depth 2	Depth 3	Depth 4
LEMMI				
LEMST				
SPIRP				
CERAD		20		
ELODC		80	20	80
POTAR			80	20
POTAP				
TYPHL	95			
SAGIL				
POLYN				
NUPHV				
SPARG	5			
CLADO				
Abundance	4	1	1	1

Table 27. Occurrence and Abundance of Aquatic Plants by Depth for Transact 3, Rib Lake, August, 1997. Occurrence in Percent (%) and Rake Head Abundance Ranges are (1) low to (5) high.

Code	Depth 1	Depth 2	Depth 3	Depth 4
LEMMI	5			
LEMST	3			
SPIRP	2			
CERAD	15	30	30	20
ELODC	70	70	70	80
POTAR				
POTAP				
TYPHL				
SAGIL				
POLYN				
NUPHV				
SPARG				
CLADO	5			
Abundance	3	2	2	2

Table 28. Occurrence and Abundance of Aquatic Plants by Depth for Transact 4, Rib Lake, August, 1997. Occurrence in Percent (%) and Rake Head Abundance Ranges are (1) low to (5) high.

Code	Depth 1	Depth 2	Depth 3	Depth 4
LEMMI	5			
LEMST				
SPIRP				
CERAD	40	30	30	30
ELODC	50	60	70	70
POTAR				
POTAP	5			
TYPHL				
SAGIL				
POLYN				
NUPHV				
SPARG				
CLADO		10		
Abundance	5	4	3	3

Table 29. Occurrence and Abundance of Aquatic Plants by Depth for Transact 5, Rib Lake, August, 1997. Occurrence in Percent (%) and Rake Head Abundance Ranges are (1) low to (5) high.

Code	Depth 1	Depth 2	Depth 3	Depth 4
LEMMI	2			
LEMST	3			
SPIRP	5			
CERAD		20		
ELODC	10	40	70	60
POTAR				
POTAP				10
TYPHL	50			
SAGIL				
POLYN				
NUPHV	20	40	30	30
SPARG	10			
CLADO				
Abundance	5	3	2	2

Table 30. Occurrence and Abundance of Aquatic Plants by Depth for Transact 6, Rib Lake, August, 1997. Occurrence in Percent (%) and Rake Head Abundance Ranges are (1) low to (5) high.

Code	Depth 1	Depth 2	Depth 3	Depth 4
LEMMI				
LEMST				
SPIRP				
CERAD	15	20	20	20
ELODC	30	60	60	60
POTAR				
POTAP				
TYPHL	40			
SAGIL				
POLYN				
NUPHV	5	20	20	20
SPARG	10			
CLADO				
Abundance	5	3	3	3

Table 31. WDNR Guidelines for Maximum Allowable Concentrations of Contaminants in Great Lakes Sediments for Beach Nourishment and In-Water Disposal. All values in mg/kg (dry weight) unless otherwise noted. Concentrations were established using a background approach.

Pollutants	Maximum Concentration	
Organics	Lake Michigan	Lake Superior
PCB (total)	0.05	0.05
Total 2,3,7,8 TCDD (pg/g)	1.0	1.0
Total 2,3,7,8 TCDF (pg/g)	10.0	10.0
Aldrin	0.01	0.01
Dieldrin	0.01	0.01
Chlordane	0.01	0.01
Endrin	0.05	0.05
Heptachlor	0.05	0.05
Lindane	0.05	0.05
Toxaphene	0.05	0.05
DDT	0.01	0.01
DDE	0.01	0.01
Metals		
Arsenic	10	10
Barium	500	500
Cadmium	1.0	1.0
Chromium	75	100
Copper	50	100
Lead	50	50
Mercury	0.1	0.1
Nickel	50	100
Selenium	100	100
Zinc	100	100
Other		
Oil & Grease	1,000	1,000

WDNR, 1987

NOTE: NR 347, Wis. Adm. Code, establishes criteria for particle grain size which are used in allowing dredge material deposition on existing beaches.

Table 32. U.S. EPA Pollutional Classification Guidelines for Great Lakes Harbor Sediments[1]. All values in mg/kg unless otherwise noted.

Pollutants	Nonpolluted	Moderately Polluted	Heavily Polluted
Organics			
PCB (total)	(3)	(3)	>10
Metals			
Arsenic	<3	3-8	>8
Barium	<20	20-60	>60
Cadmium	Lower Limits Not Established		>6
Chromium	<25	25-75	>75
Copper	25	25-50	>50
Cyanide	<0.10	0.10-0.25	>0.25
Iron	<17,000	17,000-25,000	>25,000
Lead	<40	40-60	>60
Manganese	<300	300-500	>500
Mercury	>1 is unacceptable for Open Lake Disposal		>1
Nickel	<20	20-50	>50
Zinc	>90	90-200	>200
Other			
Oil & Grease	<1,000	1,000-2,000	>2,000
Phosphorus (total)	<420	420-850	>850
Total Kjeldahl Nitrogen	<1,000	1,000-2,000	>2,000

1. Source: U.S. EPA 1977 Guidelines for the Pollutional Classification of Great Lakes Harbor Sediments. U.S. EPA, Region V. Chicago, IL. April 1977.

2. Additional factors such as elutriate test results, sources of contamination, particle size distribution, benthic macroinvertebrate populations, color and odor are also considered in the classification.

3. Pollutional classification of sediments with total PCBs between 1.0 and 10.0 ppm dry weight determined on case-by-case basis.

Table 33. Ontario Ministry of the Environmental Provincial Sediment Quality Guidelines for Organic Compounds Based on Biological Effects (Persaud et al. 1990). Values in mg/kg (dry weight).

Contaminants	No Effect Level	Lowest Effect Level	Limit of Tolerance[1]
Organics			
Lindane	0.001	0.003[b]	1[c]
Chlordane	0.005[a]	0.007	6
DDT (total)	-	0.007	12
p,p'DDT	0.002[a]	0.01	14
p,p'DDD	0.001	0.008	9
p,p'DDE	0.002	0.005	20
o,p'DDT	0.001	0.006	11
Dieldrin	0.001	0.02	91
PCB (total)	0.02	0.07	530
PAH (total)	-	2	11,000
Metals			
Cadmium	1	*1	10
Chromium	31	*31	110
Copper	25	*25	110
Lead	23	31	250
Mercury	0.1	0.2	2
Zinc	65	120	820
Nutrients			
Total Organic Carbon (%)	-	1	10
Phosphorus (total)	-	600	2000

Lowest Effect Levels are based on the 5th percentile of the Screening Level Concentration (SLC) except where noted otherwise.

Limit of Tolerance values are based on the 95th percentile of the SLC except where otherwise noted.

1. Organic data in this column are to be normalized to actual Total Organic Carbon (TOC) concentration of the sediment (to a maximum of 10%), e.g. @ TOC of 5%, PCB value is 529.6 x 0.05 or 26.5 ppm.

a. Guideline based on Equilibrium Partitioning Approach (E.P. derived guidelines higher than background).
b. 10% SLC.
c. 90% SLC.
- No data.
* Background value. Calculated SLC guideline lower than background.

Table 34. National Oceanic and Atmospheric Administration Selected Guidelines for Biological Effects Ranges of Sediment-Sorbed Pollutants (Long and Morgan, 1991).

Compound	ER-L Concentration	ER-M Concentration	ER-L:ER-M Ratio	Overall Apparent Effects Threshold	Subjective Degree of Confidence in ER-L/ER-M Values
Trace Elements (ppm)					
Cadmium	5	9	1.8	5	High/high
Chromium	80	145	1.8	No	Moderate/moderate
Copper	70	390	5.6	300	High/high
Lead	35	110	3.1	300	Moderate/high
Mercury	0.15	1.3	8.7	1	Moderate/high
Zinc	120	270	2.2	260	High/high
Polychlorinated Biphenyls (ppb)					
Total PCBs	50	400	7.6	370	Moderate/moderate
DDT and Metabolites (ppb)					
DDT	1	7	7	6	Low/low
DDD	2	20	10	NSD	Moderate/low
DDE	2	15	7.5	NSD	Low/low
Total DDT	3	350	117	No	Moderate/moderate
Other Pesticides (ppb)					
Lindane	NA	NA	NA	NSD	NA
Chlordane	0.5	6	12	2	Low/low
Dieldrin	0.02	8	400	No	Low/low
Polycyclic Aromatic Hydrocarbons (ppb)					
Acenaphthene	150	650	4.3	150	Low/low
Anthracene	85	960	11.3	300	Low/moderate
Benzo(a)anthracene	230	1600	7	550	Low/moderate
Benzo(a)pyrene	400	2500	6.2	700	Moderate/moderate
Benzo(e)pyrene	NA	NA	NA	NSD	NA
Chrysene	400	2800	7	900	Moderate/moderate
Dibenzo(a,h)anthracene	60	260	4.3	100	Moderate/moderate
Fluoranthene	600	3600	6	1000	High/high
Fluorene	35	640	18.3	350	Low/low
Perylene	NA	NA	NA	NSD	NA
Phenanthrene	225	1380	6.1	260	Moderate/moderate
Pyrene	350	2200	6.3	1000	Moderate/moderate
Total PAHs	4000	35000	8.8	22000	Low/low

ER-L = Effects Range - Low
ER-M = Effects Range - Median
NSD = not sufficient data.
NA = not available.

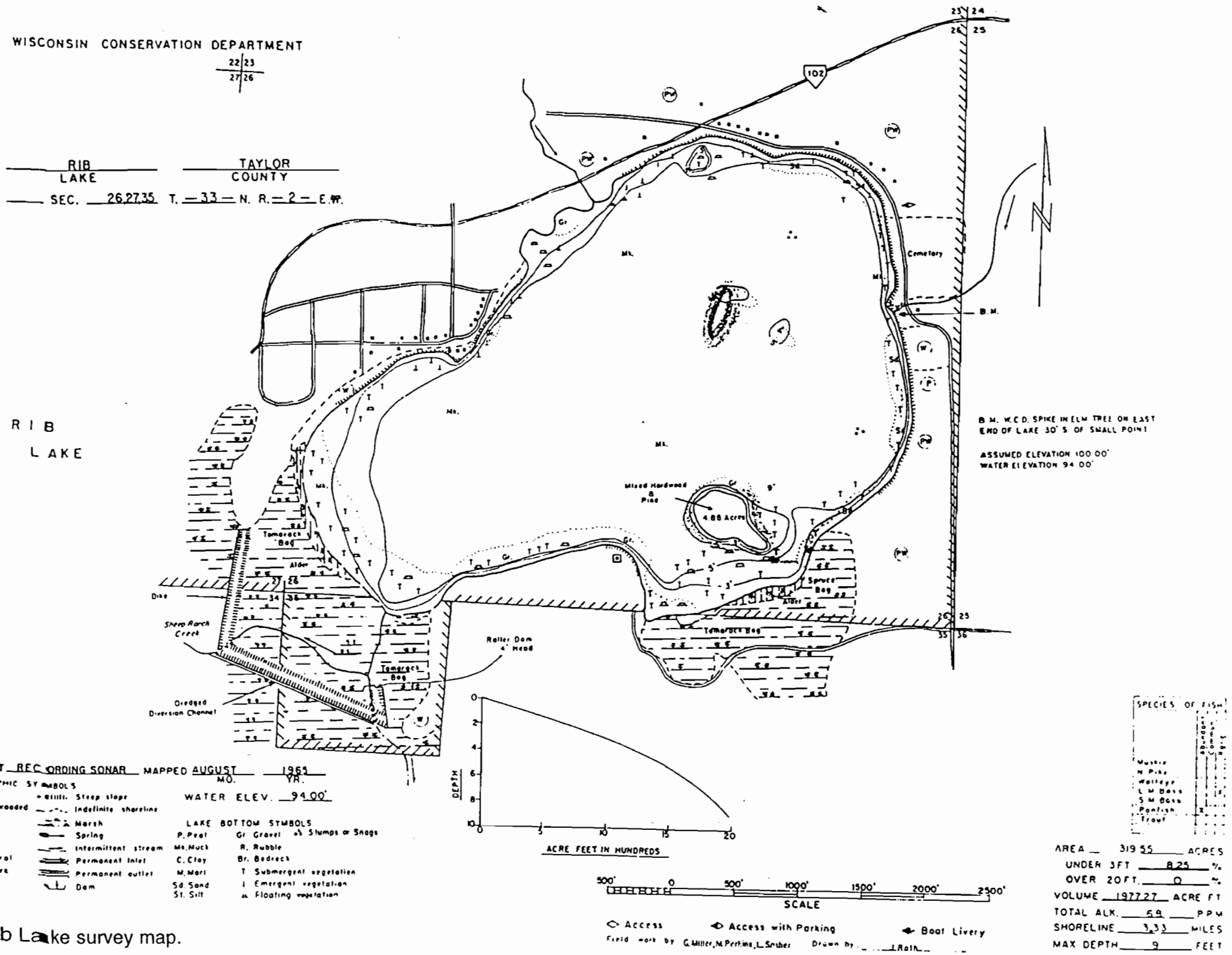

Figure 1. Rib Lake survey map.

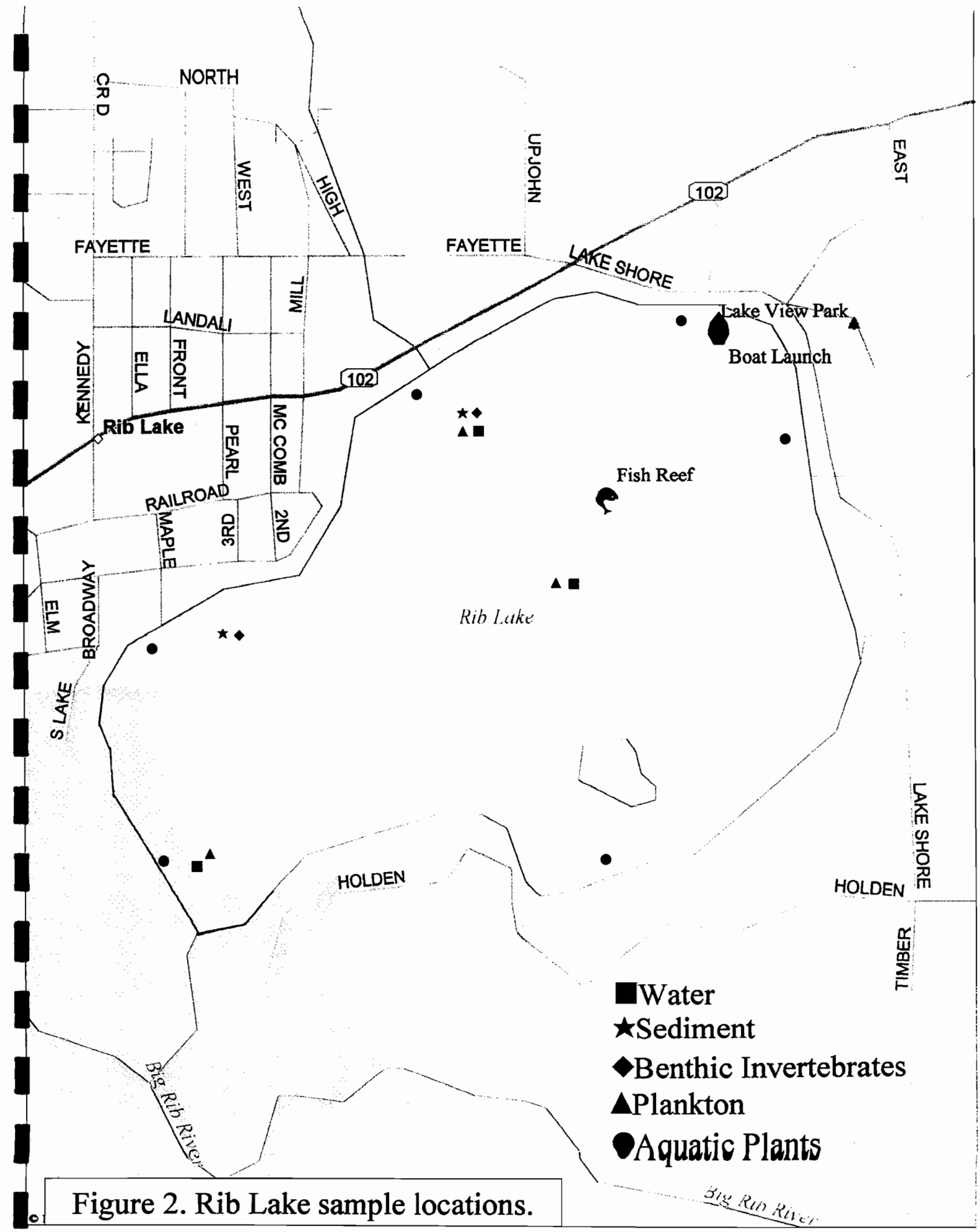

Figure 2. Rib Lake sample locations.

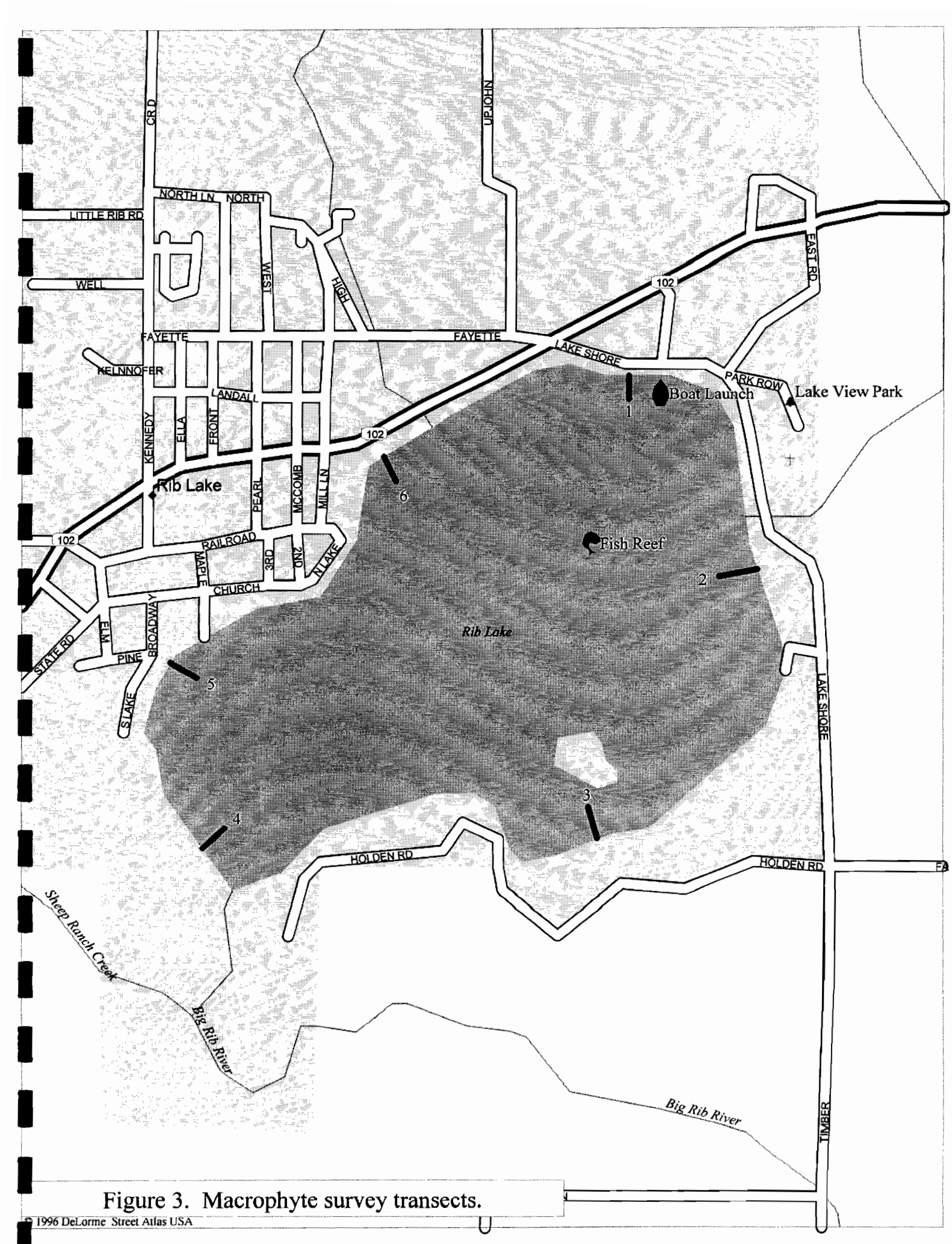

Figure 3. Macrophyte survey transects.

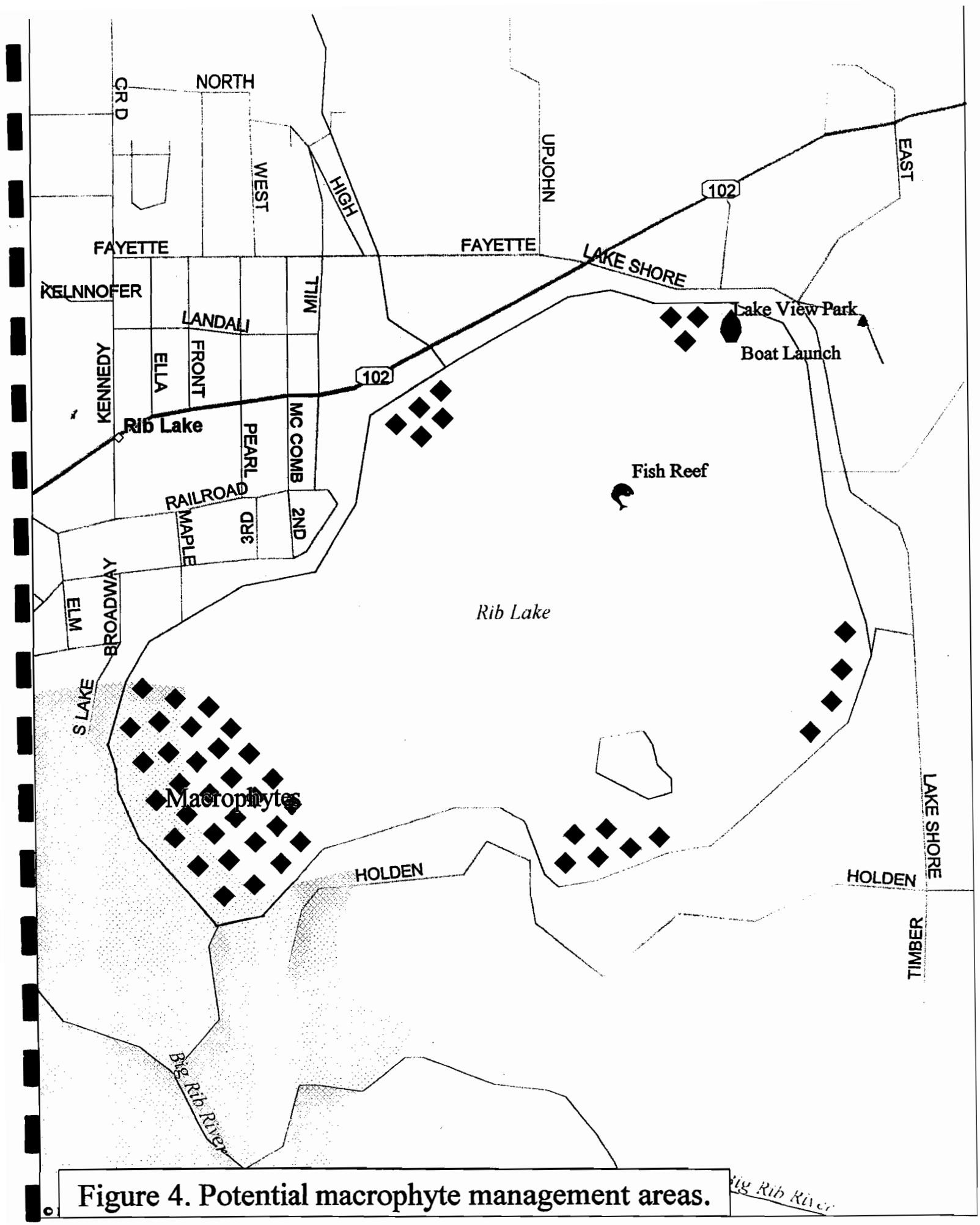

Figure 4. Potential macrophyte management areas.

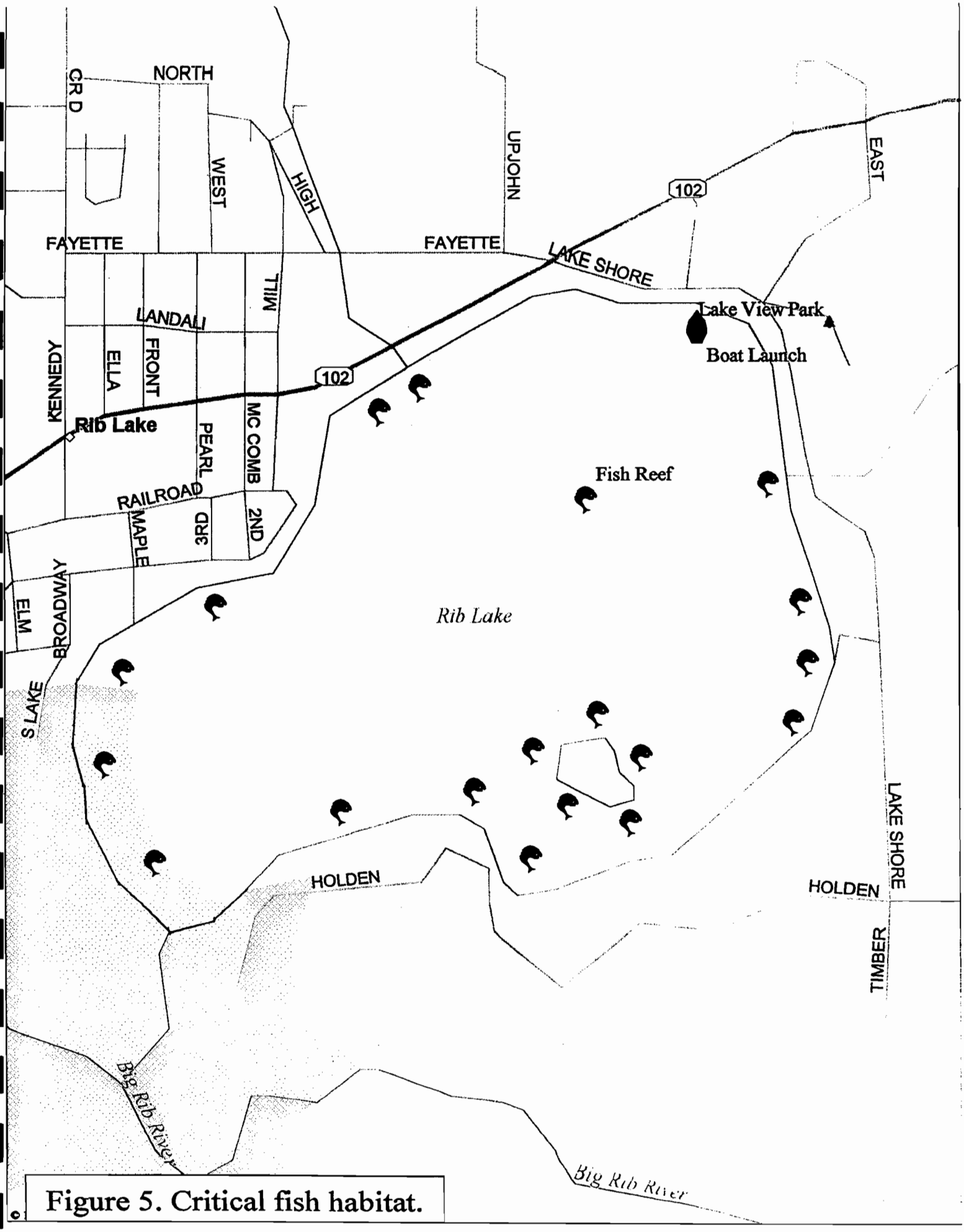

Figure 5. Critical fish habitat.