Minnesota Water Quality

Water Years 1984-1985

The 1986 Report to the Congress of the United States

MINNESOTA POLLUTION CONTROL AGENCY

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The drawing of the Great Blue Heron was done by Barbara Jablonski, a Pollution Control Technician in Water Quality at MPCA. In some regions of the country, numbers of Great Blue Herons have declined due to loss in wetlands and decrease in water quality. However, in Minnesota, it remains a conspicuous wading bird, serving as an indicator of wetland preservation and maintenance of good water quality.

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The 1986 Report to the Congress of the United States by the State of Minnesota Pursuant to Section 305(b) of the Federal Water Pollution Control Act

Minnesota Pollution Control Agency

Roseville, Minnesota 55113

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1. EXECUTIVE SUMMARY

This report, prepared by the Minnesota Pollution Control Agency (MPCA), fulfills requirements of the Clean Water Act to provide the Environmental Protection Agency and Congress with a biennial summary of water quality within the State. In addition, the document provides general information to the public and serves as a water quality management tool.

Minnesota is a water-rich state. A myriad of lakes and streams offer swimming, boating, and fishing opportunities to its citizens and visitors. Much of the annual $4.8 billion tourism industry is attributable to the State's water resources. Even though water is a renewable resource, its value for most consumptive and recreational uses is directly related to its quality or purity. Once degraded in quality, a water resource loses much of its intrinsic value. Improper disposal of solid and liquid wastes and land management practices detrimental to water quality, if left unchecked, will degrade this valued resource. To prevent degradation and to restore water quality, federal and state environmental controls are in place which regulate use of public waters for the benefit of all.

Monitoring data collected during 1984 and 1985 were evaluated to determine how well Minnesota's surface and ground waters support designated uses for drinking, swimming, fishing, and fish consumption. General water quality in the state is quite good. For waters not fully supporting their intended uses, the MPCA actively addresses the causes of nonsupport through programs dealing with point and nonpoint source pollution abatement.

The monitoring data from 1,896 miles of assessed rivers and streams showed that 83% of the mileage fully met the fishable use designation. The causes of partial and nonsupport were found to be pollutant loadings from nonpoint sources (51%), point sources (42%), and combinations of point and nonpoint sources (7%). A ten-year trend analysis indicated that water quality impacts from point sources are declining as a direct result of improved wastewater treatment. However, nonpoint sources continue to degrade water quality, particularly in highly agricultural areas of the state.

A trophic status assessment of 27.6% of Minnesota's total lake acreage showed that 28% of the assessed lake acreage fully supported designated uses (meso- and oligotrophic), 63% partially supported uses (eutrophic), and 9% did not support uses (hypereutrophic). The highly eutrophic lakes exhibited nuisance conditions which detracted from the resource's value. An estimated 90% of Minnesota'a lakes may be impacted by nonpoint sources of nutrients which accelerate lake eutrophication. The near-shore waters of Lake Superior fully supported designated fishable/swimmable uses.

Fish tissue analyses are used to identify waters suspected of having low level concentrations of bioaccumulative toxics or to screen heavily used waters for potential problems. Results from the fish tissue monitoring program are not necessarily representative of all Minnesota waters. Fish consumption advisories are issued by the Minnesota Department of Health for specific water bodies whenever monitoring data show toxics concentrations exceeding recommended standards. From 1975 to 1984, fish samples from lakes totaling 404,765 acres showed that 45% of the acreage fully supported intended uses, resulting in no need for fish consumption restrictions. The remaining 55% of assessed acreage partially supported their uses and prompted fish consumption advisories, primarily due to mercury contamination of some northeastern Minnesota lakes. In addition, fish tissue assessment of 968 miles of rivers indicated that 30% of the mileage supported designated fisheries use, 45% partially supported, and 25% did not support its use. The major causes of nonsupport were PCB contamination, particularly downstream from large population centers. However, a trend analysis of PCB concentrations in Mississippi River fish species showed a promising decline over the last ten years.

Ground water reserves supply drinking water for 94% of the public water supply systems in Minnesota. Natural quality of ground water is quite good, usually meeting all primary drinking water standards. However, land use practices and improper storage of wastes in areas where natural soils and geological formations afford little protection for ground water aquifers have resulted in ground water contamination problems. Continual progress is being made to investigate and conduct remedial actions at 120 identified sites of contamination.

The progress achieved in water quality improvements over the past years can only be maintained through continued efforts to abate pollution. Future population growth and intensified land development will place additional demands and stress on our water resources. Careful planning and a commitment to preserve these prized resources for the benefit of current and future generations must always remain a high priority.

2. BACKGROUND

Minnesota is known for its abundance of water. This wonderful natural resource of lakes, streams, wetlands, and ground water has created a unique lifestyle for Minnesotans and annually draws thousands of visitors to the State.

For the period 1980-1985, resident in-state participation in open water fishing increased 11.7%; ice fishing increased by 10.5%. Forty-one percent of all Minnesotans fish compared to 25% of the national population. Boats registered in Minnesota increased from 415,000 in 1973 to 625,000 in 1984.

Minnesota's water resources are largely responsible for the generation of $4.8 billion annually in tourism and travel dollars in Minnesota. There are 2824 public access sites on Minnesota waters, 2044 marinas, and 2084 resorts.

Because of the importance and value of Minnesota's water resources, the majority of environmental quality control expenditures are directed toward water quality. Data from 1984 shows 85.2% ($57,964,000) of environmental quality control expenditures were used for water quality; 8.0% ($5,448,000) for land quality; 3.6% ($2,421,000) for other; 3.2% ($2,215,000) for air quality.

The map in Figure 1 gives an overview of the state's water resources. Figure 2 shows those rivers which form much of the state's borders.

FIGURE 1.

Minnesota

Background

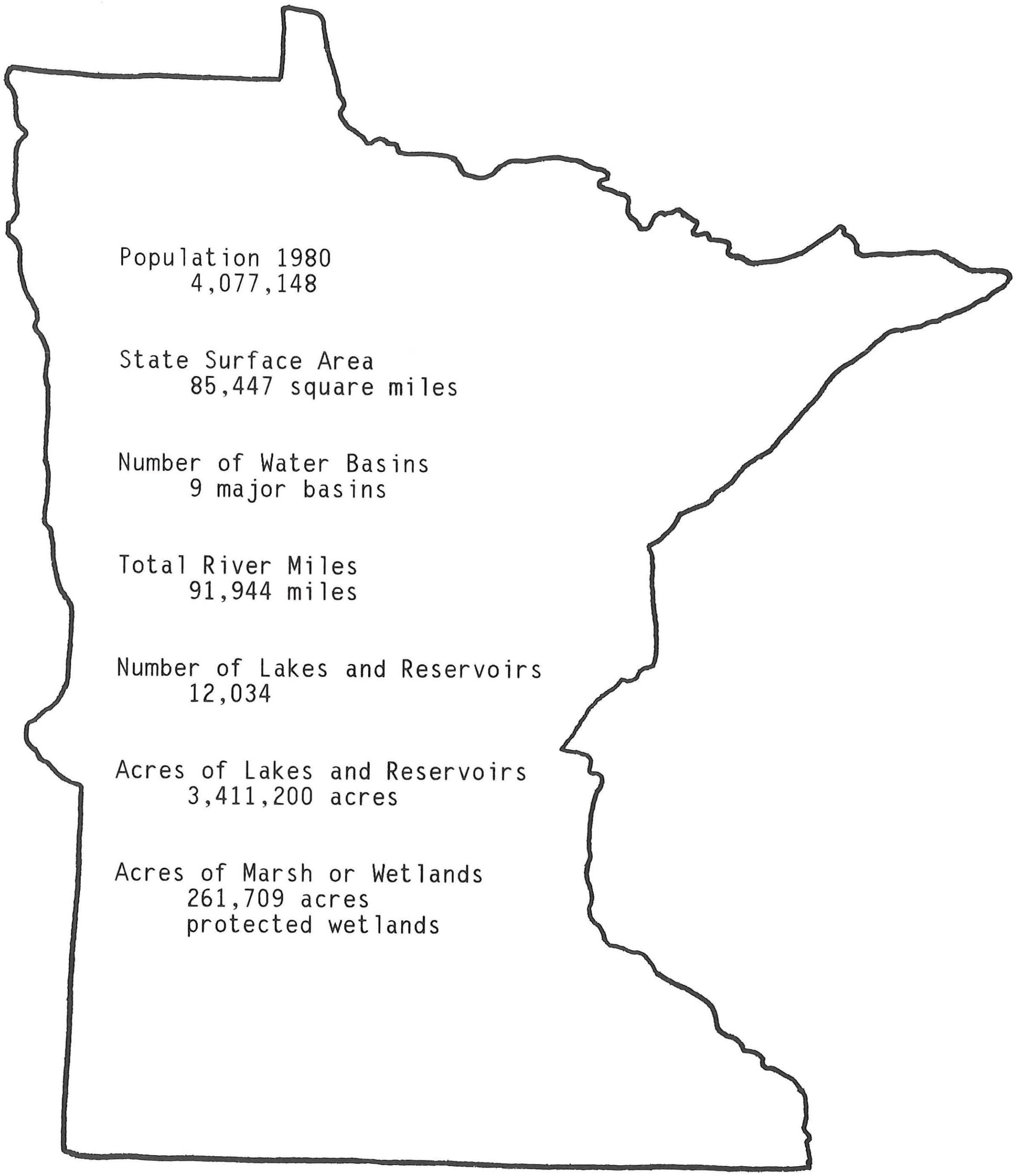
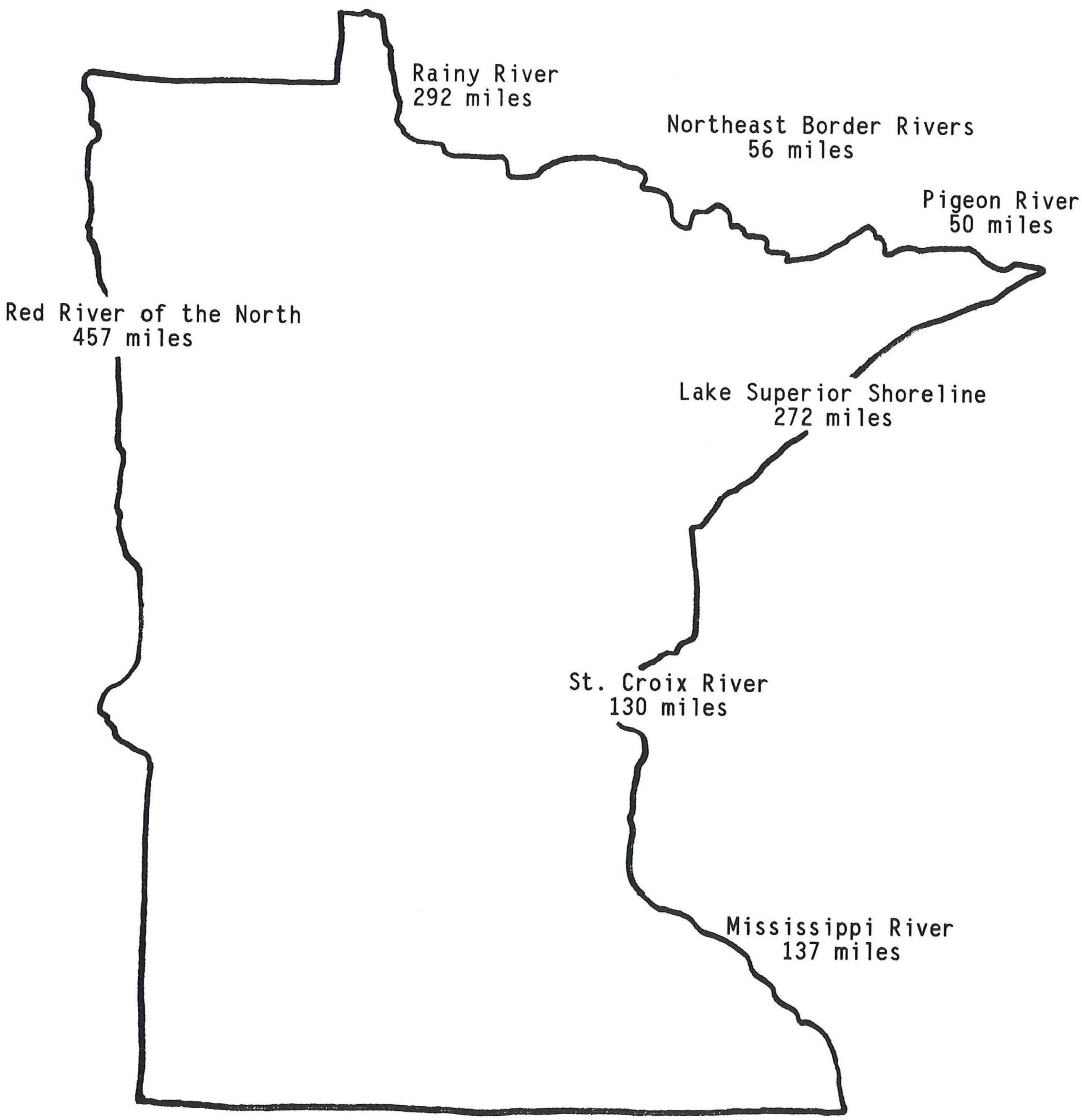


FIGURE 2.

Minnesota

Border Rivers



3. CURRENT STATUS/DESIGNATED USE SUPPORT

A. Rivers and Streams

Within the State of Minnesota there are nine major river basins with water flowing in three geographic directions. Rivers and streams flow north to Hudson Bay, east through the Great Lakes to the Atlantic Ocean, and south to the Gulf of Mexico. Of the nearly 92,000 miles of rivers and streams in Minnesota, the Minnesota Pollution Control Agency (MPCA) routinely monitors about 1,250 miles, less than 2% of the total.

The overall quality of Minnesota rivers and streams has improved in the past ten years. Minnesota has made excellent progress in addressing the problem of point source pollution. As point source dischargers have provided better treatment, Minnesota has started to look at the many problems of nonpoint source pollution. Control of nonpoint source (NPS) pollution would greatly improve the quality of Minnesota's waterways.

For water years 1984 and 1985, the MPCA assessed 2,179 miles of rivers and streams. Figure 3 summarizes the assessment process and shows the relative support for each designated use classification. The Class 7 waters which have a non-fishable/non-swimmable use classification are intermittent flowing streams and ditches with limited resource value.

Figures 4 and 5 graphically depict the relative use support for fishable and swimmable waters, respectively. Of the total mileage of fishable waters that were assessed, 92% fully or partially supported the designated use based on aquatic life standards. However, for river waters having a swimmable use classification, only 53% of the mileage fully or partially supported the use due to fecal coliform counts exceeding human health criteria. The swimmable non-support was caused by both point and nonpoint sources of contamination.

High and variable levels of fecal coliform are reported for many water bodies throughout the State of Minnesota. The organisms themselves are not a substantial threat to human health or recreational water users; however, their presence can indicate contamination by fecal wastes and may suggest the presence of pathogenic organisms associated with fecal wastes. The State of Minnesota has used fecal coliforms as indicators of fecal contamination since 1973. Factors other than presence of fecal coliforms, such as the source of the contamination, should also be considered when assessing swimmability.

FIGURE 3. RIVER STATUS - SUPPORT OF DESIGNATED USES

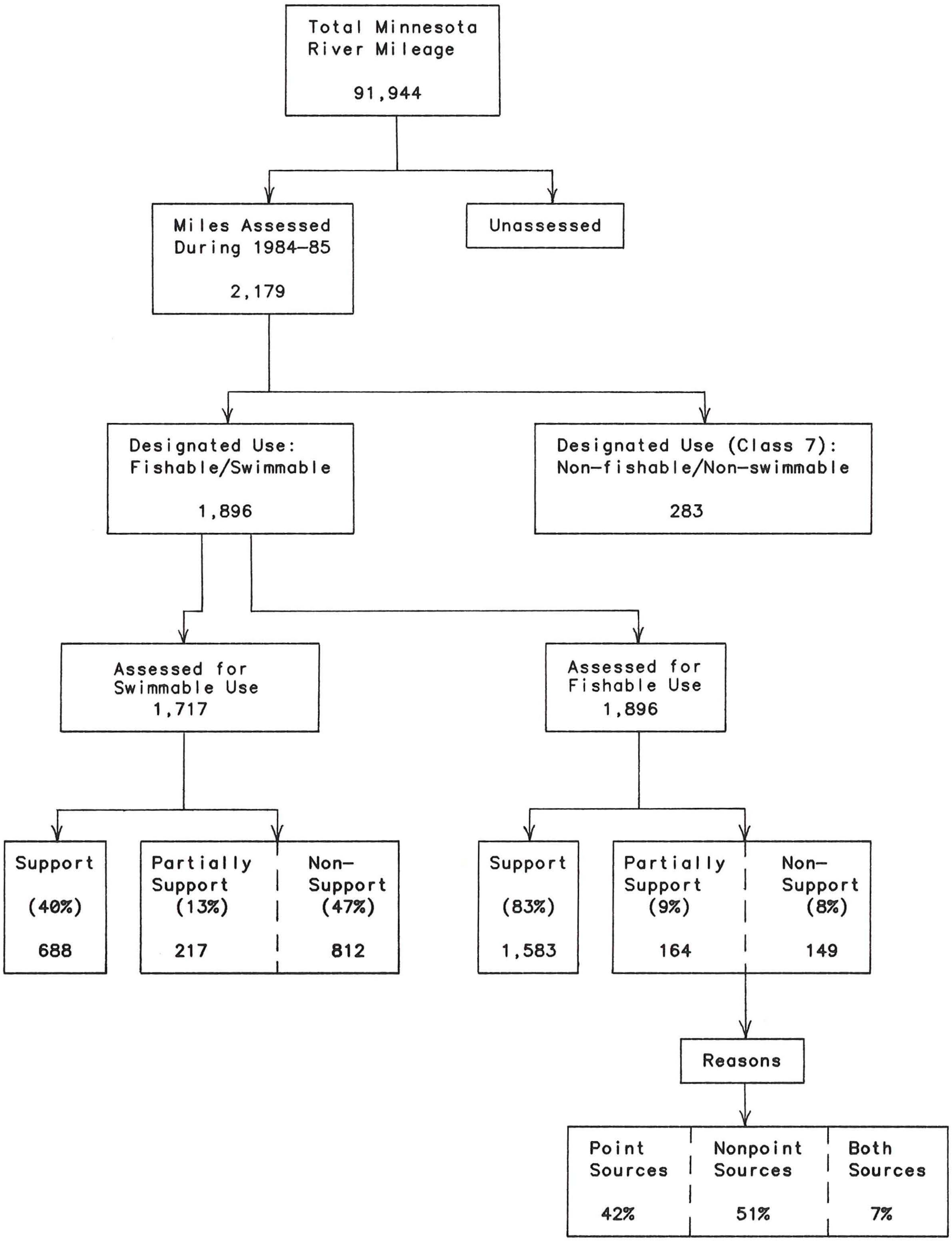


FIGURE 4.

Fishable Waters

River Miles Supporting Fishable Standards

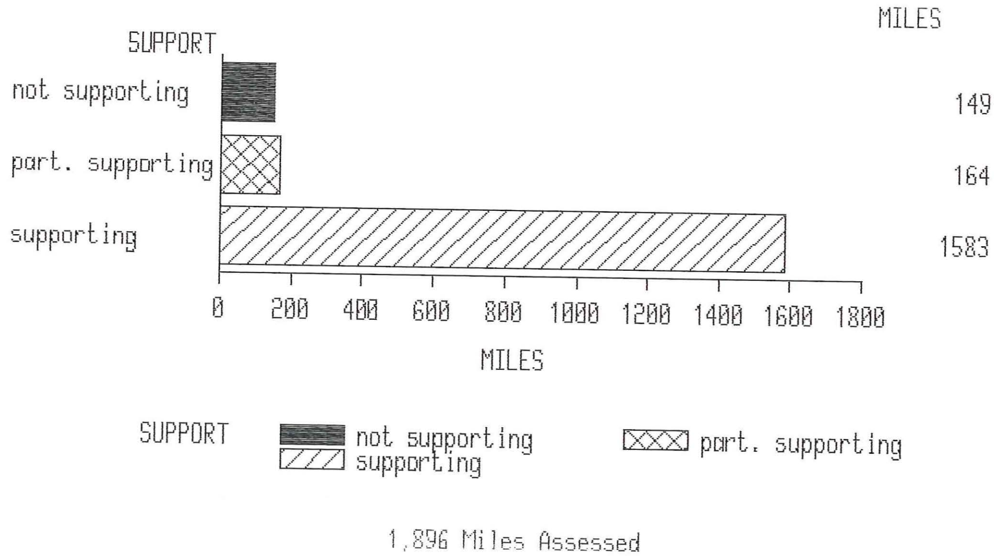
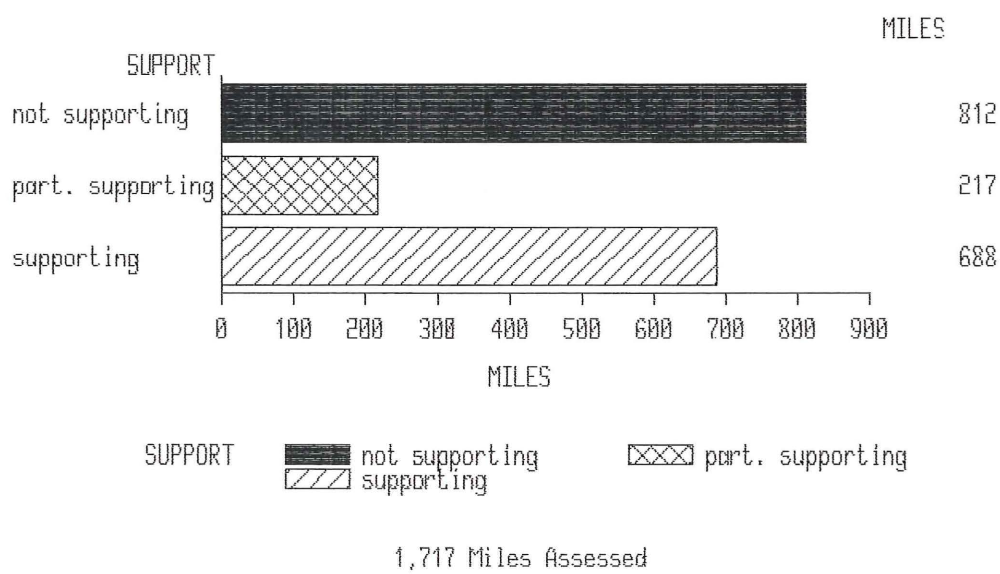


FIGURE 5.

Swimmable Waters

River Miles Supporting Swimmable Standards

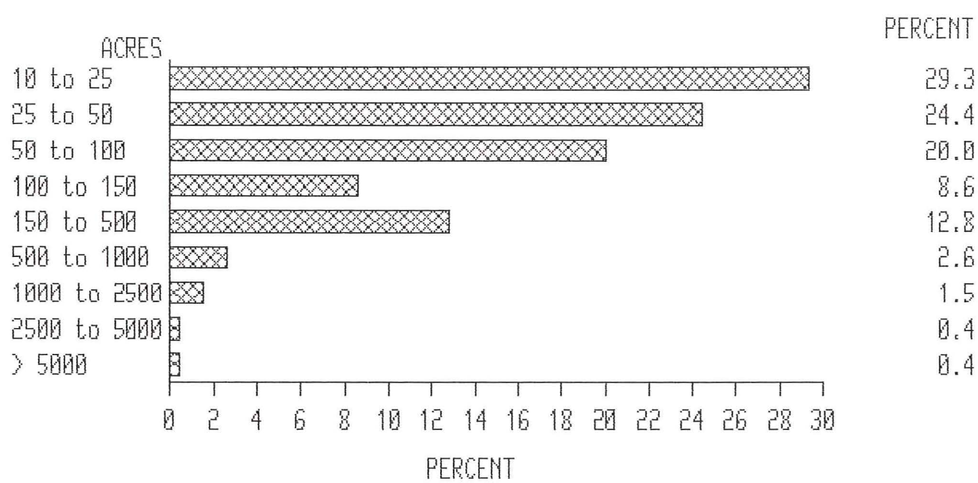


B. Inland Lakes, Reservoirs and Ponds

1) Background

Minnesota, "Land of 10,000 Lakes," is really the land of 12,034 lakes. The distribution of these lakes is shown in Figure 6 by size class and percentage. Figure 7 shows the approximate number of lake basins of 10 acres or greater by county.

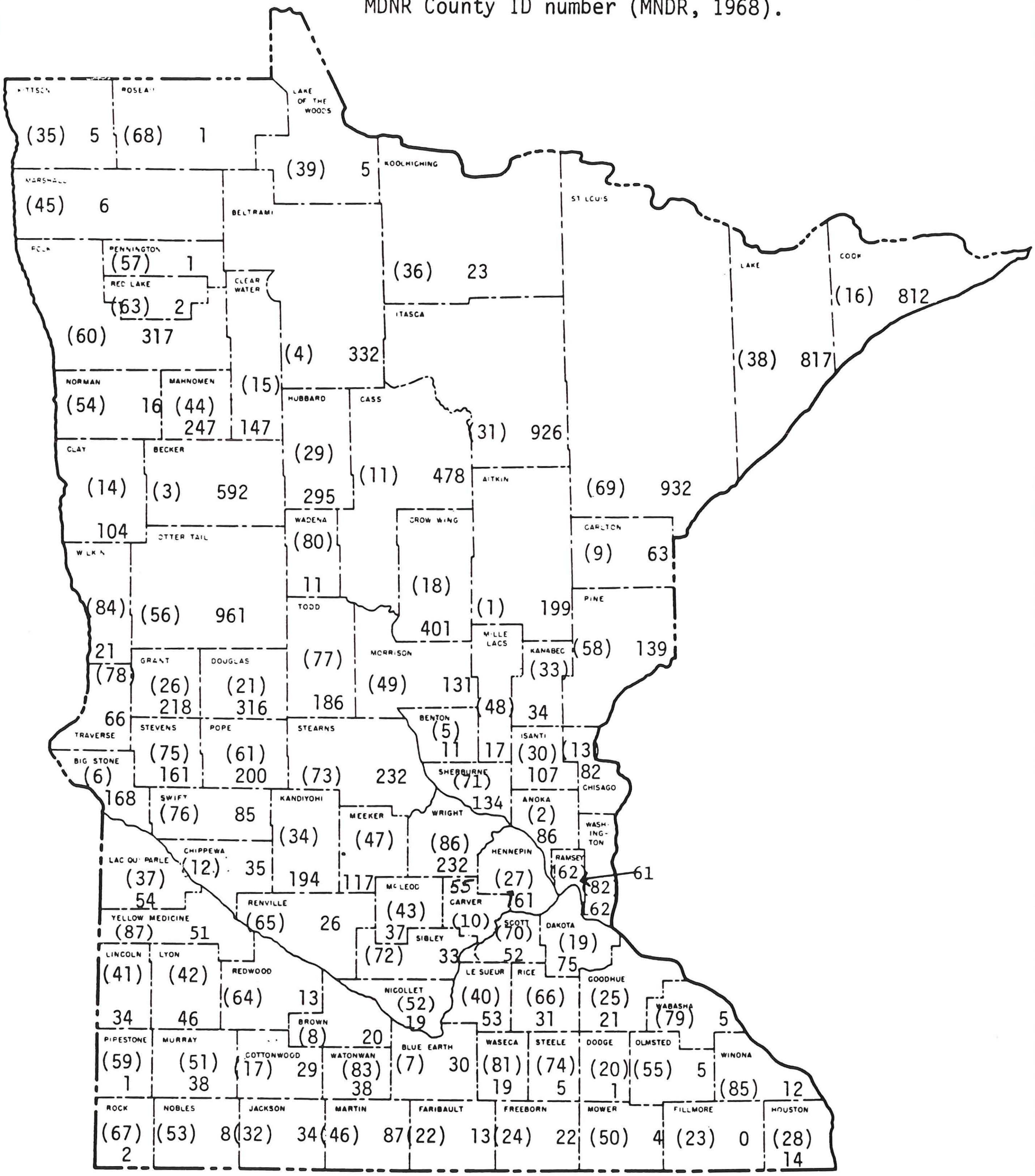
FIGURE 6. **Distribution of Minnesota Lakes by Size**
Total Lake Area in Acres



Total of 12,034 Lakes

MPCA staff have received about 275 citizen complaints and inquiries directly related to lake water quality over the last nine months of 1985. Most of the complaints and objections concern eutrophic and hypereutrophic lakes. With increasing recreational and development pressures along with the magnitude of agricultural activities, there are increasing numbers of lakes undergoing accelerated eutrophication. These lakes may tend to exhibit nuisance characteristics which detract from the resource's value. These lakes may, for example, have blue-green

FIGURE 7. NUMBER OF LAKE BASINS OF 10 ACRES OR GREATER BY COUNTY. Excludes dry basins. Number in parentheses represents MDNR County ID number (MNDR, 1968).



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algal blooms of such severity as to turn the water to "pea-soup," reducing the potential for sport fisheries and reducing riparian property values. In severe cases, toxic algal blooms may develop that are capable of killing pets, livestock, waterfowl, and other wildlife. During an average year, it is estimated that 5 to 12 instances of livestock poisoning occur as a result of blue-green algal toxicity. Body contact activities in these lakes may be reduced due to aesthetically unpleasant conditions of taste and foul odors associated with the blue-green algae. Blue-green algal blooms have also been associated with human respiratory, gastrointestinal, and dermal disorders. Swimmer's itch, caused by either parasites or blue-green algae, appears to be a periodic concern.

Therefore, hypereutrophic lakes have been designated as lakes not supporting designated uses and eutrophic lakes have been designated as lakes partially supporting the designated uses. It should be noted that eutrophic lakes often support excellent fisheries. However, these lakes also produce more algae and rooted vegetation which many citizens find objectionable for swimming or other body contact activities. Mesotrophic and oligotrophic lakes support their designated uses.

2) Assessed Acres

Acres assessed in this report were based upon monitoring data for 1,028 lakes in the state, of which 29 have surface areas greater than 5,000 acres. Assessed acres totalled 939,929 acres out of approximately 3,411,200 total lake acres in Minnesota (or about 27.6% of all lake surface area). Figures 8 and 9 show the relative use support for assessed lakes less than 5,000 acres and for lakes greater than 5,000 acres, respectively. All lakes in Minnesota are designated for both fishable and swimmable uses.

3) Trophic Status

The term trophic status refers to the nutritional status of a lake and is a relative assessment of the degree to which nutrients and the resulting algae and rooted aquatic plants are present in the lake. The lakes in Minnesota range from a state of low nutrient concentrations and low algae production (oligotrophy) to very high nutrient concentrations and high algae production (eutrophy).

In order to better visualize the distribution of lake trophic status, water quality data has been analyzed by the use of an index. The resulting index values generally range between 0 and 100 with increasing values indicating more eutrophic (or fertile) conditions. Figure 10 displays the geographical distribution of 1,028 Minnesota lakes using the trophic status index.

Based upon an analysis of data from about 1,028 lakes, the trophic status of Minnesota's 12,034 lakes were extrapolated as follows:

. oligotrophic	10%	1,203 lakes;
. mesotrophic	25%	3,009 lakes;
. eutrophic	50%	6,017 lakes;
. hypereutrophic	15%	1,805 lakes.

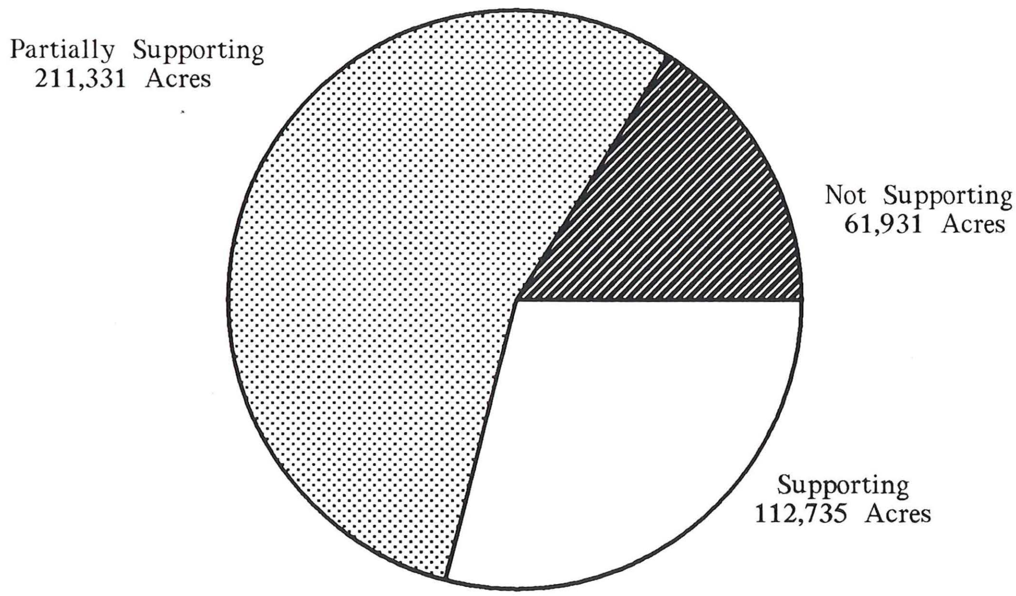
In this classification, oligotrophic lakes tend to be found in northeast and north central Minnesota. These lakes are deep and may be suitable for the propagation of cold water fisheries. The average transparency for this group is 13.4 feet, with measurements ranging from about 5 - 30 feet.

Mesotrophic lakes exhibit a regional distribution similar to the oligotrophic lakes, but are found farther south and west. These lakes are moderate in depth with an average depth of 41 feet. The average secchi disc transparency reading for this group of lakes is 11.8 feet, with measurements ranging from 2.6- 35.1 feet. These lakes are suitable for water based recreation but often not for cold water fisheries.

The eutrophic lakes comprise about 50% of the sample. The average secchi disc reading for this group of lakes is 6.6 feet, with measurements ranging from 0.7 - 22.6 feet. They are distributed throughout the state. Their watersheds are usually characterized by increased agricultural activity and urban development. They also tend to be shallower than the oligotrophic or mesotrophic lakes, and may not thermally stratify in the summer due to wind mixing or other conditions. Eutrophic lakes also may be subject to low oxygen concentrations during the winter (under ice - which is usually 115-145 days per year) due to the high oxygen demand of the sediments. These lakes are generally very productive for warm water fisheries.

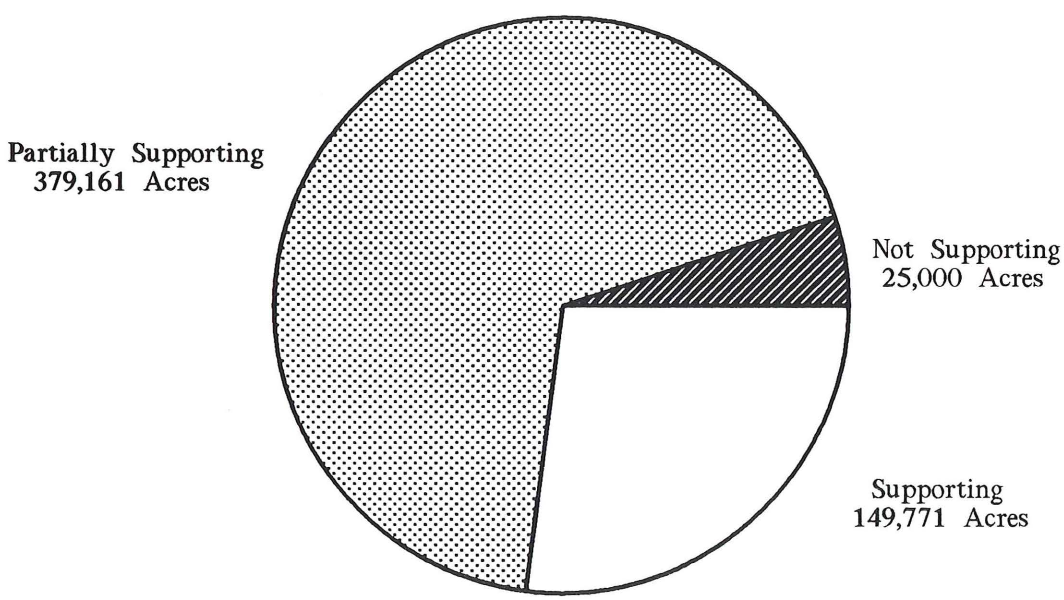
The hypereutrophic lakes comprise about 15% of the monitored lakes. Average water transparencies for this group of lakes is 2.6 feet, with measurements ranging from 0.7 - 14.4 feet. These lakes are predominantly located in the southern third of the state, commonly referred to as the agricultural zone. The watersheds of these lakes are generally characterized by extensive agricultural activity and/or urban development. These lakes are generally shallow which is partially due to high levels of sedimentation (erosion of the watershed soils). The high nutrient loadings, the extended growing season in this part of the state, and the shallow nature of these lakes combine to make these lakes highly productive. This productivity is often marked by frequent algal blooms, extensive weed growths, and fish kills associated with reduced oxygen conditions under ice or during the summer. In lakes where a fishery exists, rough fish species will dominate the warmwater community.

FIGURE 8. **Lake Acres Supporting Designated Uses**
For Lakes Less Than 5,000 Acres



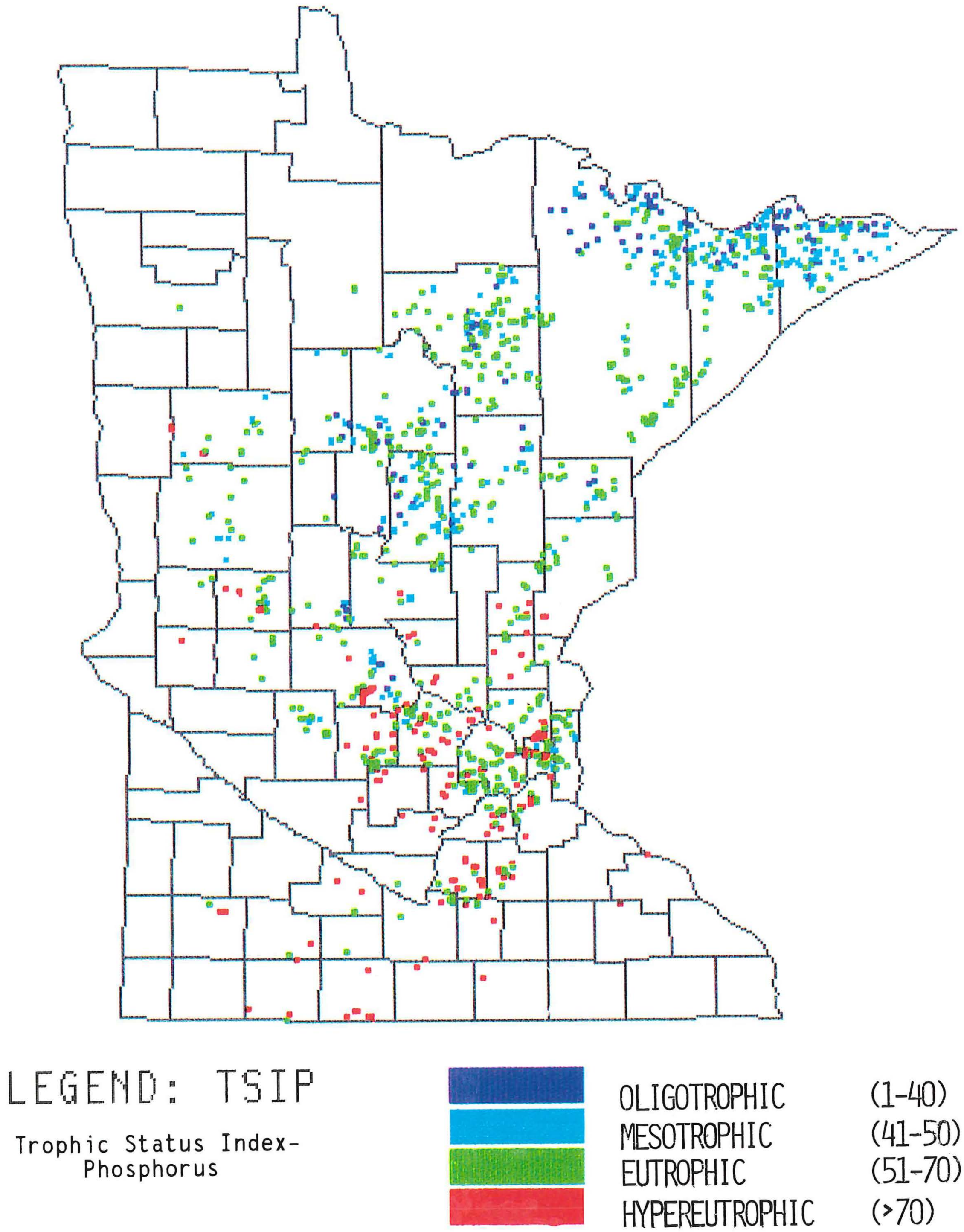
Total Assessed 385,997 Acres

FIGURE 9. **Lake Acres Supporting Designated Uses**
For Lakes Greater Than 5,000 Acres



Total Assessed 553,932 Acres

FIGURE 10. TROPHIC STATUS (TSIP) OF MINNESOTA LAKES. This is based on mean total phosphorus data for 1028 lakes: 1980-84.



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C. Lake Superior

The entire shoreline of Lake Superior fully supports its designated uses and the fishable/swimmable goals of the Clean Water Act.

The Lake Superior sport fishery has shown some dramatic improvements in recent years. An increase in total angler hours (over 450,000 angler hours in 1983) has been observed along with an increase in total catch (nearly 16,000 lake trout in 1983). Annual numbers of lake trout and total salmonids creeled have both increased in the 1980's.

Lamprey control measures and the lake trout stocking program have resulted in a lake trout population composed of a greater proportion of native fish (up to 16%). These aspects of the Lake Superior fishery indicate that fisheries and recreational uses of these waters are being attained, and substantial improvements have been realized in recent years.

D. Wetlands

1) Marsh or Wetlands Drained For Water Years 1984-1985

The Minnesota Department of Natural Resources (MDNR) regulates drainage for wetlands defined as marshes and shallow ponds (known as type 3,4 and 5 wetlands). Since 1979 there has been no drainage of the 261,709 acres defined by the MDNR as protected wetlands. Each county has jurisdiction over drainage of other types of wetlands, such as wet meadows, swamps and bogs. No estimates exist for total acres drained for these other types of wetlands.

2) Marsh or Wetlands Filled For Water Years 1984-1985

Under section 404 of the Clean Water Act, the U.S. Army Corps of Engineers administers a permit program which regulates discharges of dredged or fill materials into waters of the United States. For projects within Minnesota, the Corps receives the application for a permit, issues a public notice which is sent to the Minnesota Pollution Control Agency for review and approval (401 certification) and then either approves or denies the project. Table 1 represents acres filled or affected by projects for which permits were issued. Nationwide permits are issued for categories of activities or waters which are defined as causing minimal environmental impact.

TABLE 1. PERMITTED WETLAND ACRES FILLED OR AFFECTED FOR WATER YEARS 1984–1985

Individual and General Permits	760.0	This acreage includes one airport project involving 134 acres, and two peat projects involving a total of 480 acres. Although the peat projects were permitted in this time period, any loss experienced will occur over several years.
Nationwide Permits	249.0	This acreage includes one project involving 63 acres which the Federal Highway Administration reviewed.

During this two-year time period, 32 projects under section 404 jurisdiction were denied permits.

3) Percent of Marsh or Wetland Acreage Lost During Water Years 1984-1985

Not all activities with wetland impact fall under the jurisdiction of these two regulatory programs. Although several studies indicate that the state has less than half the wetland acreage it did 30 years ago, no reliable estimates for total wetland loss for the most recent two years exist.

4. DESIGNATED USE ATTAINMENT/NON-ATTAINMENT

The map in Figure 11 shows geographical locations of the assessed rivers and streams, distinguishing between those waters fully supporting, partially supporting, or not supporting their designated uses. Refer to Table 2 and Table 9 for specific descriptions of the waters not fully supporting their designated uses, identified by number on the map.

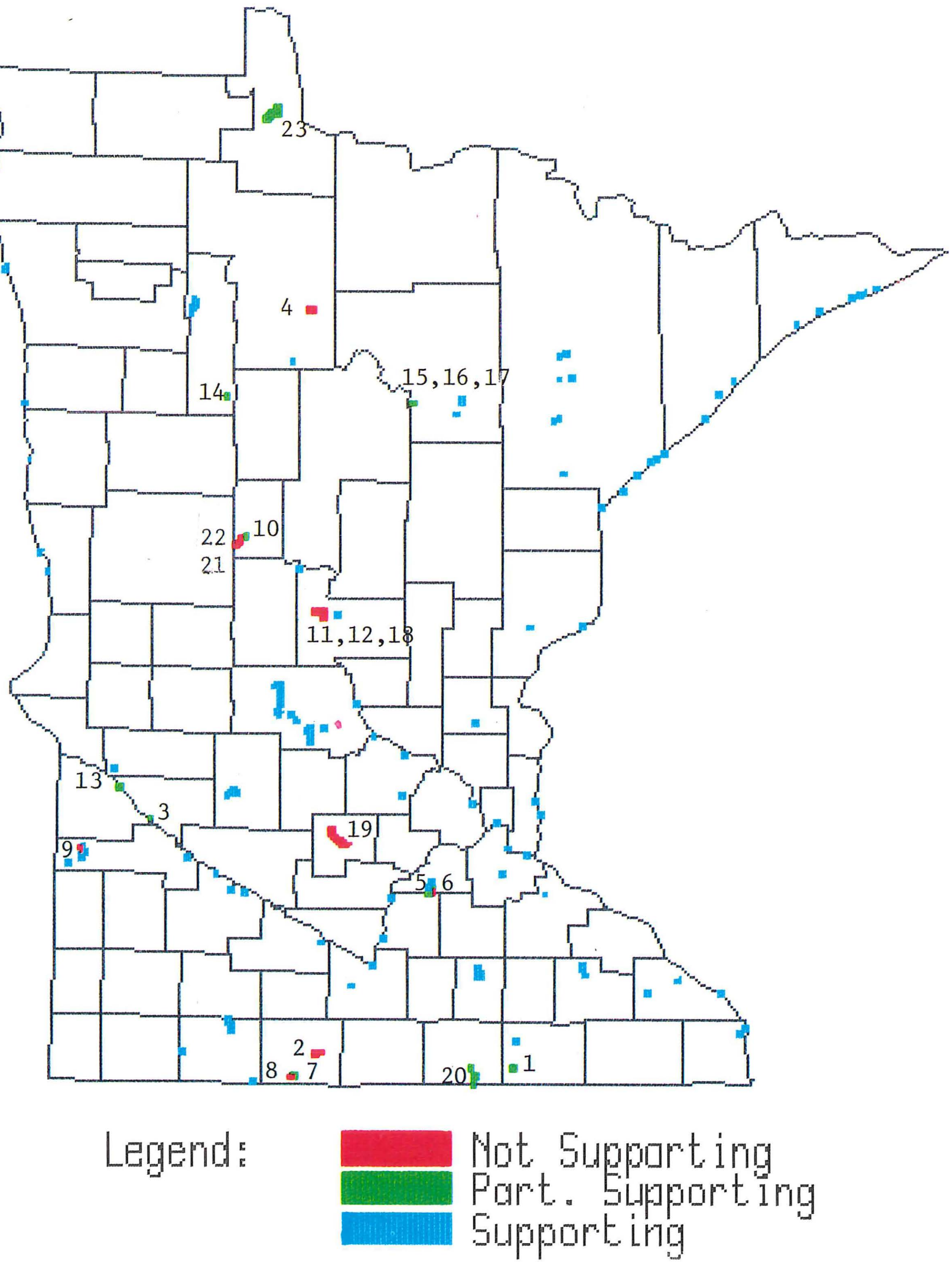
TABLE 2. MINNESOTA WATERS NOT MEETING FISHABLE STANDARDS

DESCRIPTION	MILES	COUNTY	DEGREE OF SUPPORT
1. CEDAR RIVER NEAR AUSTIN	8.40	MOWER	PARTIALLY SUPPORTS
2. CENTER CREEK BY FAIRMONT	19.40	MARTIN	DOES NOT SUPPORT
3. CHIPPEWA R NEAR MONTEVIDEO	11.20	CHIPPEWA	PARTIALLY SUPPORTS
4. COBURN CREEK NEAR BLACKDUCK	3.26	BELTRAMI	DOES NOT SUPPORT
5. E BR RAVEN STREAM BY NEW PRAGUE	10.09	SCOTT	PARTIALLY SUPPORTS
6. E BR RAVEN TRIB BY NEW PRAGUE	6.21	SCOTT	DOES NOT SUPPORT
7. E FK DES MOINES R BY CEYLON	28.50	MARTIN	PARTIALLY SUPPORTS
8. JUDICIAL DITCH 26 NEAR CEYLON	5.28	MARTIN	DOES NOT SUPPORT
9. LAZARUS CREEK NORTH OF CANBY	15.70	YELLOW MEDICINE	DOES NOT SUPPORT
10. LEAF R BY WADENA	12.70	WADENA	PARTIALLY SUPPORTS
11. LITTLE ELK RIVER AT RANDALL	11.80	MORRISON	DOES NOT SUPPORT
12. LITTLE ELK RIVER NEAR RANDALL	11.40	MORRISON	DOES NOT SUPPORT
13. MINNESOTA R WEST OF MILAN	16.10	CHIPPEWA	PARTIALLY SUPPORTS
14. MISSISSIPPI R BY LAKE ITASCA	34.50	CLEARWATER	PARTIALLY SUPPORTS
15. MISSISSIPPI R S OF DEER RIVER	6.00	ITASCA, CASS	PARTIALLY SUPPORTS
16. MISSISSIPPI R S OF DEER RIVER	6.40	ITASCA, CASS	PARTIALLY SUPPORTS
17. MISSISSIPPI R SW OF COHASSET	7.30	ITASCA	PARTIALLY SUPPORTS
18. S BR LITTLE ELK R AT RANDALL	11.80	MORRISON	DOES NOT SUPPORT
19. S FK CROW R BY HUTCHINSON	54.30	MCLEOD	DOES NOT SUPPORT
20. SHELL ROCK R BY ALBERT LEA	9.80	FREEBORN	PARTIALLY SUPPORTS
21. UNION CREEK NEAR WADENA	5.53	WADENA	DOES NOT SUPPORT
22. WHISKEY CREEK NE OF WADENA	3.91	WADENA	DOES NOT SUPPORT
23. WILLIAMS CREEK NEAR WILLIAMS	12.73	LAKE OF THE WOODS	PARTIALLY SUPPORTS

FIGURE 11.

River Status

Support of Fishable Use



NOTE: The above numbers refer to the locations listed in table 2 and in table 9.

5. TRENDS IN WATER QUALITY

The primary purpose of this report is to assess water quality at the present time, using the 1984-1985 two-year period. However, it is also important to consider whether water quality has improved, degraded or remained constant over a longer period of time. There is some difficulty in doing this because of changes in monitoring locations, changes in precipitation, and other variable factors.

To examine trends over time, monitoring locations were used for which data was available for at least four of the last twelve years (water years 1973-1985). This included 102 locations.

Trends in water quality were examined separately for each of seven aquatic ecoregions. Aquatic ecoregions are geographic areas that were developed from mapped information by the Corvallis Environmental Research Laboratory of the U.S. Environmental Protection Agency. The seven ecoregions defined for Minnesota are based on land use, soil types, land surface form, and potential natural vegetation. Streams draining watersheds within an ecoregion are believed to exhibit characteristics such as physical habitat, hydrology, water chemistry, and biotic communities more similar to each other than to streams from other ecoregions. The seven ecoregions are:

Red River Valley
Northern Minnesota Wetlands
Northern Lakes and Forests
Central Hardwood Forests
Northern Great Plains
Western Cornbelt Plains
Driftless Area

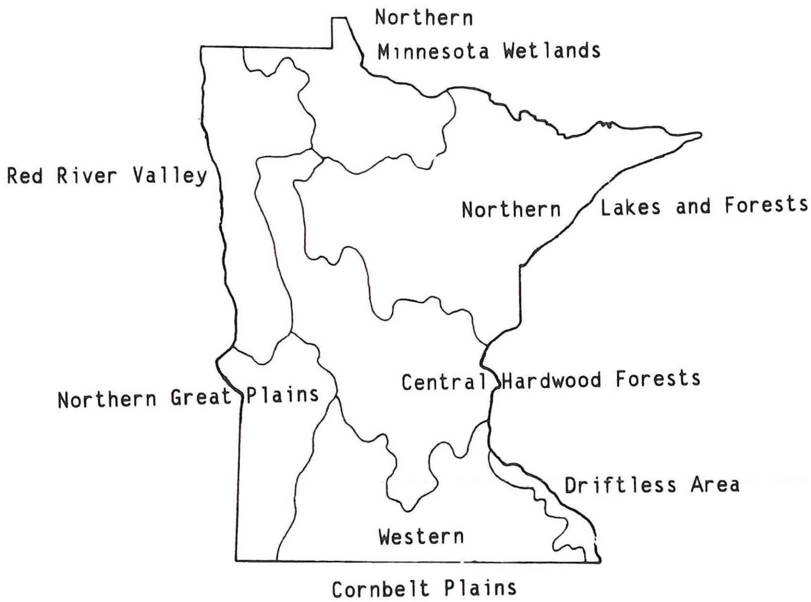
The map in Figure 12 shows the location of these areas.

The water quality parameters examined were: dissolved oxygen, un-ionized ammonia, nitrate-nitrite concentration, and total suspended solids.

Adequate dissolved oxygen is necessary for the survival and propagation of fish and other aquatic life. In addition, the concentration of ammonia must be maintained below a toxic level. Low dissolved oxygen and high ammonia concentrations in receiving waters are usually due to the inadequate treatment and discharge of organic wastes or to decomposing vegetation. For fishable waters in Minnesota, except designated trout waters, the standard to be maintained for dissolved oxygen is a minimum concentration of 5 milligrams per liter (mg/l). For the toxic, un-ionized form of ammonia, the standard is a maximum concentration of 0.04 mg/l. The designated trout waters of the state have a more stringent dissolved oxygen and un-ionized ammonia standard.

Nitrates are found in agricultural fertilizers. They are important components of production on farms, but become pollutants when washed into rivers. They fertilize the river, promoting growth of algae and weeds, either in the river itself or in downstream lakes. An increase in total suspended solids in a river is frequently caused by the erosion of soil into the river.

FIGURE 12. **Ecoregions**



For this analysis, decreased dissolved oxygen and increased un-ionized ammonia were considered to be associated with point source pollution, whereas increased nitrate-nitrite concentration and increased total suspended solids were considered to be associated with surface runoff and nonpoint source pollution.

Water quality is also affected by changes in flow. Periods of high flow provide greater dilution for point source pollutants, thus decreasing their concentrations. However, periods of high flow are also associated with increased runoff and higher concentrations of nonpoint source pollutants.

Figures 13 A-G plot the water quality parameters and flow characteristics for each ecoregion for water years 1973-1985.

Each flow ratio shown in Figures 13 A-G compares the average flow for that year to the average long-term flow (1950 to the present). For instance, a flow ratio of 2.0 indicates that the average flow of representative rivers in that ecoregion for that year is twice their long-term average flow. The flow ratio graphs have a line drawn in at the flow ratio of 1.0 so that it is relatively easy to determine whether the flow for any given year is above or below the long-term average.

The plots of water quality parameters show the median (middle value) of all observations for each water year. The best-fitting trend line is also indicated. Because of the large variations in the data, these trend lines should be used with caution. They should not be used to quantify the trend.

FIGURE 13. SELECTED WATER QUALITY MEASURES AND FLOW RATES BY ECOREGION
Water Years 1973-1985
All parameters except flow are expressed in mg/l.

A. Central Hardwood Forests

B. Driftless Area

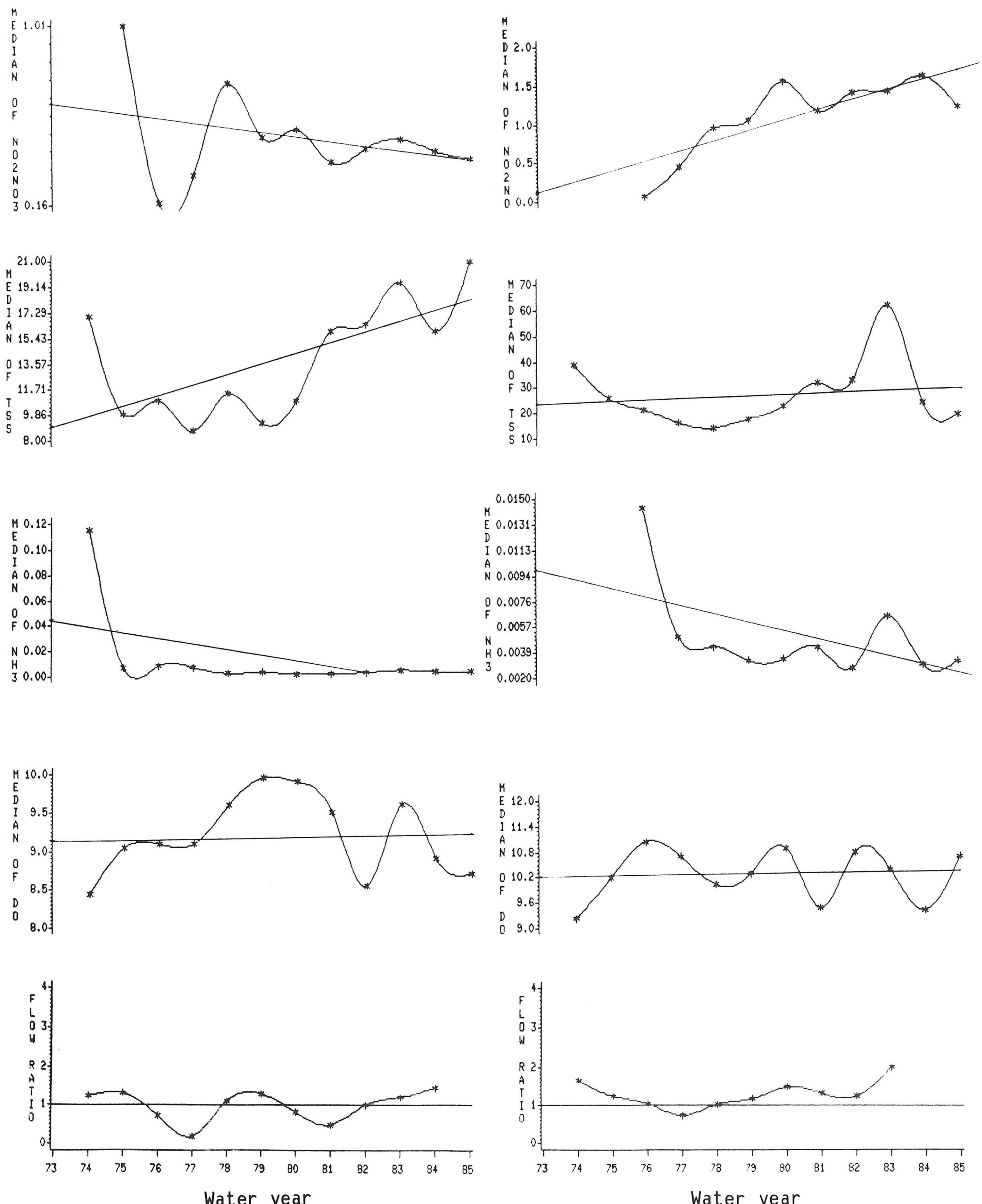


FIGURE 13. SELECTED WATER QUALITY MEASURES AND FLOW RATES BY ECOREGION
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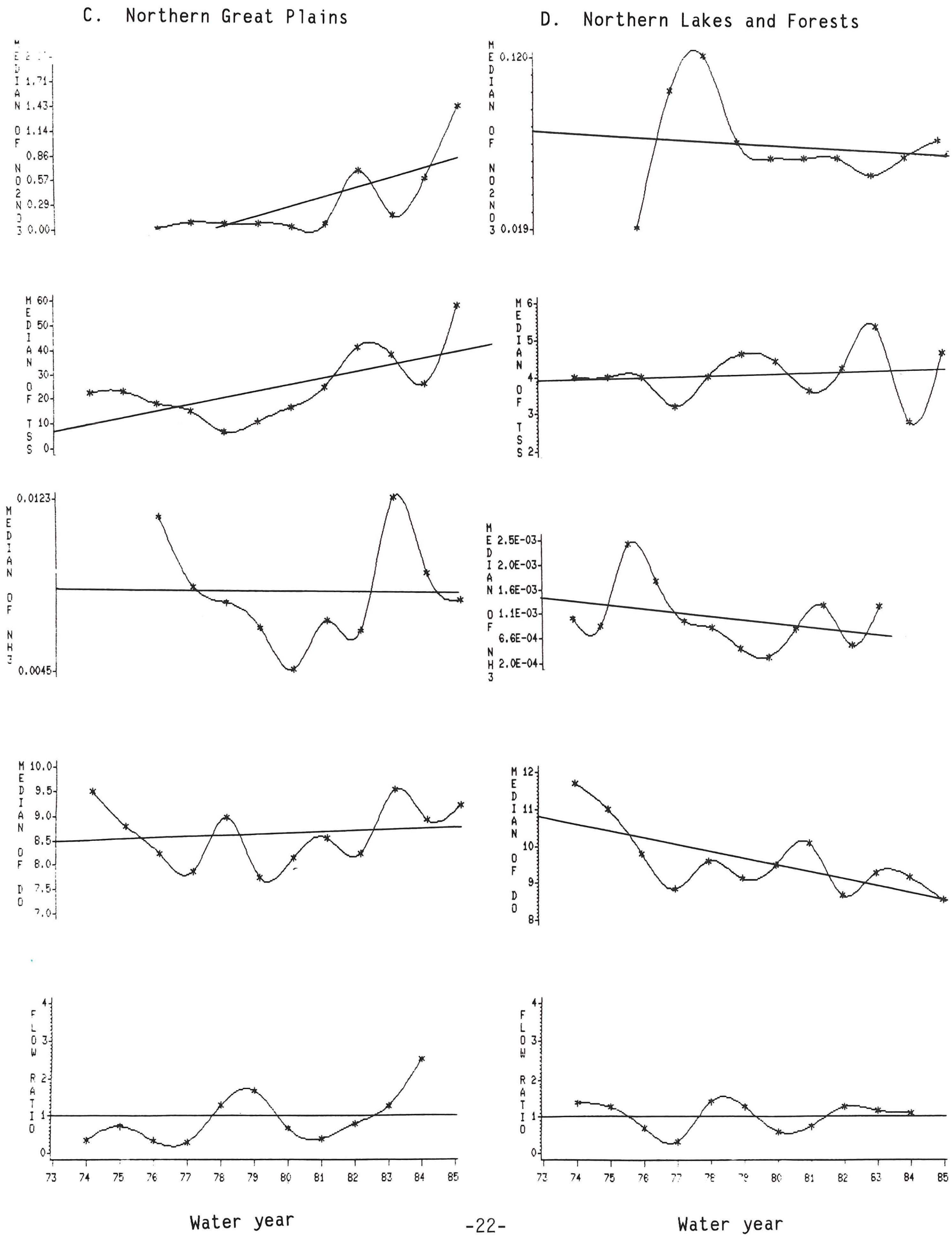


FIGURE 13. SELECTED WATER QUALITY MEASURES AND FLOW RATES BY ECOREGION
Water Years 1973-1985
All parameters except flow are expressed in mg/l.

E. Northern Minnesota Wetlands

F. Red River Valley

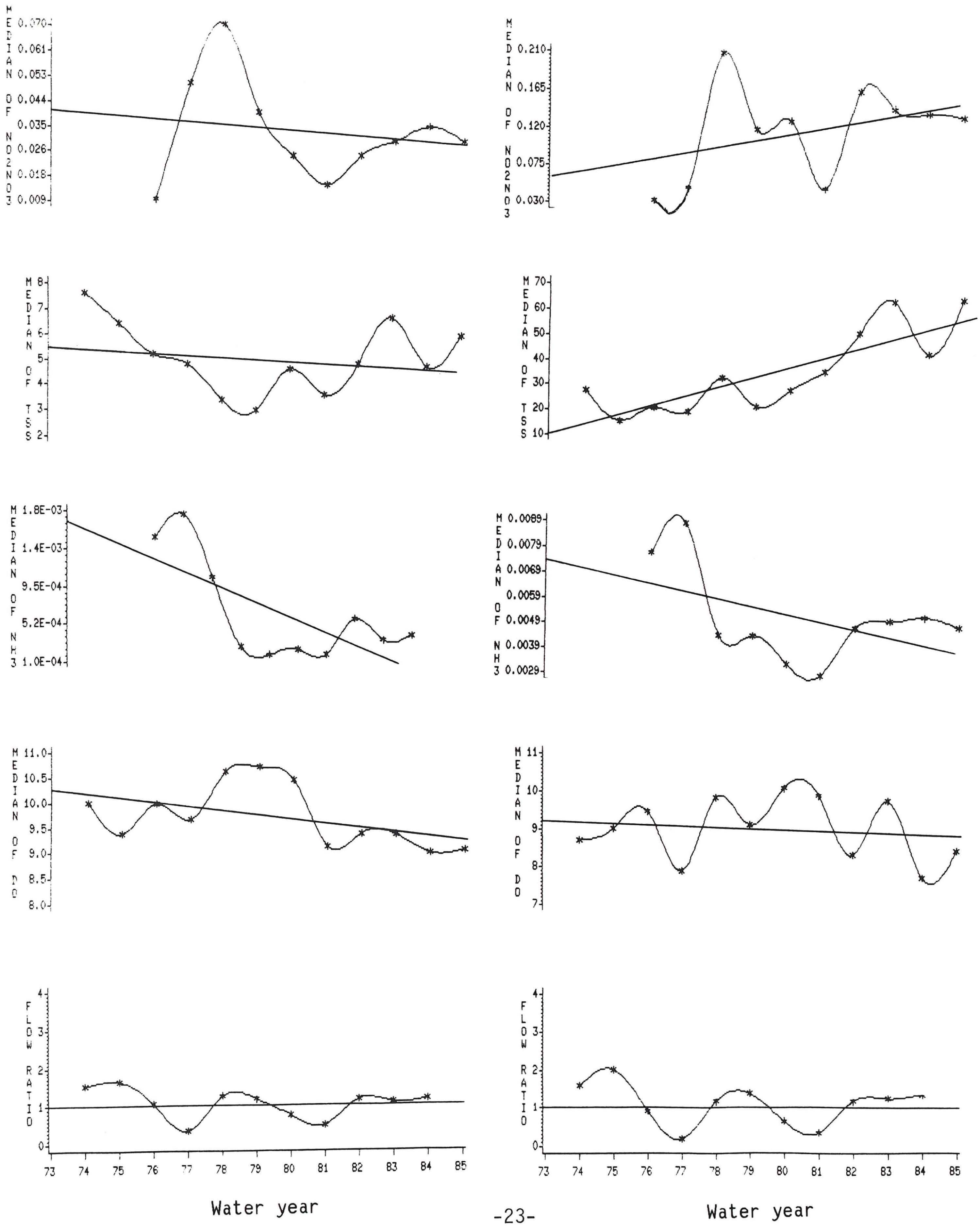
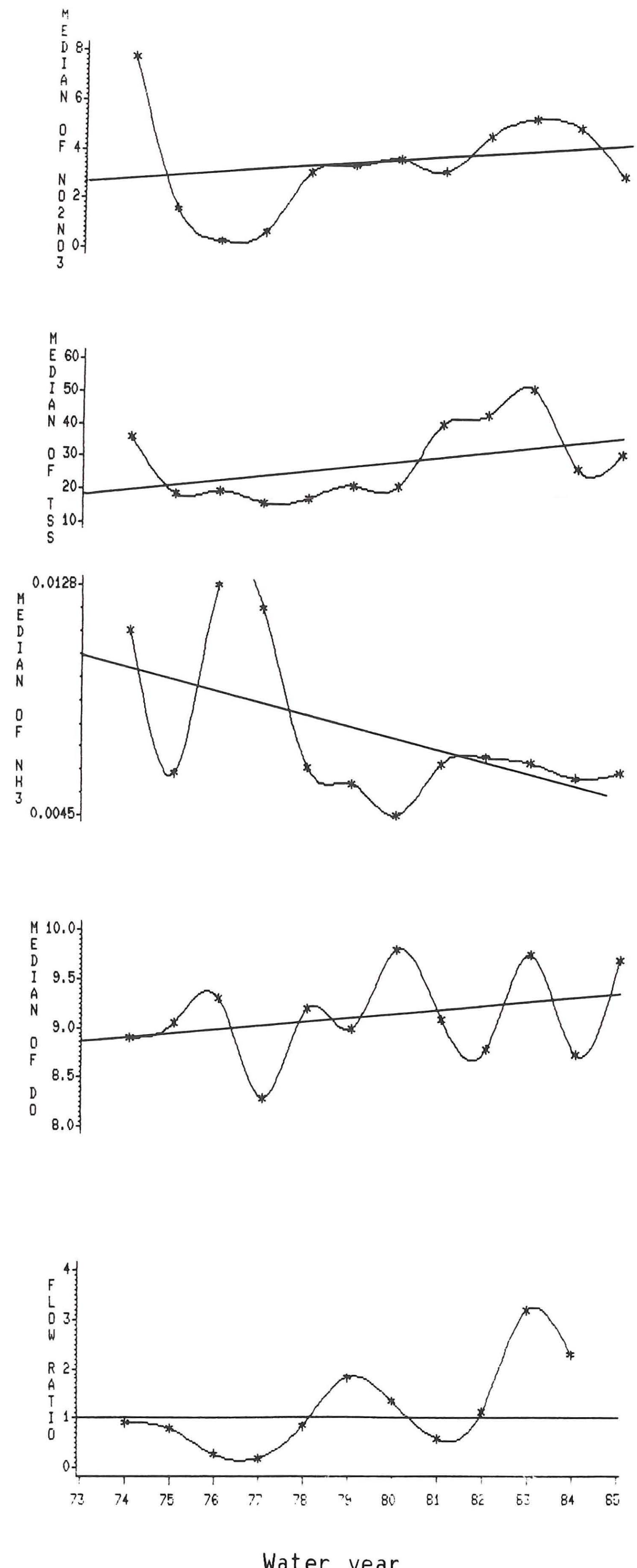


FIGURE 13. SELECTED WATER QUALITY MEASURES AND FLOW RATES BY ECOREGION
Water Years 1973-1985
All parameters except flow are expressed in mg/l.

G. Western Cornbelt Plains



Trends indicated for rivers and streams in the Central Hardwood Forests ecoregion are shown in Figure 13 A. Examining these graphs from top to bottom shows, for this twelve-year period, decreasing concentrations of nitrite-nitrate (NO_2 NO_3), increasing concentrations of total suspended solids (TSS), and essentially no long term trend in un-ionized ammonia (NH_3) or in dissolved oxygen (DO) values. The flow ratio graph shows that, in this ecoregion, water years 1974, 1975, 1979, and 1984 were relatively high flow or wet years and 1977 and 1981 were relatively dry years.

Figures 13 B through 13 G can be examined in the same way to determine trends for rivers and streams in the other ecoregions. A decrease in the median dissolved oxygen value could indicate degradation; decreases in the other three measures indicate water quality improvement. Those numbers with E in them are written in scientific notation. For instance, 2.5E-03 means 2.5 times 10^{-3} or .0025 mg/l.

Table 3 summarizes the information on Figures 13 A through 13 G by indicating for each ecoregion the twelve-year trend for each of the four water quality measures.

A more appropriate measure of the significance of the trend is the nonparametric correlation coefficient, Kendall's tau-b. A correlation is made between the water quality parameter and water year. This measure does not make assumptions about the distribution of the data. Those water quality parameters and ecoregions for which there is a significant trend over time are indicated with an asterisk * in Table 3.

There were decreases in un-ionized ammonia concentrations in many of the ecoregions and relatively small changes in dissolved oxygen values in all ecoregions other than Northern Lakes and Forests. These trends indicate more improvement than degradation in those water quality measures most affected by point source pollution. They also indicate some areas of need for more improvement and/or protection from degradation.

Those water quality measures most affected by nonpoint source pollution, nitrite-nitrate concentration and total suspended solids, were more likely to indicate degradation. Nitrite-nitrate concentrations showed significant increases in the Driftless Area and the Northern Great Plains. Total suspended solids concentrations showed significant increases in the Red River Valley, the Central Hardwood Forests, and the Western Cornbelt Plains. There were no statistically significant trends in either nitrite-nitrate concentrations or total suspended solids in the less agricultural areas--the Northern Lakes and Forests and the Northern Minnesota Wetlands. The Minnesota Pollution Control Agency's response to the threat of nonpoint source pollution is outlined in Section 7. C. ONGOING AND PROPOSED ACTIONS TO CONTROL NPS POLLUTION.

TABLE 3. TRENDS IN WATER QUALITY MEASURES OVER TIME
Water Years 1973–1985

	Nitrate–Nitrite	Total Suspended Solids	Un–ionized Ammonia	Dissolved Oxygen
Central Hardwood Forests	Decrease	Increase *	No Trend	No Trend
Driftless Area	Increase *	No Trend	Decrease	No Trend
Northern Great Plains	Increase *	Increase	No Trend	Increase
Northern Lakes and Forests	No Trend	Increase	Decrease	Decrease *
Northern Minnesota Wetlands	No Trend	No Trend	Decrease	Decrease
Red River Valley	Increase	Increase *	No Trend	No Trend
Western Cornbelt Plains	Increase	Increase *	Decrease	No Trend

* Indicates statistically significant trend over time $p < .05$

"No Trend" is indicated if there is a high probability that the apparent increase or decrease is due to chance fluctuations. $p > .50$

6. CAUSES OF NONSUPPORT OF DESIGNATED USES

A. Relative Assessment of Nonsupport Uses

1) Rivers and Streams

During water years 1984-85 (Oct. 1, 1983 - Sept. 30, 1985) a total of 377 stations were monitored for water quality throughout Minnesota. These stations represent 174 river reaches totaling 1,925 river miles. All resulting data were entered in STORET along with the water quality standards for waters in Minnesota. Using this data base, river reaches were identified which had violations of water quality standards.

For waters classified as fishable, stations and the reach of the river they represented were considered to be partially supported for fishing if either the dissolved oxygen standard or the un-ionized ammonia standard or both were violated between 11 and 25 percent of the time. They were considered not supported if violations exceeded 25 percent (Table 4).

TABLE 4. MINNESOTA WATERS NOT MEETING FISHABLE STANDARDS

DESCRIPTION	MILES	COUNTY	DEGREE OF SUPPORT
1. CEDAR RIVER NEAR AUSTIN	8.40	MOWER	PARTIALLY SUPPORTS
2. CENTER CREEK BY FAIRMONT	19.40	MARTIN	DOES NOT SUPPORT
3. CHIPPEWA R NEAR MONTEVIDEO	11.20	CHIPPEWA	PARTIALLY SUPPORTS
4. COBURN CREEK NEAR BLACKDUCK	3.26	BELTRAMI	DOES NOT SUPPORT
5. E BR RAVEN STREAM BY NEW PRAGUE	10.09	SCOTT	PARTIALLY SUPPORTS
6. E BR RAVEN TRIB BY NEW PRAGUE	6.21	SCOTT	DOES NOT SUPPORT
7. E FK DES MOINES R BY CEYLON	28.50	MARTIN	PARTIALLY SUPPORTS
8. JUDICIAL DITCH 26 NEAR CEYLON	5.28	MARTIN	DOES NOT SUPPORT
9. LAZARUS CREEK NORTH OF CANBY	15.70	YELLOW MEDICINE	DOES NOT SUPPORT
10. LEAF R BY WADENA	12.70	WADENA	PARTIALLY SUPPORTS
11. LITTLE ELK RIVER AT RANDALL	11.80	MORRISON	DOES NOT SUPPORT
12. LITTLE ELK RIVER NEAR RANDALL	11.40	MORRISON	DOES NOT SUPPORT
13. MINNESOTA R WEST OF MILAN	16.10	CHIPPEWA	PARTIALLY SUPPORTS
14. MISSISSIPPI R BY LAKE ITASCA	34.50	CLEARWATER	PARTIALLY SUPPORTS
15. MISSISSIPPI R S OF DEER RIVER	6.00	ITASCA, CASS	PARTIALLY SUPPORTS
16. MISSISSIPPI R S OF DEER RIVER	6.40	ITASCA, CASS	PARTIALLY SUPPORTS
17. MISSISSIPPI R SW OF COHASSET	7.30	ITASCA	PARTIALLY SUPPORTS
18. S BR LITTLE ELK R AT RANDALL	11.80	MORRISON	DOES NOT SUPPORT
19. S FK CROW R BY HUTCHINSON	54.30	MCLEOD	DOES NOT SUPPORT
20. SHELL ROCK R BY ALBERT LEA	9.80	FREEBORN	PARTIALLY SUPPORTS
21. UNION CREEK NEAR WADENA	5.53	WADENA	DOES NOT SUPPORT
22. WHISKEY CREEK NE OF WADENA	3.91	WADENA	DOES NOT SUPPORT
23. WILLIAMS CREEK NEAR WILLIAMS	12.73	LAKE OF THE WOODS	PARTIALLY SUPPORTS

For waters classified as swimmable, stations and the reach of the river they represented were considered to be partially supported for swimming if the geometric mean of fecal coliform bacteria data violated the standard between 11 and 25 percent of the time. They were considered not supported if violations exceeded 25 percent. Fecal coliform bacteria data were used only during the "swimming season", or from May 1, 1984 to Sept. 30, 1984, and from May 1, 1985 to Sept. 30, 1985 (Table 5).

Nonpoint source pollution was determined to be the cause of 51 percent of the violations of the 313 river miles that did not support the fishable use. Municipal sources were determined to cause 42 percent of the violations. Seven percent of the violations were caused by both nonpoint pollution and municipal sources (Figure 14). Along with the apparent need to curb nonpoint source pollution, continued emphasis must be placed on point source controls through increased municipal construction grant funds to ensure that these concentrated sources of pollution are abated as soon as possible.

FIGURE 14. **Causes of Nonsupport of Designated Uses**

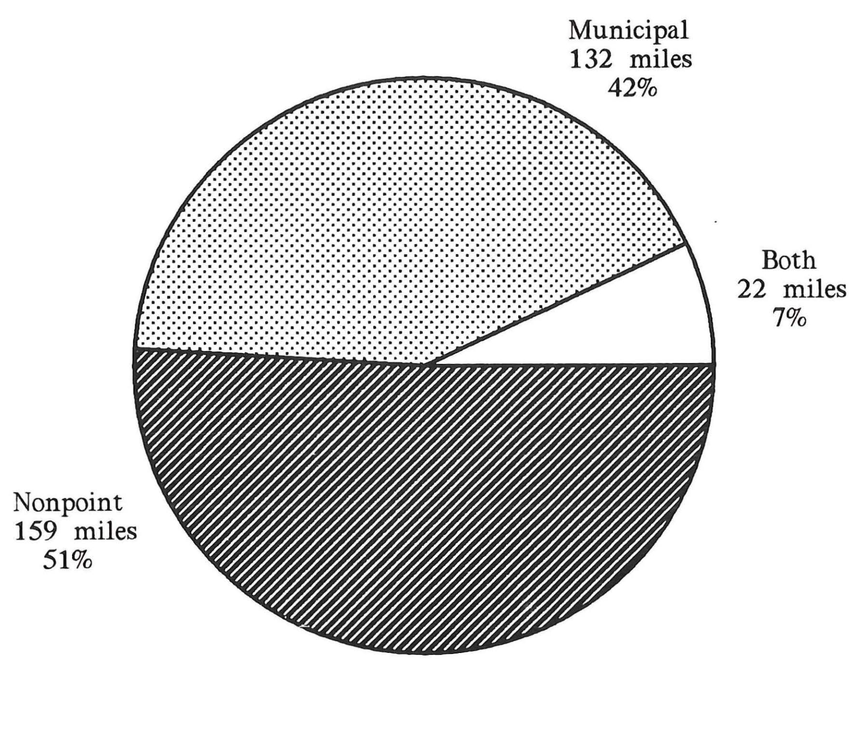


TABLE 5. MINNESOTA WATERS NOT MEETING SWIMMABLE STANDARDS

DESCRIPTION	MILES	COUNTY	DEGREE OF SUPPORT
BLUE EARTH RIVER AT MANKATO	3.4	BLUE EARTH	DOES NOT SUPPORT
BRULE RIVER SW OF HOVLAND	11.4	COOK	PARTIALLY SUPPORTS
CANBY CREEK BY CANBY	9.3	YELLOW MEDICINE	DOES NOT SUPPORT
CANNON RIVER AT WELCH	20.4	GOODHUE	PARTIALLY SUPPORTS
CEDAR RIVER BY AUSTIN	16.4	MOWER	DOES NOT SUPPORT
CENTER CREEK BY FAIRMONT	19.4	MARTIN	DOES NOT SUPPORT
CHIPPEWA RIVER AT MONTEVIDEO	11.2	CHIPPEWA	DOES NOT SUPPORT
COBURN CREEK AT BLACKDUCK	3.3	BELTRAMI	DOES NOT SUPPORT
COTTONWOOD RIVER AT NEW ULM	19.9	BROWN	DOES NOT SUPPORT
E BR DES MOINES RIVER BY CEYLON	28.5	MARTIN	DOES NOT SUPPORT
E BR DES MOINES R TRIB BY CEYLON	5.3	MARTIN	DOES NOT SUPPORT
E BR RAVEN STREAM TRIB, NEW PRAGUE	6.2	SCOTT	DOES NOT SUPPORT
GARVIN BROOK BY MINNESOTA CITY	17.1	WINONA	DOES NOT SUPPORT
GREENWOOD RIVER NE OF GRAND MARAIS	6.1	COOK	PARTIALLY SUPPORTS
KETTLE RIVER E OF HINCKLEY	15.0	PINE	PARTIALLY SUPPORTS
KNIFE RIVER AT KNIFE RIVER	13.3	LAKE	PARTIALLY SUPPORTS
LESTER RIVER AT DULUTH	16.7	ST LOUIS	PARTIALLY SUPPORTS
LOST RIVER BY GONVICK	44.1	CLEARWATER	DOES NOT SUPPORT
MINNESOTA RIVER AT HENDERSON	32.1	SIBLEY	DOES NOT SUPPORT
MINNESOTA RIVER AT COURTLAND	25.6	NICOLLET	DOES NOT SUPPORT
MINNESOTA RIVER AT MORTON	49.1	RENVILLE	DOES NOT SUPPORT
MINNESOTA RIVER AT ST PETER	30.4	NICOLLET	DOES NOT SUPPORT
MINNESOTA RIVER AT FT SNELLING	22.0	HENNEPIN	DOES NOT SUPPORT
MINNESOTA RIVER NE OF DELHI	16.2	RENVILLE	DOES NOT SUPPORT
MINNESOTA RIVER N OF JORDAN	3.7	SCOTT	DOES NOT SUPPORT
MISSISSIPI RIVER AT FRIDLEY	11.8	HENNEPIN	PARTIALLY SUPPORTS
MISSISSIPPI RIVER AT SAUK RAPIDS	15.7	BENTON	DOES NOT SUPPORT
MISSISSIPPI RIVER AT LA CROSSE	34.1	HOUSTON	PARTIALLY SUPORTS
MISSISSIPPI RIVER AT MONTICELLO	35.1	SHERBURNE	DOES NOT SUPPORT
MISSISSIPPI RIVER AT HASTINGS	19.0	DAKOTA	DOES NOT SUPPORT
MISSISSIPPI RIVER AT ST PAUL	8.8	RAMSEY	DOES NOT SUPPORT
N FORK CROW RIVER BY ROCKFORD	10.5	WRIGHT	DOES NOT SUPPORT
NORWEGIAN CREEK BY ELLSWORTH	9.2	NOBLES	DOES NOT SUPPORT
OTTERTAIL RIVER AT BRECKENRIDGE	27.0	WILKIN	DOES NOT SUPPORT
PIPESTONE CREEK BY PIPESTONE	22.0	PIPESTONE	DOES NOT SUPPORT
POMME DE TERRE RIVER AT APPLETON	35.9	SWIFT	DOES NOT SUPPORT
RAINY RIVER AT BAUDETTE	4.7	LAKE OF WOODS	DOES NOT SUPPORT
RED LAKE RIVER AT EAST GRAND FORKS	1.5	POLK	PARTIALLY SUPPORTS
RED RIVER AT BRUSHVALE	18.3	WILKIN	DOES NOT SUPPORT
RED RIVER AT FARGO	23.8	CLAY	DOES NOT SUPPORT
RED RIVER AT GRAND FORKS	6.3	POLK	PARTIALLY SUPPORTS
RED RIVER WEST OF PERLEY	18.0	NORMAN	DOES NOT SUPPORT
REDWOOD RIVER AT NORTH REDWOOD	2.9	REDWOOD	DOES NOT SUPPORT
ROCK RIVER SOUTH OF LUVERNE	12.9	ROCK	DOES NOT SUPPORT
ROOT RIVER EAST OF HOKAH	17.3	HOUSTON	DOES NOT SUPPORT
RUM RIVER AT ISANTI	28.8	ISANTI	PARTIALLY SUPPORTS
S FK WHITEWATER RIVER NW OF UTICA	11.6	WINONA	DOES NOT SUPPORT
S FK ZUMBRO RIVER BY ROCHESTER	11.7	OLMSTED	PARTIALLY SUPPORTS
SAUK R, SPRING HILL TO SAUK RAPIDS	46.3	STEARNS	DOES NOT SUPPORT
SHELL ROCK RIVER W OF GORDONSVILLE	9.8	FREEBORN	DOES NOT SUPPORT
ST LOUIS BAY AT DULUTH	6.0	ST LOUIS	DOES NOT SUPPORT
STRAIGHT RIVER BY CLINTON FALLS	4.7	STEELE	DOES NOT SUPPORT
UNION CREEK NEAR WADENA	5.5	WADENA	DOES NOT SUPPORT
VERMILLION RIVER AT FARMINGTON	23.9	DAKOTA	DOES NOT SUPPORT
W FK DES MOINES RIVER SE OF WINDOM	33.4	JACKSON	DOES NOT SUPPORT
W FK DES MOINES RIVER BY JACKSON	26.8	JACKSON	PARTIALLY SUPPORTS
WATONWAN RIVER W OF GARDEN CITY	12.9	BLUE EARTH	PARTIALLY SUPPORTS
WILLIAMS CREEK BY WILLIAMS	12.7	LAKE OF WOODS	DOES NOT SUPPORT
YELLOW MEDICINE R AT GRANITE FALLS	16.6	YELLOW MEDICINE	DOES NOT SUPPORT

2) Lakes

The nature of runoff from a lake's watershed, both its quantity and content, determines in large part the water quality of the lake. Generally, runoff from cultivated and urban areas will carry more nutrients and sediments to lakes than that from forested or wetland areas. In order to place this into perspective, the land use/land cover (as estimated by 40 acre parcels) for the entire state is as follows: cultivation - 43.5%; open and pasture - 1.1%; Forest - 33.6%; Wetland - 6.0%; Urban - 2.2%; Extractive (mining) - 0.1%; and Water - 3.4%. Therefore, from the standpoint of land use, the largest category is agriculturally related followed by the forest land use. In an attempt to define the sources of lake eutrophication, the number of lakes which are potentially impacted by point sources (or wastewater treatment facilities) was determined to be about 164 lakes, representing about 1.4% of all Minnesota lakes. Therefore, nonpoint sources of pollution are affecting the vast majority of Minnesota lakes, of which 6,000 are estimated to be currently eutrophic and 1,800 hypereutrophic. Lake degradation is likely to continue and at an accelerated rate.

B. Relative Assessment of Major Pollutants Causing Nonsupport

1) Rivers and Streams

Fecal coliform concentrations exceeding the water quality standard resulted in nonsupport of designated uses for 1,029 of the 1,717 total river miles designated as swimmable that were assessed during 1984-85. Fecal Coliform bacteria are common to the intestinal tract of man and animals. Presence in water is an indicator of pollution and possible health risks to swimmers. Control of fecal coliform organisms in municipal sewage is accomplished through disinfection of the effluent, usually with chlorine. Many of the sampling stations however, are located in areas impacted by nonpoint source pollution, including combined sewer overflows, urban runoff, agricultural runoff, feedlots, and septic tanks.

Low dissolved oxygen concentrations in 203 miles of the total assessed fishable waters prompted the nonsupport designation. Dissolved oxygen must be available in adequate concentrations to support fish and other aquatic organisms and for the prevention of offensive odors. Low dissolved oxgyen concentrations can be caused by the discharge of excessive organic solids having high biochemical oxygen demand, the result of inadequate waste treatment.

Un-ionized ammonia concentrations in excess of the water quality standard resulted in nonsupport of designated uses for 153 miles of the assessed fishable waters. Un-ionized Ammonia, NH-3, is the more toxic form of the total ammonia in water. The higher the pH and temperature of water, the greater the concentration of un-ionized ammonia relative to the ammonium ion NH-4+. Ammonia is a natural part of the nitrogen cycle in surface waters, but municipal or industrial sources of ammonia can elevate un-ionized ammonia concentrations to toxic levels.

The assessment of fishable use was based on dissolved oxygen and un-ionized ammonia concentrations. Parameters other than those used in the assessment which affect the support of fishing and swimming uses include pH and turbidity.

pH is a measure of the acidity or alkalinity of a material, solid or liquid. pH is represented on a scale of zero to 14, where 7 represents a neutral state, zero the most acidic, and 14 the most alkaline. Most natural waters have a pH in the range of 6.0 to 8.5. Measurements of pH indicated that water quality standards were exceeded more than 11% of the time in 144 miles of assessed waters.

Turbidity is perceived as a cloudy condition in water due to the suspension of silt or finely divided organic matter that scatters and absorbs light. High turbidity is often associated with nonpoint sources of suspended material washed into rivers and streams during rain storms. Turbidity exceeded water quality standards more than 11% of the time in 126 of the assessed river miles.

2) Lakes

Eutrophication of Minnesota's lakes is largely due to the increased supply of nutrients and sediments from the watersheds. Of the nutrients, phosphorus is the key element which largely dictates the extent of aquatic plant growth. Sediment entering the streams and lakes may reduce viable habitat for fisheries, for example, and may substantially reduce the volume of a lake. Reduced lake volume may have several detrimental effects upon lake water quality such as increased internal loading of nutrients to the lake, increased plant growth, possible fish kills, and blue-green algal growths. The longevity of the waterbody may be substantially reduced. These occurrences will reduce the value of the resource to many citizens.

7. PUBLIC HEALTH / AQUATIC LIFE CONCERNS

A. Toxics-Related Concerns

1) Fish Consumption

Fishing is an important recreational activity in Minnesota. It is a major attraction for much of the 4.8 billion dollar tourism and travel industry in Minnesota. Part of the enjoyment of fishing is eating the catch. Unfortunately, some of the waterways in Minnesota are contaminated with chemicals which accumulate in fish and are toxic to human and animal consumers. For these waterways, the designated uses are partially or not supported.

In Minnesota, fish consumption advisories are issued by the Minnesota Department of Health (MDH) using data from fish collected by the Minnesota Department of Natural Resources (MDNR). The Minnesota Pollution Control Agency (MPCA) arranges for the fish collection, processes the fish, contracts for their analyses, and prepares environmental reports from the data. The advisories are issued each spring through the news media and through booklets that are sent out to anyone requesting them.

MDH reviews the current toxicological literature to determine the tolerable weekly or annual intake of contaminants which would protect public health. The concentrations of contaminants in the edible fish tissue are used to recommend the safe number of meals to eat during a specified time period. This process is called "risk assessment." Risk assessment is routinely used to determine the impacts of exposure to contaminated drinking water, air, and other environmental problems which makes it a logical method to determine the impacts of eating contaminated fish. This method is different from the traditional method of comparing fish tissue concentrations of contaminants to U.S. Food and Drug Administration standards which were developed to control fish caught commercially, not fish caught by sportsmen.

a. Methods

The advisory issued in May, 1985 was used as a basis to determine the level of contamination of Minnesota waterways in this section of the report. The advisory is comprehensive, using fish tissue data gathered from the inception of the program in 1975 to 1983. Since this advisory was issued, the results from the 1984 fish collection were completed and are included in this section. Therefore this analysis includes data from 1975-1984. The 1985 2,3,7,8 tetrachlorodibenzo-a-dioxin (2378-TCDD) data is also included. Polychlorinated biphenyls (PCBs), mercury and 2378-TCDD data are used for advisories in Minnesota at this time.

The consumption advice listed in the advisory ranges from "unrestricted" to "no consumption suggested." Waterways with all fish samples in the "unrestricted" category were listed as supporting their uses. Waterways with fish samples in the intermediate consumption categories were listed as partially supporting their uses. Waterways with one or more fish samples in the "do not eat" category were listed as not supporting their uses. Surface area for the entire lake was listed and summed irrespective of the number of samples or stations with fish tissue data. Similarly, mileage for the entire river reach segment was listed and summed irrespective of the number of samples or stations. If more than one station was sampled in a reach segment, the mileage was divided equally among them.

The fish samples used in this analysis have been collected from waters suspected of having low level concentrations of bioaccumulative toxics or from certain heavily used water bodies. Therefore, the fish tissue monitoring results may not be representative of all Minnesota surface waters. Rather, the results characterize those waters which were assessed by fish tissue monitoring.

b. Results

The locations, contaminants, and amount of water (acreage and miles) in the supporting, partially supporting, and not supporting categories are listed in Appendix A.

Approximately 404,765 acres of lakes were assessed from 1975 to 1984. Forty-five percent (180,964 acres) supported designated uses with all fish samples included in the "unrestricted" category. Similarly, 55% (223,401 acres) partially supported their uses and less than 0.1% (400 acres) did not support their uses (Figure 15). Most of the lakes that partially support their uses are in northeast Minnesota and are contaminated with mercury (Figure 17). The MPCA has been active in characterizing the lakes susceptible to mercury contamination. However, funds and necessary regulations have been lacking to determine sources and to control them. Zumbro Lake was the only lake which did not support fish consumption. This lake is contaminated with PCBs.

Fish were collected from five stations along the Minnesota shoreline of Lake Superior in 1983 and analyzed for PCBs and mercury. However, only mercury was measured due to interferences encountered during the PCB analyses. The mercury concentrations were low and no advisories were issued. Thus, all of the 272 miles of our Great Lakes shoreline appear to be supporting their uses at this time. New samples collected in 1985 will be analyzed for PCBs. The use of this resource for unlimited fish consumption will be re-evaluated at that time.

Approximately 968.5 miles of rivers were assessed. Thirty percent (291 miles) supported their uses. Similarly, 438.9 miles (45%) partially supported their uses while 238.6 miles (25%) did not support their uses (Figure 16). Most of the partially and not supported river segments are contaminated with PCBs. Generally, these reaches are below major population centers where PCBs were widely used before they were known to be an environmental hazard. The segments that did not support their uses were the lower reaches of the Minnesota, Mississippi, and St. Croix Rivers. One segment, below International Falls, did not support its uses due to 2378-TCDD contamination of large northern pike (Figure 18).

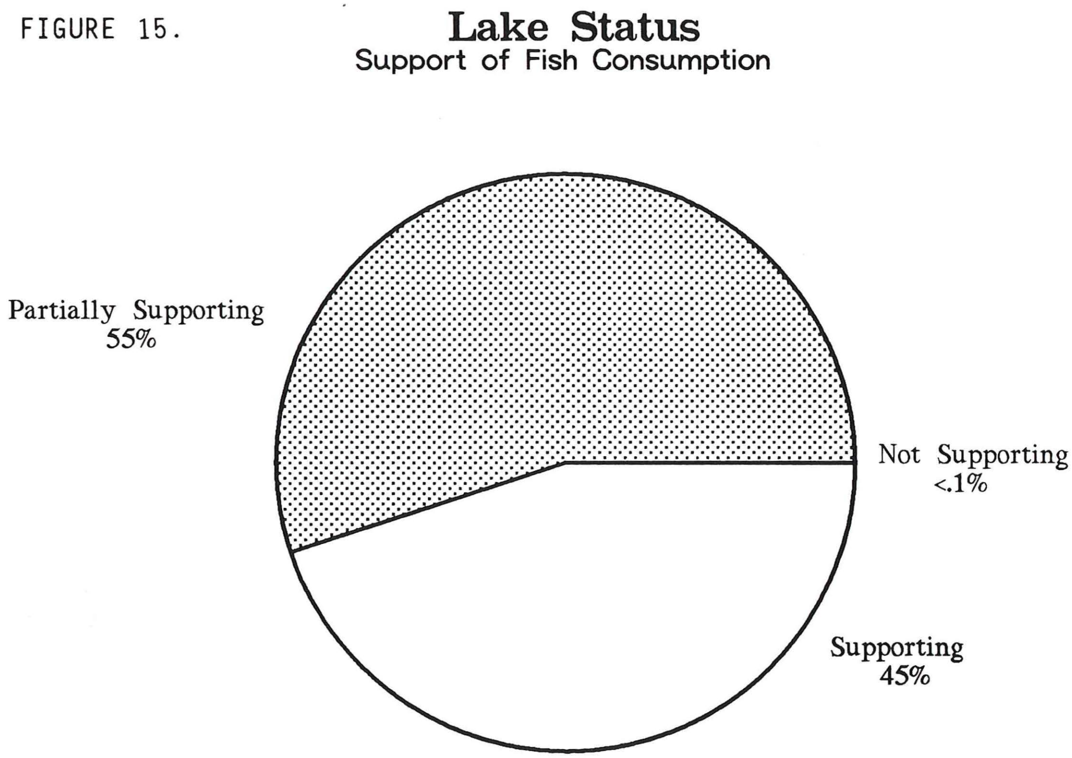
c. Trends

Trends in specific pollutants of interest in fish tissue have been examined by the Minnesota Pollution Control Agency.

PCBs are a class of organic, industrial chemicals that are very persistent in the environment, accumulate to high concentrations in animals, and may cause adverse health effects. In the spring of 1975, the U.S. Food and Drug Administration (USFDA) detected residue levels in fillets of common carp from the Upper Mississippi River that exceeded the commercial tolerance level of 5.0 ug/g. This finding resulted in the destruction of 60,000 pounds of fillets from commercial fishermen.

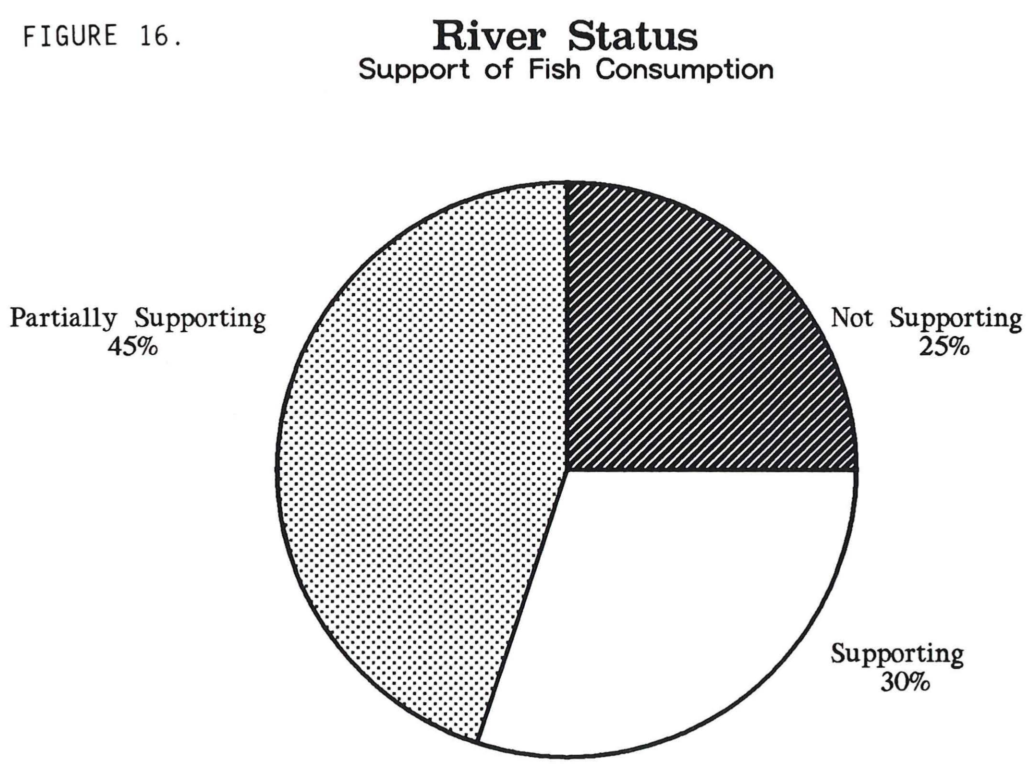
Since 1975, several state and federal laws and programs have been initiated by both the state and federal government to stop the environmental release of PCBs. The PCB concentration in common carp from the Mississippi River has decreased since 1975, as shown in Figure 19 and Table 6. Although PCB levels in fish tissue have decreased, significant levels remain and a human health advisory is in effect for the Mississippi River from St.Cloud, Minnesota to Alma, Wisconsin and from Trempleau to LaCrosse, Wisconsin.

FIGURE 15.



Total Assessed 404,765 Acres

FIGURE 16.



Total Assessed 968.5 Miles

FIGURE 17.

Lake Status

Support of Fish Consumption

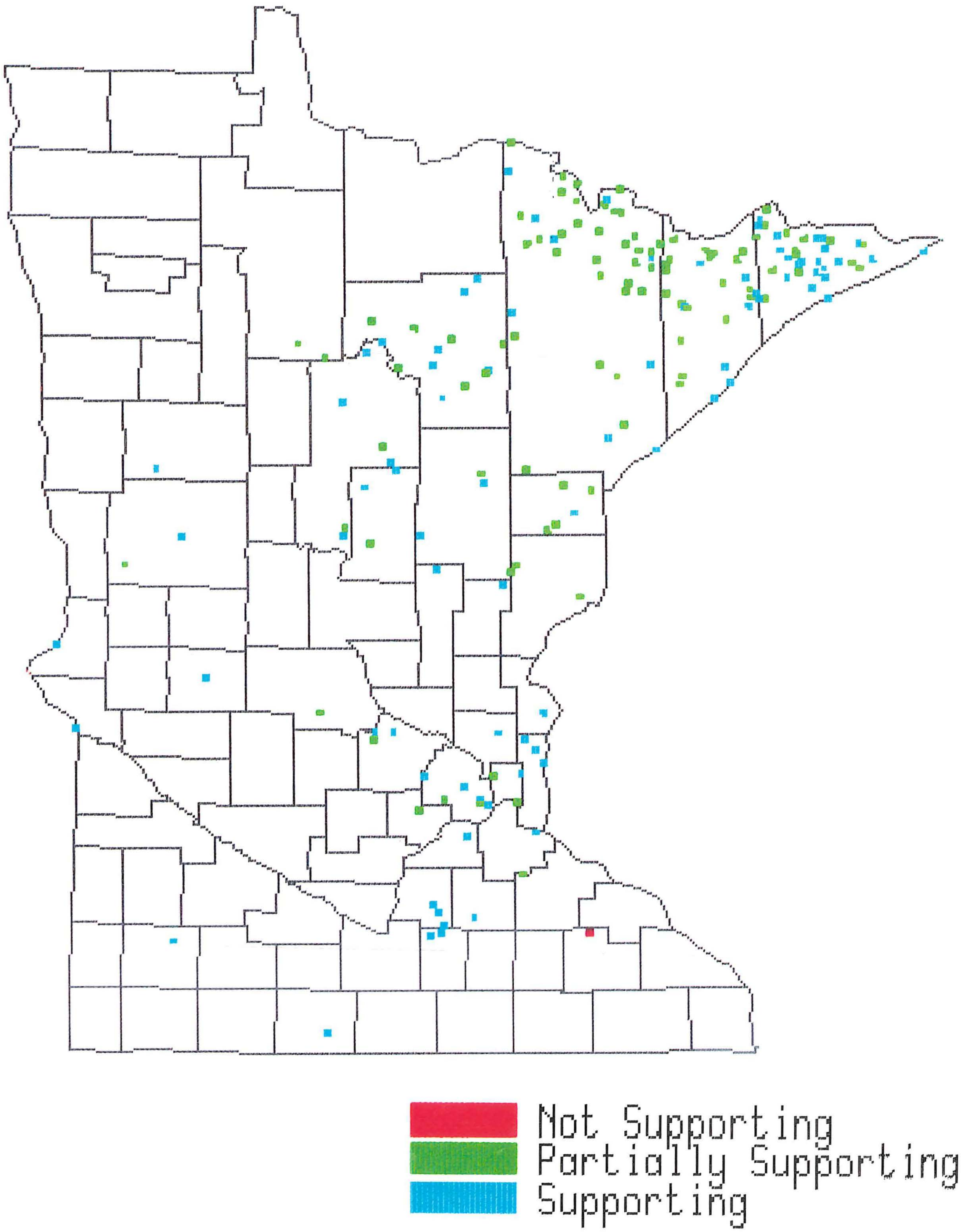


FIGURE 18.

River Status

Support of Fish Consumption

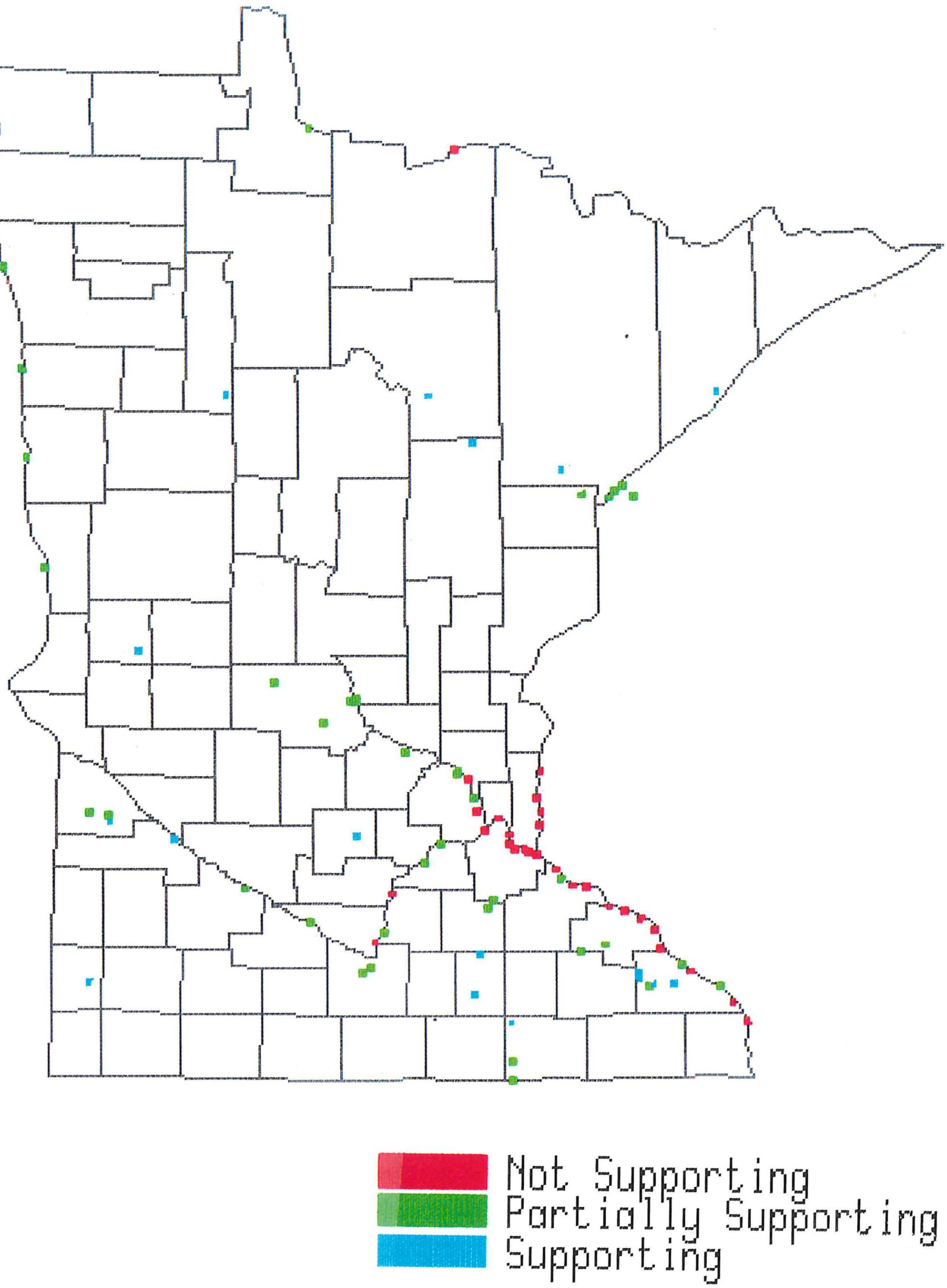


FIGURE 19. MEAN "PCB" CONCENTRATIONS IN FILLET TISSUE OF THREE SIZE CLASSES OF COMMON CARP FROM THE MISSISSIPPI RIVER FROM 1975 TO 1982.

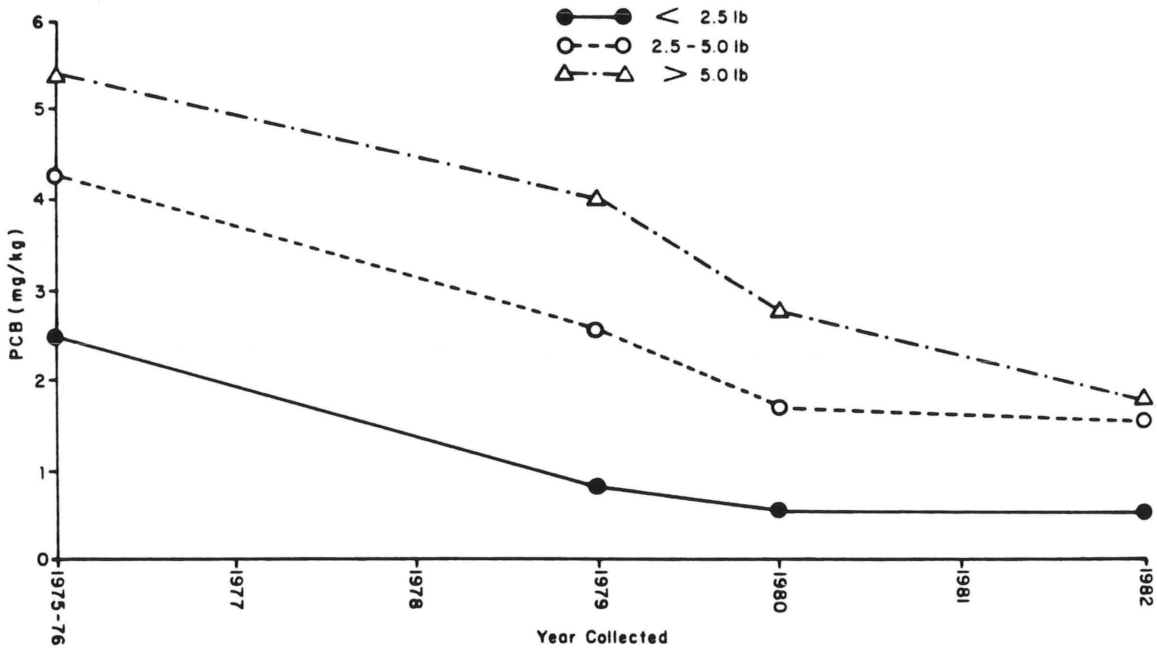


TABLE 6. MEAN PCB CONCENTRATIONS (ug/g) IN THREE SIZE CLASSES OF COMMON CARP IN 1975-76, 1979-80 AND 1983

Size Class (lb)	PCB Concentration in Tissue 1975-76	1979-80	1983
<2.5	2.47	0.68	0.61
2.5-5.0	4.21	2.07	1.68
>5.0	5.37	3.36	1.82

Mean mercury concentrations in predator fish from northeastern Minnesota lakes (0.47-0.51 ug/g) are greater than those found in lakes from other areas of the state. Mercury in northern pike and walleyes from all other areas seldom are greater than 0.20 ug/g. Ten large northeastern Minnesota lakes studied by the Minnesota Department of Natural Resources in 1977 were resampled by the MPCA in 1982. Comparisons were made of the same lake, species and length-class. For all comparisons combined, the mean difference between the two time periods was 0.03 ug/g which was not significant.

The environmental factors which could affect fish mercury concentrations may be changing very slowly. It is important to continue to sample these lakes in the future. Relatively contaminated small lakes may be responding more quickly. Examples of this type of lake should be monitored for trend analyses. Historic (pre-1950) museum fish collections from northeastern Minnesota lakes should also be sampled as another means of determining mercury trends in Minnesota.

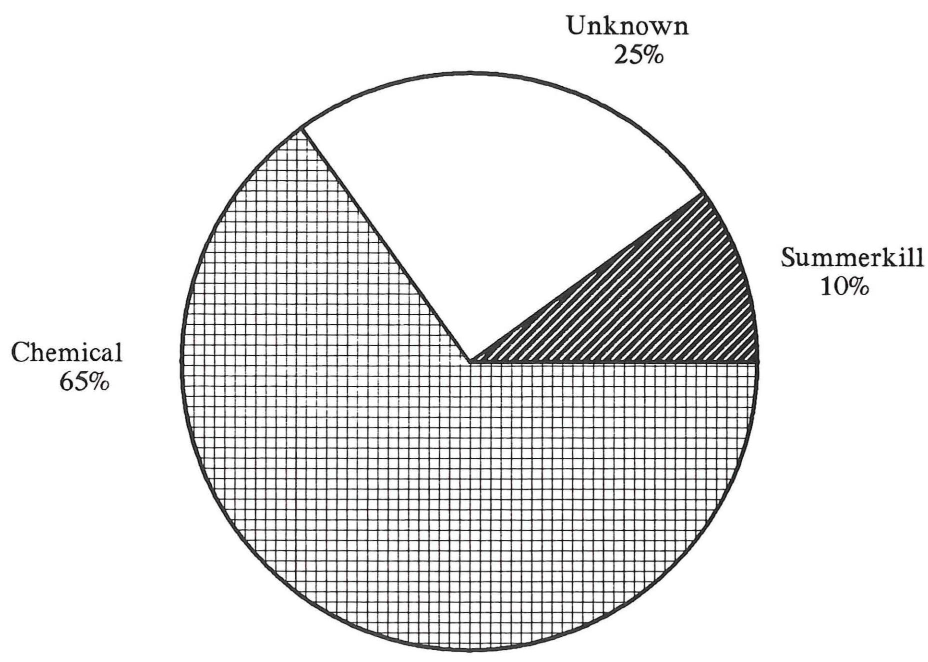
d. Summary

As stated previously, there are 3,411,200 acres of lakes, 272 miles of Great Lakes shoreline and 91,944 miles of rivers to fish in Minnesota. Fish tissue information was used to assess 404,765 acres (12%) of lakes, 272 miles (100%) of Great Lakes shoreline and 968.5 miles (1%) of rivers. Forty-five percent (45%) of the assessed lake area, 100% of the Great Lakes shoreline and 30% of the assessed river mileage supported their uses with no fish consumption restrictions. Similarly, 55% of the lake area and 45% of the river mileage partially supported their uses with some limitations on fish consumption suggested by the Minnesota Department of Health. Less than 0.1% of the lake area and 25% of the river mileage did not support their uses with some species and sizes of fish unsafe to eat. Mercury contamination in northeastern Minnesota lakes and PCB contamination in river segments below municipalities were the major causes of non-support.

2) Fishkills

Fishkills that have occurred in Minnesota from October, 1983 through October, 1985 are summarized in Table 7 and Figure 20. During the period, approximately 102,000 fish were killed. Of these, 65% died from chemical spills, 10% died from summer or winterkills and 25% died from unknown causes.

FIGURE 20. **Fish Kills in Minnesota Waters**



Total Fish Killed 102,000

TABLE 7.

DOCUMENTED FISH KILLS IN MINNESOTA WATERS
OCTOBER 1983 – OCTOBER 1985
(from Minnesota Department of Natural Resources records)

Date	Location (county)	Number of Fish Killed by: unknown	chemical	summerkill
840220	Robinson L. (Wabasha)	20920		
840330	St. Croix R. (Washington)	*		
840404	Fish L. (Dakota Co.)	1		
840405	Agnus–Henry L. (Douglas)	*		
840411	Polk L. (Washington)			**
840413	Long L. (Stearns)	202		
840523	Lansing Cr. (Mower)		1000	
840531	Schwerin Cr. (Mower)		*	
840705	Pearl Cr. (Goodhue)		2343	
840713	Camden Cr. (Hennepin)		533	
840713	Spring Brook (Rice)		249	
840716	S. Fk. Zumbro (Olmstead)	300		
840807	Salem Cr. (Mower)			*
840813	Pokegama L. (Pine)		182	
840822	Big Swan L. (Meeker)	2560		
840827	Cannon R. (Rice)		*	
840831	Battle Cr. (Ramsey)		55500	
840905	Fountain–Albert Lea L. channel (Freeborn)			10000
840916	High Island Cr. (Sibley)	1000		
841017	Spring Valley Cr. (Fillmore)		5000	
841211	Battle Cr. (Ramsey)		52	
850225	unnamed ditch (Stearns)		*	
850321	unnamed pond (Hennepin)	100		
850419	St. James Cr. (Watonwan)		269	
850514	trib. N. Br. Whitewater R. (Wabasha)		58	
850525	S. Fk. Crooked Cr (Houston)		1322	
850618	Cottonwood L. (Cottonwood)	400		
850701	Ballard Cr. (Goodhue)	9		
	TOTAL FISH	25492	66508	10000

* a fish kill was observed but number of fish was not recorded
** this single winterkill included in this column

3) Blue-green algae toxicity

Blue-green algae may dominate the spring and summer phytoplankton compositions of nutrient enriched lakes. This domination may have several significant and detrimental aspects for lake resource users. These algae may form brightly colored surface scums which, when decomposing, can produce foul odors and surface scums. Several genera of bloom forming blue-green algae may also be detrimental due to their ability to produce highly toxic substances which may be fatal to fish, waterfowl, and domesticated animals. These algae are also potentially detrimental to human health, as blue-green algal blooms have also been extensively associated with human respiratory, gastrointestinal, and dermal disorders. In general, these human symptoms have been referred to as the "summer flu". Recent studies have also suggested that the blue-green algae toxins may pass through some drinking water treatment systems.

Additional work is needed to assess the significance of the blue-green algae, especially since a large share of the state's income is related to tourism and lake water quality.

B. Non-Toxics Concerns

Within the period 1983-1985, there were two instances in Minnesota where beaches had to be temporarily closed because of the possible presence of the Norwalk Virus in the beach areas, as shown in Table 8. The suspected source of the virus was fecal contamination from infants. These beaches were reopened within a short period of time.

TABLE 8. CLOSURE OF BATHING AREAS DURING 1983-1985

Location	County	Date	Situation
Lake George	Anoka	July 29,1983	Norwalk Virus suspected in bathing area
Foot Lake	Kandiyohi	July 12,1983	Norwalk Virus suspected in bathing area

C. Basin/Segment Information

1) Site-Specific Information

Table 9 lists each of the river segments not supporting or partially supporting their designated aquatic life uses. All of these waters are currently classified for fisheries and recreational uses. The proposed action is identified for each of the segments.

2) Ongoing and Proposed Actions to Control Nonpoint Source Pollution

From the data collected during 1984 and 1985, there appears to be over 180 river miles and as many as 90% of Minnesota's lakes impacted by nonpoint source pollution. This information, however, was collected from water quality monitoring data which is limited in scope and primarily directed at identifying point source problems. In a study to identify nonpoint source problems for the Association of State and Interstate Water Pollution Control Administrators (ASIWPCA), the Minnesota Pollution Control Agency estimated that over 50% of the state's streams are impaired or threatened by nonpoint sources and, for ground water, approximately 12% of the state is susceptible to nonpoint source impacts. The nonpoint source pollution problem is also evidenced by acid deposition which threatens over 2500 lakes and by over 10,000 feedlots which occur in shoreland areas and potentially threaten water quality. These estimates strongly suggest that nonpoint source pollution is an important threat to Minnesota's water resource.

Nonpoint source pollution in Minnesota originates from both urban and rural areas and consists predominately of sediment and nutrient problems. In addition, there are some unique or special NPS problems, such as the acid rain threat mentioned above and a few naturally occurring, localized NPS impacts.

To address nonpoint source pollution problems, the MPCA is pursuing nonpoint source program development activities. These activities include revising water quality standards, identifying priority areas where the potential for nonpoint source pollution is high, promoting and participating in demonstration projects, and leading a NPS inter-agency issues team established by the Governor.

The standards revision is scheduled to occur in two phases over the next several years. The first phase of the standards revision process will involve minor revisions of the existing water quality standards. The purpose of these revisions is to clarify and direct the state's intent to control NPS pollution. This effort is presently underway and will be completed in the next triannual rule revision scheduled for December 1987.

TABLE 9. WATERS NOT FULLY SUPPORTING THEIR DESIGNATED USES

	DESCRIPTION	REACH	MILES	SPEC. DESIGN.	SUPPORT	POLLUTANT	SOURCE	PROPOSED ACTION
1.	CEDAR RIVER NEAR AUSTIN	07080201016	8.40	NONE	PART	DO, NH3-N	AUSTIN	PARTIALLY FUNDED
2.	CENTER CREEK BY FAIRMONT	07020009010	19.40	NONE	NOT	DO, NH3-N	FAIRMONT	WATER QUALITY STUDY
3.	CHIPPEWA R NEAR MONTEVIDEO	07020005001	11.20	NONE	PART	NH3-N	NONPOINT	1
4.	COBURN CREEK NEAR BLACKDUCK	09020302130	3.26	NONE	NOT	DO	BLACKDUCK, NONPOINT	FUNDED PROJECT, 1
5.	E BR RAVEN STREAM BY NEW PRAGUE	07020012124	10.09	NONE	PART	DO, NH3-N	NEW PRAGUE	# 45 NEEDS LIST
6.	E BR RAVEN TRIB BY NEW PRAGUE	07020012224	6.21	NONE	NOT	DO, NH3-N	NEW PRAGUE	# 45 NEEDS LIST
7.	E FK DES MOINES R BY CEYLON	07100003021	28.50	NONE	PART	DO	CEYLON	FUNDED PROJECT
8.	JUDICIAL DITCH 26 NEAR CEYLON	07100003221	5.28	NONE	NOT	DO	CEYLON	FUNDED PROJECT
9.	LAZARUS CREEK NORTH OF CANBY	07020003014	15.70	NONE	NOT	DO	NONPOINT	1
10.	LEAF R BY WADENA	07010107007	12.70	NONE	PART	DO	NONPOINT	1
11.	LITTLE ELK RIVER AT RANDALL	07010104028	11.80	NONE	NOT	DO	NONPOINT	1
12.	LITTLE ELK RIVER NEAR RANDALL	07010104027	11.40	NONE	NOT	DO	NONPOINT	1
13.	MINNESOTA R WEST OF MILAN	07020001002	16.10	SCENIC & REC	PART	NH3-N	NONPOINT	1
14.	MISSISSIPPI R BY LAKE ITASCA	07010101033	34.50	CANOE/BOATING	PART	DO	NONPOINT	1
15.	MISSISSIPPI R S OF DEER RIVER	07010101008	6.00	CANOE/BOATING	PART	DO	NONPOINT	1
16.	MISSISSIPPI R S OF DEER RIVER	07010101005	6.40	CANOE/BOATING	PART	DO	NONPOINT	1
17.	MISSISSIPPI R SW OF COHASSET	07010101004	7.30	CANOE/BOATING	PART	DO	NONPOINT	1
18.	S BR LITTLE ELK R AT RANDALL	07010104029	11.80	NONE	NOT	DO	NONPOINT	1
19.	S FK CROW R BY HUTCHINSON	07010205006	54.30	NONE	NOT	NH3-N	HUTCHINSON	# 33 NEEDS LIST
20.	SHELL ROCK R BY ALBERT LEA	07080202009	9.80	NONE	PART	NH3-N	NONPOINT	1
21.	UNION CREEK NEAR WADENA	07010107107	5.53	NONE	NOT	DO	WADENA, BEAVER DAMS	# 37 NEEDS LIST
22.	WHISKEY CREEK NE OF WADENA	07010107307	3.91	NONE	NOT	DO	NONPOINT	1
23.	WILLIAMS CREEK NEAR WILLIAMS	09030009116	12.73	NONE	PART	DO	WILLIAMS, NONPOINT	WATER QUALITY STUDY, 1

1. The MPCA is currently developing a program for nonpoint source pollution control. Water quality protection for these water bodies will be provided through the nonpoint source program.

The second phase of revising the water quality standards involves the development of standards directed at lakes. Preliminary work completed so far suggests that a lake standard will consist of a total phosphorus standard with intrastate variation based on the seven ecoregions defined by the U.S. Environmental Protection Agency. The purpose of the standard is to control the cultural eutrophication of Minnesota's lake resource. The lake standard should be available for NPS pollution control by 1989.

The planning stage for the identification of NPS priority areas has been completed. The next step is the actual identification process. To complete this process the MPCA is entering into a contract with the Minnesota Planning Information Center to obtain the information necessary for NPS priority area identification. Information for NPS area identification includes land use/land cover, general slope, soil texture, hydrologic group (drainage), water orientation, sedimentation rate and population density. The land use and geographic information is based on 40 acre parcels and will be summarized and modeled over each ecoregion. Priority area identification will be completed on an ecoregion basis.

Several projects are underway that demonstrate the techniques and methods used to control NPS problems. These projects consist of a Rural Clean Watershed Program (RCWP) project on Garvin Brook and two Clean Lakes Program projects. Garvin Brook is a small trout stream in a karst area with both surface and ground water problems. The Big Stone Reservoir and the Clearwater River Chain of Lakes projects deal primarily with surface water problems. In addition, the MPCA has established a staff position to initiate nonpoint source pollution control measures in the Minnesota River watershed where intensive land use activities have occurred over many years. These projects all demonstrate the need for a cooperative effort by federal, state and local governments to control nonpoint source pollution.

Clarification of the existing water quality standards, addition of a lake water quality standard, identification of NPS priority areas, continuance of demonstration projects, and participation in the Governor's issues team will allow the MPCA to pursue NPS pollution control. The standards revision, the priority area identification, and the demonstration projects allow the MPCA to identify impacted water bodies and design pollution control programs tailored to meet the water quality goals established for the water body. Participation in the Governor's issues team provides the MPCA with the leadership role needed to protect the water quality goals of the State of Minnesota.

8. GROUND WATER QUALITY

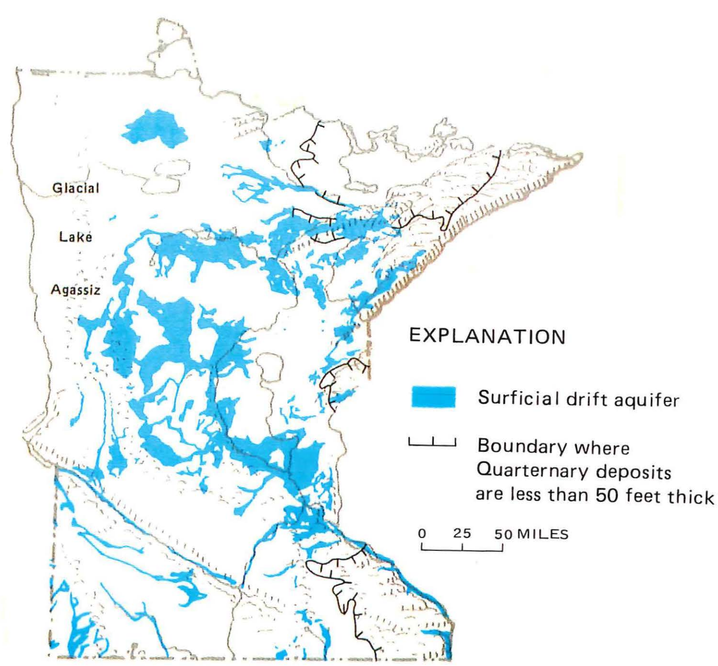
A. Overview

Minnesota's extensive water resources consist of both surface and ground water. Ninety-four percent of the State's public water supply systems and 75% of domestic supply systems draw from ground water sources. Ground water also supplies about 88% of the water used for agricultural irrigation. These withdrawals totaled more than 250 billion gallons in 1984 alone. Thus, ground water is a valuable resource, yet it is also vulnerable, subject to stresses from contamination and over withdrawal.

B. Ground Water Quality

Fourteen principal aquifers underlie the land surface of Minnesota. These are broadly grouped into unconsolidated glacial-drift aquifers, sedimentary bedrock aquifers, volcanic rock aquifers and crystalline bedrock aquifers. The drift aquifers are shown in Figure 21.

FIGURE 21. SURFICIAL DRIFT AQUIFERS



The natural quality of Minnesota's ground water is generally quite good, usually meeting all primary drinking water standards. The secondary standards of 0.3 mg/l for iron and 0.05 mg/l for manganese are commonly exceeded in up to half of the samples tested statewide as a part of the MPCA's Ground Water Quality Monitoring Program. In the southwestern part of the state there are frequent exceedances of the 250 mg/l standard for sulfate. The influence of land use activities on ground water quality can be seen in the chronic exceedances of the nitrate standard in the southwestern counties where the concentration of animal feedlots is the greatest. Nitrates are also frequently elevated in the karst areas of southeastern Minnesota, as well as in the shallow, surficial unconsolidated aquifers which supply water in the central areas along the Mississippi River Basin, although exceedances of the standard are not as common.

The major sources of contamination to Minnesota's ground water and the contaminants of concern are listed and ranked in Table 10.

TABLE 10. RANKED THREATS TO GROUND WATER QUALITY

CONTAMINANT SOURCE	RANK	CONTAMINATING SUBSTANCES
INDUSTRIAL/MANUFACTURING (ON-SITE SPILLS, ILLEGAL OR UNCONTROLLED DISPOSAL, INDUSTRIAL IMPOUNDMENTS)	1	METALS, PENTACHLOROPHENOL, PAH COMPOUNDS, INDUSTRIAL SOLVENTS, PESTICIDES
SOLID WASTE LANDFILLS AND DUMPS	2	LEACHATE: ORGANIC CHEMICALS, METALS
STORAGE AND TRANSPORTATION OF PETROLEUM AND OTHER PRODUCTS	3	GASOLINE, FUEL OIL AND BREAK-DOWN PRODUCTS, OTHER MATERIALS
AGRICULTURAL ACTIVITIES	4	NITRITES, PESTICIDES
MUNICIPAL IMPOUNDMENTS AND LAND TREATMENT FACILITIES		PRIORITY POLLUTANTS, NITRITES
INDIVIDUAL SEPTIC SYSTEMS		PRIORITY POLLUTANTS, NITRITES
ROAD SALTING/SALT STORAGE		SALINITY

C. Programs

State ground water programs are administered by several state agencies. Water quality management and conservation are handled by the Minnesota Department of Natural Resources through their appropriation permit program. The Minnesota Department of Health manages programs relating to providing safe drinking water. Private and public water well construction, maintenance and abandonment requirements as well as the requirements of the Safe Drinking Water Act fall with the Department of Health's jurisdiction. The detection, monitoring, and clean-up of ground water contamination are carried out by various programs of the MPCA. In addition to requiring site-specific ground water monitoring at different types of waste treatment and disposal facilities, the Agency conducts a statewide ambient ground water quality monitoring program to assess the natural quality of Minnesota's ground water. The most recent publication of that program is entitled, "An Appraisal of Minnesota's Ground Water Quality." The programs and interactions of the various state agencies are described more completely in "Ground Water in Minnesota, A User's Guide"

To provide for better management and a more cooperative approach to the ground water resource, the EPA provided funding in 1981 for the development of a statewide ground water protection strategy framework. The MPCA acted as lead agency in the formulation of the framework, coordinating input from twelve other local, state, or federal agencies concerned with ground water issues. A part of that effort involved preparation of the report "Assessment of Ground Water Contamination in Minnesota," completed in June of 1983. The findings of that document form the basis of information used in formulating Table 10.

Since 1983, the Agency has been addressing those concerns. The Hazardous Waste Regulatory Compliance Section of the Solid and Hazardous Waste Division conducts the Federal Resource Conservation Recovery Act (RCRA) program. The section also issues permits and enforces compliance with state hazardous waste rules. Sites which were previously contaminated through improper storage and disposal practices are investigated by the Site Response Section and, when appropriate, remedial actions are taken. Landfills and dumps are receiving much closer scrutiny from an expanded staff of hydrologists and enforcement specialists in the Solid Waste Compliance Section. Funds from the federal Superfund program and the corresponding state Superfund program are available to aid in the investigation and remediation of those contaminated sites where responsible parties cannot be identified. Table 11 lists the Hazardous Rating System (HRS) scores of the sites which appear on Minnesota'a Permanent List of Priorities. A growing staff administers the underground storage tank program in the Program Development Section of the Solid and Hazardous Waste Division. This program is currently requiring registration of all underground storage tanks in Minnesota pursuant to a 1983 state statute. Remediation of spills and leaks of petroleum products from pipelines, bulk storage and underground tanks are handled by the Spills Unit of the Division of Water Quality.

TABLE 11. HAZARDOUS RATING SYSTEMS SCORES OF SITES ON MINNESOTA'S PERMANENT LIST OF PRIORITIES

APRIL 1986

SITE NAME AND LOCATION	HRS SCORE	NPL
FMC Corp., Fridley, Anoka County	66	X
U.S. Naval Industrial Reserve Ordnance Plant, Fridley, Anoka County	63	P
Twin Cities Army Ammunition Plant, Ramsey and Hennepin County	59	X
Boise Cascade/Onan, Fridley, Anoka County	59	X
Boise Cascade/Medtronic, Fridley, Anoka County	59	X
Oakdale Dump, Oakdale, Washington County	59	X
Reilly Tar, St. Louis Park, Hennepin County	59	X
Koppers Coke, St. Paul, Ramsey County	55	X
St. Regis Paper Co. (Champion), Cass Lake, Cass County	53	X
Pine Bend/Crosby American LF, Inver Grove Heights, Dakota County	52	P
PCI, Inc., Shakopee, Scott County	52	
Anoka Municipal SLF, Ramsey, Anoka County	51	
Waste Disposal Engineering, Andover, Anoka County	51	X
Bell Lumber & Pole Company, New Brighton, Ramsey County	48	X
MacGillis & Gibbs Co., New Brighton, Ramsey County	48	X
Burlington Northern, Brainerd/Baxter, Crow Wing County	47	X
University of Minnesota, Rosemount, Dakota County	46	P
Freeway SLF, Burnsville, Dakota County	46	P
Faribault Coal Gasification Plant Site, Faribault, Minnesota	46	
Ashland, St. Paul Park, Washington County	45	
St. Augusta SLF/St. Cloud Dump, St. Augusta Township, Stearns County	45	P
Joslyn Manufacturing & Supply Co., Brooklyn Center, Hennepin County	44	X
Union Scrap Iron & Metal Co., Minneapolis, Hennepin County	43	X
Oak Grove SLF, Oak Grove Township, Anoka County	43	P
LeHillier/Mankato, South Bend Township/Mankato, Blue Earth County	42	X
Washington County LF, Lake Elmo, Washington County	42	X
Kummer SLF, Northern Township, Beltrami County	42	P
Shafer Metal Recycling, Minneapolis, Hennepin County	41	
Kandiyohi County SLF, Lake Andrew Township, Kandiyohi County	41	
Dakhue SLF, Hampton Township, Dakota County	40	
Arrowhead Refinery Company, Hermantown, St. Louis County	40	X
NL Industries/Taracorp/Golden Auto, St. Louis Park, Hennepin County	40	X
Whittaker Corp., Minneapolis, Hennepin County	40	X
Flying Cloud SLF, Eden Prairie, Hennepin County	40	
General Mills/Henkel, Minneapolis, Hennepin County	39	X
Electric Machinery, St. Cloud, Stearns County	38	
Sibley County SLF, Dryden Township, Sibley County	38	
Former Windom Municipal Dump, Windom, Cottonwood County	38	P
Nutting Truck & Caster Co., Faribault, Rice County	38	X
Perham Arsenic Site, Perham, Otter Tail County	38	X
Burnsville SLF, Burnsville, Dakota County	37	
Tonka Main Plant, Mound, Hennepin County	36	
South Andover, Andover, Anoka County	35	X
Woodlake SLF, Medina, Hennepin County	34	
Winona County SLF, Wilson Township, Winona County	34	P
Chisago and Isanti Landfill, Isanti Township, Isanti County	34	
Pickett SLF, Henrietta Township, Hubbard County	34	
Olmsted County SLF, Oronoco Township, Olmsted County	34	P
Maple Plain Dump, Maple Plain, Hennepin County	34	
Adrian Municipal Well Field, Adrian, Nobles County	34	P
Battle Lake Area SLF, Clitherall Township, Otter Tail County	34	
La Grand SLF, La Grand Township, Douglas County	34	P
Ashland Oil Co., Cottage Grove, Washington County	34	
Advance Transformer/Ironwood SLF, Spring Valley, Fillmore County	34	
3M Chemolite Disposal Site, Cottage Grove, Washington County	33	
Waite Park Ground Water, Waite Park, Stearns County	32	P
Long Prairie Ground Water Contamination, Long Prairie, Todd County	32	P
St. Louis River/U.S. Steel, Duluth, St. Louis County	32	X
St. Louis River/Interlake Inc., Duluth, St. Louis County	32	X
East Bethel Demolition LF, East Bethel, Anoka County	31	P
Atwater Municipal Well Field, Atwater, Kandiyohi County	31	
Kurt Manufacturing, Fridley, Anoka County	31	P
Honeywell, Inc., Golden Valley, Hennepin County	31	
Koch Refining/N-REN Corp., Rosemount, Dakota County	31	P
Former City of Hastings Dump, Hastings, Dakota County	31	

SITE NAME AND LOCATION	HRS SCORE	NPL
Agate Lake Scrapyard, Brainerd, Cass County	31	P
Isanti Solvent Sites, Rural Isanti, County	30	
Louisville SLF, Jordan, Scott County	29	
WLSSD Landfill/Duluth Dump, Rice Lake Township, St. Louis County	29	
Spring Grove Municipal Well Field, Spring Grove, Houston County	28	
Ritari Post and Pole, Meadow Township, Wadena County	27	
Pipestone County SLF, Rock Township, Pipestone County	27	
Koochiching County SLF, International Falls, Minnesota	27	
Electronic Industries, Inc., New Hope, Hennepin County	26	
Elk River SLF, Elk River Township, Sherburne County	25	
Weisman Scrap, Winona, Winona County	25	
Houston County SLF, Houston Township, Houston County	25	
Wadena Arsenic Site, Leaf River Township, Wadena County	25	
Dodge County SLF, Mantorville Township, Dodge County	25	
Ponderosa SLF, South Bend Township, Blue Earth County	25	
Litchfield Municipal Well Site, Litchfield, Minnesota	24	
Ashland Oil Company, Pine County	22	
Sonford Products, St. Paul Park, Washington County	22	
Wabasha County SLF, Watopa Township, Wabasha County	22	
McGuire Wire Salvage Site, Mora, Kanabec County	20	
Askov Ground Water Contamination, Askov, Pine County	18	
Boise Cascade Paint Waste Dump, Ranier, Koochiching County	17	
Clay County SLF, Hawley Township, Clay County	17	
Meeker County SLF, Litchfield, Meeker County	15	
City of Hopkins SLF, Hopkins, Hennepin County	15	
Crow Wing County SLF, Oak Lawn Township, Crow Wing County	14	
East Mesaba SLF, Virginia, St. Louis County	14	
Isanti Rumpel, Rural Isanti County	13	
Waseca County SLF, Otisco Township, Waseca County	13	
DM&IR Car and Locomotive Shops, Proctor, St. Louis County	11	
DNR-Duxbury Pesticide Site, Duxbury, Pine County	11	
Greater Morrison SLF, Little Falls Township, Morrison County	10	
Karlstad SLF, Deerwood Township, Kittson County	10	
Duluth Air Force Base, Duluth, St. Louis County	10	
Former Northwest Refinery, New Brighton, Hennepin County	9	
Tonka/Woyke Site, Annandale, Wright County	9	
3M Kerrick Disposal Site, Kerrick, Pine County	9	
DNR-Nett Lake/Orr Pesticide Site, Greaney, St. Louis County	9	
Hutchinson Technology Inc., Hutchinson, McLeod County	9	
Ford Motor Company, St. Paul, Ramsey County	8	
Fritz Craig Salvage Operation, Park Rapids, Minnesota	8	
White Bear Lake Township Dump, White Bear Lake, Ramsey County	7	
Superior Plating Inc., Minneapolis, Hennepin County	6	
Minnegasco, Minneapolis, Hennepin County	6	
McLaughlin Gormley King Company, Minneapolis, Hennepin County	4	
43 East Water Street, St. Paul, Ramsey County	3	
Ecolotech, Inc., St. Paul, Ramsey County	3	
Airco Lime Sludge Pit, Minneapolis, Hennepin County	3	
Isanti Martin, Rural Isanti County	3	
Hopkins/Allied Site, Minneapolis, Hennepin County	3	
Polymetal Products, Inc., St. Paul, Ramsey County	2	
Ecolotech, Inc., Minneapolis, Hennepin County	2	
Metals Reduction, St. Paul, Ramsey County	2	
Former McKay Mfg. Co., St. Paul, Ramsey County	2	
Minneapolis Community Development Agency, Mpls., Hennepin County	1	

Total Number of Sites = 120
X = Listed on National Priority List (NPL) = 25
P = Proposed for listing on NPL = 18

D. Geographic Areas of Concern

The vulnerability of ground water to contamination is dependent on two factors: the protection afforded the aquifer by the overlying soils and the presence of potential contaminants. The natural protection afforded some aquifers is not sufficient to avoid extensive low-level contamination from non-point sources of pollutants. Truly severe problems can result from improper storage, transport or disposal of materials and wastes in vulnerable areas. This portion of the report will show the relationship of these factors.

Two of Minnesota's extensive aquifer systems are more susceptible to contamination than are the others. Surficial drift aquifers (Figure 21) are locally important sources of ground water where present, and are often afforded little natural protection by overlying clayey or silty soils. Figure 22 shows areas of the state where the depth of overburden covering the bedrock is minimal. Particularly vulnerable are the areas of southeastern Minnesota where the underlying bedrock is soluble limestone. Sinkholes, disappearing streams, and other karst features are common here. In the northeastern part of the state the dense bedrock is unfractured and not a good source of water. Surface water is used more frequently for water supply in that area.

The presence of potential contaminants is also necessary for an aquifer to be considered vulnerable. Figure 23 shows known sites of ground water impacts from solid waste disposal facilities. For this diagram, ground water pollution means concentration in excess of drinking water standards, and ground water impacts are defined as an increase in concentration in downgradient wells over that found in upgradient wells. Figure 24 depicts the location of industrial surface impoundments from the 1980 Surface Impoundment Assessment. Figures 25 and 26 show the approximate number of hazardous waste generators and the distribution of hazardous waste treatment, storage and disposal facilities, respectively. The state's major petroleum pipelines are shown in Figure 27. Comparison of Figures 23-27 with the vulnerable areas highlighted in Figures 21 and 22 shows the ground water most likely to be impacted by man's activities on the land surface.

FIGURE 22. AREAS WHERE BEDROCK IS EXPOSED OR MINIMALLY COVERED WITH OVERBURDEN.

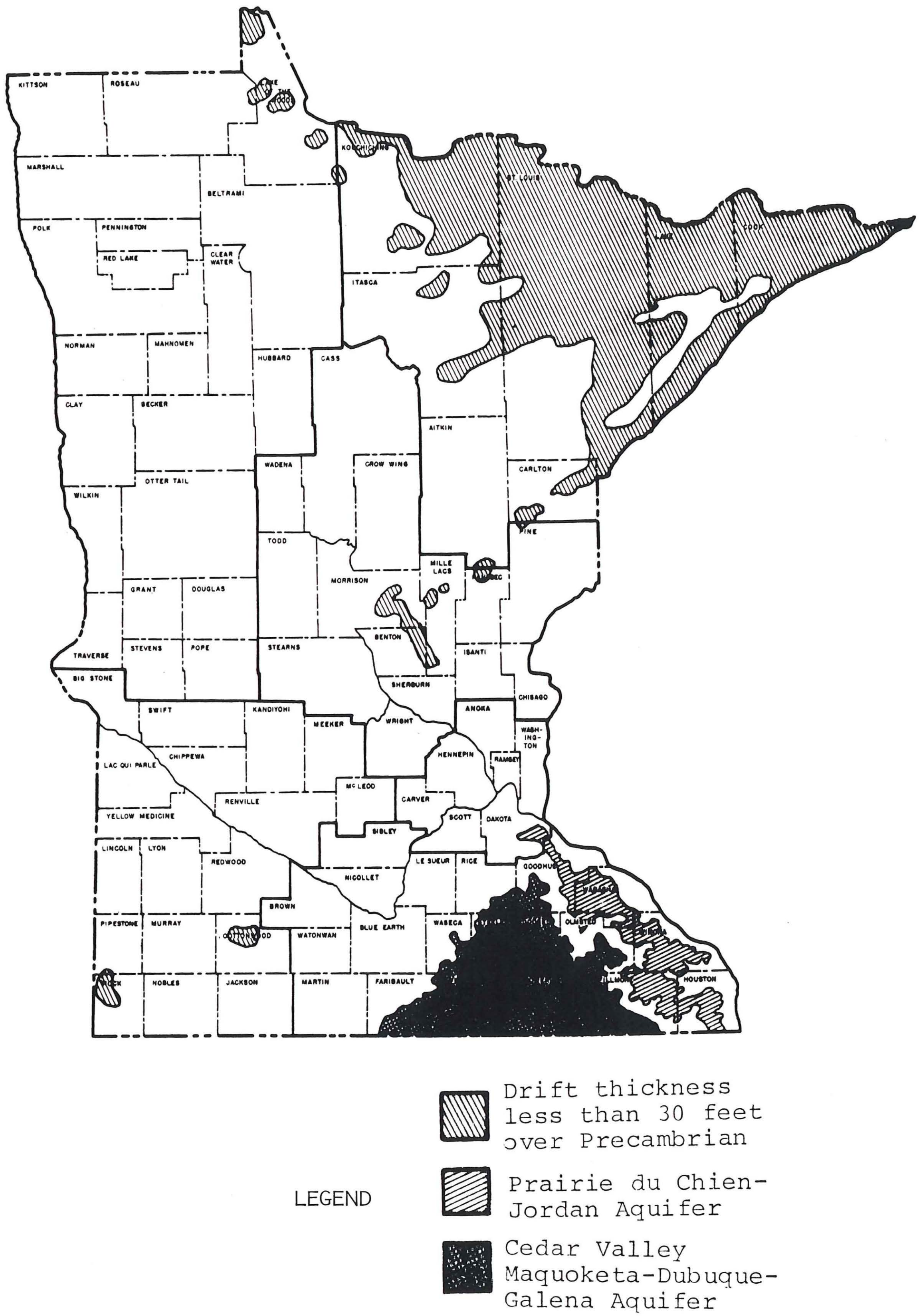


FIGURE 23. GROUND WATER POLLUTION AT PERMITTED, MIXED MUNICIPAL LANDFILLS.

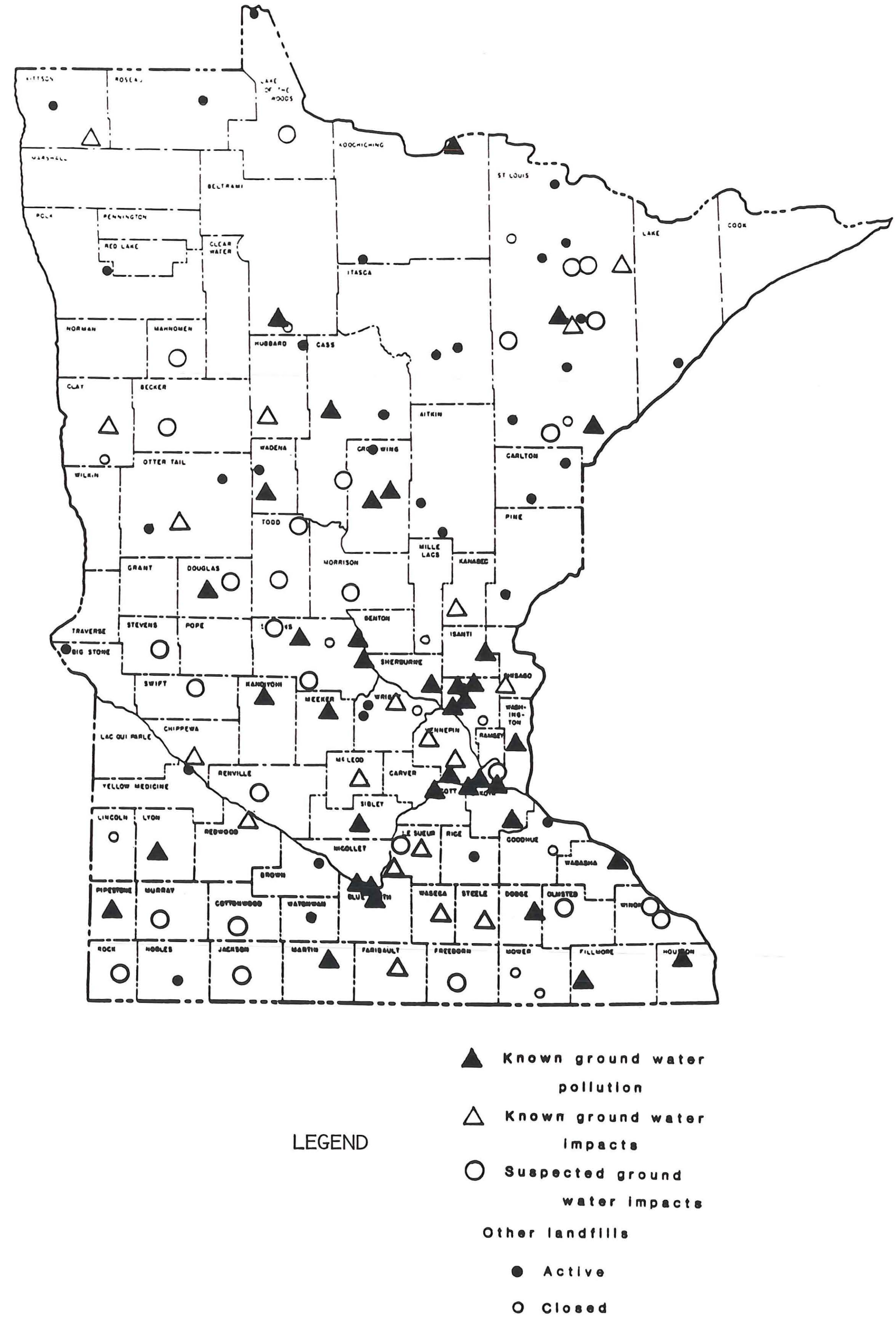
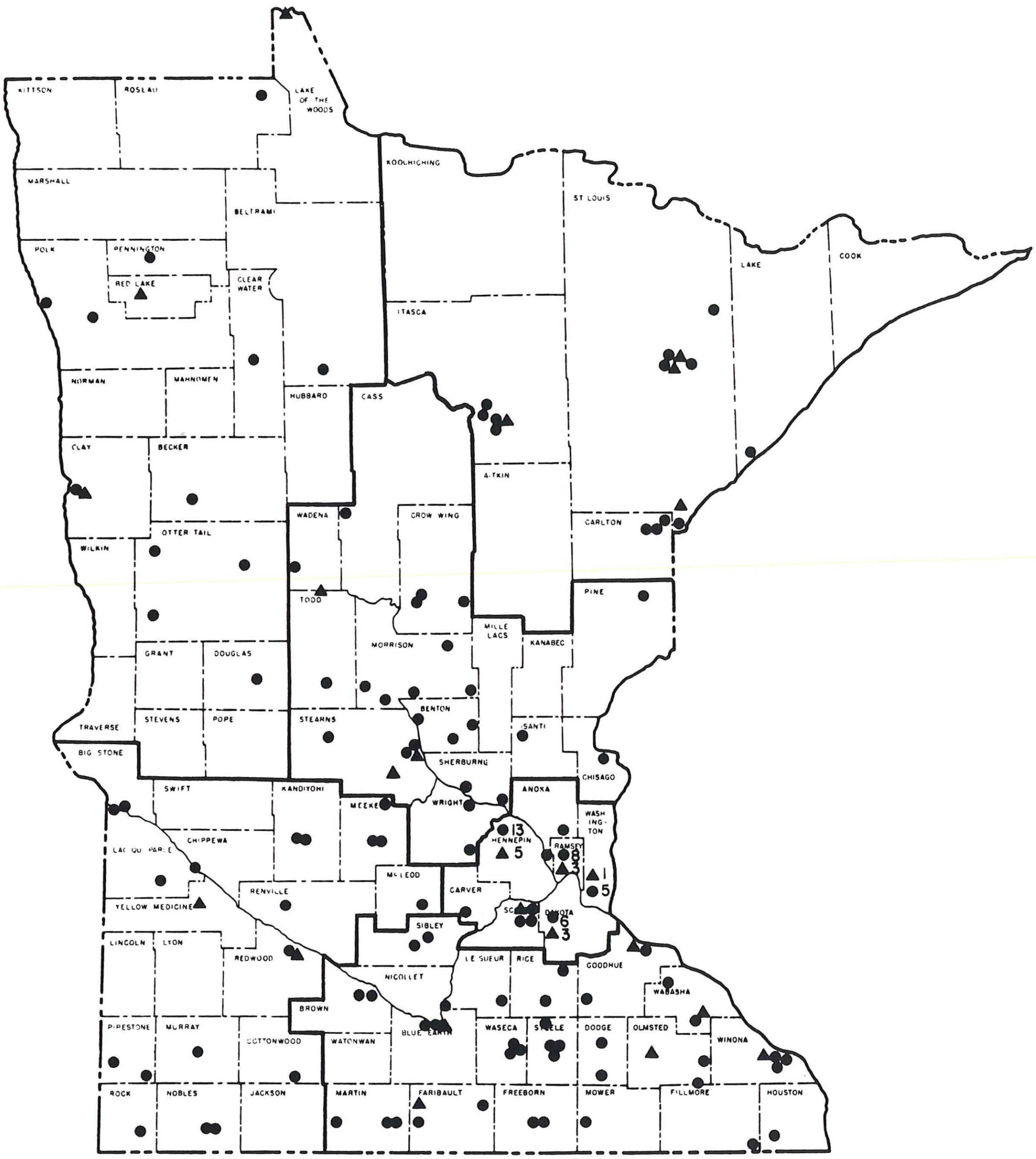


FIGURE 24. LOCATION OF INDUSTRIAL SURFACE IMPOUNDMENTS.



LEGEND ● Active Impoundments

▲ Abandoned Impoundments

FIGURE 25. HAZARDOUS WASTE GENERATORS.

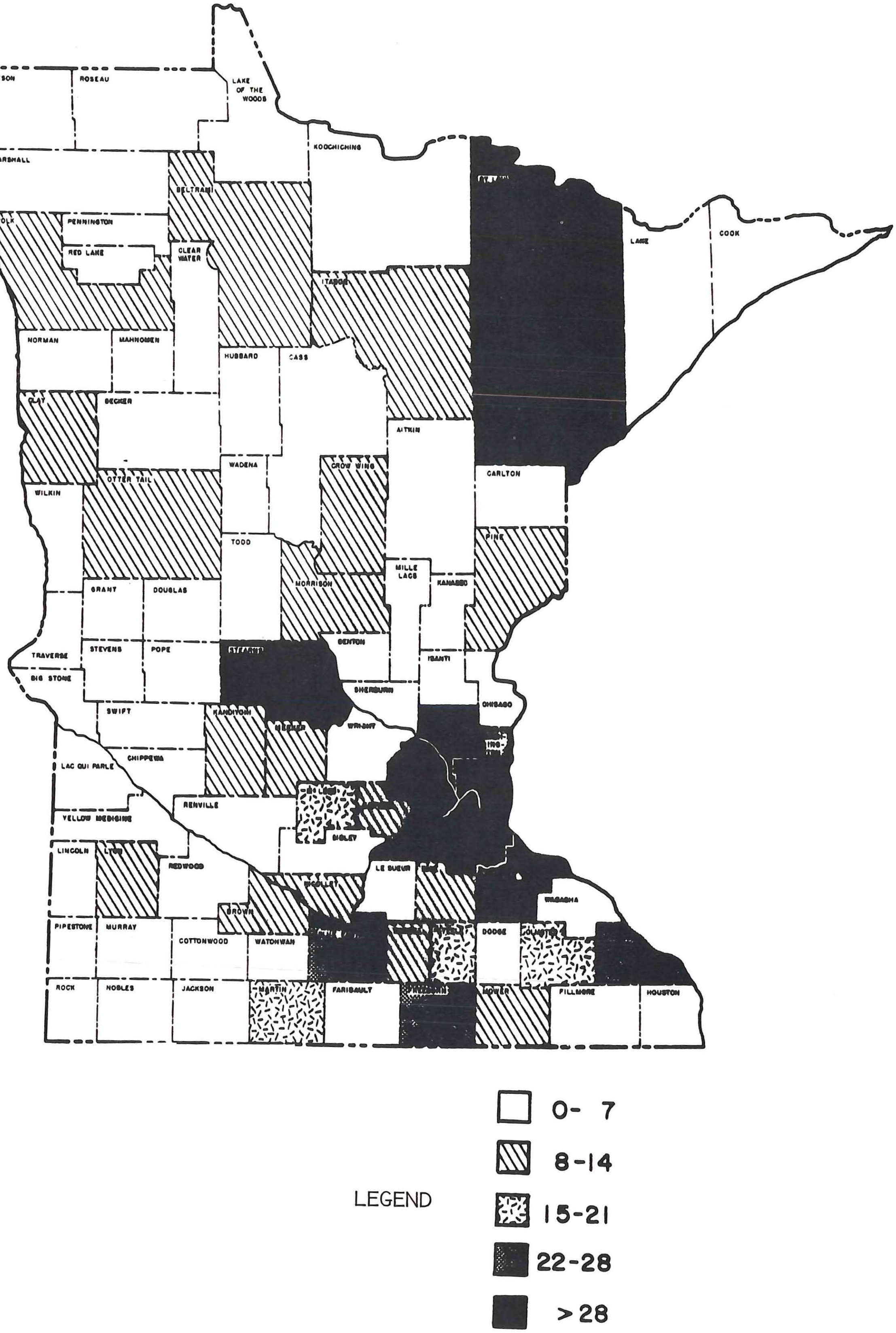
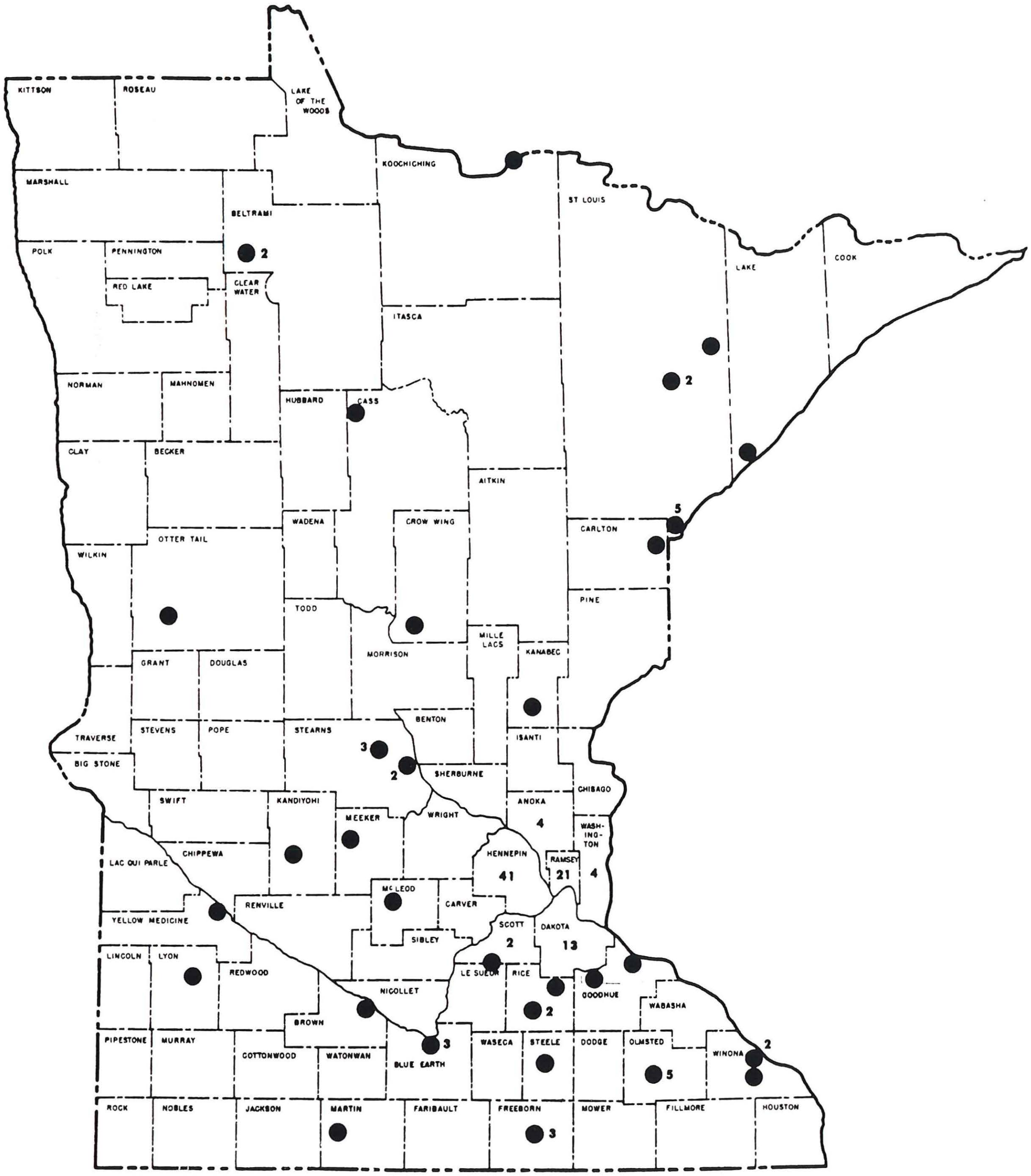
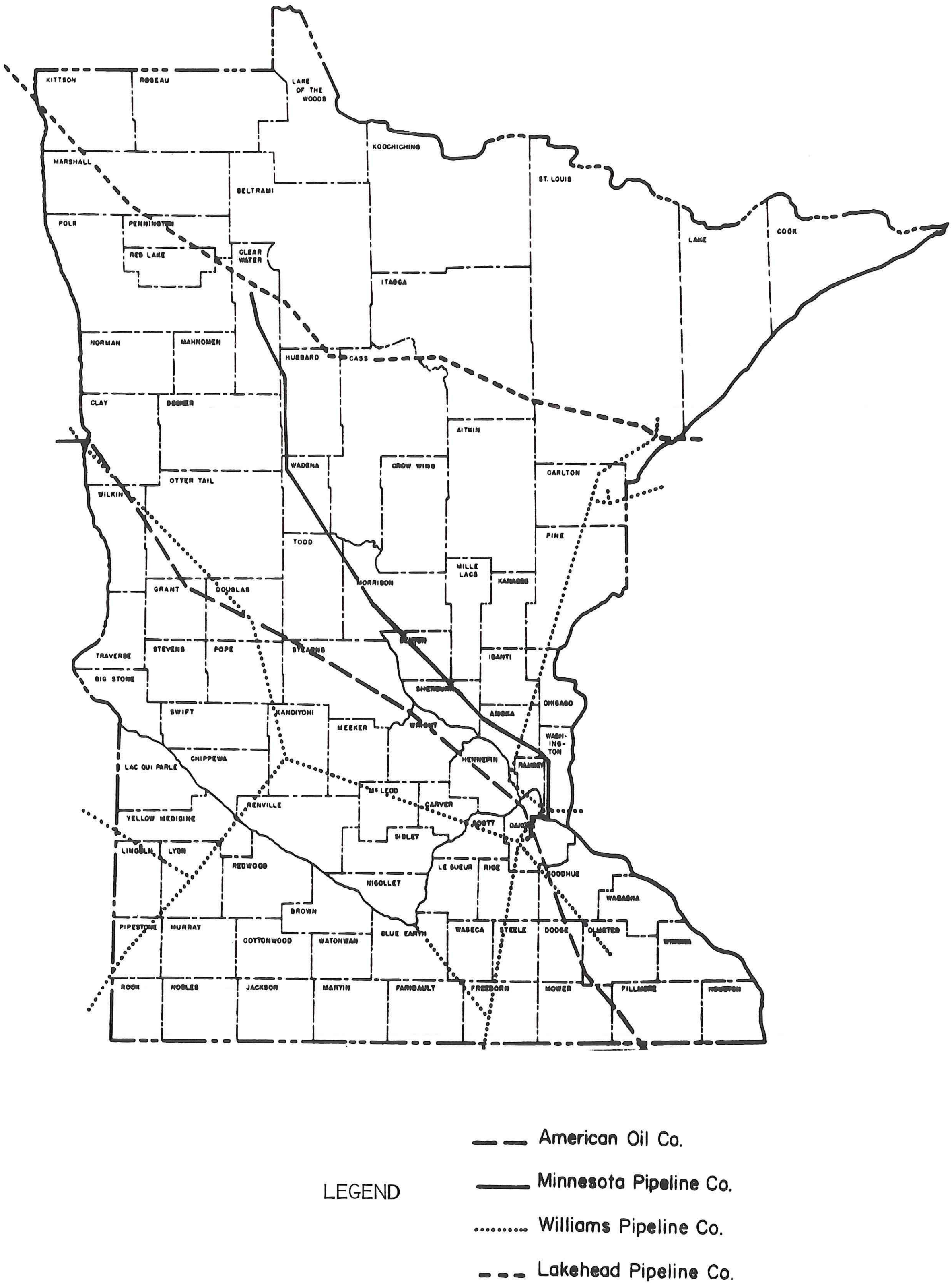


FIGURE 26. DISTRIBUTION OF HAZARDOUS WASTE TREATMENT, STORAGE AND DISPOSAL FACILITIES.



NOTE: Dots represent general locations of facilities. A dot and number indicates multiple facilities within a general location. Numerals without location dots indicate the number of facilities within a designated county.

FIGURE 27. MAJOR PIPELINE ROUTES.



9. PROGRAM DESCRIPTIONS

Minnesota is committed to the restoration and preservation of its valuable surface and underground water resources. The multi-faceted programs administered by the MPCA reflect the Agency's commitment to strive for full attainment of the national goals for clean water. Water pollution control encompasses program elements ranging from the primary identification and assessment of water quality problems, to the administration of constructive processes designed to alleviate problems, to the continual vigilance of enforcing pollution abatement requirements. The sources of pollution threatening our state's surface and ground water resources range from the well-defined, or point sources, to the more diffuse nonpoint sources.

A. Surface Waters

Programs that address the quality of surface waters of the state are administered by the MPCA's Division of Water Quality. A wide spectrum of pollutant sources become potential threats to Minnesota's lakes and streams. Domestic and industrial wastewater discharges, polluted runoff from agricultural and urbanized areas, and accidental spills and leakage of contaminants can degrade the quality of water, which in turn limits its beneficial uses.

A description of water quality programs administered by the Division of Water Quality is contained in the MPCA's "1984 Biennial Report to the Legislature" available from the Agency's Public Information Office. Annual Water Quality Program Plans, available from the Division, contain a detailed breakdown of functional responsibilities for program administration. The Water Quality Division is organized into five Sections, each having unique program responsibilities but integrated in overall objectives.

The Monitoring and Analysis Section develops water quality standards, performs routine and intensive water quality monitoring, and analyzes environmental data in order to recommend appropriate actions to curb pollution. Routine monthly sampling at 72 fixed monitoring stations during 1984 and 71 stations during 1985 continued the ongoing program to monitor general water quality and its trends over time. Lake monitoring is augmented by volunteer citizen participation in a program to measure water transparency in over 150 lakes each week during the summer season. Each year, the Section conducts numerous intensive surveys and specialized data acquisitions to define the more localized water quality problems. The Section also conducts bioassay studies that measure effluent toxicity on test organisms and collects fish for tissue analysis. All monitoring programs provide valuable data on occurrence and fate of both conventional and toxic materials in the aquatic environment.

The Permits Section reviews and issues permits to regulate activities having potentially adverse water quality impacts. About 1,500 active permits specify mandatory conditions for operating waste disposal systems and for discharging wastes to waters of the state. Permits cover municipal and industrial waste treatment facilities, dredge and fill operations, and certain agriculture operations. The Section also administers a pretreatment program that addresses the control of industrial wastes discharged to municipal collection and treatment systems.

Tracking a discharger's compliance with effluent restrictions and other special conditions contained in permits issued by the MPCA is the responsibility of the Enforcement Section. The Section reviews self-monitoring reports from dischargers, conducts annual compliance surveys, and investigates water quality related complaints. Over 90% of the major municipal and industrial dischargers are currently in compliance with their permit conditions. In cases of noncompliance, the Section initiates enforcement mechanisms to resolve the noncompliance situations. The Section also operates an Emergency Response Team which reacts to spills of petroleum products and hazardous materials on a round-the-clock basis.

The Technical Review Section provides municipal and industrial waste treatment facilities plan review and construction management assistance. Much of the water quality improvement demonstrated in recent years is attributable to construction of new or improved wastewater treatment facilities. However, many treatment needs remain. In the "1984 Needs Survey Report to Congress", Minnesota estimated that the capital investment (1984 dollars) required to build all publicly owned wastewater treatment facilities needed for compliance with the Clean Water Act would be about $1.274 billion. Meeting the treatment requirements of an expanded population by the year 2000 would require an additional capital expenditure of about $348 million. To help ensure efficient treatment plant operation following construction, the Section provides review of facilities operation and maintenance plans. In addition, comprehensive programs for operator training and certification are conducted by the Section.

The Grants Section manages both federal and state construction grants programs. These programs ensure that the highest priority wastewater treatment facilities which achieve the maximum environmental benefit are constructed with the limited public funds available. In response to a reduction in the federal grants available for construction of treatment facilities from 75% to 55% of cost in FY 1985, the State Legislature created an independent state grants program in the 1984 Session with an FY 1985 appropriation of $12 million. In addition to grant programs for treatment facilities construction, the Section administers a program to abate combined sewer overflow (CSO) problems in the Minneapolis-St. Paul Metropolitan Area and a program to secure funding and oversee qualified lake restoration projects.

B. Ground Waters

The protection of ground water quality is addressed in programs administered by both the Division of Water Quality and the Division of Solid and Hazardous Waste. Regulating the land application of wastewater, regulating the construction and operation of animal feedlots, and administering a nonpoint source control program are activities carried out by the Division of Water Quality that are designed to protect both surface and ground water quality.

The MPCA's Division of Solid and Hazardous Waste administers regulatory programs for solid and hazardous waste disposal activities. Improper handling, storage, and disposal of these wastes in the past have resulted in ground water contamination problems. The incidents of contamination have heightened public awareness of the need to protect our ground water -- a valuable and highly vulnerable resource.

The Division is comprised of four Sections. The Site Response Section provides rapid and effective response to critical ground water contamination incidents. The Solid Waste Regulatory Compliance Section deals with the disposal of non-hazardous solid waste materials. The Hazardous Waste Regulatory Compliance Section manages the Agency's RCRA programs and oversees compliance with State hazardous waste rules. Both of the Regulatory Compliance Sections provide consistent regulatory compliance activities in facility review and enforcement to the Division. The prevention of future contamination problems through comprehensive planning is a function of the Program Development Section. A detailed narrative of the Division's programs is contained in the MPCA's "1984 Biennial Report to the Legislature" available from the Agency's Public Information Office.

The MPCA routinely samples a network of wells and springs to monitor water quality of principal aquifers within the state. The objective of long term monitoring is to detect significant changes in the aquifers and to relate these changes to man's activities which impact ground water. The MPCA has identified 120 sites on its 1986 Permanent List of Priorities (Table 11) where ground water and/or public health were at risk due to the release or threatened release of a hazardous substance. For ground water contamination incidents, where public health risks are of immediate concern, both federal and state Superfund legislation provides the means for quick response. The Minnesota Environmental Response and Liability Act (ERLA) provided a $5 million fund to finance cleanups of hazardous waste sites.

C. Nonpoint Source Pollution

Nonpoint source pollution (NPS) contributes to the degradation of all waters of the state and is an impediment to the attainment of a fishable and swimmable goal in many rivers and streams. NPS pollution threatens the quality of lakes and streams and contaminates ground water. These resources provide drinking water and/or recreational opportunities for millions of people each year and represents an important sector of the Minnesota economy. Tourism brings over four billion dollars into the state annually. Properties near water resources are valued in the billions of dollars.

Many human activities allow polluting materials to escape to waters. Rain and snow melt runoff carry nutrients, sediment, bacteria, toxic chemicals, and other polluting materials from agricultural and urban areas into surface and ground water. Over the last three years the MPCA has established a solid foundation to build a NPS pollution control program.

The MPCA has initiated a public information project, two watershed management demonstration projects, effective interagency coordination and an aggressive program development strategy for NPS pollution control. This effort has developed a philosophy that a NPS pollution control program must be a water quality program implemented through a coordinated partnership on the local, state, and federal levels.

The state role in the NPS pollution control partnership is program management and technical assistance. Water quality protection requires strong technical leadership in evaluation of water quality problems, identification of water quality objectives, design of best management practices, program implementation, and overall program coordination. NPS pollution control also requires close coordination and cooperation with existing soil conservation programs, although it must be recognized that the goals of soil conservation programs are not the same as water quality goals. The MPCA will continue to provide management and technical assistance to control all aspects of NPS pollution.

10. RECOMMENDATIONS

The state and federal partnership in environmental protection has made significant strides toward achieving water quality goals defined in the Clean Water Act. Most of the conspicuous sources of pollution have either been eliminated or brought under control, resulting in marked improvements in water quality. However, problems remain. The wastewater treatment needs of the current population have not been met, many nonpoint sources of pollution are uncontrolled, lakes are threatened by acid rain and accelerated eutrophication, and the emerging awareness of toxics related contamination of surface and ground water raises additional aquatic and human health concerns. Such problems must be dealt with in order to fully achieve the goal of fishable and swimmable waters. Once achieved, the desired level of water quality must then be maintained by a continual commitment of resources to offset future impacts from growing populations and increased development.

From Minnesota's perspective, an effective water quality management program integrates a number of essential elements. Adequate support at the federal, state, and local level is needed to ensure the success of program elements that:

A. Water Quality Monitoring

- evaluate current conditions, treatment effectiveness, and long-term trends in water quality.
- ensure compliance with NPDES permits.
- detect new or emerging problems such as toxics-related contamination.
- monitor previously unassessed waters for support of use designations.
- develop water quality standards supporting use designations.
- support waste load allocation and nonpoint source control programs.
- maintain data storage.

B. Point Source Control

- provide increased federal and state assistance for construction of municipal wastewater treatment facilities.
- regulate dischargers through enforceable permits.
- ensure timely and appropriate enforcement response to permit noncompliance.
- provide training and assistance to wastewater treatment facilities operators.
- eliminate detrimental impacts on water quality from combined sewer overflows.

C. Nonpoint Source Control

- support legislation to retire highly erodible lands from production.
- continue program development, including inter-agency project coordination.
- provide cost-sharing grants to installers of best management practices that directly benefit water quality.
- provide research and demonstration project grants to determine best methods of pollution abatement and program implementation.
- support research and monitoring of water quality impacts of acid rain.

D. Ground Water Quality

- provide additional federal and state support for locating and cleaning up hazardous waste disposal sites having high potential for ground (and surface) water contamination.
- support programs which regulate and enforce rules for storage, transport, and disposal of hazardous wastes.
- monitor ground water reserves to detect long-term trends in quality and to identify geographic areas having aquifers highly vulnerable to contamination.

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Fish Mercury in Northeastern Minnesota Lakes. April, 1985.

Ground Water in Minnesota: A User's Guide. Joint Publication of the MPCA and the Minnesota State Planning Agency. January, 1984.

Ground Water Pollution at Permitted Mixed Municipal Landfills. February, 1986.

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Report on the Transparency of Minnesota Lakes; Citizen Lake Monitoring Program, 1985. April, 1986.

Trophic Status of Minnesota Lakes, 1985. November, 1985.

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APPENDIX A. USES INDICATED BY FISH TISSUE INFORMATION

RIVERS

Supporting:

	ID	LOCATION	COUNTY	POLLUTANT	REACH NUMBER	MILES
1	BV-4	BEAVER RIVER BY BEAVER BAY	LAKE		04010102009	20.0
2	CD-31	CEDAR RIVER 1 MI W OF WALTHAM	MOWER		07080201023	21.6
3	CRS-49	S FK CROW R AT CSAH-2 5 MI N OF GLENCOE	MCLEOD		07010205004	10.2
4	GB-11.3	GARVIN BROOK AT STOCKTON	WINONA		07040003023	17.1
5	LQP-18	MAIN BR LAC QUI PARLE R AT CR-56 S OF DAWSON	LAC QUI PARLE		07020003012	16.6
6	MI-252	MINNESOTA R.,USH-212 AT GRANITE FALLS	YELLOW MEDICINE		07020004017	8.7
7	PT-62	POMME DE TERRE RIVER 3 MI W. OF HOFFMAN	GRANT		07020002002	36.9
8	RO-84.4	ROCK RIVER 1 MILE EAST OF HOLLAND	PIPESTONE		10170204035	3.6
9	ROE-1.5	ROCK R.-EAST BRANCH 2.5 MI W. OF WOODSTOCK	PIPESTONE		10170204035	16.3
10	SL-38	ST. LOUIS R. USH-2 BY BROOKSTON	ST LOUIS		04010201013	9.5
11	ST-15	STRAIGHT R AT CR-13 1 MI N OF MEDFORD	STEELE		07040002019	5.6
12	ST-40	STRAIGHT RIVER AT CR BR 1 MI N OF HOPE	STEELE		07040002023	10.5
13	UM-1137	MISSISSIPPI RIVER AT JACOBSON	AITKIN		07010103012	21.7
14	UM-1178	MISSISSIPPI R. CSAH-62 COHASSET	ITASCA		07010103031	9.0
15	UM-1365	MISSISSIPPI R. BY LAKE ITASCA	CLEARWATER		07010103033	34.5
16	WWM-4	MID BR WHITEWATER R NEAR MN-74 2.5 MI SW OF ELBA	WINONA		07040003021	10.7
17	WWN-3.5	N BR WHITEWATER R 2 MI W OF ELBA	WINONA		07040003020	26.3
18	WWR-23	S BR WHITEWATER R CR-20 3.5 MI SW OF ALTURA	WINONA		07040003022	12.2 *
				Total Supporting		291.0 miles

* Reach segment divided equally among each station within a segment.

Partially Supporting:

	ID	LOCATION	COUNTY	POLLUTANT	REACH NUMBER	MILES
1	BE-11	BLUE EARTH RIVER BY RAPIDAN DAM	BLUE EARTH	PCB	07020009002	12.1
2	CA-38	CANNON RIVER NE OF NORTHFIELD	DAKOTA	PCB	07040002008	5.8 *
3	CA-41.5	CANNON RIVER SE OF NORTHFIELD	RICE	PCB	07040002008	5.8 *
4	CD-0	CEDAR RIVER 2.5 MI. W. OF LYLE	MOWER	PCB	07080201015	4.0
5	CD-10	CEDAR RIVER 3 MI S. OF AUSTIN	MOWER	PCB	07080201023	8.4
6	LQPW-0.7	W BR LAC QUI PARLE R BELOW DAM AT DAWSON	LAC QUI PARLE	PCB	07020003003	5.7
7	LQPW-8.8	W BR LAC QUI PARLE R AT US-75 4 MI S OF MADISON	LAC QUI PARLE	HG	07020003005	11.8
8	LSR-1	LESEUER R MN-66 1.5 MI NW OF RAPIDAN	BLUE EARTH	PCB	07020011001	5.2
9	MI-25	MINNESOTA R. USH-169 AT SHAKOPEE	SCOTT	PCB	07020012202	8.8
10	MI-155.5	MINNESOTA R.,CSAH-35 BY NEW ULM	NICOLLET	PCB	07020007011	15.7
11	MI-196	MINNESOTA R. USH-71 AT MORTON	RENVILLE	PCB	07020007021	5.1
12	MI-39	MINNESOTA R. CSAH-9 N OF JORDAN	SCOTT	PCB,HG	07020012004	3.7
13	MI-88	MINNESOTA R. SH-22 AT ST. PETER	NICOLLET	PCB	07020007002	5.7
14	RA-12	RAINY RIVER BRIDGE AT BAUDETTE	LAKE OF WOODS	PCB	09030008005	4.7
15	RE-157	RED R OF THE N ON MN-171 AT ST. VINCENT	KITTSON	PCB	09020311003	16.4
16	RE-274	RED RIVER SH-1 BRIDGE AT OSLO	MARSHALL	PCB	09020306004	35.7
17	RE-300	RED RIVER AT GRAND FORKS	POLK	PCB	09020301004	6.3
18	RE-373	RED RIVER SH-200 BY HALSTAD	NORMAN	PCB,HG	09020107002	14.4
19	RE-452	RED RIVER MAIN & FIRST AT FARGO	CLAY	PCB,HG	09020104002	23.8
20	RE-547	RED R ABOVE DAM AT BRECKENRIDGE	WILKIN	PCB,HG	09020104005	18.3
21	RL-0.2	RED LAKE RIVER-EAST GRAND FORKS	POLK	PCB	09020303001	1.5
22	RUM-0.6	RUM RIVER AT ANOKA	ANOKA	PCB,HG	07010207001	7.9
23	SA-0	SAUK RIVER CSAH-1 ST. CLOUD	STEARNS	PCB	07010202001	6.6 *
24	SA-21.9	SAUK RIVER AT CSAH-58 IN COLD SPRING	STEARNS	PCB	07010202002	33.0
25	SA-78.1	SAUK RIVER AT CSAH-13 IN MELROSE	STEARNS	PCB,HG	07010202006	15.4
26	SL-21.9	ST.LOUIS R .5 MI E OF SCANLON AT SCANLON DAM	CARLTON	PCB	04010201011	12.9
27	SLB-1	ST LOUIS BAY AT DULUTH-SUPERIOR	ST LOUIS	PCB,HG	04010201003	3.0 *
28	SLB-2.8	ST. LOUIS BAY 0.5 MILES E. OF DULUTH	ST LOUIS	PCB	04010201003	3.0 *
29	SLB-5.7	ST LOUIS BAY ON ST LOUIS R .5 MI S OF DULUTH	ST LOUIS	PCB	04010201004	9.4

Partially Supporting (cont.)

	ID	LOCATION	COUNTY	POLLUTANT	REACH NUMBER	MILES
30	SLB-8.6	ST. LOUIS BAY ON ST. LOUIS R 2 MI NE OF GARY	ST LOUIS	PCB	04010201006	5.4
31	UM-714	MISSISSIPPI R. BY LA MOILLE	WINONA	PCB	07040006009	8.2
32	UM-733	MISSISSIPPI R AT FOUNTAIN CITY, WI	WINONA	PCB	07040003002	7.5 *
33	UM-797	MISSISSIPPI R. AT RED WING	GOODHUE	PCB	07040001008	4.8 *
34	UM-859	MISSISSIPPI R. AT FRIDLEY	HENNEPIN	PCB	07010206002	4.7 *
35	UM-872	MISSISSIPPI R. USH-169 AT ANOKA	ANOKA	PCB	07010206006	8.3
36	UM-895	MISSISSIPPI RIVER AT MONTICELLO	SHERBURNE	PCB	07010203009	29.8
37	UM-930	MISSISSIPPI R. AT SAUK RAPIDS	BENTON	PCB	07010203010	15.7
38	WWR-26	WHITEWATER RIVER N.W. OF UTICA	WINONA	PCB	07040003022	12.2 *
39	ZUM-34.3	ZUMBRO RIVER ON CSAH-2 AT MILLVILLE	WABASHA	PCB	07040004002	21.1
40	ZUM-57.3	S BR ZUMBRO RIVER BELOW ZUMBRO LAKE DAM	WABASHA	PCB	07040004008	4.0
				Total Partially Supporting		431.8 miles

* Reach segment divided equally among each station within a segment.

Not Supporting:

	ID	LOCATION	COUNTY	POLLUTANT	REACH NUMBER	MILES
1	AL-0	ALLOUEZ BAY 1 MI NE OF ALLOUEZ WI	ST LOUIS	PCB	04010301012	0.5
2	MI-3.5	MINNESOTA R. AT FORT SNELLING PARK	HENNEPIN	PCB	07020012102	22.0
3	MI-64	MINNESOTA R. SH-19 AT HENDERSON	SIBLEY	PCB	07020012013	9.0
4	MI-94	MINNESOTA R. 3.5 MILES S.E. OF NORTH STAR	NICOLLET	PCB	07020007003	14.9
5	RA-83	RAINY R. AT INTERNATIONAL FALLS	KOOCHICHING	DIOXINS	09030004013	10.3
6	SA-3.5	SAUK R 0.5 MI NW OF ST CLOUD	STEARNS	PCB	07010202001	6.6 *
7	SC-11	ST CROIX R AT AFTON	WASHINGTON	PCB	07030005003	6.0 *
8	SC-17	ST CROIX R NEAR HUDSON, WI	WASHINGTON	PCB	07030005003	6.0 *
9	SC-23	ST CROIX R SH-212 AT STILLWATER	WASHINGTON	PCB	07030005007	13.5
10	SC-31	ST CROIX R AT MARINE-ON-ST CROIX	WASHINGTON	PCB	07030005018	36.7
11	UM-698	MISSISSIPPI R. AT LA CROSSE, WI	HOUSTON	PCB	07040006001	4.3
12	UM-707	MISSISSIPPI R. AT DAKOTA	WINONA	PCB	07040006008	11.7
13	UM-728	MISSISSIPPI R. BY WINONA	WINONA	PCB	07040003002	7.5 *
14	UM-744	MISSISSIPPI R 1 MI SW OF BUFFALO, WI	WABASHA	PCB	07040003008	7.1
15	UM-752	MISSISSIPPI R. BY KELLOGG	WABASHA	PCB	07040003009	3.7
16	UM-760	MISSISSIPPI R. AT WABASHA	WABASHA	PCB	07040003017	10.4
17	UM-767	MISSISSIPPI R 1 MI S OF PEPIN, WI	WABASHA	PCB	07040003017	8.0 *
18	UM-772	MISSISSIPPI R. AT LAKE CITY	WABASHA	PCB	07040003017	8.0 *
19	UM-785	MISSISSIPPI R. HEAD OF LAKE PEPIN	GOODHUE	PCB	07040001004	11.8
20	UM-790.5	MISSISSIPPI R. AT RED WING	WINONA	PCB	07040001005	1.1
21	UM-802	MISSISSIPPI R. 1.5 MI NE OF DIAMOND BLUFF, WI	GOODHUE	PCB	07040001008	4.8 *
22	UM-811.5	MISSISSIPPI R. BY CONFLUENCE WITH ST. CROIX R.	DAKOTA	PCB	07040001011	3.2
23	UM-815	MISSISSIPPI R. AT HASTINGS	DAKOTA	PCB	07010206001	3.8 *
24	UM-817	MISSISSIPPI RIVER 2.5 MI NW OF HASTINGS	DAKOTA	PCB	07010206001	3.8 *
25	UM-821	MISSISSIPPI R.-SPRING LAKE N. E. OF SEDIL	DAKOTA	PCB	07010206001	3.8 *
26	UM-826	MISS R. AT GREY CLOUD ISLAND	WASHINGTON	PCB	07010206001	3.8 *
27	UM-830	MISSISSIPPI R. S OF ST. PAUL	WASHINGTON	PCB	07010206001	3.8 *
28	UM-840	MISS RIVER WABASHA ST-ST. PAUL	RAMSEY	PCB	07010206001	8.8
29	UM-853.5	MISSISSIPPI R. AT MINNEAPOLIS	HENNEPIN	PCB	07010206002	4.7 *
30	UM-866	MISSISSIPPI RIVER BELOW COON RAPIDS DAM	ANOKA	PCB	07010206004	6.1
				Total Not Supported		245.7 miles
				Total Assessed		968.5 miles

* Reach segment divided equally among each station within a segment.

LAKES

Supporting:

	LAKE ID	NAME	LOCATION	COUNTY	POLLUTANT	ACRES
1	01-0033	LAKE: MINNEWAWA	4 MI NE OF MCGREGOR	AITKIN		1016
2	01-0159	LAKE: FARM ISLAND	7 MI SW OF AITKIN	AITKIN		831
3	02-0042	LAKE: COON	AT COON LAKE BEACH	ANOKA		593
4	03-0359	LAKE: SALLIE	AT SHOREHAM	BECKER		512
5	06-0152	LAKE: BIG STONE	AT ORTONVILLE	BIG STONE		5103
6	09-0016	LAKE: SAND	3 MI NW OF DUESLER	CARLTON		49
7	11-0055	LAKE: PAVELGRIT	3 MI W OF OUTING	CASS		8
8	11-0147	LAKE: WINNIBIGOSHISH	AT BENA	CASS		21620
9	11-0203-01	LAKE: LEECH	AT WALKER	CASS		45133
10	11-0305	LAKE: GULL	AT NISSWA	CASS		3861
11	13-0033	LAKE: LITTLE	2 MI NE OF LINDSTROM	CHISAGO		64
12	16-0019	LAKE: TOM	17 MI NE OF GR MARAIS	COOK		233
13	16-0077	LAKE: GREENWOOD	19 MI NE OF GR MARAIS	COOK		721
14	16-0104	LAKE: MUSQUASH	11 MI N OF GR MARAIS	COOK		57
15	16-0143	LAKE: DEVIL TRACK	3 MI N OF GRND MRAIS	COOK		758
16	16-0156	LAKE: TWO ISLAND	7 MI NW OF GRND MRAIS	COOK		321
17	16-0182	LAKE: BALL CLUB	10 MI NW OF GRND MRAIS	COOK		76
18	16-0202	LAKE: SQUINT	19.5 MI N GRAND MARAIS	COOK		7
19	16-0220	LAKE: MORGAN	18 MI N OF GR MARAIS	COOK		33
20	16-0235	LAKE: MCDONALD	12 MI NW OF GR MARAIS	COOK		40
21	16-0239	LAKE: POPLAR	20 MI NW OF GRND MRAIS	COOK		305
22	16-0252	LAKE: PIKE	9 MI W OF GRND MRAIS	COOK		327
23	16-0348	LAKE: BRULE	19 MI N OF LUTSEN	COOK		1684
24	16-0398	LAKE: WENCH	24 MI NW OF GR MARAIS	COOK		9
25	16-0406	LAKE: HOMER	17 MI N OF LUTSEN	COOK		208
26	16-0454	LAKE: CRESCENT	16 MI N OF TOFTE	COOK		338
27	16-0571	LAKE: FROST	26 MI NE OF FOREST CTR	COOK		95
28	16-0606	LAKE: ROUND	32 MI NW OF GR. MARAIS	COOK		58
29	16-0646	LAKE: FINGER	8 MI NW OF TOFTE	COOK		78
30	16-0759	LAKE: ALPINE	28 MI NE OF FOREST CTR	COOK		337
31	16-0793	LAKE: RED ROCK	29 MI NE OF FOREST CTR	COOK		142
32	16-0805-01	LAKE: ELBOW (MAIN BAY)	10 MI NW OF TOFTE	COOK		208
33	16-0806	LAKE: FREAR	12 MI NW OF TOFTE	COOK		112
34	18-0207	LAKE: SQUAW	2.5 MI SW OF OUTING	CROW WING		33
35	18-0310	LAKE: WHITEFISH	AT CROSS LAKE	CROW WING		2982
36	19-0003	LAKE: REBECCA	IN HASTINGS	DAKOTA		16
37	27-0019	LAKE: NOKOMIS	IN MINNEAPOLIS	HENNEPIN		82
38	27-0031	LAKE: CALHOUN	IN MINNEAPOLIS	HENNEPIN		170
39	27-0104	LAKE: MEDICINE	IN MEDICINE LAKE	HENNEPIN		383
40	27-0192	LAKE: REBECCA	4 MI NW OF MAPLE PLAIN	HENNEPIN		94
41	31-0106	LAKE: OX HIDE	.5 MI NW OF PENGILLY	ITASCA		52
42	31-0171	LAKE: CRUM	14 MI E OF EFFIE	ITASCA		8
43	31-0175	LAKE: LONG	6 MI W OF TOGO	ITASCA		34
44	31-0316	LAKE: BASS	11 MI E OF EFFIE	ITASCA		50
45	31-0532	LAKE: POKEGAMA	1 MI SW OF GRAN RAPIDS	ITASCA		2638
46	31-0645	LAKE: KREMER	9 MI SE OF MARCELL	ITASCA		25
47	31-0719	LAKE: DEER	9 MI NW OF GRD RAPIDS	ITASCA		1588
48	31-0857	LAKE: CUT FOOT SIOUX (WH	LAKE) 9 MI SE SQUAW LK	ITASCA		1120
49	33-0003	LAKE: FIVE	13 MI W OF SANDSTONE	KANABEC		17
50	38-0047	LAKE: WILSON	13 MI E OF ISABELLA	LAKE		251
51	38-0080	LAKE: KAWISHIWI	10 MI E OF FOREST CTR	LAKE		161
52	38-0406	LAKE: LAX	4 MI NW OF SILVER BAY	LAKE		110
53	38-0605	LAKE: ONE	10 MI NW OF FOREST CTR	LAKE		354
54	38-0673	LAKE: HIGHLIFE	13 MI NW OF ISABELLA	LAKE		8
55	40-0014	LAKE: SABRE	5 MI NW OF WATERVILLE	LE SUEUR		102
56	40-0031	LAKE: TETONKA	AT WATERVILLE	LE SUEUR		489
57	40-0032	LAKE: GORMAN	4 MI SE OF LE CENTER	LE SUEUR		2018
58	46-0031	LAKE: HALL	2 MI SW OF FAIRMONT	MARTIN		223
59	48-0002	LAKE: MILLE LACS	AT GARRISON	MILLE LACS		53627
60	51-0046	LAKE: SHETEK	3 MI E OF MASON	MURRAY		1356

Supporting (cont.)

	LAKE ID	NAME		LOCATION	COUNTY	POLLUTANT	ACRES
61	56-0242	LAKE:	OTTER TAIL	AT OTTERTAIL	OTTER TAIL		5970
62	61-0130	LAKE:	MINNEWASKA	AT GLENWOOD	POPE		2877
63	66-0008	LAKE:	CANNON	2.5 MI W OF FARIBAULT	RICE		643
64	69-0041	LAKE:	BASSETT	6 MI N OF BRIMSON	ST LOUIS		183
65	69-0071	LAKE:	HIGH	5 MI N OF ELY	ST LOUIS		112
66	69-0218	LAKE:	EAGLES NEST NO. 4	8 MI E OF SOUDAN	ST LOUIS		81
67	69-0481	LAKE:	FAT	32 MI NW OF ELY	ST LOUIS		41
68	69-0491	LAKE:	FISH	6.5 MI NW OF DULUTH	ST LOUIS		1242
69	69-0749	LAKE:	MYRTLE	7 MI E OF ORR	ST LOUIS		359
70	69-0842	LAKE:	BLACKDUCK	10 MI N OF ORR	ST LOUIS		511
71	69-0845	LAKE:	KABETOGAMA	AT KABETOGAMA	ST LOUIS		8054
72	69-0933	LAKE:	SIDE	8 MI SE OF TOGO	ST LOUIS		150
73	70-0026	LAKE:	LOWER PRIOR	IN PRIOR LAKE	SCOTT		334
74	78-0025	LAKE:	TRAVERSE	1 MI NW BROWNS VALLEY	TRAVERSE		4665
75	81-0055	LAKE:	REEDS	7 MI NW OF WASECA	WASECA		75
76	81-0095	LAKE:	ELYSIAN	AT ELYSIAN	WASECA		926
77	82-0049	LAKE:	BIG CARNELIAN	4 MI S OF MARIN-ST-CR	WASHINGTON		179
78	82-0052	LAKE:	BIG MARINE	3 MI W OF MARINE-ST-CR	WASHINGTON		638
79	82-0159	LAKE:	FOREST	IN FOREST LAKE	WASHINGTON		444
80	82-0167	LAKE:	WHITE BEAR	IN WHITE BEAR LAKE	WASHINGTON		1046
81	86-0140	LAKE:	SILVER LAKE	.5 MI S OF SILVER CRK	WRIGHT		36
82	86-0252	LAKE:	CLEARWATER	1 MI N OF ANNANDALE	WRIGHT		1287

Total Supporting 180,964 acres

Partially Supprting:

	LAKE ID	NAME		LOCATION	COUNTY	POLLUTANT	ACRES
1	01-0062	LAKE:	BIG SANDY	10 MI N OF MCGREGOR	AITKIN	HG	2659
2	04-0030	LAKE:	CASS	AT CASS LAKE	BELTRAMI	PCB	12049
3	04-2001	LAKE:	STUMP	5 MI NE OF BEMIDJI	BELTRAMI	PCB,HG	*
4	09-0001	LAKE:	THOMSON RESERVOIR	AT THOMSON	CARLTON	HG	155
5	09-0032	LAKE:	BIG	9 MI W OF CLOQUET	CARLTON	HG	205
6	09-0038	LAKE:	HANGING HORN	2 MI S OF BARNUM	CARLTON	HG	165
7	09-0041	LAKE:	MOOSEHEAD	AT MOOSE LAKE	CARLTON	HG	117
8	10-0059	LAKE:	WACONIA	AT WACONIA	CARVER	PCB	1055
9	11-0116	LAKE:	STEVENS	8 MI SE OF LONGVILLE	CASS	HG	35
10	11-0216	LAKE:	AGATE	3.5 MI S OF LAKE SHORE	CASS	PCB,HG	60
11	16-0029	LAKE:	DEVILFISH	12 MI NW OF HOVLAND	COOK	HG	161
12	16-0049	LAKE:	TROUT	9 MI W OF HOVLAND	COOK	PCB,HG	104
13	16-0089	LAKE:	NORTHERN LIGHT	12 MI NE OF GR MARAIS	COOK	HG	175
14	16-0146	LAKE:	E. BEARSKIN	19 MI N OF GRND MRAIS	COOK	HG	260
15	16-0299	LAKE:	RUSH	24 MI NW OF GR MARAIS	COOK	HG	110
16	16-0347	LAKE:	LITTLE CASCADE	16 MI NW OF GR MARAIS	COOK	HG	106
17	16-0356	LAKE:	GUNFLINT	30 MI N OF LUTSEN	COOK	HG	1637
18	16-0412	LAKE:	NORTH CONE	23 MI NW OF GR MARAIS	COOK	HG	34
19	16-0435	LAKE:	DAVIS	24 MI NW OF GR MARAIS	COOK	HG	188
20	16-0496	LAKE:	SAWBILL	20 MI N OF TOFTE	COOK	HG	382
21	16-0629	LAKE:	SEA GULL	28 MI NE OF FOREST CTR	COOK	HG	1511
22	16-0633	LAKE:	SAGANAGA	44 MI NW OF GRD MARAIS	COOK	HG	7935
23	16-0645	LAKE:	TOOHEY	11 MI NW OF TOFTE	COOK	HG	164
24	16-0811	LAKE:	GABIMICHIGAMI	23 MI NE OF FOREST CTR	COOK	HG	500
25	18-0145	LAKE:	RICE	AT BRAINERD	CROW WING	PCB,HG	175
26	18-0206	LAKE:	PAPOOSE	2 MI S OF OUTING	CROW WING	HG	37
27	19-0006	LAKE:	BYLLESBY RESERVOIR	AT RANDOLPH	DAKOTA	PCB	580
28	27-0016	LAKE:	HARRIET	IN MINNEAPOLIS	HENNEPIN	PCB	142
29	27-0133	LAKE:	MINNETONKA	15 MI W OF MINNEAPOLIS, MN	HENNEPIN	PCB	5857
30	31-0047	LAKE:	HORSEHEAD	5.5 MI N OF KEEWATIN	ITASCA	HG	7
31	31-0108	LAKE:	SNOWBALL	2 MI W OF PENGILLY	ITASCA	HG	79
32	31-0216	LAKE:	TROUT	1 MI S OF COLERAINE	ITASCA	HG	764

Partially Supporting (cont.)

	LAKE ID	NAME		LOCATION	COUNTY	POLLUTANT	ACRES
33	31-0416	LAKE:	BLACK ISLAND	9 MI SE OF MARCELL	ITASCA	HG	41
34	31-0417	LAKE:	NOSE	9 MI SE OF MARCELL	ITASCA	HG	38
35	31-0786	LAKE:	JESSIE	18 MI N OF DEER RIVER	ITASCA	HG	661
36	31-0812	LAKE:	BALL CLUB	6 MI W OF DEER RIVER	ITASCA	HG	1592
37	31-0896	LAKE:	ROUND	AT SQUAW LAKE	ITASCA	HG	1199
38	38-0064	LAKE:	COFFEE	11 MI E OF FOREST CTR	LAKE	HG	51
39	38-0068	LAKE:	WINDY	11 MI SE OF FOREST CTR	LAKE	HG	182
40	38-0153	LAKE:	ADAMS	16 MI NE OF FOREST CTR	LAKE	HG	181
41	38-0336	LAKE:	AMBER	12 MI NE OF FOREST CTR	LAKE	HG	54
42	38-0393	LAKE:	DUMBELL	4 MI E OF ISABELLA	LAKE	HG	192
43	38-0396	LAKE:	ISABELLA	1 MI NE OF FOREST CTR	LAKE	HG	613
44	38-0488	LAKE:	DISAPPOINTMENT	13 MI N OF FOREST CTR	LAKE	HG	395
45	38-0526	LAKE:	PARENT	12 MI NW OF FOREST CTR	LAKE	HG	635
46	38-0529	LAKE:	SNOWBANK	14 MI NW OF FOREST CTR	LAKE	HG	1336
47	38-0645	LAKE:	BASSWOOD-WHOLELAKE	9 MI NE OF ELY	LAKE	HG	11897
48	38-0651	LAKE:	KANE	1.5 MI SE OF MCNAIR	LAKE	HG	44
49	38-0656	LAKE:	GREENWOOD	13 MI SW OF ISABELLA	LAKE	HG	594
50	38-0664	LAKE:	DUNNIGAN	14 MI NW OF ISABELLA	LAKE	HG	33
51	38-0674	LAKE:	EAST CHUB	22.5 MI S OF ELY	LAKE	HG	25
52	38-0738	LAKE:	GARDEN	4 MI SE OF ELY	LAKE	HG	271
53	38-0750	LAKE:	CHRISTIANSON	4 MI S OF MCNAIR	LAKE	HG	63
54	38-0786	LAKE:	SANDPIT	10 MI NE OF ELY	LAKE	HG	26
55	38-0811	LAKE:	FALL	.5 MI NE OF WINTON	LAKE	HG	879
56	56-0824	LAKE:	DAYTON	2 MI SW OF FERGUS FLLS	OTTER TAIL	PCB,HG	111
57	58-0024	LAKE:	BIG TAMARACK	4 MI S OF DUXBURY	PINE	HG	30
58	58-0127	LAKE:	LITTLE BASS	2 MI NW OF FINLAYSON	PINE	HG	6
59	58-0138	LAKE:	BIG PINE	5 MI W OF	PINE	HG	156
60	62-0004	LAKE:	PIGSEYE	IN ST PAUL	RAMSEY	PCB	206
61	62-0067	LAKE:	LONG	IN NEW BRIGHTON	RAMSEY	PCB	74
62	69-0003	LAKE:	BIRCH	10 MI SE OF ELY	LAKE	HG	3086
63	69-0004	LAKE:	WHITE IRON	2 MI SE OF ELY	ST LOUIS	HG	1387
64	69-0069	LAKE:	SHAGAWA	AT ELY	ST LOUIS	HG	959
65	69-0084	LAKE:	SLETTEN	6 MI N OF ELY	ST LOUIS	HG	7
66	69-0115	LAKE:	BEAR ISLAND	3 MI N OF BABBITT	ST LOUIS	HG	1079
67	69-0118	LAKE:	BURNTSIDE	3 MI NW OF ELY	ST LOUIS	HG	4142
68	69-0181	LAKE:	SLIM	9 MI NW OF ELY	ST LOUIS	HG	119
69	69-0190	LAKE:	BIG	14 MI NW OF ELY	ST LOUIS	HG	704
70	69-0224	LAKE:	LAC LA CROIX	7 MI E OF CRANE LAKE	ST LOUIS	HG	13787
71	69-0254	LAKE:	BEAR HEAD	9 MI SE OF TOWER	ST LOUIS	HG	272
72	69-0285	LAKE:	EAGLENEST #4	2 MI S OF ROBINSON	ST LOUIS	HG	595
73	69-0316	LAKE:	BIG MOOSE	14 MI NW OF ELY	ST LOUIS	HG	417
74	69-0330	LAKE:	OYSTER	24 MI NW OF ELY	ST LOUIS	HG	288
75	69-0343	LAKE:	HUSTLER	26 MI NW OF ELY	ST LOUIS	HG	110
76	69-0372	LAKE:	ISLAND	11.5 MI N OF DULUTH	ST LOUIS	HG	694
77	69-0375	LAKE:	WHITEFACE RESVR.	9 MI SE OF MAKINEN	ST LOUIS	HG	2266
78	69-0378	LAKE:	VERMILLION	AT TOWER	ST LOUIS	HG	16412
79	69-0456	LAKE:	JEANETTE	10 MI E OF BUYCK	ST LOUIS	HG	118
80	69-0470	LAKE:	LOON	30 MI N OF TOWER	ST LOUIS	HG	1058
81	69-0498	LAKE:	TROUT	11 MI N OF TOWER	ST LOUIS	HG	3092
82	69-0562	LAKE:	COE	10 MI SW OF AURORA	ST LOUIS	HG	20
83	69-0615	LAKE:	ECHO	18 MI NE OF ORR	ST LOUIS	HG	426
84	69-0616	LAKE:	CRANE	24 MI NE OF ORR	ST LOUIS	HG	1249
85	69-0617	LAKE:	SAND POINT	7.5 MI N OF CRANE LAKE	ST LOUIS	HG	3597
86	69-0691	LAKE:	JOHNSON	4 MI NW OF CRANE LAKE	ST LOUIS	HG	681
87	69-0693	LAKE:	NAMAKAN	12 MI NE OF CRANE LAKE	ST LOUIS	HG	11436
88	69-0694	LAKE:	RAINY	2 MI SE OF ISLAND VIEW	ST LOUIS	HG	89354
89	69-0744	LAKE:	ELBOW	9 MI SE OF ORR	ST LOUIS	HG	749
90	69-0748	LAKE:	KJOSTAD	11 MI NE OF ORR	ST LOUIS	HG	179
91	69-0806	LAKE:	MOOSE	3 MI NE OF ORR	ST LOUIS	HG	395
92	69-0841	LAKE:	PELICAN	3 MI W OF ORR	ST LOUIS	HG	4429

Partially Supporting (cont.)

	LAKE ID	NAME	LOCATION	COUNTY	POLLUTANT	ACRES
93	69-0848	LAKE: PRAIRIE	8 MI S OF FLOODWOOD	ST LOUIS	HG	345
94	69-0864	LAKE: ASH	13 MI NW OF ORR	ST LOUIS	HG	270
95	69-0923	LAKE: HOBSON	5 MI NW OF CHISOLM	ST LOUIS	HG	26
96	73-0157	LAKE: HORSESHOE	1 MI S OF RICHMOND	STEARNS	HG	402
97	86-0251	LAKE: PLEASANT	AT ANNANDALE	WRIGHT	HG	258

Total Partially Supporting 206,805 acres

* Acreage not included in the totals

Not Supporting:

	LAKE ID	NAME	LOCATION	COUNTY	POLLUTANT	ACRES
1	55-0004	LAKE: ZUMBRO	2 MI NE OF ORONOCO	OLMSTED	PCB,HG	400

Total Not Supporting 400 acres

Total assessed 404,765 acres

GREAT LAKES SHORELINE

Supporting:

	LAKE ID	USE	NAME	LOCATION	COUNTY	POLLUTANT	MILES
1	16-0001-N033	S	LAKE: SUPERIOR	S OF HAT POINT	COOK		**
2	16-0001-N034	S	LAKE: SUPERIOR	S OF TERRACE POINT	COOK		**
3	16-0001-N035	S	LAKE: SUPERIOR	SW OF SPLIT ROCK POINT	LAKE		**
4	16-0001-N036	S	LAKE: SUPERIOR	SE OF FRENCH RIVER	ST LOUIS		**
5	16-0001-N037	S	LAKE: SUPERIOR	2.5 MI E OF BEAVER BAY	LAKE		**

Total Shoreline Supporting 272 miles

Total Shoreline Assessed 272 miles

** These samples are thought to represent all of the Minnesota shoreline.