MINNESOTA

STATE GOVERNMENT

ISSUES

NONPOINT SOURCE POLLUTION ISSUES TEAM REPORT

November, 1986

PRESENTED TO

ENERGY/ENVIRONMENT/RESOURCES

SUBCABINET

Executive Branch Policy Development Program

1986-1987

NONPOINT SOURCE POLLUTION
ISSUES TEAM REPORT

November 1986

Presented To:

ENERGY/ENVIRONMENT/RESOURCES SUBCABINET

NONPOINT SOURCE POLLUTION ISSUES TEAM

Michael Robertson, Chair
Deputy Executive Director
Minnesota Pollution Control Agency

Participating Agencies

Minnesota Pollution Control Agency (MPCA)

Minnesota Department of Natural Resources (MDNR)

Minnesota Department of Agriculture (MDA)

Minnesota Department of Health (MDH)

Minnesota Department of Transportation (MDOT)

USDA - Soil Conservation Service (SCS)

Minnesota Soil and Water Conservation Board (SWCB)

Minnesota Water Resources Board (WRB)

Minnesota State Planning Agency (SPA)

Metropolitan Council

Minnesota Extension Service (MES)

Waste Management Board (WMB)

Metropolitan Waste Control Commission (MWCC)

NPS ISSUES TEAM REPORT

I. EXECUTIVE SUMMARY

Nonpoint sources of water pollution are the major reason that a number of Minnesota surface and ground waters are not clean enough to support desired uses, ranging from drinking water to fishing, swimming and boating.

The 1972 Clean Water Act established a nationwide goal to restore and maintain the chemical, physical and biological integrity of the nation's waters. This is a goal the State of Minnesota is committed to achieving and maintaining.

A twelve year trend analysis indicates that water quality impacts from municipal and industrial point sources are declining as a direct result of improved wastewater treatment. However, nonpoint sources of pollution continue to degrade water quality, particularly in highly agricultural areas of the state. Many human activities and land uses result in pollution as nutrients, sediment, bacteria, toxic chemicals, and other pollutants are carried from agricultural and urban areas into surface and ground water.

Nonpoint sources of pollution are defined as land management or land use activities that contribute to pollution as a result of runoff, seepage or percolation and are not defined as point sources under Minnesota Statutes Section 115.01, subd. 15. This definition includes rural and urban land uses, as well as specialty land uses such as transportation, and recognizes that both surface and ground water can be affected by nonpoint sources of pollution.

Major sources of nonpoint source pollution include: agricultural runoff; pesticide and fertilizer use; feedlot runoff; urban runoff from streets, yards and construction sites; leachate from septic systems; runoff from forestry and mining activities; highway de-icing chemicals; dredging and drainage activities; and the impacts from the loss of wetlands.

These sources of pollution result in a wide variety of water resource use impairments ranging from reduced recreational opportunities from degraded fisheries, impaired boating and loss of swimming opportunities, increased treatment costs for industrial and consumptive uses, to loss by toxic contamination.

Degradation of water quality from nonpoint sources of pollution may be the most serious and complex environmental problem in Minnesota today. It encompasses a wide range of pollutants generated by a large number of sources and causes serious impacts and use impairments of surface and ground water quality across the state.

Recognizing the seriousness of this problem, the Energy/Environment/ Resources Subcabinet approved the charge to the Nonpoint Source Pollution (NPS) Issues Team, "to develop recommendations for a state and local program to protect and improve the water quality of Minnesota's lakes, rivers and ground water through control of nonpoint sources of pollution."

To accomplish this charge, the NPS Issues Team reviewed the 1980 Water Quality Management Plan recommendations, current activities and problems, and developed recommendations to address the identified needs. The NPS Issues Team, chaired by Michael Robertson, Deputy Executive Director, Minnesota Pollution Control Agency, included staff of the: Pollution Control Agency (MPCA), Department of Natural Resources (MDNR), Department of Agriculture (MDA), Department of Health (MDH), Department of Transportation (MDOT), Soil and Water Conservation Board (SWCB), Water Resources Board (WRB), State Planning Agency (SPA), Metropolitan Council, Minnesota Extension Service (MES), Waste Management Board (WMB), Metropolitan Waste Control Commission (MWCC), and United States Department of Agriculture-Soil Conservation Service (SCS). The NPS Issues Team met as a full group eleven (11) times between January and August. Additional meetings of subgroups were held to discuss specific issues and develop recommendations to be presented to the full NPS Issues Team.

The NPS Issues Team recognizes that achieving water quality objectives will require a comprehensive water quality program designed to address many different pollutants from many different origins.

An effective water quality program must be an integral part of a comprehensive water resources program and must include:

- ongoing research and monitoring to provide data and information so water quality trends and facts guide program implementation.

- information and education efforts that are integrated into water quality programs so the general public and individual land managers have a factual understanding of the problem and have up-to-date and factual information on the alternative management solutions on which to base their resource management decisions.

- a combination of financial and technical assistance and regulatory incentives so individual land managers adopt management practices to control critical pollution problems.

- coordination of the various agencies involved in the interdisciplinary management of programs and authorities related to control of nonpoint sources of pollution and an evaluation process to assess the effectiveness in protecting and improving water quality.

- adequate funding to implement the program.

The NPS Issues Team concluded that achievement of Minnesota's water quality goals will require a comprehensive water quality program, implemented through a coordinated local, state and federal partnership, which utilizes existing programs to the fullest extent. The NPS Issues Team agreed this could best be accomplished through a coordinated two-tier Nonpoint Source Pollution Control Strategy. The two tiers of this strategy include: 1) the establishment of special projects to solve high priority existing or potential water quality problems caused by nonpoint sources of pollution,

and 2) the use of land management practices implemented through statewide programs to protect resources from further degradation by nonpoint sources of pollution and achieve water quality goals. The Nonpoint Issues Team has identified four recommendations to implement this strategy.

The following statements summarize the recommendations contained in the report.

RECOMMENDATION A:

It is recommended that a program be established to protect and improve surface and ground water quality in Minnesota by providing state financial and technical assistance to local units of government. The Clean Water Partnership Program is proposed to provide interested local units of government resources to establish water quality projects to protect and improve lakes, streams and aquifers degraded by nonpoint sources of pollution. This program will be closely linked to local water planning and management programs.

RECOMMENDATION B:

It is recommended that Minnesota implement water quality management practices statewide using existing programs and institutions where possible, to protect water quality from degradation by nonpoint sources of pollution. Specific recommendations are:

Topic 1: Pesticides and Fertilizers

It is recommended that additional pesticide monitoring be established, pesticide detection capabilities be improved, pesticide management practices be developed and provided to applicators, an assessment of pesticide use in Minnesota be completed, pesticide regulations be increased and funding for pesticide related programs be generated by pesticide company license fees and product registration surcharges.

Topic 2: Agricultural Runoff

It is recommended that waters susceptible to nonpoint source pollution be identified, water quality and land use data be integrated, soil surveys be completed, land management practices for water quality be defined, information and education efforts be directed at land managers and water quality and the SWCB receive additional funds to focus at water quality goals through their programs.

Topic 3: Animal Feedlots

It is recommended that additional emphasis be placed on local involvement in feedlot regulations, educational efforts and additional funding be made available to assist feedlot operators causing water quality problems.

Topic 4: Urban Runoff/Infiltration and Construction

It is recommended the MPCA (through the NPDES program) administer a Storm Water Pollution Control Program developed in cooperation with the SWCB and other state agencies, that would allow/encourage local units of government to adopt and administer storm water, erosion and sediment control ordinances.

Topic 5: On-Site Sewage Systems

It is recommended that on-site sewage system training programs be continued, certification be required for on-site sewage system installers, and that on-site sewage system regulations be revised.

Topic 6: Hydrologic Modifications

It is recommended that significant changes be made in state policy related to wetland protection and public and private drainage activities.

Topic 7: Forestry Runoff

It is recommended that counties adopt ordinances that regulate private forestry practices in shoreland areas.

Topic 8: Mining Runoff

It is recommended that MPCA and DNR continue current efforts to control mining runoff.

Topic 9: Highway De-Icing Chemicals

It is recommended that local road authorities cover their salt storage piles.

Topic 10: Special Erosion Problems

It is recommended that the SWCB Streambank, Lakeshore and Roadside erosion program receive additional funding.

RECOMMENDATION C:

It is recommended that a program be established to provide financial assistance to local units of government statewide, to carry out local water quality management activities through their existing authorities. This assistance should be made as part of a comprehensive program of financial assistance for local water resources planning and management capabilities coordinated through county governments.

RECOMMENDATION D:

It is recommended that the Minnesota Pollution Control Agency provide overall coordination of programs and activities used to control nonpoint sources of pollution and evaluate the effectiveness of those programs in meeting Minnesota's water quality goals. This should be accomplished by working through the Environmental Quality Board's Water Resources Committee.

II. NATURE AND EXTENT OF THE PROBLEM

BACKGROUND

A major national effort to combat water pollution began with the passage of the federal Clean Water Act of 1972. The basic goal of the Clean Water Act was to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." This is a goal the State of Minnesota is committed to achieving and maintaining. This legislation created a variety of programs to study and regulate sources of water pollution. Most of the responsibility for carrying out these programs was assigned to state governments, under supervision of the federal Environmental Protection Agency (EPA). In 1967, the Minnesota Legislature established the Minnesota Pollution Control Agency, "To meet the variety and complexity of problems relating to water, air and land pollution in areas of the state affected thereby, and to achieve a reasonable degree of purity of water, air and land resources of the state consistent with the maximum enjoyment and use..." Minnesota Statutes Chapter 116.

Since passage of the legislation, MPCA and EPA have concentrated their water cleanup efforts on so called "point sources" of pollution: discharges of wastewater, usually via pipes, from municipal sewage systems and from industrial or commercial operations. At the heart of these efforts has been a permitting program for all point sources and a grant program to pay most of the cost of building municipal sewage treatment facilities. Great progress in eliminating pollution from point sources has been achieved since these programs began operating. A recent twelve year trend analysis indicates that water quality impacts from municipal and industrial sources are declining as a direct result of improved wastewater treatment.

Nonpoint sources of pollution continue to degrade water quality. Water quality monitoring in rivers has shown that the majority of impaired uses is a result of nonpoint sources of pollution and the combination of point and nonpoint sources of pollution. The need for effective programs to control nonpoint sources of pollution is clear if Minnesota is to achieve and maintain its water quality goal.

In the mid-1970s, the Minnesota Pollution Control Agency (MPCA), in cooperation with state and federal agencies and local officials, initiated the Water Quality Management Planning effort required under Section 208 of the Clean Water Act. The purpose of the planning effort was to identify significant water quality problems due to nonpoint sources of water pollution and set forth effective programs to correct those problems.

A number of significant developments have occurred and impacted the original intent of the 1980 Minnesota Water Quality Management Plan. Fiscal, administrative and legislative constraints limited its implementation. Recognizing the seriousness of the nonpoint source (NPS) pollution problem, the Energy/Environment/Resources subcabinet approved the charge to the NPS Issues Team, "to develop recommendations for a state and local program to protect and improve the water quality of Minnesota's lakes, rivers and ground water through control of nonpoint sources of

pollution." To accomplish this charge, the NPS Issues Team brought many of the agencies with responsibility and authorities for addressing the problem together to review past state and federal program recommendations, including the 1980 Water Quality Management Plan (208), current programs and activities, and provide current recommendations for a comprehensive program to solve water quality problems resulting from nonpoint source pollution.

NATURE OF THE PROBLEM

Nonpoint sources of pollution are defined as land management or land use activities that contribute to pollution as a result of runoff, seepage or percolation and are not defined as a point source under Minnesota Statutes, Section 115.01, Subdivision 15.

Nonpoint sources of water pollution are the major reason that a number of Minnesota surface and ground waters are not clean enough to support desired uses, ranging from drinking water to fishing. This pollution is a result of many land use activities. Soil erosion has long been recognized as a visible problem resulting from intensive land use. In addition to sediment, nutrients, pesticides, bacteria, toxic chemicals and other pollutants are carried from urban and rural areas into surface and ground water. The ground water aspect of nonpoint source pollution is a relatively new consideration. The concerns for ground water quality are twofold: 1) traditional methods of handling surface runoff hold the water on the land, encouraging infiltration and possibly ground water quality degradation; 2) runoff may enter the ground water directly through abandoned, unsealed wells. The MDH estimates that there are between 400,000 to 800,000 abandoned wells in Minnesota. These concerns underlie the following proposed activities for resolving nonpoint source pollution. Although abandoned wells are not covered as a separate topic within this report, effective state and local programs for abandoned well inventory, tracking, and sealing must be developed. Table 1 describes the potential water quality impacts of several of these pollutants. Additional information related to pollution problems is found in the sections preceding the individual recommendations and in the attached booklet Protecting Minnesota's Waters...The Land-Use Connection.

TABLE 1 NONPOINT SOURCE WATER QUALITY IMPACTS

Pollutant	Origins	Impacts on Water Quality and Associated Users
Sediment	Agriculture Urban Runoff Construction Mining Forestry	o Decrease in transmission of light through water. - Decrease in primary productivity (aquatic plants and phytoplankton) upon which other species feed, causing decrease in food supply. - Obscures sources of food, habitat, hiding places, nesting sites; also interferes with mating activities that rely on sight and delays reproduction timing. o Directly affects respiration and digestion of aquatic species (e.g., gill abrasion). o Decreases viability of aquatic life. Decreases survival rates of fish eggs and therefore size of fish population; affects species composition. o Increases temperature of surface layer of water--increases stratification and reduces oxygen-mixing with lower layers, therefore decreasing oxygen supply for supporting aquatic life. o Decreases value for recreational and commercial activities. - Reduces aesthetic value. - Reduces sport and commercial fish populations. - Decreases boating and swimming activities. - Interferes with navigation. o Increases drinking water costs.
Toxic Chemicals	Agriculture Urban Runoff Construction Forestry	o Hinders photosynthesis in aquatic plants. o Sublethal effects lower organism's resistance and increase susceptibility to other environmental stresses. o Can affect reproduction, respiration, growth and development, reduce food supply and be fatal to life. o Some toxic chemicals can bioaccumulate in tissues of fish and other species. o Some pesticides are carcinogenic and mutagenic or teratogenic to aquatic life. o Reduces commercial/sport fishing and other recreational values. o Creates health hazard from human consumption of contaminated fish/water.

TABLE 1 (Continued)

Pollutant	Origins	Impacts on Water Quality and Associated Uses
Nutrients (Phosphorus, Nitrogen)	Agriculture Animal Feedlots Urban Runoff Construction Forestry On-Site Sewage Systems	o Promotes accelerated aging of lakes. - Algal blooms and decay of organic materials create turbid conditions that eliminate submerged aquatic vegetation and destroy habitat and food for aquatic animals and waterfowl. - Blooms of toxic algae can affect health of swimmers and aesthetic qualities of waterbodies (odor and murkiness). - Blooms of toxic algae can cause illness and death in animals and livestock that drink water. - Favors survival of less desirable fish species. - Interferes with boating and fishing. - Reduces dissolved-oxygen levels can suffocate fish. - Reduces waterfront property values. o Degradation of ground water quality. - Reduces quality of drinking water supplies. - NO_3 (nitrates) can cause infant health problems.
Bacteria	Agriculture Animal Feedlots Urban Runoffs On-site Sewage Systems	o Introduces pathogens (disease-bearing organisms) to surface and ground waters. o Reduces recreational uses. o Increases treatment costs for drinking water. o Creates a human health hazard.

EXTENT OF THE PROBLEM

Assessing the extent of nonpoint source (NPS) pollution problems is very difficult, because of the large number of pollutants which must be considered and the diversity of Minnesota's lake, stream and ground water resources.

Two methods were used to complete a general assessment of NPS pollution problems in Minnesota. The first method involved a survey of local resource managers to identify the causes and types of NPS pollution problems affecting water bodies. The second method involved a regional description of Minnesota focusing on NPS related characteristics. A complete description of both methods is presented in the Appendices.

1. Local Experience

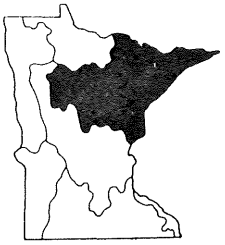
   To assess nonpoint source pollution problems, the MPCA requested Minnesota Department of Natural Resources (MDNR) fishery managers and county zoning administrators to address nonpoint source pollution concerns by soliciting a list of impacted water bodies, their uses, and the causes and types of NPS pollution affecting the identified water bodies (Appendix A).

   The MDNR fishery managers frequently cited eutrophication, sedimentation, turbid conditions, and physical habitat destruction as the dominant types of nonpoint source pollution problems in their management areas. The frequently cited causes of nonpoint source pollution problems were agricultural fertilization activities, animal wastes, and agricultural soil erosion. The county zoning administrators cited eutrophication and sedimentation as the dominant types of nonpoint source pollution in their management areas. The frequently cited causes of nonpoint source pollution problems were agricultural fertilization activities, agricultural soil erosion, and on-site sewage systems. Other types and causes of nonpoint source pollution cited by the resource managers include oxygen depletion, bacteria contamination, urban runoff, and agricultural pesticides.

   It can be concluded from the survey of MDNR fishery managers and county zoning administrators that nonpoint source pollution (soil erosion, animal wastes, fertilizers, pesticides, and on-site sewage systems) affect many Minnesota water bodies. Stream nonpoint source concerns generally relate to soil erosion and sediments; whereas, lake nonpoint source pollution concerns generally relate to nutrients. Ground water contamination is also a concern in southeastern Minnesota.

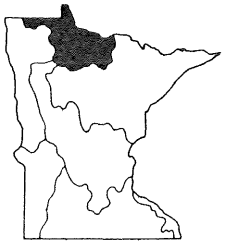
2. Regional Assessment

   For assessing environmental problems Minnesota can be divided into several areas called ecoregions. These regions are based on similarities of land use, soils, land surface form, and potential natural vegetation. To assess NPS pollution problems the land use, topographic, and water body characteristics of the ecoregions were reviewed (Appendix B). This review lead to the following interpretation of Minnesota's NPS pollution problems.



The Northern Lakes and Forest ecoregion, located in northeastern Minnesota, encompasses approximately one-third of the state. This area contains a large proportion of the State's high quality lakes, is heavily forested and represents a prime recreational resource. Streams and wetlands are also of very high quality and offer good recreational opportunities. Most inhabitants of this lightly populated area reside in Duluth and the Iron Range communities where mining has been an important activity.

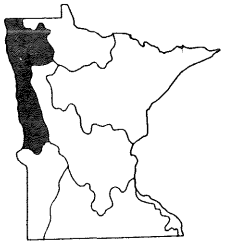
Agricultural activity, as suggested by the low percentage of cultivated and pastured land uses, is not extensive in this ecoregion. NPS pollution in the Northern Lakes and Forest area is of relatively minor concern because of these land-use factors; however, there are other factors, such as slope and lake nutrient levels that suggest sensitivity to NPS pollution. Pollution problems that do occur are expected to be localized in areas where lakeshore development, urban areas, mining, or intensive forestry practices occur.



The Northern Minnesota Wetlands ecoregion, which represents approximately ten percent of the state, is dominated by extensive forests and covered by large areas of water and wetlands. The few lakes and streams that occur here, represent high quality water bodies.

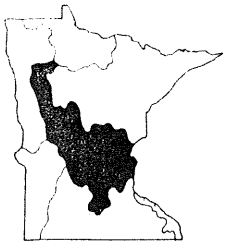
The population density is very low and the activities of many of the inhabitants is oriented towards forestry and the wood products industry. Agricultural activity is limited to small areas with well drained soils.

NPS pollution of the Northern Minnesota Wetlands ecoregion is not extensive. Pollution problems that do exist are localized in pockets where small community development, extensive forestry practices, and the limited agricultural activities occur.



The Red River Valley ecoregion, in the northwestern corner of the state is well known for its agricultural productivity. Over eighty percent of this region is cultivated, predominately with small grains. The land is very flat, the average slope of only a few forty acre parcels exceeds two percent. Individual farms tend to be large and cultivated areas extensive. Soils are generally thick and dominated by a clay texture. Ground water pollution, because of the soil characteristics, does not appear to be a major concern.

Few water bodies exist in the Red River Valley area, and streams represent an important natural resource. Many of the streams in the Red River Valley have been increasing in nitrate and suspended solids concentrations. Average nitrate concentrations, although they have been increasing, represent relatively low levels. In contrast, suspended solids concentrations are quite high and levels have increased dramatically over the past twelve years. This assessment and the intensive land use suggest NPS pollution problems with respect to suspended solids and possibly nitrates are occurring and may be considered important water quality concerns for the Red River Valley ecoregion.



The Central Hardwood Forest ecoregion runs diagonally across the state and represents a transition between the northern forests and the southern agricultural areas. About fifty percent of the ecoregion is cultivated; in addition, there are a variety of other land uses. No one type of land use dominates.

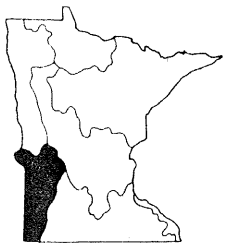
Along with the variety of land uses is a high population density. Many of the the Central Hardwood Forest ecoregion inhabitants reside in the southeastern part of the ecoregion. There are several moderately sized communities along with the Twin Cities, located in this area.

Stream water quality of the Central Hardwood Forest area can be considered moderate, but may be deteriorating as suggested by a slight increase in suspended solids concentrations over the past twelve years. Lakes are abundant in the area and of moderate productivity with good gamefish populations. These lakes represent a substantial recreational resource in this area of high population density; and, similar to the lakes to the north, the Central Hardwood Forest lakes are sensitive to nutrient pollution from nonpoint sources.

These factors suggest that the Central Hardwood Forest ecoregion is sensitive to and being impacted by NPS pollution, particularly from sediments and nutrients. The NPS pollution problems do not appear widespread throughout the entire area, but are limited to areas with intensive land use such as urban development or agricultural activities. In addition, there is an abundant surficial drift ground water resource that is subject to NPS pollution from nutrients and pesticides.

The Central Hardwood Forest ecoregion could benefit from both NPS pollution control and protection activities. There are water bodies in this ecoregion that have been impacted by NPS pollution where control activities would be beneficial. There is also an abundance of non-impacted water bodies that should be protected from future degradation by land-use activities.

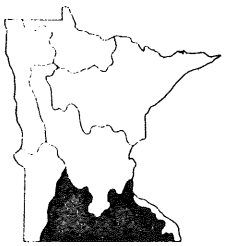
The Northern Great Plains ecoregion is located in southwestern Minnesota. This is an intensely cultivated area with a low population density and many factors that suggest NPS pollution is a concern.



Over eighty percent of the ecoregion is cultivated, primarily with row crops of corn and soybeans. There is very little forested area. Soil texture is predominately silt, an easily eroded type of soil, and slopes are slight to moderate.

Streams of the Northern Great Plains have been showing increasing concentrations of nitrates and suspended solids. Lakes are characterized by high nutrient concentrations and roughfish or winterkill ecological classifications. Although not extensive, there are also areas of surficial drift aquifers that represent an important ground water resource. This resource is sensitive to pesticide and nutrient pollution.

These factors suggest NPS pollution is a concern in the Northern Great Plains ecoregion. The water resources of the area are impacted by nutrients and sediments. The water resource, important for recreation and agricultural production, should be protected from the deteriorating effects of NPS pollution.



The Western Cornbelt Plains, which occupies about twenty percent of the southern portion of the state, is similar to the Northern Great Plains in many ways. This region of slight to moderate slopes is prime agricultural land used primarily for the production of corn and soybeans. The thick silty soils are naturally productive, but often enriched with fertilizers and treated with pesticides to increase crop yields.

The population density of the Western Cornbelt Plains, however, is greater than the population density of the Northern Great Plains. Farms tend to be slightly smaller and there are numerous small to moderately sized communities scattered throughout the region.

Both streams and lakes in the region are considered nutrient rich reflecting the naturally productive soils as well as the fertilizers used to increase crop production. Concentrations of nitrates and suspended solids have been increasing in area streams suggesting NPS pollution is affecting many water bodies in this ecoregion. Area lakes, although productive and often ecologically classified as roughfish or winterkill, support good warmwater fisheries with appropriate management practices.

The natural features of the Western Cornbelt Plains and the intensive agricultural management practices promote expected high NPS loadings to area lakes and streams. Nutrients and sediments are a concern. There is also a concern for the ground water resources, because of the presence of surficial drift aquifers and karst features in the eastern portion of the ecoregion. These areas are sensitive to the nutrients and pesticides that also effect the surface water resource.

The Driftless Area, although the smallest of Minnesota's ecoregions, is the most interesting. This ecoregion represents only two percent of the state and is located in an area of southeastern Minnesota not subjected to recent glacial activity. Soils of the Driftless Area are thin and streams in the well developed drainage system have cut deep valleys resulting in numerous steep slopes. Open, pasture or forested areas occur on the steep slopes. Much of the flatter land in the region is used for agricultural production of corn and other row crops.

Few lakes occur in the Driftless Area. Streams, in general, have high suspended solids levels and moderate, but increasing, nitrate levels. Although the Driftless Area is small the stream resource is important because many streams are ground water fed and can support cold water fisheries.

The most interesting characteristic of the Driftless Area is the karst topography. The thin soils and exposed bedrock typical of karst areas result in a rich ground water resource. These same karst features, however, also result in a ground water resource sensitive to pollution, particularly from nonpoint sources. These characteristics of the Driftless Area ecoregion suggest the surface and ground water resources are being impacted by nutrient and pesticide contamination.

The NPS pollution problems of the state can be summarized by the following map (Figure I).

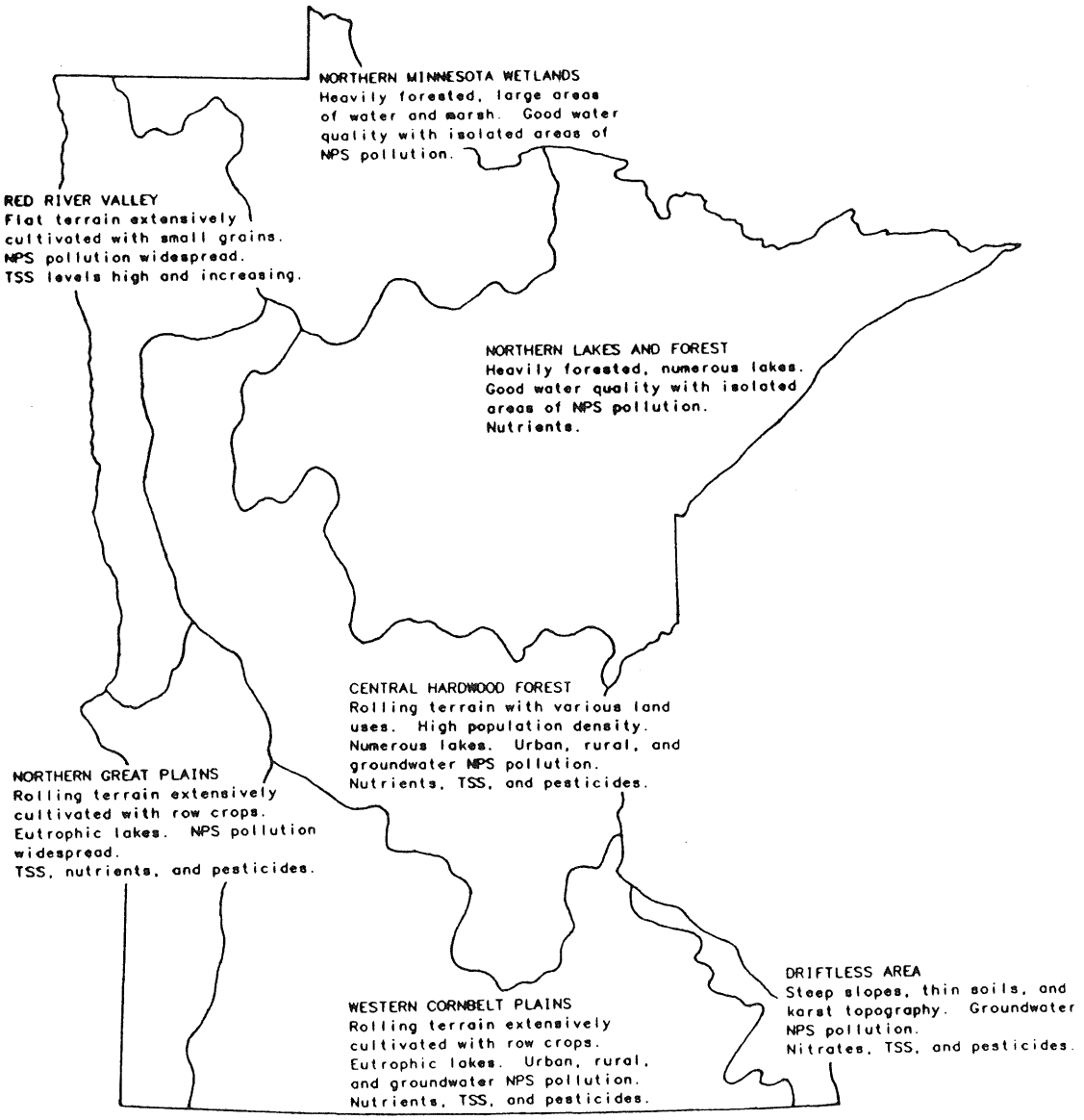


FIGURE I. A BRIEF DESCRIPTION OF MINNESOTA'S SEVEN ECOREGIONS and the main NPS pollution concerns.

III. RECOMMENDATIONS

The NPS Issues Team concluded that achievement of Minnesota's water quality goals will require a comprehensive water quality program, implemented through a coordinated local, state and federal partnership that utilizes existing programs to the fullest extent. The NPS Issues Team agreed this could best be accomplished through a coordinated two-tier Nonpoint Source Pollution Control Strategy. The two tiers of this strategy include: 1) the establishment of special projects to solve existing or potential water quality problems caused by nonpoint sources of pollution, and 2) the use of water quality management practices implemented through programs statewide, to protect resources from further degradation by nonpoint sources of pollution.

This strategy must be supported through a comprehensive program which includes:

1. ongoing research and monitoring to provide data and information so water quality trends and facts guide program implementation,

2. information and education efforts must be integrated into water quality programs so the general public and individual land managers have a factual understanding of the problem and information which is current and tailored to their needs on the alternative management solutions available to them to make informed management decisions,

3. a combination of financial and technical assistance and regulatory incentives so individual land managers will adopt management practices to control critical pollution problems,

4. coordination of the agencies and various disciplines involved in the management of programs and authorities related to the control of nonpoint sources of pollution and evaluation of program effectiveness in protecting and improving water quality,

5. adequate funding to implement the program.

The NPS Issues Team recommends the following programs and program adjustments be used to establish a comprehensive approach to abating water quality problems resulting from nonpoint sources of pollution.

RECOMMENDATION A: Minnesota Clean Water Partnership Program

It is recommended that a program be established to protect and improve surface and ground water in Minnesota, through state financial and technical assistance to local units of government to fund locally sponsored projects, for the control of sources of pollution not adequately controlled through existing programs.

The Minnesota Clean Water Partnership Program purpose is to provide state financial and technical assistance to local units of government for water quality projects based on geographical areas contributing to surface or ground water for the protection and improvement of lakes, streams and aquifers from nonpoint sources of pollution.

The Clean Water Partnership Program objectives are:

1. to identify water quality problems and their causes;

2. to focus technical and financial resources to critical areas;

3. to provide technical and financial resources to local units of government for implementation of water quality protection and improvement; and

4. to coordinate interaction of the nonpoint source program with elements of the state water quality program and other existing resource management programs.

The Clean Water Partnership Program project approach provides many advantages:

1. Projects may be selected and designed to deal with identified problems, existing and potential, with clearly defined water quality objectives.

2. The project provides a flexible approach to address all nonpoint pollution concerns within an area, whether urban or rural, surface or ground water resources, potential as well as existing, so that nonpoint pollution problems can be solved.

3. The project approach provides an opportunity for local units of government to take the lead in projects so local objectives and insights are included in design and implementation of watershed plans and project implementation can be coordinated with ongoing land use programs, controls and activities.

4. While the project approach allows local units of government to sponsor and implement the project, the overall program administrative responsibility remains with the state to insure water quality objectives are the primary concern when projects are planned and implemented.

Minnesota Clean Water Partnership Program Framework

A program of local/state/federal partnership projects (locally lead with state and federal financial and technical assistance) is recommended as the basic approach for solving nonpoint source water pollution problems, existing and potential. The proposed program may be divided into four main categories: 1. Clean Water Partnership Project Selection; 2. Clean Water Partnership Project Diagnostic and Implementation Design Study; 3. Clean Water Partnership Project Implementation; and 4. Program Administration. Figure II outlines the main categories in the program.

1. Clean Water Partnership Project Selection

For the program to be successful, limited resources must be directed at identified nonpoint source problems in rural and urban watersheds, where effective corrective and preventative actions can be carried out. Important tools for selection of Clean Water Partnership projects will be: a) identification of areas of the state with surface and ground water vulnerable to the impacts of nonpoint source pollution; b) identification of local support and commitment to sponsoring a project (priority should be given for projects which include Soil and Water Conservation Districts and Watershed Districts); and c) a technical advisory committee to review and recommend projects.

a. Identification of Areas of the State Vulnerable to the Impacts of Nonpoint Source Pollution

Identification of areas of the state and water bodies with a high potential for nonpoint source pollution is being developed by MPCA staff. Water resources tend to reflect characteristics of the geographical areas contributing to them, so by mapping soil type, land use, land surface form surficial hydrogeology and depth to first bedrock and potential natural vegetation, regionalized assessments of water quality and water quality potential can be made. This information provides an objective evaluation of areas of the state vulnerable to the impacts of nonpoint source pollution (Appendix B).

b. Identification of Responsible Local Unit of Government

The key to the success of individual Clean Water Partnership projects is dependent on strong, knowledgeable, local leadership and a commitment to water quality protection at the local level.

FIGURE II

SUMMARY OF MINNESOTA CLEAN WATER PARTNERSHIP PROGRAM

RESPONSIBILITY	FUNCTION	ACTIVITIES	COOPERATING AGENCIES AND PROGRAMS AS APPROPRIATE
*MPCA	CLEAN WATER PARTNERSHIP PROJECT SELECTION	- Identification of Priority Project Areas - Demonstration of Local Commitment to Project - Recommendation of Technical Advisory Committee	* Soil and Water Conservation Board - State Cost Share Program - Streambank, Lakeshore and Roadside Erosion Program * USDA - Soil Conservation Service - Technical Assistance * USDA - Agricultural Stabilization and Conservation Service - Agricultural Conservation Program
*Responsible Local Unit	CLEAN WATER PARTNERSHIP PROJECT DIAGNOSTIC AND IMPLEMENTATION DESIGN STUDY	- Diagnostic Study *Problem Identification * Water Quality Objectives * Identification of Priority Management Areas - Implementation Design Study * Identification of Official Controls * Identification of BMPs * Identification of Incentives * Information/Education Program * Monitoring/Project Evaluation * Roles and Responsibilities * Work Schedule * Funding Needs	* Minnesota Department of Natural Resources - Shoreland Management Program - Fish and Wildlife Management Program - Protected Waters Permit Program * Minnesota Department of Agriculture - Pesticide Monitoring and Regulation * Minnesota Department of Health - Drinking Water Monitoring and Regulation - Well Construction and Abandonment * Minnesota Extension Service - Information and Education * University of Minnesota - Research * Minnesota Pollution Control Agency - Feedlot Permit Program - Water Quality Monitoring Program - Solid and Hazardous Waste Management
*Responsible Local Unit	CLEAN WATER PARTNERSHIP PROJECT IMPLEMENTATION	- Implementation of Design Study * Installation of BMPs * Adoption of Official Controls	* Planning Information Center * Water Resources Board * Minnesota Department of Transportation * U.S. Environmental Protection Agency - Clean Lakes Program - Nonpoint Source Program * Minnesota Geological Survey
*MPCA	CLEAN WATER PARTNERSHIP PROGRAM ADMINISTRATION	- Project Evaluation - Grant Administration - Program Evaluation - Project Support - Interagency Coordination	

Implementation of Clean Water Partnership projects must be led by a local unit of government with authority to prepare and implement the Diagnostic Study and Implementation Plan. This requires the responsible local unit of government have the authority to: coordinate and enter into contracts with local, state and federal agencies, and private organizations; raise funds; adopt and enforce local ordinances; and many other activities, including maintaining personal contact with local land users, public meetings, and other means to assure a broad base of support exists for project implementation.

Local units of government include municipalities, towns, counties, soil and water conservation districts, watershed districts, organizations formed for the joint exercise of powers under Minnesota Statutes, Section 471.59, and other special purpose districts or authorities exercising authority in water and related land resources management at the local level.

Identification of project areas with a responsible local unit of government committed to leading a project is a very important part of project selection. A measure of a local unit of government's interest and commitment to leading a project would be submission of a project application; letters of support from local units of government to demonstrate their commitment and involvement; and one of the following:

1) Local Water Plan authorized under Minnesota Statutes Chapter 110B - Comprehensive Local Water Management Act,

2) Surface Water Management Plan required under Minnesota Statutes Chapter 473.875 - Metropolitan Surface Water Management Act,

3) Overall Plan required under Minnesota Statutes Chapter 112 - Watershed Management Act, or

4) Other local plan that at a minimum would provide an inventory of existing physical and hydrologic information on the area, a general identification of water quality problems, local goals and demonstrates the local commitment to water quality protection or improvement.

The plans will provide existing information related to water resources management and a measure of local interest and commitment of the local community to leading a Clean Water Partnership project. After July 1, 1991, only projects part of, or responsive to, a local water plan under Minnesota Statutes, Chapter 110B, 112 or 473.775-.882 will be eligible.

c. Recommendation of Technical Advisory Committee

A technical advisory committee, chaired by the Minnesota Pollution Control Agency and made up of a representative from the Department of Natural Resources, Department of Agriculture, Soil and Water Conservation Board, Water Resources Board, State Planning Agency, Minnesota Extension Service, Department of Health, U.S. Environmental Protection Agency, USDA-Soil Conservation Service and USDA-Agricultural Stabilization and Conservation Service will review the local government project application, areas vulnerable to NPS pollution and other information and recommend to the MPCA Citizen's Board the projects that should receive state financial assistance for Clean Water Partnership Project Diagnostic Study and Implementation Plan and Implementation phase.

2. Diagnostic Study and Implementation Plan

The Diagnostic Study and Implementation Plan are important parts of a Clean Water Partnership project. The diagnostic study is the technical diagnosis of the problem including the development of reasonable water quality goals and objectives. The Implementation Plan describes the combination of management practices, incentives and controls that will be needed to reach the identified goals and objectives.

Funding for the Diagnostic Study and Implementation Plan will be provided to local units of government at a fifty percent state to local match.

a. Diagnostic Study

The Diagnostic Study includes identification of potential or existing water quality problems and the sources of the problems, identification of priority management areas within the project area and the water quality goals and objectives. A diagnostic study may require technical assistance and information from many local, state and federal agencies cooperating in the project (see Figure II). Included will be water quality monitoring, modeling and analysis of the information to translate data and information into water quality goals and objectives that are reasonable for the project and consistent with the State's water quality goals and objectives. This effort will benefit from assistance and cooperation from MPCA, DNR, MDH, MDA, MES, and other affected agencies. Another portion of the diagnostic study must identify the land areas contributing pollution, since often a limited portion of the land area contributes a significant percentage of the pollution. Focusing the project on those land areas can pay off. Local knowledge and information combined with modeling tools and analysis can identify the areas contributing pollution. This effort will require assistance and coordination from local units of government, SWCD, SCS, SPA, DNR, ASCS, SWCB, MES, MPCA and other assisting agencies.

b. Implementation Plan

The Implementation Plan includes identification of the types of best management practices to be used including practices for specific problem sites, identification of official controls and incentives necessary to alleviate problems, identification of the information and education procedures to be used, design of monitoring and project evaluation program, definition of roles and responsibilities of local units of government and the various state and federal agencies involved, and a description of how the project will be coordinated with existing programs. The Implementation Plan must also propose a work schedule and identify funding needs, including the source of the local funds. Again, the cooperation and assistance of many agencies will be necessary for the development of the implementation plan for the project.

The local unit of government sponsoring the project will be responsible for completion of the Diagnostic Study and Implementation Plan. The responsible local unit of government will have the option to determine the best alternative for completing the Diagnostic Study and Implementation Plan whether hiring staff or contacting for services, but local technical resources (i.e. SWCD, SCS, colleges, etc.) should be used as appropriate.

Once the Diagnostic Study and Implementation Plan are complete, the technical advisory committee will review the proposal for feasibility and make a recommendation to the MPCA Citizen's Board for funding the project's implementation.

3. Clean Water Partnership Project Implementation

The implementation phase of the project will perform the activities proposed in the Implementation Plan. Projects will receive 50 percent state to local match funding commitments for multiple year intervals (project phasing will be further evaluated), although projects must submit annual reports. Successful project implementation will require coordination and cooperation of many agencies and organizations including local units of government in the project area, SWCD, SCS, SWCB, ASCS, DNR, SWCB, MDA, MES, MPCA, MDH and other cooperating agencies.

4. Program Administration

For the Clean Water Partnership Program to be effective water quality objectives must be the primary focus as projects are planned and implemented. To insure water quality is the program focus, the program responsibility must reside with the Minnesota Pollution Control Agency with program guidance from the technical advisory committee.

MPCA program administration responsibilities will include grant administration, program evaluation, project evaluation, project support and state and federal level interagency and program coordination.

Clean Water Partnership Program Rationale

The Clean Water Partnership Program is proposed as a comprehensive program with enough flexibility to control the range of nonpoint source pollution problems found across the state by providing financial and technical assistance to local units of government on an individual project basis.

This proposal builds on past state and federal program recommendations, builds on current programs and addresses the need for a comprehensive program to solve water quality problems resulting from nonpoint sources of pollution.

The Clean Water Partnership Program proposal reflects the recommendations of the Minnesota Water Planning Board's 1981 publication Toward Efficient Allocation and Management: Special Study on Local Water Management incorporates existing authorities (i.e. Watershed Management Act, Metropolitan Surface Water Management Act, Comprehensive Local Water Management Act) and provides incentives for local participation through financial and technical assistance and emphasizes coordination and use of existing programs and agencies.

The Clean Water Partnership builds on the MPCA's experience administering the Big Stone Lake and Clearwater Chain of Lakes NPS demonstration projects (Appendix C). The Clean Water Act, Section 314 Clean Lakes Program has provided the Agency with experience in: grants administration to local units of government; project evaluation, project support; and interagency coordination for projects.

The Clean Water Partnership Program establishes the process for the MPCA to select projects and administer the proposed new Section 319 of the Clean Water Act (Appendix D). Minnesota has valuable resources to protect and must be prepared to implement the proposed Federal Nonpoint Source Control Program.

Clean Water Partnership Program Funding

The Clean Water Partnership Program proposal requires establishment of a funding source to provide program administration and financial assistance to local units of government for the preparation of the Diagnostic Study and Implementation Plan and Project Implementation. The funds are especially important to initiate the Diagnostic Study and Implementation Plan so Minnesota has projects prepared to implement using federal grants provided under the existing Section 314 (Clean Lakes Program) and proposed Section 319 (Nonpoint Source Control Program) of the Federal Clean Water Act.

The Clean Water Partnership Program will provide local units of government a program that is flexible and comprehensive enough to address water quality management problems ranging from rural, urban, or other sources not adequately controlled through existing programs for the protection and improvement of surface and ground water in Minnesota.

RECOMMENDATION B: Statewide Programs

It is recommended Minnesota implement water quality management practices statewide through existing programs, to protect resources from the degradation by nonpoint sources of pollution. Listed below are specific recommendations related to the topics of: Pesticides and Fertilizers, Agricultural Runoff, Animal Feedlots, Urban Runoff/Infiltration and Construction, On-Site Sewage Systems, Hydrologic Modification, Forestry Runoff, Mining Runoff, Highway De-Icing, and Special Erosion Problems.

TOPIC 1: Pesticides and Fertilizers

Nature and Magnitude of the Problem - The use of pesticides and fertilizers in Minnesota can result in the pollution of surface and ground water. This is a significant water quality concern and can be a serious health risk. Regional ground water aquifers cannot be realistically decontaminated and the long term health effects from continued low level exposure are unknown. Therefore, the implications of contaminated ground water are expensive and serious.

Pesticides:

Pesticides are a wide range of chemical substances intended to prevent, destroy or repel organisms harmful to man or his activities, and include herbicides, insecticides, fungicides, nematicides and rodenticides, as well as substances targeted to other organisms. There are approximately 7500 such products registered for use in Minnesota. These chemicals have a wide variety of chemical and physical characteristics and, therefore, their toxicity and environmental impacts vary considerably. Regulation of pesticide sale, storage, transportation, use, and disposal is a responsibility of the MDA. Enforcement is achieved through the implementation and administration of the Minnesota Pesticide Control Law and the Federal Insecticide, Fungicide and Rodenticide Act. As part of that responsibility, the MDA collects a registration fee for each product registered for sale in Minnesota.

Usage of pesticides in Minnesota is widespread, but largely unquantified. Federal and state laws require accounting of only 'Restricted Use' pesticides. 'General Use' pesticides, including those in urban use, are not tracked.

- Agriculture accounts for the greatest usage of pesticides. Herbicides account for 90% of agricultural pesticide use. In 1984, it is estimated that 23,237,000 acres of agricultural land in Minnesota were treated for weed control by both aerial and ground application methods. Minnesota farmers used pesticides at least once on over 96% of their corn, soybean and sugar beet acreage for harvest in 1984. An estimated 89% of the wheat acreage was treated, 88% of the sunflowers, 80% of the flax and 60% of other small grains.

Eighty-five percent of the herbicides used in Minnesota are self applied and 15 percent are commercially applied. It was estimated from the 1984 Agricultural Statistics Survey that 39,674,000 pounds of active pesticide ingredients are used in Minnesota annually.

- Urban usage of pesticides presents special concerns because of the large number of people in close proximity to the areas of application and the large number of untrained homeowner applicators. The total amounts of commonly used products has not been quantified for urban areas.

- Aquatic nuisance control through use of pesticides is an activity regulated by the MDNR.

In the years 1982, 1983, and 1984, the MDNR issued permits for pesticide application to approximately 65,334, 70,267, 46,760 acres of water respectively for vegetation, algae, snails, leeches and swimmers itch control. Although undocumented, there appears to be a significant amount of unpermitted use.

- Forestry usage of herbicides are part of the management of commercially harvested forests. The applications are primarily during early growth stages, perhaps twice in the 60-120 year life of a forest. Only about 27,390 acres of the approximately 13,695,000 acres of commercial forest receive pesticide application each year.

In recent years, pesticides have been detected in ground water/drinking water in many areas of the nation. These findings, coupled with Minnesota's extensive pesticide usage and widespread dependence on ground water as a source of drinking water, have given rise to increasing public health and water quality concerns. At present, there is very limited information on the fate of pesticides in the environment and ground water/drinking water in Minnesota. Past monitoring efforts have generally been limited to emergency responses, special studies of limited scope and to public surface water supply monitoring for Safe Drinking Water Act pesticide parameters. These findings do not adequately describe the nature or extent of pesticide-related ground water/drinking water contamination in the state.

Pesticides may contaminate ground water from improper application, disposal of incompletely rinsed containers, and runoff or seepage from storage, mixing, loading or spray tank cleaning areas. Recently, there has been increasing concern about movement of pesticides through the soil into ground water when pesticides are applied to fields under normal farming practices.

Current LCMR funded surveys of sensitive ground water for pesticides are being conducted by the MDA and MDH. These surveys will provide initial, statewide information on ground water contamination by pesticides used in normal farming practices.

Pesticides can be transported to surface water by application of chemicals; drift from spray; erosion of pesticide treated soil; disposal of incompletely rinsed containers; and runoff from storage, mixing, loading or spray tank cleaning areas.

In addition to the lack of historic, comprehensive, systematically-gathered pesticide monitoring data, the following other factors make definition of the nature and magnitude of pesticide-related water quality problems and public health risks difficult to describe:

a. Physical and chemical mechanisms influencing pesticide movement and fate in soils and ground water are complex and not completely understood;

b. Pesticides found in water from indirect sources of contamination (i.e. normal farming practices) are usually observed in trace amounts. The presence of low levels of pesticides is significant but the public health/environmental implications are not always clear;

c. Except for 2,4-D, water quality/drinking water standards have not been established for the most commonly used pesticides in Minnesota;

d. Laboratory capabilities for detection and verification of potentially significant trace amounts of pesticides are improving but still limited, and analytical costs are high.

Fertilizer:

The three primary plant nutrients applied to crops are nitrogen, phosphate and potassium. For the year ending June 1984, Minnesota consumption of primary plant nutrients in fertilizer totaled 1.65 million tons. Past attention addressed phosphorus runoff to lakes and its associated eutrophication.

Serious and occasionally fatal blood disorders (commonly called "blue baby syndrome" or methemoglobinemia) have occurred in infants less than 6 months of age following ingestion of well waters containing nitrate at concentrations greater than 10 milligrams per liter as nitrate-N. As a result, a maximum contaminant level of 10 milligrams per liter as nitrate-N has been established for nitrate in public drinking water supplies. The same number is a recommended action level for private suppliers.

High nitrate levels in ground water have usually been associated with septic tank/drainfields or feedlots. Historically, nitrogen has been applied for crop production purposes at rates to achieve maximum economic return. Some studies have pointed to fertilizer and manure nitrogen as sources of elevated nitrate concentrations in rural ground water supplies.

Recommended Policies and Programs:

a. Research and Monitoring

1) It is recommended that permanent surface and ground water/drinking water monitoring programs for pesticides commonly used in Minnesota should be established, maintained and adequately financed, and that agencies should coordinate their monitoring efforts. Data generated from these programs and other relevant monitoring efforts should be entered into a statewide data management system.

2) It is recommended that the MDA and MDH state laboratory analytical capabilities be expanded and improved for detecting trace levels of pesticides.

3) It is recommended that further research and information concerning health effects/health risks and fate of pesticides in the environment and ground water/drinking water be initiated.

4) It is recommended that best management practices for pesticide and fertilizer use should be developed and evaluated for Minnesota conditions by the University of Minnesota.

5) It is recommended that, in addition to the existing accounting system for restricted use chemicals, the Minnesota Department of Agriculture should establish a survey system to determine and quantify general distribution and use of pesticides in Minnesota.

6) It is recommended that the MPCA, MDA, MGS, MDNR, MDH cooperatively identify areas of the state which are vulnerable or particularly sensitive to pesticide contamination and analyze and map historical and current pesticide use, soil and aquifer properties, and existing water quality data. These areas should be factored into the state ground water protection strategy and identification of priority watersheds.

b. Information and Education

1) It is recommended that the University of Minnesota survey the public perceptions and needs pertaining to pesticide and fertilizer use and their environmental effects. The state agencies should develop and promote public education and information efforts aimed at these perceptions and needs, especially related to public health. These activities should be conducted in accordance with the water resources communication strategy to be developed by the EQB - Water Resources Committee.

2) It is recommended that the Minnesota Extension Service transfer the technical data to practical demonstration and educational efforts directed at the use of pesticides and fertilizers, including the environmental and economic returns of best management practices.

c. Regulation

1) It is recommended that the Minnesota Department of Health establish a certification/accreditation program for laboratories conducting water quality analysis, especially for pesticides.

2) It is recommended that federal water quality standards be established for commonly used pesticides, and Minnesota water quality standards or recommended action levels be established for significant pesticides not included in federal standards.

3) It is recommended that the Minnesota Pesticide Control Law administered by MDA be amended and strengthened by the Legislature to achieve improved control over application and enforcement of pesticides.

4) It is recommended that the Minnesota Department of Natural Resources increase and strengthen their enforcement of pesticide use under aquatic nuisance control regulations.

d. Funding

1) It is recommended that an annual pesticide registrant license fee and product registration surcharge be dedicated to funding ground water/drinking water monitoring, health and environmental assessment and education programs.

2) It is recommended that the MDA fertilizer tonnage tax be increased to fund or support research and education programs related to fertilizer management and water quality problems.

3) It is recommended that the Legislature should continue to appropriate funds to the University of Minnesota for research on the impacts of agricultural pesticide and fertilizer use on water quality.

TOPIC 2: Agricultural Runoff

Nature and Magnitude of the Problem - Sediment, nutrients, oxygen-consuming substances and microbiological contaminants are pollutants from agricultural land use.

By volume, sediment is the pollutant entering Minnesota's waters in the greatest quantity. Cropland erosion is the major source of sediment. According to the 1982 National Resources Inventory, prepared by USDA Soil Conservation Service, approximately 153 million tons of soil are eroded each year in Minnesota as a result of wind and water. One hundred and forty-eight million tons or 96% of this erosion occurs on Minnesota's cropland, even though the state's 23 million acres of cropland represents only 43% of the state's rural land. Twelve million eight hundred thousand acres of cropland are in serious need of erosion control.

While much of the resultant sediment is deposited close to its point of origin, a significant amount enters the waters of the state contributing to their degradation. Water quality data from monitored waters in the major farming areas of the state show that levels of sediment frequently are high enough to cause serious water quality problems and frequently exceed the criteria indicative of good conditions for aquatic life. These areas include the Minnesota, Missouri-Des Moines, Cedar and portions of the Red and Mississippi River basins. In these watersheds the sediment levels markedly exceed those of non-farming watersheds. This sediment also transports appreciable quantities of phosphorus and some pesticides.

Phosphorus impacts on lakes and lake eutrophication are a major water quality concern in Minnesota. Essentially all monitored lakes in predominately agricultural basins of Minnesota are in a eutrophic condition, characterized by excessive algae and or weed growth. While agricultural practices are not the only cause of the eutrophic conditions of many of the state's lakes, reducing phosphorus in runoff from farming can be a means of protecting lakes from further degradation.

Improper manure storage and handling, improper manure/commercial fertilizer management can contribute to surface water pollution by ammonia, oxygen-consuming organic materials or microbiological contamination and lead to ground water pollution by nitrates or bacteria, particularly in the Karst areas of southeastern Minnesota and in southwest Minnesota.

Water quality data show that microbiological contamination, measured by fecal coliform counts, frequently exceed state standards in the areas of the state devoted to agriculture. There is some threat to ground water as well, especially in the Karst areas of southeast Minnesota.

Direct access of livestock to streams and lakes cause serious surface water problems from ammonia, oxygen-consuming organic materials or micobiological contamination from animal wastes. Livestock also trample banks and vegetation, and causing streambank erosion and stir-up bottom sediment, destroying stream vegetation and fish habitat.

To date, the emphasis of research and erosion control programs has focused on limiting soil losses to "tolerable" levels for maintaining soil productivity. To achieve water quality goals, emphasis must also be placed on the cost of water quality damages of agricultural runoff.

The adoption of water quality and soil erosion management practices by individual land managers is the key to solving water quality and soil erosion problems. Dr. Peter J. Nowak, Associate Professor, University of Wisconsin, has made the following generalizations from research on farmer attitudes toward adoption of conservation practices.

a. Land managers often fail to accurately identify resource problems and fail to recognize the consequences of their management practices on natural resources.

b. There is confusion about the roles and responsibilities of the different agencies responsible for resource management.

c. Land managers often base decisions on management practices on inaccurate beliefs, including inaccurate economic information, perceived problems and the requirements associated with receiving technical and financial assistance.

Controlling the agricultural runoff problem requires targeting scarce resources to get maximum water quality protection. Such targeting efforts must use state of the art techniques rather than simple geographical distributions. It will also require that information and education programs become a priority and be designed to address the barriers to land managers adoption of management practices, identified above. Finally, a strong delivery system which is accepted by the agricultural community is necessary to provide direct assistance to farmers and other land managers.

Recommended Policies and Programs:

a. Research and Monitoring

1) It is recommended that in order to target limited resources to get maximum water quality protection, the MPCA, with the cooperation of appropriate state agencies, prioritize the receiving waters of the State for susceptibility to nonpoint sources of pollution.

2) It is recommended that an integrated water quality and land use information data base be established and organized by hydrologic units and maintained to facilitate water quality planning and management in Minnesota. This activity should be coordinated by the State Planning Agency - Planning Information Center.

3) It is recommended that the legislature require, by July 1990, all counties not participating in the cooperative soil survey program initiate agreements to begin a detailed soil survey, despite not being eligible for funding from LCMR after July 1987. Additionally, one year after completion of soils mapping, all

soil surveys should be digitized so this information can readily be used as a basis for resource management decisions. Increase funding at the federal, state and local level should be provided to complete soil surveys. Funding for digitization should be provided by the State Legislature to assist counties in this effort.

4) It is recommended that the MPCA adopt agricultural Best Management Practice Standards for water quality and develop them in cooperation with SWCB, MDA, U of M, SCS, MDH, DOT, MES and other interested agencies.

b. Information and Education

1) It is recommended that the Minnesota Extension Service, in cooperation with other interested agencies and organizations, should develop a local water quality leadership training program to develop the capabilities of local leaders to address issues and solutions to effectively protect water quality.

2) It is recommended that the MPCA, SWCB, Minnesota Extension Service and SCS develop and refine a marketing approach to information and education, by developing materials and programs to provide the resource managers accurate information on the water quality problems associated with some agricultural management practices, alternative solutions and roles and responsibilities of the various resource management agencies. This effort should be conducted in accordance with the water resources communication strategy to be developed by the EQB - Water Resources Committee.

3) It is recommended the Minnesota Extension Service focus attention on the water quality impacts associated with agriculture and develop educational programs emphasizing the economic and environmental benefits of best management practices.

c. Regulation

1) It is recommended that by July 1, 1988 the SWCB prepare a report on the participation in the state's soil loss limits law. If it has not been widely adopted, the Legislature should make it mandatory for counties to adopt an erosion control ordinance in accordance with the law.

2) It is recommended that the State of Minnesota require vegetative filter strips be maintained adjacent to all protected waters and public ditch systems and that the MDNR should develop and administer enforcement procedures to ensure this.

d. Funding

1) It is recommended that the Administration and Congress appropriate funds to the USDA, Soil Conservation Service to continue to provide technical assistance to individual landusers, state and local units of government. Technical support should be maintained at the local, area (multi-county), state and regional (multi-state) levels within the SCS's current delivery system. Overall funding levels for SCS should be increased, including funding for water quality programs.

2) It is recommended that the Minnesota Legislature provide additional funding to the MPCA and SWCB to provide the technical assistance needed to implement the state's water quality goals.

3) It is recommended that the State of Minnesota focus additional funds through the SWCB cost-share program for water quality goals. The program should be adjusted to reflect water quality goals by using magnitude of problem and cost of treatment data, which should be generated by the MPCA, SWCB and other affected agencies.

4) It is recommended that the Federal Conservation Reserve Program and the State Reinvest in Minnesota Reserve Program should be funded to establish permanent vegetation on at least 2.5 million acres of the state's marginal cropland. Priority should be given to those marginal lands which are contributing to NPS pollution.

5) It is recommended that the Administration and Congress continue to support and fund the sodbuster and swampbuster provisions of the 1985 Federal Farm Bill.

6) It is recommended that the SWCB should provide assistance to Soil and Water Conservation Districts to continue to develop their ability to provide technical assistance and program delivery to meet the increasing complexity and number of local resource management needs.

TOPIC 3: Animal Feedlots

Nature and Magnitude of the Problem - Pollution from feedlots occurs when surface water runoff from a feedlot carries pollutants from the accumulated animal manure into ground and surface water.

The pollutants include:

Phosphorus and nitrogen compounds which may cause a variety of problems. Phosphorus accelerates the enrichment of lakes and eutrophication. Animal manure and feedlot runoff can be a major source of phosphorus. Untreated municipal sewage typically has a phosphorus content around 8 milligrams per liter, while feedlot runoff is 85 milligrams per liter. Cattle or hog manure may be 2,500 milligrams per liter and is a serious pollutant source. Nitrogen compounds, such as ammonia, which can be toxic to aquatic life, and nitrate, which can cause methemoglobmemia in human infants, are also concerns, especially in ground water.

Organic compounds are also serious pollutants because they cause a depletion of oxygen in water. This depletion of oxygen can cause fish kills and odors. Untreated municipal sewage typically has an oxygen demand (BOD) around 250 milligrams per liter, compared to feedlot runoff which is 4,500 milligrams per liter and cattle or hog manure which may be 50,000 milligrams per liter.

Microorganisms, some of which are pathogenic and cause disease in humans as well as other animals.

The potential for pollution from animal manure and feedlot runoff can be clearly seen by the strength of the waste. In addition, the number of feedlots increases the potential for problems. The 1980 208 Plan estimated that there were as many as 90,000 feedlots in Minnesota; of these 9,000 to 14,000 were located in shoreland areas and considered to be pollution hazards. Using 1984 agricultural statistics, we can infer that there are probably between 70,000 and 80,000 feedlots in Minnesota today, with a slightly smaller proportion causing pollution problems. Although the trend has been toward fewer feedlots, they tend to be larger, more concentrated operations.

During 1977 and 1978, forty Soil and Water Conservation Districts were contracted to undertake a feedlot survey aimed at quantifying the number and pollution potential of feedlots in shoreland areas. Ninety five percent of the 5,100 feedlots surveyed in shoreland areas were determined to be "potential pollution hazards". The study concluded that the seriousness of a feedlot's threat to water quality depends upon the operator's current management practices, the characteristics of the receiving water, and the physical setting of the feedlot. Certain areas of the state are more subject to water quality degradation than others, especially the karst area in southeastern Minnesota. Many counties were identified as having surface waters highly subject to degradation as a result of phosphorus enrichment in deeper lakes and excessive BOD loadings.

Existing Programs:

In 1971, the MPCA established a feedlot permit program. Revised in 1979, the feedlot rules require a farmer to apply for a permit when any of the following conditions exist:

a. a new animal feedlot is proposed; or
b. a change in operation, modification, or expansion of an existing animal feedlot is proposed; or
c. ownership of an existing animal feedlot is changed; or
d. a National Pollutant Discharge Elimination System (NPDES) permit is required under state or federal rules.

A farmer must also apply for a feedlot permit when an inspection by the MPCA staff or a county feedlot pollution control officer determines that the animal feedlot creates or maintains a potential pollution hazard. At the present time, an estimated 15,000 feedlots are permitted.

By requiring a farmer to apply for a permit whenever he is starting or purchasing animal facilities or investing in changes to his existing operation, the program can prevent the creation of new pollution problems from feedlots. Also, if a pollution problem does exist, the most appropriate time to ask for corrective action to be taken by the land owner is when an investment is being made in the operation.

The feedlot program rules provide for a cooperative program between counties and the MPCA, which allows the County Board to request authority to issue most feedlot permits. This provides an excellent mechanism to coordinate local zoning with the feedlot rules. The cooperative county-state program is effective because it enables local involvement and insight on problems, and provides close coordination between state and local programs. At the present time, 22 counties participate.

For the feedlot permit program to be effective, it requires not only good county-state cooperation, but also close coordination between other state and federal agencies involved in feedlot pollution control. The Agricultural Stabilization and Conservation Service (ASCS), Soil Conservation Service (SCS), Soil and Water Conservation Board (SWCB), and MPCA have entered into an interagency agreement to coordinate their animal waste control programs so that federal and state cost-share funds, technical assistance programs, and the state permit program will work together efficiently. The ASCS and SWCB each have cost-share programs to provide incentives to install pollution control equipment. The SCS and Soil and Water Conservation Districts (SWCD) provide technical assistance. The MPCA permit program acts as a catalyst to bring farmers into these programs by adding a regulatory incentive.

An additional financial incentive was available in the past in the form of a 10% state income tax credit for qualifying pollution control equipment. This credit was eliminated during a recent effort to simplify the tax forms.

Recommended Policies and Programs:

a. Research and Monitoring

1) It is recommended that the MPCA, in cooperation with the USDA-SCS, SWCB and Association of Minnesota Counties, develop model ordinances for counties and townships for land application of manure.

2) It is recommended that the U of M, in cooperation with USDA-ARS and SCS, MPCA and SWCB, conduct research on alternative feedlot runoff treatment systems, with minimum operating and maintenance costs. Additional research is also needed to determine the effectiveness of vegetated buffer strips for treating spring runoff under frozen soil conditions.

3) It is recommended that a statewide feedlot survey be done, to reassess the extent of feedlot pollution problems, and to identify areas which will require special attention to minimize water quality problems related to feedlots.

4) It is recommended that the MPCA examine how participation in the county feedlot permit program can be increased.

b. Information and Education

1) It is recommended that the MPCA initiate a statewide educational effort to increase the public awareness of the environmental problems associated with animal waste and increase the proportion of feedlot operators aware of the feedlot permit program requirements and assistance available to solve problems. These activities should be conducted in accordance with the water resources communication strategy to be developed by the EQB - Water Resources Committee.

c. Regulation

1) It is recommended that the DNR shoreland rules be revised to include a requirement that a feedlot permit be obtained before a conditional use permit for a feedlot in shoreland areas can be granted.

d. Funding

1) It is recommended that the present USDA - Agricultural Conservation and Stabilization Service, Agricultural Conservation Program limit for individual animal waste control facilities be raised to provide adequate incentive for voluntary installation of feedlot pollution control practices. It is recommended that the funding levels for feedlots be raised to target 20% of ACP funds to feedlot pollution control systems.

2) It is recommended that the State of Minnesota appropriate additional funds to the SWCB for feedlot pollution control efforts, approximately equivalent to the amount of money which the defunct feedlot pollution control tax credit provided for pollution control each year.

TOPIC 4: Urban Runoff/Infiltration and Construction

Urban Runoff/Infiltration:

Nature and Magnitude of the Problem - Urban runoff pollution is caused by rain and snowmelt runoff picking up pollutants from an urban area. In some cases snowmelt or storm water runoff carries a pollutant load equal to or exceeding sanitary sewage. Five factors which influence the generation of runoff, the rate at which it flows, and the pollutant load are: precipitation, antecedent conditions, the percentage of impervious surface area, soil characteristics, and topography. Other activities in urban areas affecting the quality of runoff/infiltration include: traffic density; littering; fertilizer and pesticide use; atmospheric deposition; construction; animal wastes; landfills/dumps; surface impoundments; on-site sewage disposal; municipal/industrial sludge disposal; hazardous material/waste/spillage or leakage during generation, handling, storage and transportation; hazardous material/waste disposal; unauthorized waste disposal; salt application/storage, etc.

The pollutants present in urban runoff and infiltration impact both surface and ground water quality. The general impacts they have on water quality if deposited in excessive quantities include:

- Toxics: Heavy metals and many complex organic compounds are toxics to both humans and aquatic life. These compounds can also accumulate in bottom materials and in fish tissue where they may produce other chronic effects. The same substances may infiltrate and contaminate ground water/drinking water.

- Nutrients: High phosphorus levels can lead to excessive plant growth and poor water conditions. Some nitrogen compounds, such as ammonia, which is very toxic, and nitrate which may lead to fatal conditions in infants, are also very harmful nutrients.

- Bacteria: Fecal coliforms are present in animal wastes and may indicate the presence of other organisms harmful to humans.

- Suspended Solids: High levels of suspended solids contribute to turbid conditions, which retards plant growth and limits the use of waters by humans for recreation and consumption. Suspended solids may also smoother habitat critical to aquatic life and carry other absorbed pollutants.

- Oxygen-Consuming Materials: Adequate oxygen levels are essential to maintaining healthy aquatic systems. Wastes that are biologically or chemically active can deplete oxygen to very low levels.

Construction:

Nature and Magnitude of the Problem - Construction activities contribute significantly to water pollution by erosion, sedimentation and harmful materials that are moved from the construction site and enter water bodies by way of runoff. Housing, industry, commerce, recreation and transportation are the major categories of land use that involve new construction.

Construction activities can have an impact on water quality in three ways. First, disturbance of the natural land cover accelerates the process of erosion, which results in an increase in sediment pollution of water. The second potential area of water quality impact is caused by substances used on the construction site. These substances are carried away by runoff or adsorbed onto sediment which washes into surface waters. Examples are construction chemicals (paints, glues, preservatives, acid, cleaning solutions and solvents) oils, greases, petroleum products or residues of construction activities. The third type of potential water quality impact is the long term erosion problem caused by the inability of the completed development to adequately convey storm water runoff through or from the site. This may be caused by inadequate drainage design or the lack of water quality management practices.

Vegetation, climate, soils, and topography all interact in a complex way to make each site unique in its potential to generate pollutants. Soil erosion rates during the active construction phases of urban developments are often many times greater than on farmlands. Typical annual soil losses on croplands range from 3 to 10 tons per acre, while losses from construction sites may range from 30 to 750 tons per acre. The extremely high erosion rates usually occur on limited areas where surface runoff becomes concentrated.

Sediment lowers water quality for municipal, industrial and recreational uses and reduces the storage capacity of lakes and reservoirs. Sediment can pose serious health hazards by carrying potentially toxic substances such as petroleum products, pesticides and heavy metals to our water supplies. Sediments and toxic materials not only destroy fish and wildlife habitats, but also reduce values of streams and lakes which in turn reduce the value of adjacent property, especially in residential areas. Taxpayers and downstream property owners pay for the carelessness of construction site practices when sediment fills ditches, storm sewers and culverts, which must be cleaned at great expense. In addition, the loss of soil from the site causes increased costs of service roads, loss of fill material, and need to replace topsoil, which increases development cost and delays project completion.

Water quality damages and associated costs are needless and wasteful since practical and effective management practices can be used to avoid them.

Recommended Policies and Programs:

a. Research and Monitoring

It is recommended the state support continued research and monitoring on the water quality impacts of urban runoff/infiltration, the effectiveness of various control measures and assessment of the problem in Minnesota.

b. Regulation

It is recommended the MPCA, with the assistance of the SWCB, develop a storm water pollution control program. The regulatory program should meet the U.S. EPA storm water runoff requirements and include

guidelines that require local units of government, covered under the rules, to enact storm water runoff, erosion and sediment control ordinances for construction and development activities.

U.S. EPA regulations require dischargers to apply for NPDES permits pursuant to 40 CFR (122.21) for storm water discharges in urban areas. The MPCA would continue to issue NPDES permits for significant storm water discharges. The recommended program would allow the MPCA to issue general permits to communities that adopt a storm water, erosion and sediment control ordinance that would require installation and operation of BMPs, storm water planning for construction and development activities, and local inspection and enforcement. The program should be coordinated with the MDNR Protected Waters Permit Program.

Soil and Water Conservation Districts should serve as a technical resource to local communities, review and comment on local programs and perform inspections.

A community not enforcing their local storm water, erosion and sediment control ordinance would be out of compliance with their NPDES general permit and subject to MPCA enforcement procedures.

The MPCA and SWCB should develop a model ordinance, technical standards for best management practices, appropriate technical support materials and an information and training program in cooperation with MDOT, MDNR, SCS, WRB, Metropolitan Council, EPA, and other interested state and federal agencies.

* STORM WATER POLLUTION CONTROL PROGRAM LEADERSHIP RESPONSIBILITIES *

MPCA
- Apply effluent and water quality standards for storm water, erosion and sediment control where applicable
- Adopt acceptable technical standards and BMPs as permit requirements
- Administer NPDES permits
- Coordinate review and approve local programs
- Enforcement

SWCB and MPCA
- Develop model ordinances
- Develop acceptable technical standards and BMPs
- Ensure interagency coordination
- Information and education
- Review local programs

SWCB
- Develop and administer training programs

SWCB and SCS
- Provide technical assistance

WRB
- Coordinate Metropolitan Surface Water Management Plans and Local Water Plans with this program.

DNR
- Provide technical assistance on storm water runoff control
- Enforce Protected Waters Permit regulations

LOCAL GOVERNMENT RESPONSIBILITIES

Communities:
- Adopt ordinances, install and operate BMPs, administer and enforce local controls

SWCD
- Act as technical resource to local government and perform inspections as requested. Review and comment on local programs

c. Funding

1) It is recommended that funds be appropriated to the MPCA and SWCB to develop the recommended storm water pollution control program.

TOPIC 5: On-Site Sewage Systems

Nature and Magnitude of the Problem - Currently, there are over 230 Minnesota municipalities and numerous developed lakeshore and suburban areas without municipal sewer systems. Many of the homes in these areas have holding tanks or individual sewage treatment systems. In addition, many seasonal homes are being converted to permanent residences without consideration of the capabilities of their existing sewage handling system.

Holding tanks simply hold domestic wastes and must be pumped regularly. Individual sewage treatment systems, commonly referred to as septic systems, function by the natural decomposition of wastes on the site where they originate. Properly designed, sited, and operated, these systems will have a life span of 20 to 50 years. Improper design, siting and operation or the improper disposal of wastes removed from septic systems or holding tanks can lead to the contamination of the ground and surface water, threatening the public health and the quality of Minnesota's water resources. Individual sewage treatment systems are the source of many waterborne disease outbreaks cited by public health officials.

Septic systems are relatively simple, consisting of two components, an underground septic storage tank and drainfields. Wastewater first flows to the storage tank where it separates into solids and liquids. Bacteria decompose the solids in the tank creating a sludge that settles to the bottom or forms a scum and floats on the surface. The liquid portion flows from the tank to the drain field where it undergoes treatment by filtering and biological decomposition. Properly functioning septic systems rely on some dilution in the ground water. In improperly functioning systems, sludge may build up and untreated wastes may flow to the drain field and clog the soil pores. This results in the failure of the entire system. If the drain field is undersized or too close to the water table or if the soil is too coarse, there may be little or no attenuation of the contaminants in the liquid.

Both septic systems and holding tanks must be periodically pumped or cleaned to remove solids and other materials. The solids from septic systems have undergone some treatment and can be disposed of by proper land spreading. Care must be taken to prevent excessive loading of the land and the spread of disease. Wastes from holding tanks generally have not undergone extensive breakdown and additional treatment may be required for proper disposal of these materials.

Even systems that are properly designed and pumped at recommended intervals can cause water quality problems if homeowners place materials down the drains that kill the organisms providing biological decomposition of the wastes in the septic tank or the soils beneath the drain field. These materials include paints, solvents and cleaning agents, pesticides, and some so-called septic tank cleaners. Besides damaging the system, the materials themselves are potential ground water contaminants and may affect drinking water supplies.

Nitrate contamination of the ground water will occur even with a properly functioning system. In isolated areas nitrates from on-site sewage systems can generally be assimilated by the aquifer and will not exceed acceptable levels, i.e. the drinking water standard. There are, however, certain factors and combinations of factors that can easily result in nitrate contamination of local shallow wells beyond levels that are considered safe for human consumption. These factors include soil type, hydrogeologic setting, hydraulic gradient and development density. Development density is particularly important because of the cumulative addition of nitrate loading to a unit area.

On-site sewage systems may also be responsible for the addition of other nutrients to the ground or surface water. Along heavily developed lakeshore areas these nutrients may enter the lake via ground water discharge, surface breakout, and septic tank leakage. Once in the lake the nutrients can degrade lake quality through accelerated eutrophication.

Recommendations:

a. Research and Monitoring

1) It is recommended that additional studies be conducted to understand local and regional environmental patterns of on-site sewage system problems. Legislative funds should be made available to conduct studies on:

- Lake nutrient enrichment from lakeshore septic systems.
- The fate of toxic chemicals in on-site sewage systems.
- The effectiveness of large community or cluster development on-site sewage systems in controlling septic pollution.
- Sizing of on-site sewage systems.

b. Information and Education

1) The Minnesota Extension Service has been conducting a workshop/training program around the state for on-site sewage system installers, inspectors, sludge haulers and other interested individuals for several years. This workshop/training program has been well received by installers, inspectors and haulers from Minnesota and adjoining states and Provinces. Legislative funding should be made available to the Agricultural Extension Service to continue and expand this workshop/training program, particularly if certification becomes mandatory.

2) There is a recognized need to educate the general public on the proper operation, and maintenance of on-site sewage systems, especially with regard to toxic chemicals. A public service campaign and educational effort on the proper operation and maintenance of on-site sewage systems should be developed and conducted by the Minnesota Pollution Control Agency. These activities should be conducted in accordance with the water resources communications strategy to be developed by the EQB - Water Resources Committee.

c. Regulations

1) It is recommended that legislation be drafted and enacted to require certification of on-site sewage waste system installers and septage haulers. Training for certification should be provided through Minnesota Pollution Control Agency approved workshop/training programs.

2) It is recommended that MPCA adopt rules or plans for controlling septage handling and disposal. The U.S. Environmental Protection Agency has proposed a requirement that all states adopt such rules or standards.

3) To assure proper and uniform design, installation, and maintenance of on-site sewage systems in the state, it is recommended that the code be revised to reflect current technology and knowledge and required as mandatory statewide.

4) It is recommended that the MDNR establish more specific performance standards to guide county initiatives for eliminating nonconforming sewer systems in shoreland areas.

TOPIC 6: Hydrologic Modification

Wetlands:

Nature and Magnitude of the Problem - Wetlands protect water quality by reducing peak runoff and trapping sediment and nutrients. They also provide islands of aesthetic diversity in landscapes that may otherwise may be dominated by uniform land use, such as row crops or urban development. Wetlands also are recognized for their importance in providing vital habitat for fish and wildlife.

Most of these beneficial aspects of wetlands have gone unquantified for two reasons: a) they are difficult to evaluate in terms of dollars and cents; and b) they are often cumulative, that is, the destruction of an individual wetland may appear inconsequential unless considered along with other similar actions.

Public benefits are often diffuse and harder to define than the direct economic benefit realized by an individual converting a marsh or wetland into agricultural and or a building site. Therefore, the public benefit of wetland preservation often is lost. As a result, wetland losses between 1964-1974 revealed destruction of approximately 40% of the potholes in certain counties in western Minnesota.

Between 1974-1979, approximately 860 basins in several western Minnesota counties were drained (over 16% of all existing water basins in those areas). Despite continued efforts at improvement in the existing regulatory program over the last several years, a significant number of isolated wetlands, especially prairie potholes, peatlands, and type 1, 2, 6, 7 and 8 wetlands remain unregulated.

At the present time there are inconsistencies in the Minnesota statutes (106, 105 and 116) and programs and policies related to wetlands.

Recommended Policies and Programs:

a. Regulation

1) It is recommended that the Minnesota Legislature adopt a state wide policy to protect wetlands and water quality, which says:

"It is the policy of the State to minimize the destruction, loss or degradation of wetlands to preserve and enhance the natural and beneficial values of wetlands, and to avoid the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. Where no practicable alternative exists, appropriate mitigation, compensation or restoration must be rendered."

2) It is recommended the EQB - Water Resources Committee direct a task force to review state statutes, rules and programs to see if they are consistent with the above policy and make recommendations for revisions to state statutes, rules and programs inconsistent with this policy, by July 1, 1988.

3) It is recommended the EQB - Water Resources Committee direct a task force to recommend how programs can be administered consistent with the above policy.

Drainage Activities:

Nature and Magnitude of the Problem - Modernization of the state drainage code is in order. The recent modification of Minnesota Statutes, Chapter 106 did much to make the Drainage Code more easy to understand. However, the changes did not address the environmental concerns. The Minnesota Legislature has gone on record to include environmental concerns in drainage proceedings, but these have been largely ineffective. The process, as it currently exists, has raised questions dealing with equitable assessments; equitable representation at proceedings; determination of damages and benefits; wetland destruction and preservation; environmental concerns like those of flooding, water quality, erosion, sedimentation, land conversion and ground water recharge; and accountability for overseeing system facilities and performance of annual inspections. These issues have been raised above and beyond the question of consistency with environmental procedures and policies of the state.

Recommended Policies and Programs:

a. Research and Monitoring

1) It is recommended that the MDNR conduct an inventory of the state's public drainage systems.

b. Regulation

1) It is recommended that the EQB - Water Resources Committee direct a task force to review the Minnesota statutes related to drainage law (Chapter 106) in the following manner:

a) The statutes should acknowledge the benefit that wetland restoration and enhancement may have on long term water supply, reduce ditch maintenance costs, reduced flooding, recreation enhancement and the benefit to local economies.

The adequacy of land treatment measures should be considered in all drainage projects. The installation of best management practices to reduce soil erosion should be a prerequisite to establishment of new ditches as well as repairs and improvements to existing ditches. Rules related to those statutes should be revised to insure adequate environmental review of proposed drainage ditch projects. The public benefit and public welfare clauses of the statutes should closely reflect the concepts contained

in state environmental review processes Chapter 116(d) relating to conservation of soil, water, forest, biota and related natural resources of the state. Detrimental impacts to wetlands should be a consideration in the evaluation of public benefits. Criteria for consideration of the detrimental environmental impacts should be developed, including water quality impacts, consideration of downstream flooding, destruction of public and protected waters, destruction of fish and wildlife enhancement areas, adverse water quality impacts, and project related potential erosion by wind or water. Lost public benefits should be evaluated on an equal basis with benefits of development. All unavoidable impacts should be mitigated, compensated or restored as appropriate to offset the loss of public benefit, and the costs of such measures included as project costs.

2) It is recommended the EQB - Water Resources Committee direct a task force to develop rules for private drainage and include:

   a) Criteria to regulate private connections to public drainage systems on the basis of flow and quality,

   b) BMP's for construction and operation of private drainage ditches,

   c) requirements that all contributing drainage areas be adequately protected to reduce soil erosion.

Dredge and Fill:

Nature and Magnitude of the Problem - Dredge and fill activities affect both water quality and the overall aquatic environment. The traditional pollutants of concern, to water quality include suspended solids which may have associated chemicals. These chemicals may have potential for bioaccumulation and other toxic effects. The most prevalent impacts of dredge and fill activities are physical disruption of waters and wetlands and potential effects of resuspended polluted sediment in aquatic ecosystems. These activities can be grouped into two classifications: (1) maintenance, and 2) new dredge and fill activities. Activities classified as maintenance range from small projects by individuals to maintenance dredging undertaken by the U.S. Army Corps of Engineers. The extent of maintenance dredge and fill activities over the state has not been quantified, but the Corps of Engineers dredges about 1.5 million cubic yards annually in the navigation channels of the Mississippi, St. Croix, and Minnesota Rivers, and the Duluth Superior Harbor. New dredge and fill activities have an incrementally larger, more lasting impact. A major impact is from drainage ditch construction and reconstruction in the state. In addition, harbors and other dredging projects have secondary effects from development. Dredging also can have beneficial effects, such as those associated with lake restoration projects.

Recommended Policies and Programs:

a. Research and Monitoring

1) The Minnesota Department of Natural Resources, MPCA, and U.S. Army Corps of Engineers should encourage governmental agencies and private dredgers, by permit policy and other measures, to utilize dredging methods which have a potential for less environmental impact than the existing practices. The agencies should study and adopt best management practices for dredge and fill activities.

2) The MPCA and the U.S. Environmental Protection Agency should study and develop specific guidance for the disposal of dredge material which will provide protection against ecological impacts of such disposal, especially the biological impacts of toxic discharges and their bioaccumulation.

TOPIC 7: Forestry

Nature and Magnitude of the Problem - The study of the relationship of forestry activities to water quality in Minnesota indicates that water pollution is not generally severe in forested areas, however an extremely high proportion of highly classified waters occur in forested areas. Therefore, whenever pollution does occur from forest activities, it is likely to harm a high-quality environment.

While forestry and other activities common to forested lands in Minnesota do not appear to constitute a frequent or widespread threat to water quality, certain practices, if done carelessly or improperly can cause localized detrimental effects on the valuable and relatively sensitive ecosystems common to most Minnesota forested areas.

Forestry activities in Minnesota identified as potential causes for water quality degradation include:

- construction of roads in forest land
- recreational activities
- clearing for fire breaks
- timber harvest operations including skidding of logs and development of landing areas
- mechanical site preparation
- prescribed burning for site preparation
- application of pesticides for site preparation

There are known effective management practices for controlling and preventing pollution from forestry activities. Forested lands in Minnesota are sixty-three percent public, managed by the United States Forest Service (USFS), MDNR, or counties, and thirty-seven percent under private ownership. The USFS, MDNR and counties have sufficient authority to protect water quality by regulating activities occurring within public forested lands. Establishing effective forestry management practices on private land is the primary concern for continued water quality protection from forestry activities.

Recommended Policies and Programs:

a. Information and Education

The MDNR, SWCB and SWCDs should continue to provide information and training to inform counties and private landowners, and assist them in implementing erosion and sediment control and best forest management practices.

b. Regulation

To control private forest management practices in shoreland areas, counties should adopt and implement a shoreland management ordinance which requires:

1) a vegetated buffer strip be left between the ordinary high water level and the cutting area during timber harvest and reforestation the strip should be of sufficient width to effectively filter sediments out of surface runoff;

2) landing or yarding areas and skid and haul roads when located on shoreland areas, must be designed and managed to minimize water quality impacts;

3) a no clear-cutting provision should be incorporated into the State's Shoreland Management Rules;

4) a reforestation plan for reestablishment of desired forest species after timber harvest which minimizes erosion into public waters.

c. Funding

It is recommended that the State of Minnesota appropriate additional funds to the Minnesota Forest Improvement [(forestry cost-share)(PFM)] Program for establishment of best forest management practices on non-industrial private woodlands for the protection of the environment.

TOPIC 8: Mining Runoff

Nature and Magnitude of the Problem - Mining has been, and probably will continue to be, a major industry in Minnesota. A variety of minerals and other substances including ferrous metallic minerals (natural iron ore, taconite), sand and gravel, building stone, non-ferrous metallic mineral ores (copper, nickel, gold...), peat, and uranium ore have the potential to be mined. Mining includes all or any part of the process of removing, stockpiling, processing, storing, transporting, and reclaiming any material in connection with the commercial production or extraction of minerals or other substances (DNR, 1977).

Sand and gravel excavation is Minnesota's most widely occurring mining activity. Sand, gravel and building stone mining operations may generate significant amounts of suspended solids, which may have direct adverse water quality effects or contribute to turbidity. In 1977, the Metropolitan Council conducted a water quality management study of sand and gravel mining in the Twin Cities Metro Area which has a concentration of these operations. While this study found that rainfall runoff from these operations is not a significant source of pollutants, there is a need to develop a consistent approach to assist local units of government in regulating these operations.

Natural iron ore and taconite mining occur primarily on the Mesabi range, and to a lesser degree on the Cuyuna range. The principal water pollutants which result from active taconite and iron ore mining are suspended solids (which also contribute to turbidity), and dissolved metals (primarily iron). In certain areas, fibers are also a pollutant of concern. These pollutants may be released during the mining operation, during processing, or from tailings basins and waste rock or lean ore stockpiles. All of these pollutants are potentially harmful to aquatic life at certain levels.

Left behind by past iron mining operations, there are many abandoned iron ore piles and tailings ponds containing surface, overburden rock, lean ore, and tailings in northeastern Minnesota. Some of these sites may become operative again. Others will probably remain abandoned. If disturbed, these wastes could be sources of suspended solids and dissolved metals.

Non-ferrous metallic mineral deposits of possible commercial significance extend across the northern part of the state. Prospecting and exploration has been limited by the thick layer of surface overburden covering much of the potentially mineralized rock. If these ores are discovered and mined, there may be adverse effects on the water quality of this area. These ores contain substances, such as heavy metals, which cause toxic conditions and sulfides which can seriously alter the acidity of receiving waters. Examples of heavy metals which can be associated with this type of mining include cadmium, copper, zinc, lead, cobalt, nickel, arsenic and mercury. In addition, certain mining wastes can cause impacts due to the presence of processing additives. An additive of particular concern is cyanide. While there is existing knowledge about what type of pollutants could be expected and what the water quality effects could be, further information is needed with respect to what control technologies should be utilized to abate adverse effects on water quality.

Minnesota contains an estimated 7.5 million acres of peatland, the largest peat area of any of the lower 48 states. The state owns or administers an estimated 50% of these peatlands and is therefore in a strong position to influence any development (SPA, 1978). Monitoring data have indicated the potential for water quality impacts resulting from the drainage of peatlands. The pollutant of primary concern is suspended solids. However, for the drainage of sphagnum peatlands, acidity is also of concern.

Recommended Policies and Programs:

a. Research and Monitoring

1) It is recommended that the Soil and Water Conservation Board (SWCB) should lead an interagency task force in developing technical guidelines for regulation of existing and abandoned sand and gravel operations by local governments. These technical guidelines should include, but not be limited to, control of runoff, sedimentation, and reclamation procedures.

2) It is recommended that the DNR continue existing field studies which are designed to control the leaching of heavy metals from non-ferrous mine wastes and evaluate the various control techniques being implemented in Minnesota and other states.

3) It is recommended that research be conducted on control technologies for discharges from peat mining operations.

4) It is recommended that the DNR and MPCA should cooperatively investigate potential ground and surface water quality impacts resulting from the disposal of wastes generated by the processing of non-ferrous metallic minerals. Particular emphasis should be given to investigating the water quality impacts from those processes which utilize cyanide.

5) It is recommended that the MPCA continue their monitoring efforts and support monitoring of mining activities conducted by other state and federal agencies.

b. Regulation

1) It is recommended that the MPCA and DNR continue to regulate mining operations through the existing NPDES/SDS, mineland reclamation and DNR Division of Waters permit programs.

2) It is recommended that the MPCA and DNR coordinate their regulation of mining operations so as to minimize regulatory overlap and duplication.

TOPIC 9: Highway De-Icing Chemicals

Nature and Magnitude of the Problem - The stockpiling and application of highway de-icing chemicals, primarily sodium chloride, can have detrimental impact on surface and ground water quality. Evidence indicates that intensive or concentrated application of salts to roadways can cause water quality problems, particularly in small lakes and streams. There are no known cases of ground water contamination in Minnesota from de-icing application. Application of de-icing salts to roads in rural areas appears unlikely to cause water quality problems. The potential for pollution occurring from the application of de-icing chemicals is more difficult to determine than the potential of pollution from stockpiles. There have been numerous documented cases of surface and ground water contamination caused by runoff from inadequate stored stockpiles of salt and sand mixed with salt. One study estimated if all storage inadequacies were eliminated, over 80 percent of the reported cost to the environment from the use of de-icing chemicals could be eliminated.

In 1977, MNDOT established a policy regarding their storage of salt and sand/salt mixtures in order to reduce the potential for surface and ground water contamination near its stockpile sites. This policy is based on recognized best management practices and requires that:

a. all salt and sand/salt mixtures be placed on bituminous pads which must be sloped to prevent surface water from draining through the stockpiles;

b. all salt piles be covered with polyethylene if not stored in a shed, and all sand/salt mixtures be moved to empty salt sheds or covered during spring and summer;

c. any runoff from the stockpiles be contained.

There are currently 213 sites to which MNDOT has salt delivered during the fall and winter. Of the 213 sites, 208 have some type of storage sheds. At the remaining 5 sites, the salt piles are kept covered with polyethylene at all times and the sand/salt mixtures are kept covered during the non-use months.

A survey conducted by the Minnesota House Committee on Transportation, Science and Technology revealed the following about county and municipal storage practices:

	Counties Responding		Storage Method (%)		
	%	(No.)	In. Bldg.	Under Tarp	In Open
County	77	(66)	51	13	36
Municipal	54	(52)	38	11	51

The pollution potential from county and municipal storage should be considered high because of the large percentage of open uncovered sites. The Minnesota Legislature enacted Statute 160.215 in 1971 in an attempt to minimize damage from application of de-icing chemicals. This statute

established guidelines for the application of de-icing chemicals. MNDOT believes that their current application rates and procedures are in compliance with the established guidelines and cannot be significantly improved given current technological and fiscal constraints without detrimental decrease in the level of service provided. MNDOT does continue research in an attempt to improve its ice removal practices.

Based on available information, it appears that efforts to assess and minimize the potential for surface and ground water contamination due to highway de-icing chemicals would be best directed towards improving storage practices at those state, county and municipal storage facilities where they are found to be inadequate.

Recommended Policies and Programs:

a. Research and Monitoring

It is recommended that the Minnesota Legislature continue to support the Minnesota Department of Transportation's research efforts on alternative highway de-icing chemicals.

b. Information and Education

It is recommended that MNDOT develop and implement an educational package on management practices for storage and application of highway de-icing chemicals, that may be used to train state and local staff.

c. Regulation

1) It is recommended that the Minnesota Legislature enact legislation adopting the MNDOT storage policy as a minimum standard for salt storage sites across the state. This requirement would apply to the Minnesota Department Transportation, counties, municipalities and urban townships of 5000 or more in population.

a) When locating new salt or sand/salt mixture storage sites, the proximity of the site to existing water wells, lakes, rivers, streams, ground water recharge areas and flood-prone areas must be considered; the use of such areas for stockpiles must be avoided whenever possible.

b) All salt and sand/salt stockpiles must be placed on impervious pads constructed to hold all stored material and to drain all runoff to a holding tank or basin.

c) Impervious pads should be constructed for enclosed stockpiles to prevent surface water from running through the base of the pile.

d) All salt/sand mixtures should be moved to salt sheds at season's end. If sufficient enclosed space is not available, the mixture should be covered during the spring and summer. All mixtures remaining on the site through the warm months should be enclosed or covered as soon as possible, but not later than May 1; they should remain covered until October 1.

2) It is recommended that the MPCA require NPDES permits and identify best management practices for private firms that stockpile large amounts of highway de-icing chemicals that have the potential for surface and ground water pollution.

TOPIC 10: Special Erosion Problems

Roadside Erosion:

Nature and Magnitude of the Problem - Roadside erosion is occurring along many established roads in Minnesota. A 1973 study estimated that 4.3 million cubic yards of soil have eroded from road ditches in Minnesota. Areas of the state with the most serious roadside erosion problems generally have high concentrations of lakes and streams. Roadside erosion was found to be caused by:

- Inadequate design for drainage from land adjacent to roadsides (drainage from parking lots, county and judicial ditches, agricultural drainage, open ditches etc.)

- Poor maintenance practices -Use of roadsides by recreational vehicles (four wheel drive vehicles, dirt bikes, snowmobiles, and other all terrain vehicles or off the road vehicles);

- Use of roadsides for utilities construction, livestock moving or crop planting; and

- Lack of vegetation established during construction.

The full extent of the roadside erosion problem is difficult to assess at any one time because new erosion sites are developing continually. Sediment lowers water quality for municipal, industrial and recreational uses and reduces the storage capacity of lakes and reservoirs. Sediments not only destroy fish and wildlife habitats, but also reduce values of streams and lakes, which in turn reduce the value of adjacent property. Roadside erosion also causes excessive maintenance costs and produces unsafe highway conditions.

A number of road authorities exist in Minnesota: the MNDOT, counties, municipalities, and townships. Each is responsible for setting maintenance policies for roads under its authority. Local units of government lack adequate financial and physical resources to correct the existing roadside erosion problems. Therefore, the existing management structure does not adequately address the roadside erosion problem.

Streambank and Lakeshore Erosion:

Nature and Magnitude of the Problem - Many human activities contribute to accelerated streambank and lakeshore erosion. A 1978 study estimated 1524 miles of eroded streambanks and 165 miles of eroded lakeshore in the state. Streambank and lakeshore erosion are accelerated when activities increase water volume and velocity or destroy the actual bank and the vegetative cover which acts to limit erosion. Streambank and lakeshore erosion are significant since the sediment directly enters water resources.

Often as a part of urban and rural development, stream channels are realigned and straightened, resulting in a steeper stream gradient which increases the velocity and flow of potential erosive action. Urban and rural development may also increase volume and velocity of water entering a stream resulting in more streambank erosion. Livestock with direct access to waters trample the bank and stream bottoms and destroy vegetation exposing bare soil to erosion during rainfall and increase water temperature.

Shaping of banks and replacing trees, shrubs and grass can be effective treatment techniques for less severely eroding streams or lakeshores. More structural controls may be used in areas with severe erosive forces. Fencing is often needed to keep cattle and other livestock away from banks and out of water.

Recommended Policies and Programs:

a. Information and Education

It is recommended that a public information and education program be initiated by the SWCB and the MNDOT to address activities that cause roadside erosion; i.e. inadequate design for drainage from land adjacent to roadsides; use of roadsides by recreational vehicles; guidelines to counties and municipalities on seeding construction sites.

b. Funding

1) It is recommended that the Administration and Congress appropriate funds to the Soil Conservation Service's Resource Conservation and Development (RC&D) Program to provide assistance to local units of government to assess erosion problems, design control plans, and finance corrections to address some of the state's streambank, lakeshore and erosion control needs.

2) It is recommended that the State of Minnesota appropriate additional funds to the Soil and Water Conservation Board's cost-share grant program for streambank lakeshore and roadside erosion control projects. This program began as a demonstration project funded by the Legislative Commission on Minnesota Resources and as a result of its success, it was authorized as a permanent program during the 1979 Legislative session. The program provides financial assistance to local units of government for the cost of controlling erosion occurring along streambanks, lakeshores and roadsides. Program funding has ranged from $250,000 to $0 annually since 1979. The SWCB has received in excess of $500,000 of project requests in some years.

RECOMMENDATION C: Local Assistance

It is recommended that a program be established to provide financial assistance to local units of government to carry out local water quality management activities. This assistance should be made as part of a comprehensive program of financial assistance for local water resources planning and management capabilities.

In most of the topics of Recommendation B, there is need for local leadership and involvement. This is a direct result of the importance of local knowledge and authorities in achieving nonpoint source pollution control.

To provide local units of government an incentive to become active in protecting water quality using their planning, zoning, official controls, authorities, local knowledge, information and technical resources, a program should be established to provide funds for water quality management activities, local staff and related administration. The funding should be administered through the county, although it may be used to fund activities and staff of other local units of government including SWCD, WD, municipalities, etc. to:

1. develop local water plans authorized or required by Minnesota Statutes, Chapter 110B, 112 or 473.775-.882,

2. participate in the County Feedlot Permit Program,

3. provide follow up and enforcement of shoreland management ordinances,

4. provide Soil and Water Conservation District technical assistance to local units of government and individuals for land and water resources management,

5. improve local regulation of onsite sewage treatment system installation, operation and maintenance,

6. provide local regulation and assistance for forestry management practices to control erosion and sediment in shoreland areas, and

7. other activities related to water quality protection and management.

Each county participating would be required to submit an annual report of activities and a proposal of activities for the following year. This program should complement and coordinate with the MDH Community Health Services Program as well as other local, state and federal programs related to water resources management. A portion of the program funds should be reserved for state agencies to provide assistance for local activities.

RECOMMENDATION D: NPS Program Coordination and Evaluation

It is recommended that the Minnesota Pollution Control Agency provide overall coordination of programs and activities used to control nonpoint sources of pollution and evaluate the effectiveness of those programs in meeting Minnesota's water quality goals.

Effective implementation of nonpoint source pollution control in Minnesota requires close coordination between the state agencies (15), federal agencies (over 10), and local units of government (over 2,870) with authorities and programs related to water quality and land use management (Appendix E), if it is to successfully provide a network of services designed to reach land managers for the purpose of water quality protection and improvement. To accomplish coordination, the MPCA should work through the EQB - Water Resources Committee to develop a document which defines the various agency roles and responsibilities. Memoranda of Agreement should be developed to formalize interactions. In addition, each of the agencies should compile an annual report which documents their water quality activities and accomplishments so the MPCA can compile a biennial progress report on progress of NPS activities.

Every six years, the MPCA, with the cooperation of other state agencies, should report to the EQB - Water Resources Committee on the effectiveness of programs in controlling NPS and recommend adjustments to programs where necessary.

APPENDIX A

A Survey of Local Resource Managers on NPS Pollution

A Survey of Local Resource Managers on NPS Pollution

INTRODUCTION

Nonpoint sources (NPS) of pollution are land use or land mangement activities that contribute to runoff, seepage or percolation or contribute to the pollution of runoff, seepage or percolation and are not discharged by a specific conveyance system such as a pipe. To focus control and protection programs on NPS pollution, an evaluation of the problem is needed. This evaluation must be systematic, comprehensive, and it must consider site-specific conditions. The site-specific experience of local resource managers and their staff is very important for this assessment.

The State of Michigan, in a priority setting excercise, developed a procedure in which area resource managers were instrumental in identifying NPS pollution problems. Michigan developed a survey in which area managers were asked to list the important waterbodies under their management that were impacted by NPSs of pollution. They were also requested to identify what the impact was (dissolved oxygen, sedimentation, excessive nutrients, etc.) and the probable sources of the impact (fertilization activities, erosion, animal wastes, etc.). The Minnesota Pollution Control Agency (MPCA) also recognizes the valuable information available through local resource managers.

DATA PRESENTATION

To assess NPS pollution problems, the MPCA requested Minnesota Department of Natural Resources (MDNR) fishery managers and county zoning administrators* to answer several questions relating to NPS pollution. The questions were presented in a survey format (Figure 1), and addressed NPS pollution by soliciting a list of impacted water bodies, their uses, and the causes and types of pollution affecting the identified water bodies. The local resource managers were provided approximately one (1) month to respond to the questions which were mailed in April and May of 1986.

Fifty-nine (59) percent of the twenty-seven (27) MDNR fishery management areas responded to the survey (Figure 2). They identified 220 NPS impacted water bodies; 141 lakes and 79 streams (Tables 1 & 2). Forty-nine percent (49) of the eighty (80) county zoning administrators responded to the survey (Figure 3). They identified 168 NPS impacted water bodies; 103 lakes, 64 streams, and 1 ground water resource (Tables 1 & 2). All but one (1) of the resource managers responding to the survey expressed some concern about NPS pollution, and six (6) resource managers indicated that NPS pollution was widespread in their management areas.

* The seven (7) county Twin Cities Metropolitan Area is not inluded in the survey. These counties are completing extensive water management plans which address NPS pollution.

DISCUSSION

The MDNR fishery managers frequently cited eutrophication, sedimentation, turbid conditions, and physical habitat destruction as the types of NPS pollution problems in their management areas. The frequently cited causes of NPS pollution problems were agricultural fertilization activities, animal wastes, and agricultural soil erosion. The county zoning administrators often cited eutrophication and sedimentation as the types of NPS pollution in their management areas. The frequently cited causes of NPS pollution problems were agricultural fertilization activities, agricultural soil erosion, and on-site sewage systems. Other types and causes of NPS pollution cited by the resource managers include oxygen depletion, bacteria contamination, urban runoff, and agricultural pesticides (Figures 4 & 5). In general, the resource managers felt that water body use could improve in many of the water bodies they identified.

It can be concluded from the survey of MDNR fishery managers and county zoning administrators that nonpoint sources of pollution (soil erosion, animal wastes, fertilizers, pesticides, and on-site sewage systems) affect many Minnesota water bodies. Stream NPS concerns generally relate to soil erosion and sediments; whereas, lake NPS pollution concerns generally relate to nutrients. Ground water contamination is also a concern in southeastern Minnesota.

NONPOINT WATERBODY SURVEY

County_____ Completed by_____

Are there significant impacts from NPSs in your area?	List specific waterbodies (streams, stream segments, lakes or impoundments) impacted by NPSs.	If there are effects list effect(s) from Table A.*	If there are impacts list source(s) from Table B.*	List existing uses from Table C.*	List potential uses from Table C.*
yes no unknown	1				
	2				
Are there likely to be future NPS problems? yes no unknown	3				
	4				
	5				
Comments: List additional comments, waterbodies, the NPS effects, sources and the uses on back of survey form.					

Table A

If the effect is:	Indicate:
Oxygen depletion	1
Lake/impoundment eutrophication	2
Coliform bacteria contamination	3
Sedimentation	4
Toxicity due to pesticides, heavy metals, etc.	5
Turbid conditions	6
Physical habitat degradation	7
Unknown	8
Other	9

Table B

If the source is:	Indicate:
Urban runoff	A
Agricutural pesticide application	B
Agricultural fertilizer application	C
Agricultural soil erosion	D
Silvicultural activies	E
Mining activities	F
Onsite septic systems	G
Animal Wastes	H
Residential Fertilization activities	I
Hydromodification	J
Construction site soil erosion	K
Unknown	L
Other	M

Table C

If the use or potential use is:	Indicate:
Fishing (poor)	S
Fishing (moderate)	T
Fishing (good)	U
Fishing (unique)**	V
Swimming (poor)	W
Swimming (good)	X
Unknown	Y
Other	Z

*Select as many effects, sources, or uses that apply.

**Consider a fishery unique if it represents a species uncommon to the County such as a trout fishery where warmwater conditions normally prevail or the waterbody supports an endangered or rare species.

MN POLLUTION CONTROL AGENCY
Division of Water Quality
September 1986

Figure 1. THE NPS SURVEY AS PRESENTED TO THE COUNTIES.

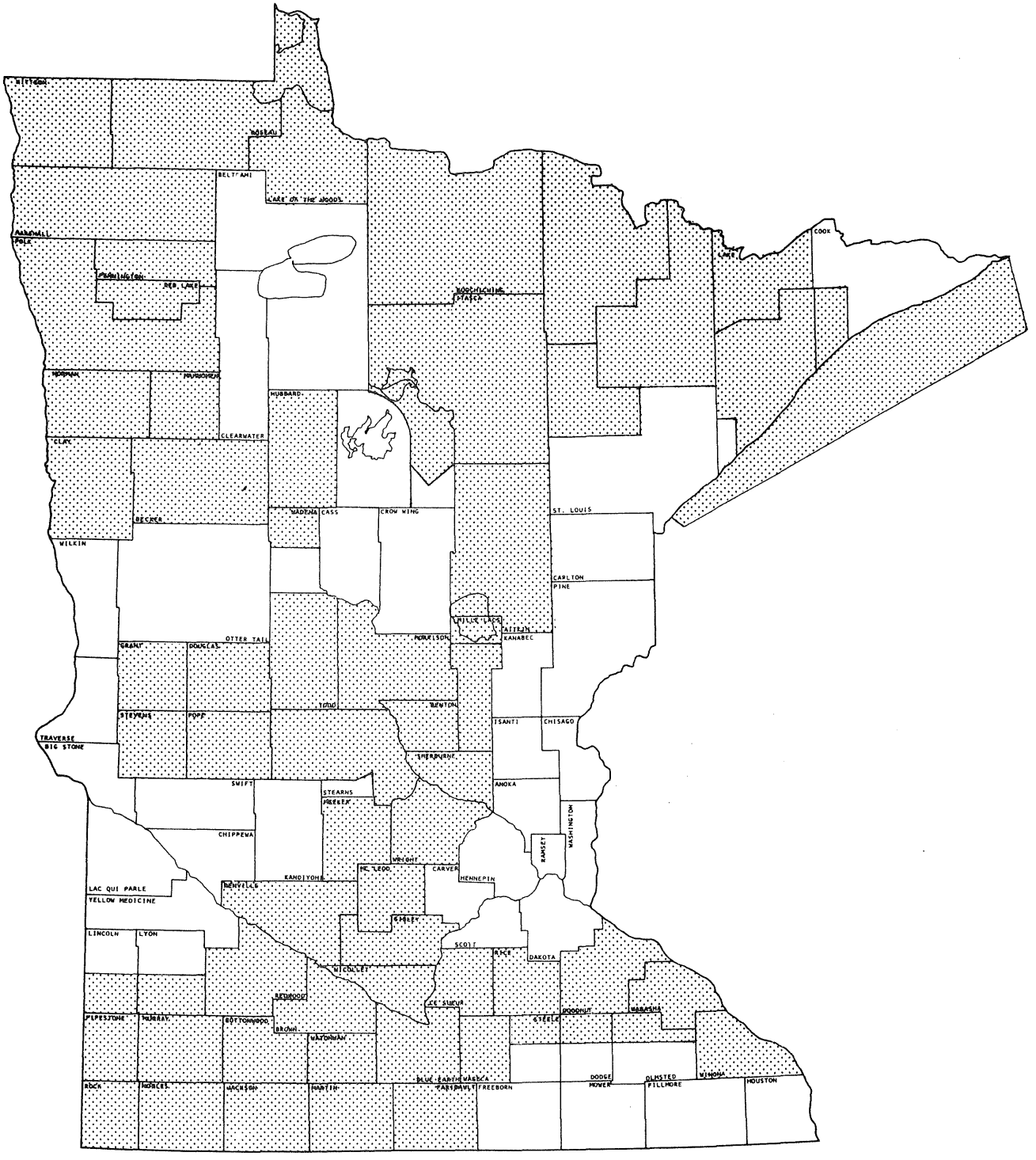


Figure 2. FISHERY MANAGEMENT AREAS (STIPPLED) RESPONDING TO THE SURVEY.

MN POLLUTION CONTROL AGENCY
Division of Water Quality
September 1986

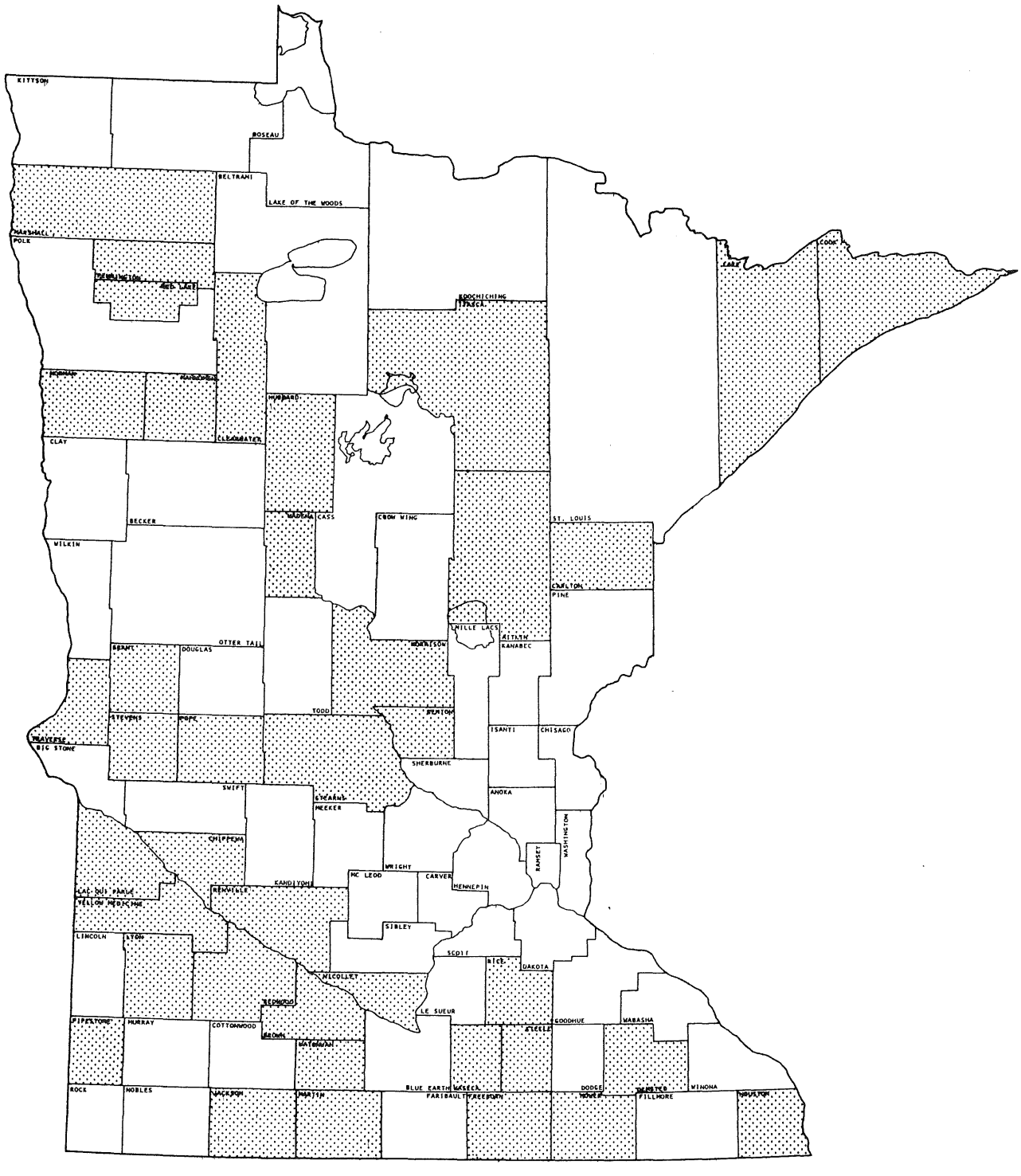
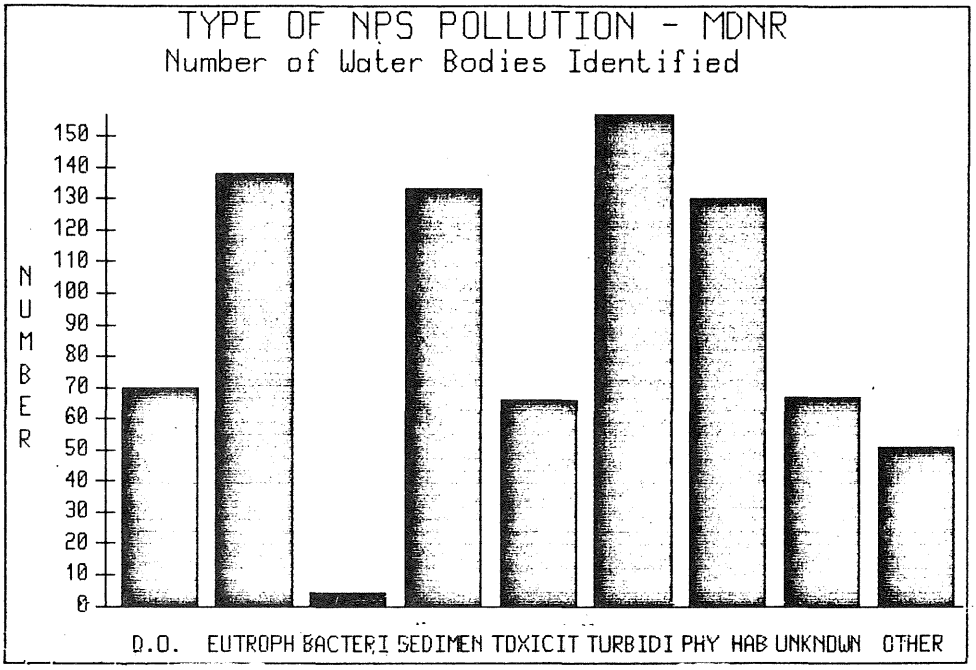
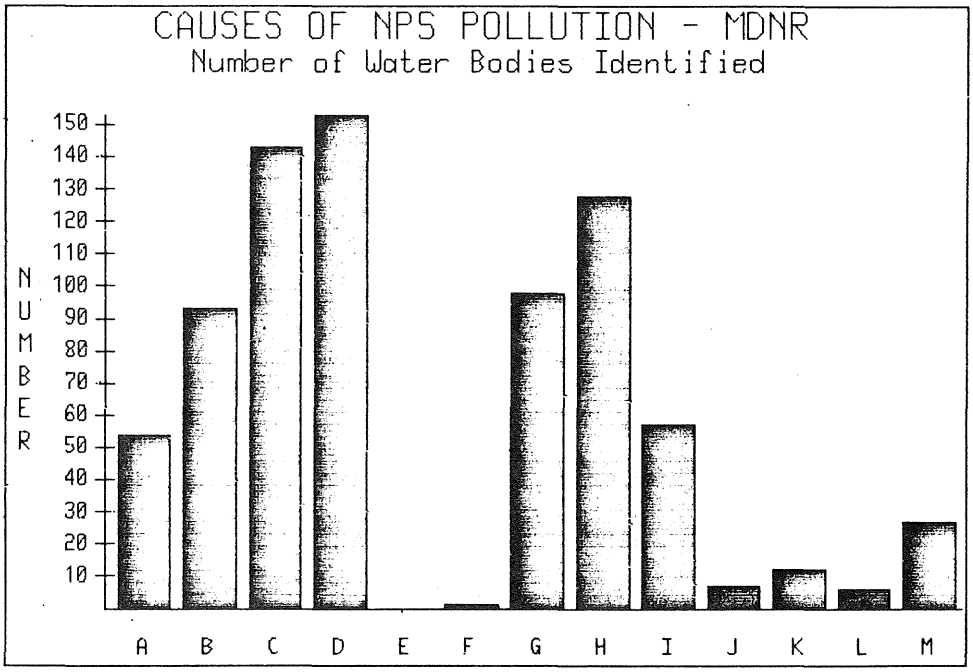


Figure 3. COUNTIES (STIPPLED) RESPONDING TO THE SURVEY.

MN POLLUTION CONTROL AGENCY
Division of Water Quality
Septembeer 1986

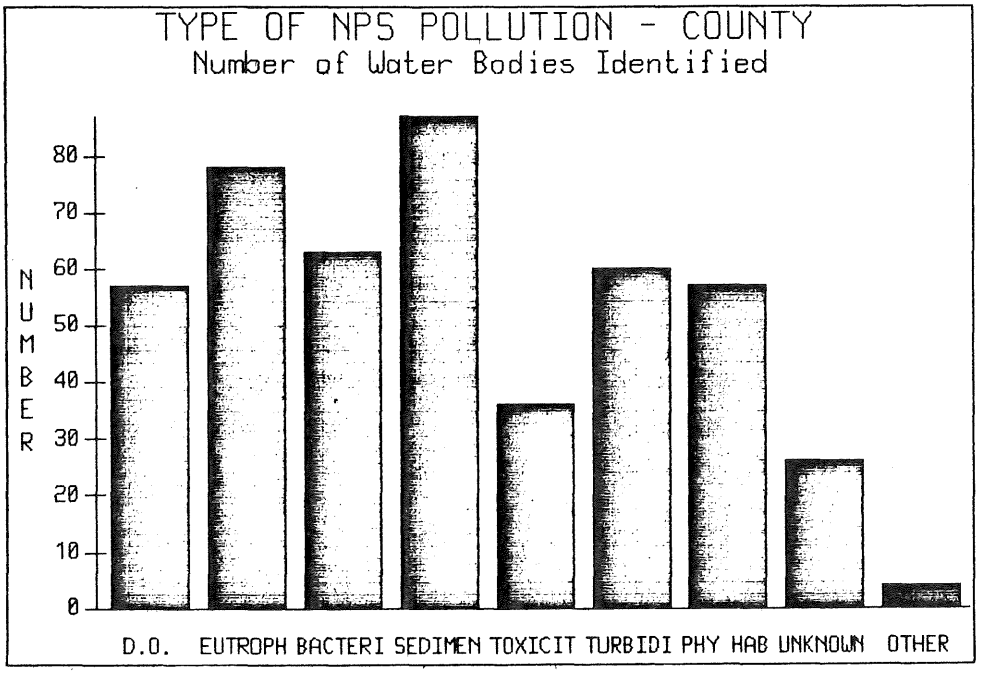


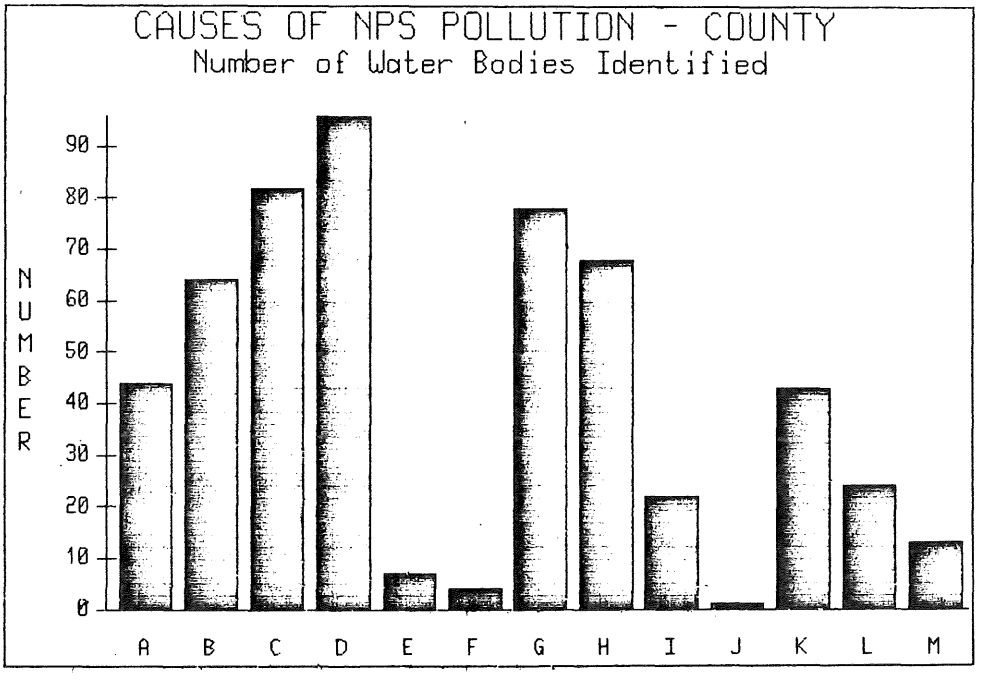


A – Urban Runoff
B – Agricultural Pesticide Application
C – Agricultural Fertilizer Application
D – Agricultural Soil Erosion
E – Silvicultural Activities
F – Mining Activities
G – On-site Sewage Systems
H – Animal Wastes
I – Fertilizer Application
J – Hydromodification
K – Construction Site Soil Erosion
L – Unknown
M – Other

Figure 4. RESULTS OF THE NPS SURVEY - MDNR FISHERY MANAGERS.

MN POLLUTION CONTROL AGENCY
Division of Water Quality
September 1986





A – Urban Runoff
B – Agricultural Pesticide Application
C – Agricultural Fertilizer Application
D – Agricultural Soil Erosion
E – Silvicultural Activities
F – Mining Activities
G – On-site Sewage Systems
H – Animal Wastes
I – Residential Fertilizer Application
J – Hydromodification
K – Construction Site Soil Erosion
L – Unknown
M – Other

Figure 5. RESULTS OF THE NPS SURVEY - COUNTY ZONING ADMINISTRATORS.

MN POLLUTION CONTROL AGENCY
Division of Water Quality
September 1986

Table 2. NPS IMPACTED STREAMS identified by local resource managers.

Name	Location
Baptism River*	
East Branch	Lake
Bear Creek	Winona
Belle Creek	Goodhue
Black River	Pennington
Blue Earth River	Southern Minnesota
Bullard Creek	Goodhue
Burns Valley Creek	Winona
West	
East	
Main	
Canby Creek	Yellow Medicine
Cannon River*	Southeastern Minnesota
Carys Creek	Mower
Cedar River	Mower
Cedar Valley Creek	Winona
Center Creek	Martin
Chippewa River	Chippewa
Clearwater River*	Pennington, Red Lake
Clearwater River*	Stearns
Cobb River	Blue Earth
Cold Spring Brook	Wabasha
Cottonwood River*	Brown, Redwood
Crow River*	Central Minnesota
North Fork	
County Ditch No. 35A	Renville
Dobbins Creek	Mower
East Swan River	Itasca
Fish Hook Creek	
Florida Creek	Yellow Medicine
Garvin Brook	Winona
Gilbert Creek	Wabasha
Gilmore Creek	Winona
Gorman Creek	Wabasha
Hay Creek	Goodhue
Hazel Creek	Morrison
Indian Creek	Wabasha
East	
West	
Judicial Ditch No. 1	Pipestone
Judicial Ditch No. 15	Renville
Kinney Creek	St. Louis
Lac Qui Parle River	Yellow Medicine
Lazarus Creek	Yellow Medicine
LeSueur River	Southern Minnesota
Little Cannon River	Goodhue
Little Cedar Creek	Mower
Little Cottonwood River	Brown
Little Pickwick Creek	Winona
Little Rock Creek	Benton, Morrison
Long Creek	Wabasha
Long Prairie River	Central Minnesota
Lost River	Red Lake
Maple River	Blue Earth, Faribault
Mazeppa Creek	Goodhue, Wabasha
Middle Creek	Wabasha
Middle River	Marshall
Mill Creek	Wright
Miller Creek	Wabasha
Minnesota River*	Southern Minnesota
Mississippi River*	Southern Minnesota
Moose River	Marshall
Mud River	Marshall
Mustinka River*	Western Minnesota
Okabena Creek	Nobles
Orchard Creek	Mower
Otter Creek	Mower
Oxhide Creek	Itasca
Pickwick Creek	Winona
Pine Creek	Winona
Pipestone Creek*	Pipestone
Pleasant Valley Creek	Winona
Pomme de Terre	Grant
Rainy River	Northern Minnesota
Ramsey Creek	Redwood
Red River	Northwestern Minnesota
Red Lake River*	Pennington, Red Lake
Redwood River*	Redwood, Lyon
Robinson Creek	Mower
Root River*	Houston, Olmsted
North Branch	Mower
Rose Creek	Mower
St. James Creek*	Watonwan
Sauk River	Stearns
Silver Creek	Wright
Skunk Creek	Lake
Snake Creek	Wabasha
Snake River	Marshall
Speltz Creek	Winona
Spring Brook	
Spring Creek	Goodhue
Spring Creek	Wabasha
Stockton Valley Creek	Winona
Straight River	Becker, Hubbard
Straight River*	Southeastern Minnesota
Sucker Creek	Meeker
Swan River	Morrison
Tamarac River	Marshall
Thief River*	Marshall, Pennington
Trout Valley Creek	Winona
Turtle Creek	Mower
Twelve Mile Creek	Wright
Two Rivers	Kittson
Upper Iowa River	
& Tributaries	Mower
Watonwan River	Southern Minnesota
Wells Creek	Goodhue
Whitewater River	Southeastern Minnesota
Main Branch	
Middle Branch	
North Branch	
South Branch	
Wild Rice River	Mahnomen
Williams Creek	Lake of the Woods
Yellow Medicine River	Yellow Medicine
Zumbro River	Southeastern Minnesota
Middle Fork	
N. Branch Middle Fork	
North Fork	
S. Branch Middle Fork	
South Fork	

* Water Bodies identified by more than one resource manager.

Table 1. NPS IMPACTED LAKES identified by local resource managers.

Name	MDNR ID No.	Name	MDNR ID No.	Name	MDNR ID No.	Name	MDNR ID No.
Gun	1-0099	Fish Hook	29-0242	Roberds*	66-0018	Winona	85-0011
French	1-0104	Portage	29-0250	Circle*	66-0027	Mud	86-
Little Toad	3-0189	Swan	31-0067	Fox*	66-0029	Mink	86-0088
Cotton	3-0286	Loon*	32-0020	Union*	66-0032	Buffalo	86-0090
Sallie	3-0359	Heron	32-0057	French*	66-0038	Little Waverly	86-0106
Floyd	3-0387	Round	32-0069	Masaska*	66-0039	Deer	86-0107
Melissa	3-0475	Lac Qui Parle	37-0046	Lower Sakatah	66-0044	Waverly	86-0114
Little Cormorant	3-0506	Fall	38-0811	Hunt*	66-0047	Ramsey	86-0120
Ida	3-0582	Horseshoe	40-0001	Rice	66-0048	North Twin	86-0123
Sand	3-0659	Upper Sakatah	40-0002	Cedar	66-0052	Mary	86-0125
Little Rock*	5-0013	Sunfish	40-0009	Shields*	66-0055	South Twin	86-0126
Madison	7-0044	Sabre	40-0014	Crane	69-0616	Maple	86-0134
George	7-0047	Green Leaf	40-0020	Sand Point	69-0617	Silver	86-0140
Duck	7-0053	Tetonka	40-0031	Majestic	69-0721	Locke	86-0168
Ballantyne	7-0054	Gorman	40-0032	Pelican	69-0841	Dutch	86-0184
Lura	7-0079	Volney	40-0033	Kabetogama	69-0845	Howard	86-0199
Loon	7-0096	Roemhildt	40-0039	Little Elk	71-0141	Mink	86-0229
Crystal	7-0098	Steele	40-0044	Julia	71-0145	Somers	86-0230
Clear	8-0011	Fish	40-0051	Briggs	71-0146	Wiegand*	86-0242
Hanska*	8-0026	Rays	40-0056	Rush	71-0147	Grass*	86-0243
Sleepy Eye*	8-0045	Frances	40-0057	Schneiders	73-0082	Clearwater*	86-0252
Chub	9-0008	German	40-0063	Great Northern	73-0083	Cokata	86-0263
Park	9-0029	Scotch	40-0109	Knaus	73-0086	French	86-0273
Big	9-0032	Henry	40-0104	Krays	73-0087	Caroline*	86-0281
Big Hanging Horn	9-0038	Scotch	40-0109	Bolting	73-0088	Louisa*	86-0282
Eagle	9-0057	Washington	40-0117	Zumwalles	73-0089	Augusta*	86-0284
Island	9-0060	Emily	40-0118	Marie*	73-0114		
Carlton	12-	Clear	40-0124	Upper Spunk	73-0117		
Superior*	16-0001	Benton	41-0043	Lower Spunk	73-0123		
Devils Track	16-0143	Tulaby	44-0003	Middle Spunk*	73-0128		
Hungry Jack	16-0227	South Twin	44-0014	East/Koetter/			
Poplar	16-0239	Island*	44-0038	Cedar Island	73-0133		
Cairbou	16-0360	South Silver	46-0020	Two Rivers	73-0138		
Moutian	17-0003	Hall	46-0031	Becker	73-0156		
Byllesby	19-0006	Fox*	46-0109	Horseshoe	73-0157		
Smith	21-0016	Manuella	47-0050	Rice	73-0196		
Le Homme Dieu	21-0056	Pierz	49-0024	Koronis	73-0200		
Indian	21-0076	Fish Trap	49-0137	Beaver	74-0023		
Maple	21-0079	East Side	50-0002	South			
Ida	21-0123	Shetek	51-0046	Pomme de Terre	75-		
Pocket	21-0140	Middle	52-0023	Page*	75-0019		
Lobster	21-0144	Okabena	52-0028	Long*	75-0024		
Freeborn	21-0162	Swan	52-0034	North			
Mill	21-0180	Silver	55-0003	Pomme de Terre	75-0061		
Oscar	21-0257	Zumbro	55-0004	Perkins	75-0075		
Stowe	21-0264	Shady	55-0005	Hattie*	75-0200		
Red Rock	21-0291	Indian	59-	Big Sauk	77-0150		
Bass	22-0074	Maple	60-0305	Osakis	77-0215		
Albert Lea	24-0014	Grove*	61-0023	Traverse	78-0025		
Geneva	24-0015	Amelia	61-0064	Mud	80-0024		
Fountian	24-0018	Leven	61-0066	Lower Twin	80-0030		
Twin Lakes	24-0027 & 31	Pelican*	61-0111	Blueberry	80-0034		
Bear	24-0028	Ann	61-0122	Stocking	80-0037		
Pelican	26-0002	Minnewaska*	61-0130	Watkins	81-		
Barrett	26-0095	Redwood	64-0058	St. Olaf*	81-0003		
Pomme de Terre	26-0097	Lyman	66-	Clear*	81-0014		
lightning	26-0282	Cannon*	66-0008	Loon*	81-0015		
Eleventh Crow Wing	29-0036	Wells	66-0010	Reeds*	81-0055		
Belle Taine	29-0146	Dudley*	66-0014	Rice	81-0088		
Long	29-0161	Kelley*	66-0015	Elysian*	81-0095		

* Water bodies identified by more than one resource manager.

APPENDIX B

Statewide Assessment of NPS Pollution

STATEWIDE ASSESSMENT OF NPS POLLUTION

INTRODUCTION

Purpose

The Federal Clean Water Act of 1972 initiated a major national effort to control water pollution by establishing water quality goals. In Minnesota, the responsibility to meet the goals of the Clean Water Act was assigned to the Minnesota Pollution Control Agency (MPCA). Much of the past pollution control effort has focused on point sources of pollution. Nonpoint source (NPS) pollution control is now recognized as an important consideration and is the focus of more effort by the MPCA.

To develop a NPS pollution control program and meet the goals of the Clean Water Act, the MPCA must: 1) assess statewide NPS pollution, 2) develop an effective approach to meeting NPS water quality objectives, 3) coordinate all NPS pollution control activities, and 4) establish a mechanism to direct limited resources to areas where the greatest NPS pollution control needs exist. The purpose of this report is to assess various statewide characteristics which relate to NPS pollution so the MPCA can effectively plan for NPS pollution control.

Background

Assessing NPS pollution statewide is a complicated task with a variety of ways of being achieved. In Iowa, an agricultural state, NPS pollution assessment for developing control priorities has been based on a series of evaluation criteria and ranking systems. The priority criteria and ranking systems were designed to address the potential value of surface waters with the most severe NPS problems (Nonpoint Notes, 1978). Wisconsin, to direct its NPS control activities and to identify areas with high potential for NPS pollution, compared land use areas and types of land management to water resources data. Wisconsin also developed a system to incorporate local public support when selecting an area for NPS pollution control (Konrad et al., 1985).

Minnesota has a diverse lake and stream resource and abundant ground water reserves that must be considered with the state's topographic features and land use when selecting NPS priority areas. The exercises for assessing NPS pollution developed in Iowa and Wisconsin have positive attributes that can be applied in Minnesota. To assess NPS pollution statewide, Minnesota must rely on the experience of these states and others and the experience gained through many years of progressive pollution control.

Scope

This report is a description of Minnesota and an assessment of NPS pollution statewide. The NPS assessment is based on a regional summarization of land use, topographic and water resource characteristics. This type of information summarization has a tendency to mask important area specific characteristics. This assessment can only be considered a general interpretation of numerous factors as they relate to NPS pollution and does not provide a measure of the

magnitude of NPS pollution problems in the state. It does provide a comparison between regions of the NPS pollution potential and suggests what the NPS pollution problems may consist of. The assessment can be used to direct NPS pollution control activities to important areas of the state.

Ground water pollution potential is also considered in the NPS pollution assessment. Ground water pollution potential, however, cannot be evaluated on the same regional basis used for surface water assessments. Sensitive ground water areas are identified separately.

DATA PRESENTATION

Aquatic Ecoregions

Assessing Minnesota's NPS pollution is an exercise which focuses on aquatic ecoregions. Aquatic ecoregions are geographic areas of identifiable and measurable spatial patterns that were developed from mapped information by the Corvallis Environmental Research Laboratory of the U.S. Environmental Protection Agency (EPA). The seven aquatic ecoregions in Minnesota (Figure 1) are based on land use, soils, land surface form, and potential natural vegetation. These ecoregions provide a basis to describe various land and surface water characteristics. Streams within an ecoregion should exhibit characteristics such as physical habitat, hydrology, water chemistry and biotic communities, more similar to each other than to streams from other ecoregions. A further description of aquatic ecoregions is provided in (Omernik, J.M., 1987).

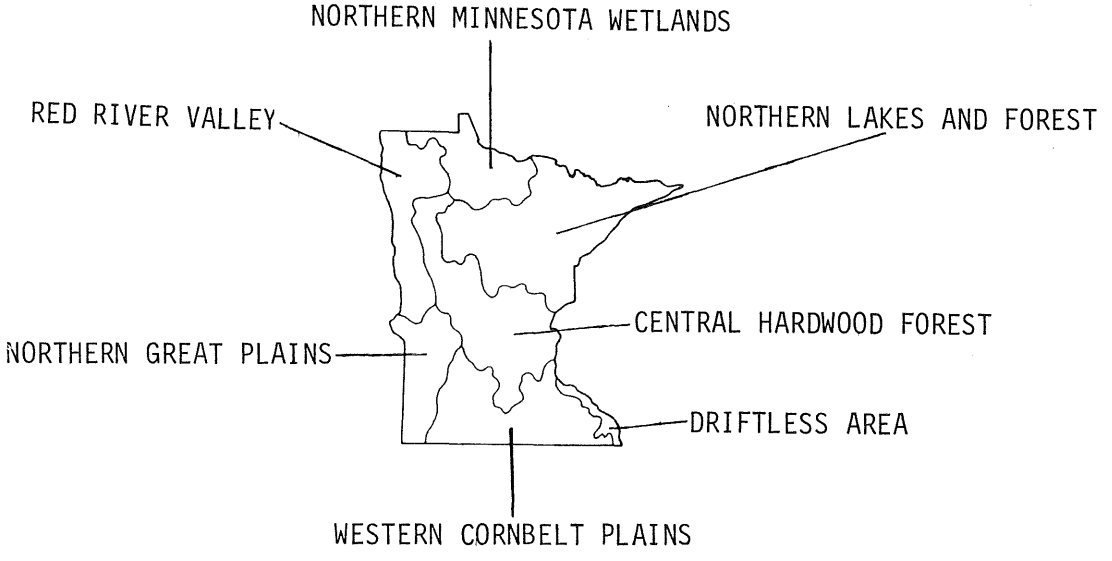


Figure 1. THE SEVEN (7) AQUATIC ECOREGIONS IN MINNESOTA.
Developed by the U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory.

Aquatic ecoregions, as indicated, are defined from mapped information of land use, soils, land surface form and potential natural vegetation. This and other information was summarized for each ecoregion and used to subjectively assess NPS pollution characteristics of the ecoregions. The ecoregion assessments can be divided into the three (3) main categories of land use, topographic features, and water body characteristics.

Land Use

Numerous studies have been conducted which relate land use activities and NPS pollution. These studies range from the Missouri Ozark Plateau where a significant inverse relationship between forest land use and the concentration of most stream chemical parameters was found (Smart et al., 1981 and Smart et al., 1985) to the Minnesota 208 study which investigated and found several urban development and rural land use water quality relationships (MPCA, 1978).

The land use NPS pollution relationships have been used in various modeling efforts to predict runoff quantity and quality. Reviews of the modeling efforts have been completed by Morck (1984) and Hendrickson and Stefan (1985). From these reviews and the modeling efforts it appears there are numerous modifying and site specific factors that affect the relationship between land use and NPS pollution and that predicting NPS pollution from land use is difficult. For the purpose of assessing NPS pollution in ecoregions it is assumed that land use characteristics suggest intensity of use and high use intensity suggests greater NPS pollution.

Table 1 is a review of the land use characteristics for the seven (7) Minnesota ecoregions. Urban and other (urban development, mineral extraction and transportation), cultivation with row crops (corn and soybeans), and cultivation with small grains, represent intensive land use activities. Pasture and open lands, forested areas, and water and marsh represent low intensity land use activities. Higher population densities also suggest greater land use intensities.

TABLE 1. LAND USE CHARACTERISTICS OF MINNESOTA'S ECOREGIONS

Ecoregion	Area (sq. mi.)	Population[2] Total (x 1000)	Population[2] Density (#/sq. mi.)	Land Surface Development[1] Forested (%)	Pasture & Open (%)	Cultivated (%)	Dominant Crop[3&6]	Water & Marsh (%)	Urban & Other[4] (%)
Red River Valley	9,072	138.2	15.4	6.2	8.5	81.7	Small grains	2.7	0.8
Northern Minnesota Wetlands	8,371	33.1	4.0	54.0	6.5	9.4		29.8	0.3
Northern Lakes and Forests	26,586	460.3	17.5	75.2	7.2	4.6		10.6	2.4
Central Hardwood Forests	16,775	2,501.0	149.5[5] (68.6)	15.9	21.4	49.3	Corn, soybeans & small grains	8.1	5.3
Driftless Area	1,488	82.3	55.0	36.7	14.1	40.5	Corn	5.9	1.7
Western Cornbelt Plains	15,956	697.3	43.5	3.4	10.0	82.9	Corn & soybeans	1.7	1.9
Northern Great Plains	6,736	127.8	18.9	0.7	11.4	83.7	Corn & soybeans	2.9	1.2

[1] Based on Planning Information Center 40 acre plot data where ecoregions boundaries are defined along minor watersheds. The percentage reported is the percentage of 40 acre plots in the ecoregion dominated by the characteristic indicated.

[2] Based on Planning Information Center Minor Civil Division data. Where a Minor Civil Division occurred in more than one ecoregion population was divided proportionally by area.

[3] Based on Minnesota Department of Agriculture Statistical Data for Minnesota Counties. Minnesota Agricultural Statistics Service. 1985. "Agricultural Statistics 1985" Minnesota Department of Agriculture. St. Paul, Minnesota. 82 pages.

[4] Urban and other includes urban residential, urban non-residential or mixed residential development, transportation, and mineral extraction data.

[5] Includes the Twin Cities Metropolitan Area. If Ramsey and Hennepin Counties are not included, the population density is 68.6.

[6] The dominant pesticides used on corn are Alochlor, Dicamba, and 2,4-D. The dominant pesticides used on soybeans are Trifluralin and Bentazon. The dominant pesticides used on small grains are 2,4-D amine, 2-4-D ester, and MCPA

Minnesota is approximately 85,000 square miles in size. Over 39,000 square miles of this area can be characterized by some type of intensive land use activity. Much of the intensive land use activity is located in the Red River Valley (RRV), Western Cornbelt Plains (WCP), Northern Great Plains (NGP), Central Hardwood Forest (CHF) and Driftless Area (DA) ecoregions. The CHF and DA ecoregions appear to have the greatest population densities and intensive land use activities. NPS pollution problems are likely in these areas, particularly from NPS pollutants related to urban development and agricultural row crop production. The WCP, NGP and RRV ecoregions are dominated by intensive agricultural land use activities. These ecoregions are likely to have NPS pollution problems associated with agricultural activities, such as sediments and sedimentation.

Over 38,000 square miles of Minnesota is characterized by less intensive land uses of pasture and open lands, forests, and water and marsh. The less intensive land uses generally occur in the Northern Lakes and Forest (NLF) and Northern Minnesota Wetlands (NMW) ecoregions. Extensive problems of NPS pollution from intensive land use activities is not likely; although, pockets of NPS pollution may occur where urban development, forestry activities or other intensive land use practices are concentrated.

Topographic Features

There are factors, other than land use, that influence NPS pollution. Some of these factors can be described as topographic features and are associated with characteristics related to the land surface. The literature suggests numerous topographic features that can be useful for assessing NPS pollution problems (IJC, 1978, Maas et al., 1985, Clark et al., 1985, Myers et al., 1985 and others). The topographic features for Minnesota's ecoregions that are easily assessed and likely to suggest NPS pollution are water orientation, slope, soil texture, and hydrologic group.

Water orientation identifies those 40 acre parcels which adjoin or contain a water body. Stream oriented parcels are those 40 acre parcels that relate to a permanent stream or river, an intermittent stream, or a drainage ditch; whereas, lake oriented parcels are those parcels containing lake or island shoreline.

According to Maas et al., (1985) the distance to the nearest water course is inversely related to the pollutant delivery ratio for the common NPS pollutants sediment, nitrogen, phosphorus and pathogens. Water orientation provides an estimate of the distance to water bodies by indicating the proportion of land surface area associated with a water body. For estimating NPS pollution from water orientation, it is assumed that all land areas provide an equal source of NPS pollution within the ecoregion. Water orientation, therefore, provides an estimate of the likelihood that NPS pollutants from a specific land area will affect a water body.

Many NPS pollutants are transported to water bodies in solution or by attachment to sediment and soil particles. The movement of NPS pollutants, an important factor in assessing NPS pollution, is related to the generation of runoff. The generation of runoff is affected by many topographic features including slope, soil texture, and hydrologic group.

Hydrologic groups represent soil infiltration rates and can suggest the potential for generating precipitation runoff. The greater the infiltration rate the less frequently precipitation events will generate runoff and result in the movement of NPS pollutants to a water body.

Soil texture relates to the movement of NPS pollutants in two (2) ways. Fine textured soils with densely packed soil particles generally limit the ability of water to move through or into the soil. This enhances the potential for runoff. In addition, fine textured soils have a relatively large surface area for pollutant attachment and, because of their small particle size, are carried greater distances than coarse textured soils. Although, fine textured soils can be difficult to erode, once eroded they enhance pollutant transport by moving greater distances.

Slope is another topographic feature that relates to the generation of runoff and the movement of NPS pollutants in more than one way. Precipitation falling on steep slopes begins to runoff immediately and there is little time available for water to soak into the land's surface. Steep slopes enhance runoff potential. Steep slopes also result in the rapid movement of runoff. Faster moving runoff has the ability to pick up and carry soil particles greater distances than slow moving runoff. This enhances the movement of pollutants associated with soil particles.

Table 2 provides a description of the seven (7) Minnesota ecoregions by the topographic features discussed above. These topographic features can be used to assess NPS pollution potential of the ecoregions. As with the land use factors previously discussed, the topographic features listed in Table 2 represent only a few of the numerous topographic features that relate to NPS pollution. The features assessed in Table 2 provide only an estimate for the chance of NPS pollution problems and do not suggest the level or magnitude of any NPS pollution problems.

TABLE 2. TOPOGRAPHIC FEATURES OF MINNESOTA'S ECOREGIONS.[1]
Percentage of Ecoregion.

	RRV	NMW	NLF	CHF	DA	WCP	NGP
Water Orientation							
Not Oriented	71.6	64.8	63.3	63.3	49.3	64.2	59.9
Stream Oriented	27.0	22.5	19.4	23.8	47.2	32.9	35.0
Lake Oriented	1.1	2.0	14.0	11.5	2.9	2.7	4.6
Water	0.3	10.8	3.3	1.5	0.6	0.3	0.5
Slope[2]							
<1%	95.9	99.0	53.9	58.6	16.2	58.1	65.1
1%	3.6	0.9	27.7	30.0	13.4	28.0	27.9
2%	0.4	0.1	9.2	7.7	11.4	6.9	5.3
3-6%	0.1	0.0	8.3	3.6	31.5	6.3	1.7
>6%	0.0	0.0	0.8	0.1	27.5	0.8	0.0
Soil Texture[2]							
Sand	28.6	23.9	57.6	50.3	3.9	5.9	11.6
Silt	24.0	10.1	15.4	39.7	95.4	92.2	84.0
Clay	42.2	12.4	7.6	1.0	0.0	0.5	3.5
Other[3]	5.2	53.6	19.4	9.0	0.7	1.4	0.9
Soil Hydrologic Group[2]							
High Rate of Water Transmission	6.7	2.8	10.9	13.7	3.7	2.5	0.6
Moderate Rate of Water Transmission	7.3	8.8	18.5	49.7	82.7	59.7	62.3
Slow Rate of Water Transmission	62.7	60.9	36.8	25.1	13.0	30.2	21.8
Very Slow Rate of Water Transmission	22.8	12.6	19.1	4.9	0.0	6.7	14.0
No Rating	0.3	4.2	11.4	5.1	0.0	0.6	0.8

[1]Based on Planning Information Center 40 acre plot data where ecoregion boundaries are defined along minor watersheds. The numbers indicated are the percentage of 40 acre plots in the ecoregion dominated by the characteristic indicated.

[2]Planning Information Center data grouped into these general categories.

[3]Other includes Peat, Water and Mine Dumps

It is apparent when reviewing Table 2 that the DA has several topographic features conducive to NPS pollution. Based primarily on slope, the potential for NPS pollution is relatively high in this ecoregion. From Table 2 it is also apparent that the NMW ecoregion, where very little slope occurs, has a low potential for NPS pollution. In contrast to these two (2) ecoregions, assessing NPS pollution problems based on the topographic features of the remaining five (5) ecoregions is more difficult. It appears that NPS pollution in the lake oriented NLF ecoregion is more likely than in the WCP and NGP ecoregions which are more stream oriented. It also appears that the WCP and NGP ecoregions have a greater chance for NPS pollution impacts than the CHF and RRV ecoregions. The RRV ecoregion has very little slope and the CHF ecoregion has good drainage characteristics. Based on the topographic features reviewed in Table 2, there are areas in each of the seven ecoregions where NPS is a concern either for existing problems or future problems if present land use activities change. The Driftless Area is the ecoregion most likely to have NPS pollution problems based on topographic features.

Water Body Characteristics

In assessing ecoregion NPS pollution, only land surface characteristics have been reviewed. Water body characteristics are an important part of NPS pollution and also need to be considered. Many water body characteristics and their relationship to NPS pollution have been reviewed and reported on in the literature (Overcash and Davidson, 1981; Baker, 1984; MPCA, 1978; USEPA, 1985 and others). In addition, numerous water body characteristics are currently being studied through various programs such as the Rural Clean Water Program administered by the U.S. Department of Agriculture.

In a recent report, the MPCA reviewed trends in water quality over a twelve (12) year period (MPCA, 1986). This trend analysis can serve as a basis for assessing the NPS pollution problems of Minnesota's streams. The results of the MPCA's trend analysis are presented in Table 3.

TABLE 3. TRENDS IN WATER QUALITY MEASURES OVER TIME. WATER YEARS 1973-1985

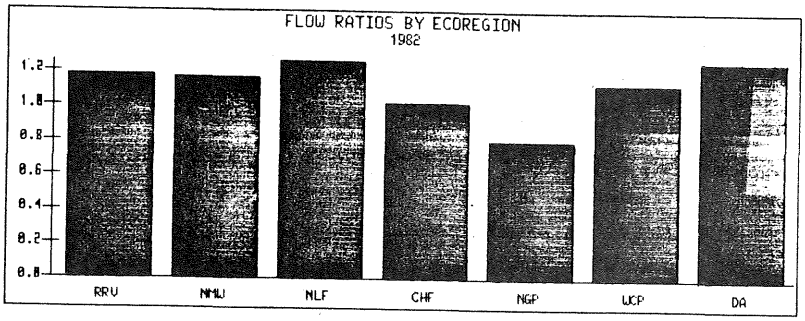
Ecoregion	NO_2+NO_3	TSS	NH_3-N	D.O.	Flow Ratio***
CHF	Decrease	Increase*	No Trend	No Trend	No Trend
DA	Increase*	No Trend	Decrease	No Trend	No Trend
NGP	Increase*	Increase	No Trend	Increase	Increase
NLF	No Trend**	Increase	Decrease	Decrease*	No Trend
NMW	No Trend	No Trend	Decrease	Decrease	No Trend
RRV	Increase	Increase*	No Trend	No Trend	No Trend
WCP	Increase	Increase*	Decrease	No Trend	Increase

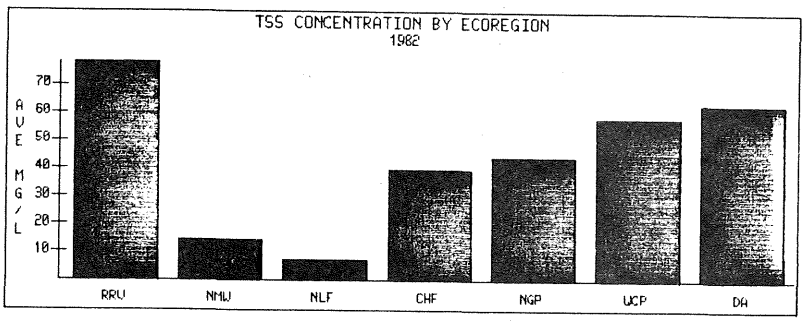
*Significant over time $p < 0.05$

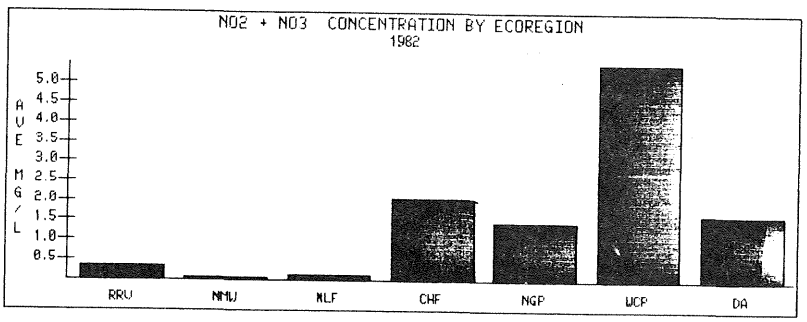
**No trend indicates there is a high probability that the apparent increase or decrease is due to chance fluctuation $p > 0.05$

***The information concerning flow ratio was not statistically analyzed in the MPCA report. It is simply an observation of the best fit line of the ratio of the average annual flow to the average long term flow over water years 1973-1985.

It is cautioned that the analysis of water quality data over a twelve (12) year period may not provide enough information to fully assess water quality trends. Within a twelve (12) year period meteorological or other natural variations may simulate or mask some trends of water quality. The MPCA trend analysis can be used to suggest which ecoregion streams are experiencing a change in water quality. Other sources of information need to be investigated to verify the cause of any changes observed over the twelve (12) year period.







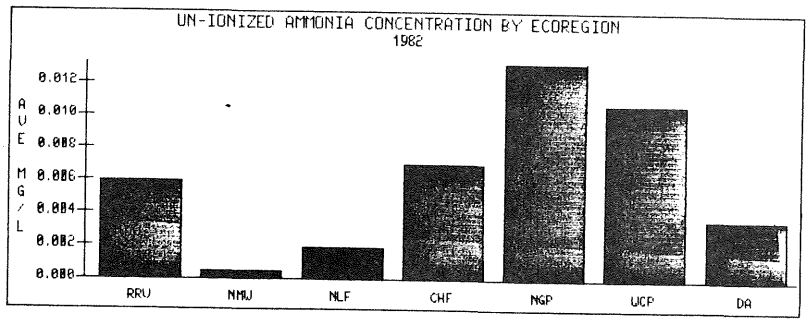


Figure 2. AVERAGE STREAM WATER QUALITY FOR 1982.

In addition to the trend analysis, average stream pollutant concentrations for a typical flow year, i.e. 1982, can be used to estimate the level of NPS pollution impacts in the ecoregions. Average concentrations for nitrate plus nitrite nitrogen (NO_2 + NO_3), total suspended solids (TSS), dissolved oxygen (DO) and ammonia (NH_3N) are presented in Figure 2. Ecoregions characterized by increasing trends and high levels of water quality parameters suggest areas with the greatest NPS stream impacts.

Table 3 suggests both increasing and decreasing trends in several water quality parameters have occurred since 1973. In the RRV, an increase in the concentrations of NO_2+NO_3 and TSS have been observed. The increase in TSS is particularly important. The TSS concentration in this ecoregion is high, has nearly doubled in the past twelve years, and does not appear to be associated with an increase in flow. The increase in TSS concentration appears to coincide with increasing cultivation activities of marginal lands and removal of shelter belts.

Streams of the NGP ecoregion also experienced an increase in NO_2+NO_3 concentrations. This increase appears to coincide with improved dissolved oxygen (DO) concentrations and increased flows. The increased flows may be associated with the observed water quality changes, however, it was not determined if the flow increase was due to meteorological conditions or recent drainage activities in the ecoregion. Water quality changes in the WCP ecoregion are similar to the NGP, however, the DO concentrations do not appear to have improved and unionized ammonia (NH_3-N) has shown a slight decrease. In contrast to the NGP ecoregion, the WCP ecoregion has very high levels of NO_2+NO_3.

The remaining ecoregions do not show as many changes in stream water quality. The streams of the NLF ecoregion do show a slight increase in TSS and a decrease in DO concentrations. The concentrations of all the pollutants reviewed in this ecoregion are considered acceptable. Significant increases in NO_2+NO_3 in the DA and TSS in the CHF ecoregions have been observed. The NO_2+NO_3 levels in the DA and the TSS levels in the CHF appear moderate relative to the other agricultural ecoregions.

In addition to streams, Minnesota has an abundant lake resource, particularly in four (4) of the ecoregions where over 95 percent of the state's lakes occur. This lake resource also needs to be considered when assessing NPS pollution in the NLF, CHF, WCP, and NGP ecoregions. Table 4 is a summary of the lake characteristics for these ecoregions. The information is based on a relatively small proportion of Minnesota's 12,034 lakes and, similar to the information on streams, only suggests differences in lake characteristics between ecoregions. A need does exist for additional lake information, particularly concerning water quality characteristics.

TABLE 4. LAKE CHARACTERISTICS BY ECOREGION

Ecoregion	Number of Lakes > 10 Acres	Maximum[1] Depth (feet)	Surface[1] Area (acres)	Secchi Disk[1] Transparency (feet)	Total[1] Phosphorus (ug/l)	Ecological Classification[2]			
						Trout	Walleye	Bass, Panfish & Walleye	Roughfish, Winterkill
NLF	5,558	36	236	8.9	23	3	20	52	13
CHF	4,765	33	257	4.8	56	2	5	43	34
NGP	855	10	488	2.8	178	-	-	27	65
WCP	577	10	524	1.6	126	-	-	11	66

[1]Estimated median value.

[2]Percentage of lakes greater than 150 acres. Data summarized from Borchet et al. (1970).

The NLF and CHF ecoregions contain a large number of lakes. Many of these lakes are greater than thirty (30) feet deep and are of intermediate size (150 to 350 acres). The lakes in these two ecoregions are also characterized by Minnesota Department of Natural Resources gamefish Ecological Classifications. In contrast to the lakes of the NLF and CHF ecoregions, the lakes of the NGP and WCP ecoregions are generally shallower, and largerly classified as roughfish or winterkill lakes. These large shallow lakes are typically well mixed and nutrient rich.

Based on the lake characteristics of Table 4 the potential for additional NPS impacts appears greater in the NLF and CHF ecoregions than in the NGP and WCP ecoregions. Existing lake NPS pollution problems appear greatest in NGP and WCP ecoregions. The main pollutant of concern for lakes is nutrients, however, in the southwestern part of the state where numerous shallow lakes occur, impact by erosion and sediments is also important.

Ground Water

Ground water in Minnesota is an important resource. Approximately 94 percent of the public-supply water systems and 75 percent of all Minnesotans derive their domestic water supplies from ground water. Ground water also supplies about 88 percent of the water used for agricultural irrigation (U.S.G.S. Water-Supply Paper 2275). This ground water resource is susceptible to NPS pollution.

A quick review of ground water NPS relations suggests that a simplified NPS pollution assessment can be made by identifying surficial drift aquifers and areas with shallow soil depths. Figure 3, redrawn from the U.S. Geological Survey (Water-Supply Paper 2275), displays these sensitive areas.

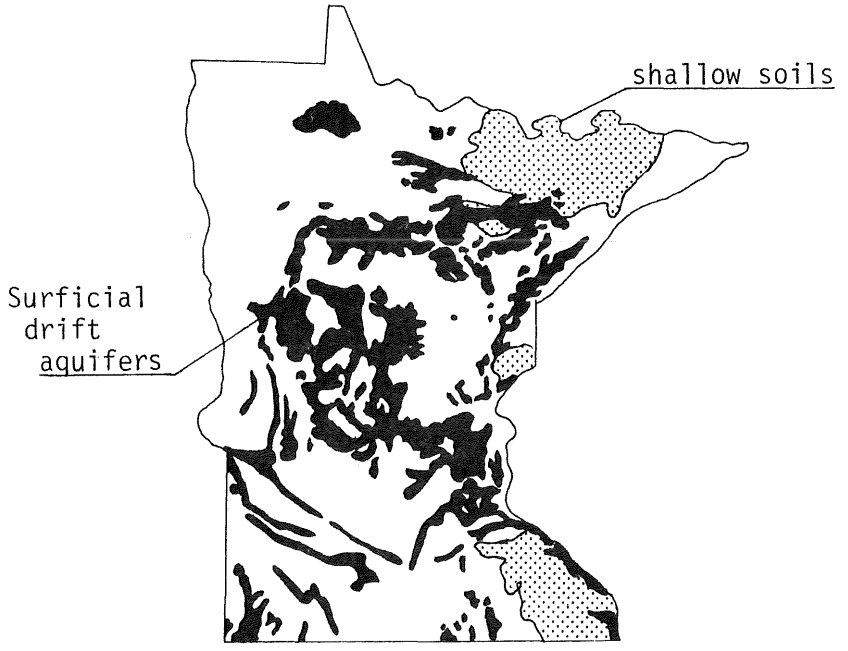


Figure 3. SURFICIAL DRIFT AQUIFERS AND AREAS OF SHALLOW SOIL DEPTH. Redrawn from the U.S. Geological Survey, Water-Supply Paper 2275.

Areas of low potential for ground water NPS pollution are those areas where depth to bedrock offers adequate protection and surficial drift aquifers are not present. Moderate pollution potential areas are those areas where depth to bedrock is inadequate or surficial drift aquifers occur. The areas with the highest potential for ground water pollution are those areas where depth to bedrock is inadequate and surficial drift aquifers occur. An exception to this NPS pollution assessment is southeastern Minnesota where karst features make the ground water resource particularly sensitive to potential NPS pollution.

CONCLUSIONS

In conclusion, when land use intensity, topographic features, and water body characteristics are considered, the NPS pollution potential of Minnesota's seven (7) ecoregions can be addressed. Figure 4 presents a summary of this NPS pollution description.

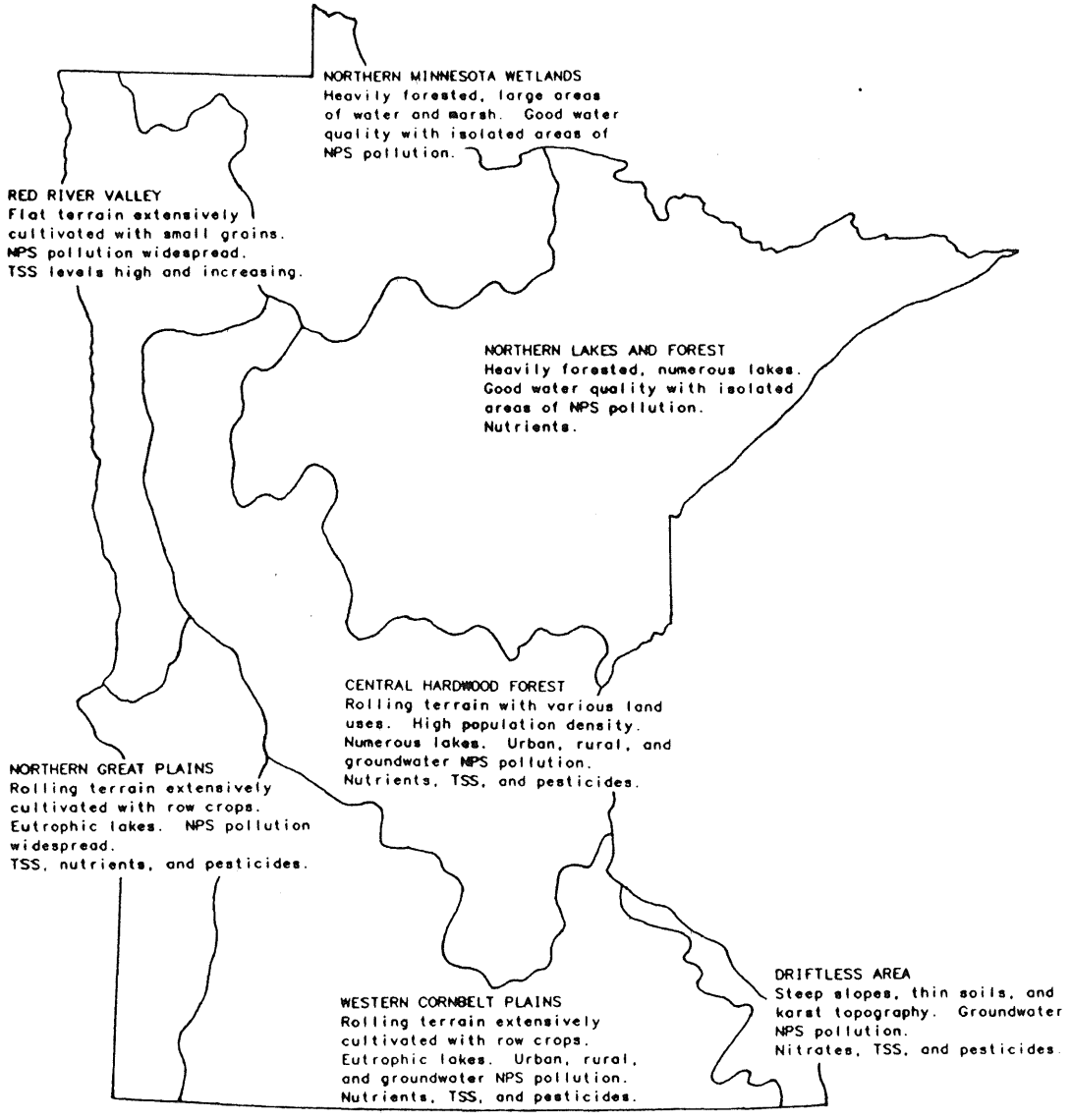


Figure 4. A BRIEF DESCRIPTION OF MINNESOTA'S SEVEN ECOREGIONS and the main NPS Pollution concerns.

Several ecoregions have surface water NPS pollution problems. These ecoregions have several land use, topographic and water body characteristics suggesting NPS pollution problems. The DA and the CHF ecoregions both have high population densities. The DA also has steep slopes and the CHF is characterized by an abundance of lakes. The RRV, WCP and NGP ecoregions are characterized by intense agricultural land use activities. These areas represent high agricultural NPS pollution areas. The NLF ecoregion is characterized by an abundance of low nutrient lakes. This ecoregion along with the CHF ecoregion represents an area with lake oriented NPS pollution problems or potential problems. The NPS pollution potential of the remaining ecoregion, the NMW, is low.

Ground water NPS pollution problem areas are scattered throughout the state. The Driftless Area, because of its karst features, is particularly sensitive to ground water NPS pollution problems.

In any problem assessment exercise, it is important to remember that environmental assessments are meant only to develop initial management programs and not intended to restrict program implementation. Minnesota is too diverse and variable to rely on the information presented here to solely direct program implementation.

REFERENCES

Baker, D.B. 1984. Identifying water quality problems from the monitoring experience. Pages 17-44. Extension - EPA Region V, Agricultural Nonpoint Conference. NACO. North Central Leadership Conference. Grand Rapids, Michigan. July 17.

Borchert, J.R., G.W. Orning, J. Stinchfield, and L. Maki. 1970. Minnesota's Lakeshore: Resources, Development, Policy Needs (Part 2). Summary of Minnesota lakeshore development study. University of Minnesota. Department of Geography and Center for Urban and Regional Affairs. Minneapolis.

Clark II, E.H., J.A. Haverkamp, and W. Chapman. 1985. Eroding Soils: The Off-Farm Impacts. The Conservation Foundation. Washington, D.C. 252 pages.

Hendrickson, A.C.H. and H.G. Stefan. 1985. Models for daily quantity and quality of runoff: input to a dynamic lake water quality simulation model. University of Minnesota. St. Anthony Falls Hydraulic Laboratory. External Memorandum No. 196. 119 pages.

International Joint Commission. 1978. Environmental Management Strategy for the Great Lakes System. International Joint Commission, International Reference Group on Great Lakes Pollution from Lake Use Activities. Windsor, Ontario. 173 pages.

Konrad, J.G., J.S. Baumann, and S.E. Bergquist. 1985. Nonpoint pollution control: the Wisconsin experience. J. Soil and Water Conservation 40(1):55-61.

Maas, R.P., M.D. Smolen and S.A. Dressing. 1985. Selecting critical areas for nonpoint source pollution control. J. Soil and Water Conservation 40(1):68-71.

Minnesota Department of Agriculture. 1985. Minnesota Agricultural Statistics. 1985. Minnesota Agricultural Statistics Service. St. Paul, Minnesota. 82 pages.

Minnesota Pollution Control Agency. 1978. Water quality and non-point sources. Water Quality Management Planning 208. MPCA, Division of Water Quality. 84 pages.

Minnesota Pollution Control Agency. 1986. Minnesota Water Quality: Water Years 1984-1985. The 1986 Report to the Congress of the United States. MPCA, Division of Water Quality. 69 pages.

Morck, R. 1984. Surface water management: an overview of runoff quantity and quality models. Publication NO. 10-84-165. Metropolitan Council. St. Paul, Minnesota. 37 pages.

Myers, C.F., J. Meek, S. Tuller, and A. Weinberg. 1985. Nonpoint Sources of Water Pollution. J. Soil and Water Conservation. 40(1):14-18.

Nonpoint Notes on 208 Implementation. 1978. Selecting Priority Areas For Implementing Agricultural Nonpoint Source Control Measures. Nonpoint Note No. 17. November 1, 1978.

Omernik, J.M. 1987. Ecoregions of the Centerminous United States. Annals of the Association of America Geographers. In. Press.

Overcash, M.R. and J.M. Davidson. (Eds) 1981. Environmental Impacts of Nonpoint Source Pollution. Ann Arbor Science. Ann Arbor, Michigan. 449 pages.

Smart, M.M., T.W. Barney and J.R. Jones. 1981. Watershed impact on stream water quality: a technique for regional assessment. J. Soil and Water Conservation. 297-300.

Smart, M.M., J.R. Jones and J.L. Sebaugh. 1985. Stream-watershed relations in the Missouri Ozark Plateau Province. J. Environ. Quality. 14(1):77-82.

U.S. Environmental Protection Agency. 1985. Perspectives on Nonpoint Source Pollution. U.S. EPA. Office of Water Regulations and Standards. Washington, D.C. EPA 440/5-85-001. 514 pages.

U.S. Geological Survey. Water Supply Paper 2275. Minnesota ground water resources. U.S.G.S. St. Paul, Minnesota. Pages 261-268.

APPENDIX C

Big Stone Lake and Clearwater Chain of Lakes
NPS Demonstration Projects

BIG STONE LAKE NONPOINT SOURCE DEMONSTRATION PROJECT

A Project Summary

Introduction

The Minnesota Pollution Control Agency (MPCA), the Upper Minnesota River Watershed District, the Big Stone Soil and Water Conservation District, Minnesota Soil and Water Conservation Board, the U.S. Department of Agriculture Soil Conservation Service, and the South Dakota Department of Water and Natural Resources are cooperating to control nonpoint source pollution for the restoration and protection of Big Stone Lake through integrated land and water resources management. The project is demonstrating the importance of coordination and cooperation in the identification of pollution sources and in the implementation of management practices for water quality protection and improvement.

Basin Description

Big Stone Lake is located on the border of South Dakota and Minnesota. Big Stone Lake is a large hypereutrophic warm water lake with a surface area of 12,360 acres, a shoreline length of 59.9 miles and a maximum depth of 18 feet. The 441,284 acre natural watershed of Big Stone Lake was increased to 729,841 acres when the Whetstone River was diverted into the lake by the construction of a dam in 1939 for flood control. The addition of the Whetstone River flows significantly increased problems of nutrient enrichment and sedimentation. Two-thirds of the 729,841 acre watershed lie in South Dakota and one- third in Minnesota. Big Stone Lake and its contributing watershed lie within two states, five counties, one watershed district and a multitude of other local government boundaries. It was recognized that a successful project would require the cooperation and involvement of both Minnesota and South Dakota.

Project Management

In Minnesota, local leadership for the project is provided by the Upper Minnesota River Watershed District (UMRWD), while the MPCA provides water quality technical assistance and coordinates the involvement of other state and federal agenices. The UMRWD is responsible for the planning and implementation of this nonpoint source pollution project through the use of an U.S. Environmental Protection Agency (EPA) Clean Lakes Program grant in the amount of $495,887 and an equivalent amount of local and state matching funds. The UMRWD is working closely with the Big Stone Soil and Water Conservation District and their programs, the Minnesota Soil and Water Conservation Board, the USDA Soil Conservation Service, and the South Dakota Department of Water and Natural Resources (SDDWNR). The South Dakota portion of the project is led and administered by a SDDWNR staff person stationed in the project area.

Lake Water Quality

High nutrient and sediment loadings have resulted in severe water quality problems in the lake. Growth of blue-green algae which may result in surface scums and bad odors is the primary factor limiting recreational use of the lake from early July to October. Excessive algae growth is usually the principal factor limiting water transparency. Water transparency is also occasionally limited by sediment in shallow areas near major tributary inlets. Extensive aquatic macrophyte growth covers many shallow areas during the summer. Water quality degradation, over the past 20 years, has led to a significant decline in sport fishing and water-based recreational use of the lake which has been an important regional resort and vacation area during the past 100 years.

Erosion from cropland and runoff from animal feeding operations are major sources of nutrient and sediment loadings to Big Stone Lake. Rapid runoff characteristics and stream bank erosion in some subwatersheds also contribute to lake pollution loadings. Water quality monitoring on tributary streams has shown unacceptable loads of both nutrients and sediment. While nonpoint source pollution from intensive agricultural land use is the major source of pollutants to Big Stone Lake, other sources such as the municipal sewage facilities at Browns Valley, Minnesota and Sisseton, South Dakota, also contribute to water quality degradation.

Focusing the Project

Using water quality monitoring data, three subwatersheds were identified in which to focus work activities. Two subwatersheds were selected because they contributed the greatest load per unit area and the greatest total load of phosphorus to Big Stone Lake. The third subwatershed was selected because it has been the focus of a watershed study by the USDA - Agricultural Research Service in cooperation with the MPCA.

Once subwatersheds of manageable size were selected, a computerized agricultural nonpoint source pollutant delivery model (AGNPS) was used to predict critical areas in the subwatersheds. The AGNPS model was developed by the U.S. Department of Agriculture - Agricultural Research Service, Morris, Minnesota and funded by the MPCA. The model divides a watershed into 40 acre cells and then uses information on factors such as soil, land use, crop, tillage, and slope from each cell to predict the runoff volume, and sediment and nutrient concentrations in the runoff. Critical cells were identified by examining the AGNPS estimates of sediment and phosphorus exported from each cell. Recommended best management practices for the critical cells were also identified.

Implementation of Best Management Practices

Success of the project is dependent on the implementation of management practices that have been determined to be the most effective, practical means of reducing pollution, i.e., best management practices. Acceptance and use of best management practices on individual farms must rely on the voluntary participation of landowners. Adoption of practices will be the result of technical staff working closely with landowners to respond to their questions on economics, use, and operational changes of the practice.

Both structural and nonstructural best management practices will be important in this project. Many of the structural practices such as grassed waterways, terraces, and buffer strips will be implemented with the technical assistance and engineering of the Soil Conservation Service and cost-share assistance of the Agricultural Stabilization and Conservation Service, the Minnesota Soil and Water Conservation Board Cost Share Program and project funds provided by the MPCA/EPA Clean Lakes Program.

Many of the practices most beneficial to water quality are nonstructural management techniques including fertilizer management, crop rotation, and tillage techniques. An example of the project efforts in this area is the purchase of a no-till drill by the UMRWD. The no-till equipment was purchased to allow farmers the opportunity to use the equipment, with the belief that if they raise a successful crop with it, they will be more likely to consider purchasing their own conservation tillage equipment. Farmers have been accepting the no-till drill for seeding wheat, but have been reluctant to plant no-till soybeans due to weed control concerns. After one and a half years, over 750 acres have been seeded to wheat or soybeans using the no-till drill. To address farmers' weed control concerns in no-till soybeans, the project has developed a herbicide/tillage demonstration plot for soybeans.

Important to adoption of both structural and nonstructural practices will be the information-education program being led by the Minnesota Soil and Water Conservation Board and funded through a Legislative Commission on Minnesota Resources (LCMR) grant and the MPCA/EPA Clean Lakes Program. The purpose of the communications program is to increase the voluntary adoption of recommended Best Management Practices within target areas. This program is designed to compliment existing technical and financial assistance efforts.

Another aspect of the implementation project is focusing on the restoration of a 160 acre wetland to reduce sediment and nutrient loadings to the lake and reduce stream bank erosion by storing runoff and reducing high flows. Restoration of this previously drained wetland in the Meadowbrook watershed is being accomplished with the cooperation and assistance of the Minnesota Department of Natural Resources and The Nature Conservancy with additional funding from the UMRWD, Citizens of Big Stone Lake, and the U.S. EPA. When completed, the wetland will control runoff from about 3,000 acres of upland.

Other programs receiving attention in this project include feedlot runoff control, lake level and Whetstone River flow management, shoreland erosion control, and streambank erosion control. Feedlot runoff control is receiving the most emphasis in the South Dakota portion of the watershed. Most of the feedlot problems in the Minnesota portion of the watershed have already been dealt with. Lake level and Whetstone River flow management are major concerns which have been addressed over the past year. A new dam with control structures was installed last year in an attempt to better control the Whetstone River flows to the Minnesota River rather than letting the river with its accompanying nutrient and sediment loads flow into Big Stone Lake. The diversion appears to be working. Use of the dam for lake level control has also been proposed; however, action has been stalled due to interagency concerns and disagreements on its in-lake and downstream effects. The Shoreland Erosion Management program

has not received priority attention because of limited staff time. Shoreland owners have indicated their willingness to pay a large portion of the expense involved; however, federal and state budget cuts will probably hurt the program, especially in the area of U.S. Soil Conservation Service (SCS) engineering resources. The Streambank Erosion program has also proceeded slowly due to limited SCS engineering resources. The primary focus of the streambank management program will be the installation of erosion control structures in Salmonsen Creek.

CLEARWATER RIVER CHAIN OF LAKES NPS DEMONSTRATION PROJECT

A Project Summary

Introduction

The Tri-County Conservation Project (TCCP) has been developed to address agricultural nonpoint source pollution problems in the Clearwater River Watershed. The project is designed to aid in the implementation of agricultural conservation practices which will work towards improving the water quality of Clearwater River Chain of Lakes. In addition to the specific project goals, the TCCP will demonstrate a foundation upon which future nonpoint source pollution projects can be implemented in Minnesota.

Basin and Problem Description

The Clearwater River Watershed is located in Meeker, Stearns, and Wright Counties of Minnesota. The 174 square mile drainage area is primarily agricultural land interspersed with lakes, streams, wetlands, and a few small urban areas. Approximately 80% of the area is cropland or pasture. The twenty-three lakes in the area have a surface area of approximately 8,000 acres. The Clearwater River flows through ten of these lakes before emptying into the Mississippi River. In recent years, and particularly within the last decade, the water quality of the Clearwater River and the surrounding lakes has been deteriorating at a rate which has greatly reduced the recreational and aesthetic potential of the area. The major water quality problem in the lakes is the occurrence of nuisance algal blooms and excessive weed growth, both emergent and submergent. The primary source of this pollution problem is high nutrient and sediment loading from agricultural runoff. Other sources, including septic systems, streambank erosion, municipal and industrial discharges, and internal cycling in lakes may also contribute to the problem.

Project Management

A grant from the U.S. Environmental Protection Agency (EPA) through the Minnesota Pollution Control Agency (MPCA) Clean Lakes Program combined with local and state matching funds is being used in the implementation of this water quality improvement program through the cooperation of local, state, and federal agencies. Local coordination of the project is being provided by the Clearwater River Watershed District with the assistance of the Meeker, Stearns, and Wright County Soil and Water Conservation Districts. A project steering committee composed of the chairmen of each district is active in the development of a good implementation program. Other agencies participating in the project include the U.S. Soil Conservation Service (SCS), MPCA, Minnesota Soil and Water Conservation Board (SWCB), and the Minnesota Extension Service. The coordination and cooperation of these agencies is necessary for the project to be successful in the protection and improvement of the area's water quality through the implementation of best management practices.

Program Development

Critical areas in the watershed were selected by using SWCD and SCS staff experience and the Agricultural Nonpoint Source Pollution (AGNPS) model. The computerized AGNPS model was developed by the USDA - Agricultural Research Service, Morris, Minnesota with funding from the MPCA. The model predicts runoff volume, and sediment and nutrient loadings from individual cells within the watershed by using physical and land use information collected for each cell. Based on the AGNPS results and technical staff input, critical subwatersheds were selected to receive priority attention in the project.

The TCCP steering committee and technical staff have met regularly during the past year to formulate the project's approach to implementing best management practices in the project area. Two primary approaches have been selected for use in the project. The first is a subwatershed approach where farmers located in critical areas of the Clearwater River Watershed have been asked to participate in the development of a special conservation program which will best meet their needs, as well as the water quality improvement needs of the area's lakes. The TCCP steering committee and technical staff are assisting in the development of this program. The program will be designed to complement existing state and federal cost-share and technical assistance programs.

The second approach involves the development of a watershed-wide communications program to encourage farmers to adopt agricultural best management practices. The development of this information and education program is being coordinated by the SWCB. One of the first activities implemented through the communications program was the development of a tillage demonstration plot in each county of the watershed. The plots were designed by and will be managed with the assistance of the Minnesota Extension Service to demonstrate the advantages of various conservation tillage, pesticide, and fertilizer management practices. Other components of the communications program include quarterly project newsletters, self-guided tours, and conservation practice workshops.

APPENDIX D

Summary of Proposed Section 319 of the Clean Water Act

SUMMARY OF NONPOINT SOURCE POLLUTION (Section 319)

OF THE CLEAN WATER ACT

PASSED BY CONGRESS OCTOBER, 1986

The newly created Section 319 requires each State to submit a proposed 4 year NPS management program to EPA which:

— identifies navigable waters not expected to meet water quality standards/goals as a result of nonpoint sources of pollution,

— identifies major pollutants,

— identifies significant pollutant contributors,

— identifies best management practices that will be used to solve the range of problems,

— identifies the programs that will be used to implement nonpoint source pollution control activities,

— provides certification of legal authority, and

— identifies available state funding.

Once submitted, U.S. EPA has 180 days to approve the program, with approval based on the likelihood of proposed management program in meeting the Clean Water Act's requirements of:

— adequate authority,

— expeditous schedule, and

— adequate best management practices.

Approved State nonpoint source pollution management programs will recieve grants subject to U.S. EPA criteria.

— Funds for State/Local implementation or demonstration projects up to 60% federal share.

— Funding priority shall be for difficult, innovative, interstate or ground water projects.

— Ten percent of the funds can be used for state administration, although additional funds may be used for regulatory, enforcement, training and educational programs.

— $70 Million authorized for 1987, $100 Million for 1988-90, and $130 Million for 1991.

APPENDIX E

Summary of Agencies and Activities Related to Nonpoint Source Pollution and Local Water Management Authorities

The Table I summary of Agency activities related to nonpoint source pollution focuses on the functions performed by an existing program. Functions can be characterized as those parts that are performed as significant portions of a government institution's overall purpose and responsibility.

The functions which are relevant are:

A. Research - Conducting studies related to water pollution concerns in order to discover or establish basic facts or principles.

B. Education and Information - Establishing and using means of communication to increase the public's knowledge and awareness of problems and solutions related to water quality.

C. Policy and Program Development - Designing, coordinating or reviewing policies and programs related to water quality.

D. Technical Assistance - Providing data, data analysis, design, design application, and training services to public or private groups or individuals.

E. Financial Assistance - Providing loans, grants, tax benefits or other financial incentives which assist public or private groups or individuals to perform any function necessary for effective and efficient management.

F. Administrative Assistance - Providing direct assistance to public or private groups or individuals by performing accounting, budgeting, personnel, contracting, printing, paper work processing, or other administrative tasks related to any function necessary for effective and efficient management.

G. Regulation - Controlling, directing, or governing the conduct of public or private groups or individuals by means of establishing or enforcing required procedures or standards, according to adopted law and policy.

H. Construction, Operation, and Maintenance - Conducting activities or managing physical facilities which are related to maintenance or improvement of water quality.

I. Monitoring - Checking on the present condition of water quality or other related environmental characteristics, or on the performance of public or private groups or individuals who may, through their activities, impact water quality.

Table II identifies local water management authorities.

TABLE 1 SUMMARY OF AGENCY ACTIVITIES RELATED TO NONPOINT SOURCE POLLUTION

STATE	Research	Education Information	Policy & Program Development	Technical Assistance	Financial Assistance	Admin. Assistance	Regulation	Construction Operation Maintenance	Monitoring
MN Pollution Control Agency	X	X	X	X	X	X	X		X
MN Dept. of Natural Resources	X	X	X	X	X		X	X	X
MN Dept. of Agriculture		X	X	X			X		X
- Soil & Water Conservation Board		X	X	X	X	X			
MN Dept. of Transportation	X	X	X	X	X			X	X
MN Dept. of Health		X	X	X	X	X	X		X
University of Minnesota	X	X							
- Agricultural Extension Svc.		X		X					
Water Resources Board			X						
Dept. of Energy, Planning and Development									
- Environmental Quality Board		X	X						
- Land Management Information				X					
- Southern MN River Basin Board			X						
MN Dept. of Administration							X		
Metropolitan Council		X		X					X
LOCAL									
Counties			X	X	X	X	X	X	
Soil and Water Conservation Districts		X	X	X	X	X		X	
Watershed Districts		X	X	X	X	X	X	X	X
Special Purpose Districts, i.e. Lake Improvement Districts Sanitary Sewer Districts, etc.			X				X	X	
Townships			X			X	X	X	
Municipalities			X			X	X	X	
County Extension		X		X					
FEDERAL									
United States Environmental Protection Agency	X	X	X	X	X		X		X
U.S. Dept. of Agriculture									
- Soil Conservation Service		X	X	X	X	X		X	X
- Agricultural Stabilization & Conservation Service			X		X	X			
- Science & Education Admin. - Agricultural Research	X			X					
- Farmers Home Administration					X				
- Extension Service		X		X					
- Forest Service								X	
U.S. Dept. of Interior									
- Geological Survey	X	X		X					X
- Fish and Wildlife Svc.	X	X		X					
U.S. Army Corps of Engineers		X	X	X	X		X	X	
U.S. Dept. of Transportation	X		X		X		X	X	

Table II

Source: Toward Efficient Allocation and Management: 1983-85 Priority Recommendations, p. 14
Minnesota Water Planning Board.

LOCAL WATER MANAGEMENT AUTHORITIES

Authorities	County	City	Township	Watershed District	Soil & Water Conservation	LRRWMB	Lake Improvement District	Drainage and Conservancy	Rural Water Systems	Lake Conservation District	Sanitary Districts	Regional Development Commission 2/
Number of units	87	855	1800	35	92	1	2	3	5	2	5	13
Public water and sewer systems	x	x	x	x		x	x		x		x	
Stormsewers and stormwater	x	x		x	x	x	x	x		x		
Drainage 3/	x	x		x	x	x		x				
Flood control	x	x		x	x	x		x				
Management of lakes	x	x	x	x		x	x			x		
Establishment and operation of lake improvement districts	x	x	x									
Water surface use regulation	x	x	x				x			x		
Dam safety	x	x										
Stream maintenance	x	x	x	x	x	x		x				
Flood plain zoning	x	x	x	x		x						
Shoreland management	x	x	x							x		
Erosion control	x	x		x	x		x			x		
Public waters regulation	x	x	x	x	x	x	x					
Water quality protection 4/	x	x	x	x	x		x			x	x	
Water planning	x	x	x	x	x	x	x	x	x	x	x	x
Water appropriation		x		x	x							

1/ Does not include joint powers agreements or the Metropolitan Waste Control Commission. Authorities cited for townships refer only to non-urban townships. Authorities of urban towns parallel cities.

2/ Does not include certain powers available only to the Metropolitan Council.

3/ Includes reclaiming and filling of wetlands.

4/ Includes regulating use of streams for waste disposal, control of vegetation in public waters, and septic tank and feedlot regulation.