FINAL REPORT

DEC 17 2001

1999 Project Abstract
For the Period Ending June 30, 2001

TITLE: ENVIRONMENTAL INDICATORS INITIATIVE - CONTINUATION

PROJECT MANAGER: Keith Wendt
ORGANIZATION: Department of Natural Resources
Office of Management and Budget Services
Science Policy Section
ADDRESS: 500 Lafayette Road, Box 10
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WEB SITE ADDRESS: http://www.dnr.state.mn.us/eii

FUND: Environmental Trust Fund
LEGAL CITATION: ML 1999, Chap. 231 Sec. 16, Subd. 12(c)

APPROPRIATION AMOUNT: $400,000

Overall Project Outcome and Results

Citizens want to know how well Minnesota's natural resources and environment are being managed. Common sense requires that DNR and its partners document natural resource status and trends and demonstrate how programs lead to improved natural resources and better environmental conditions. The Environmental Indicators Initiative, a pilot project initiated by the Legislative Commission on Minnesota Resources built, tested, and applied frameworks to help natural resource managers achieve the following results:

- Indicators that document natural resource status and trends
- Indicators that link natural resource activities to natural resource outcomes
- Targets developed for indicators that enable us to forecast and measure program results
- Indicators and targets integrated into DNR management plans and programs
- A scientifically credible and comprehensive picture of the state's natural resources and the effects of DNR management (see DNR's *Natural Resources Stewardship 2001. Key Indicators of Progress*)
- Inter-agency coordination on developing common natural resource and environmental goals and associated performance indicators.

Project Results Use and Dissemination

EII efforts fostered the growth of a network of citizens, resource professionals and policy makers using indicators in natural resource learning and decision making. EII-designed frameworks and indicators are now incorporated into DNR standard operations. Lessons learned during the pilot project allowed DNR and partners to refine indicator development and move forward with application of those frameworks which best enhance our ability to use indicators to forecast and measure environmental results. The LCMR pilot project and continuing DNR work laid an important foundation for contributing to a broader effort recently established by the Governor's Office of Results Management to strengthen accountability and responsiveness to citizens by measuring and reporting results. DNR is sharing best-practices learned through the last six years of developing indicators and applying frameworks that promote the use of indicators in decision-making aimed at achieving environmental and natural resource results.

DRAFT

Date of Report: July 1, 2001
Date of Work program Approval:
Project Completion Date: June 30, 2001

LCMR Final Work Program Report

I. PROJECT TITLE: ENVIRONMENTAL INDICATORS INITIATIVE - CONTINUATION

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Total Biennial Project Budget:

$ LCMR:	$ 400,000
$ LCMR Amount Spent:	$ 346,028
$ LCMR Balance:	$ 53,972

A. Legal Citation: ML 1999, Chap. 231 Sec. 16, Subd. 12(c)

Appropriation Language: $200,000 the first year and $200,000 the second year are from the trust fund to the commissioner of natural resources for the third and final biennium to complete a set of statewide environmental indicators that will assist public understanding of Minnesota environmental health and the effectiveness of sustainable development efforts.

B. Status of Match Requirement: none

II. and III. FINAL PROJECT SUMMARY:

Citizens want to know how well Minnesota's natural resources and environment are being managed. Common sense requires that DNR and its partners document natural resource status and trends and demonstrate how programs lead to improved natural resources and better environmental conditions. The Environmental Indicators Initiative, a pilot project initiated by the Legislative Commission on Minnesota Resources tested, built, and applied frameworks to achieve the following results:

- Indicators that document natural resource status and trends
- Indicators that link natural resource activities to natural resource outcomes.
- Targets developed for indicators that enable us to forecast and measure program results.
- Indicators and targets integrated into DNR management plans and programs.
- A scientifically credible and comprehensive picture of the state's natural resources and the effects of DNR management (see DNR's *Natural Resources Stewardship 2001: Key Indicators of Progress*).
- Inter-agency coordination on developing common natural resource and environmental goals and associated performance indicators.

EII efforts fostered the growth of a network of citizens, resource professionals and policy makers using indicators in natural resource learning and decision making. EII-designed frameworks and indicators are now incorporated into DNR standard operations (see Section IV). Lessons learned during the pilot project (see Section IV) have allowed DNR and partners to refine indicator development and move forward with application of those frameworks which proved to have the greatest impact on enhancing our ability to use indicators to forecast and measure environmental results. The LCMR pilot project and continuing DNR work has laid an important foundation for contributing to a broader effort recently established by the Governor's Office of Results Management to strengthen accountability and responsiveness to citizens by measuring and reporting results. DNR is sharing best-practices learned through the last six years of developing indicators and applying frameworks that promote the use of indicators to improve decision-making aimed at achieving environmental and natural resource results.

The Environmental Indicators Initiative website at **http://www.dnr.state.mn.us/eii** explains in detail our work with partners to develop and adopt indicators for assessing natural resource trends and managing for environmental results.

IV. OUTLINE OF PROJECT RESULTS (AND LESSONS LEARNED)

Overview

The Environmental Indicators Initiative achieved the following results: 1) Environmental indicators used in natural resource management with the purpose of achieving results and reporting on progress toward goals, 2) Networks of citizens, resource professionals, and policy makers sharing indicator information and using indicators for effective management, and 3) Environmental Indicators used for assessments that provide general information about environmental trends. Project results are summarized below and are

described and illustrated on the Environmental Indicators Initiative Website at **http:// www.dnr.state.mn.us/eii/**

Lessons Learned

During the pilot project the EII learned several key lessons about indicator development.

Lesson 1: Indicator development and uses

The EII first tested an approach to indicator development in which we explored building one set of statewide indicators based on the best available science. Under this approach, one common set of environmental indicators would be adopted by many users. This set ideally would influence policies and budgets and set the stage for one common standardized approach to indicator data collection across environmental agencies. This "build it and they will come" approach had significant shortcomings:

- There is no one small set of universally applied indicators that can address all environmental concerns.
- A one-size-all deterministic model for indicator development cannot address the wide range of different uses for indicators.
- Indicators developed in isolation from program goal setting and performance measurement have limited value.

Based on what we learned, we developed a more collaborative and systemic approach to indicator development. Rather than starting with a prepackaged set of indicators, we engaged partners — citizen and community groups, local governments, and agencies — in a process that starts with asking partners to define their information needs and describe their intended uses of environmental indicators. We then worked to institutionalize the use of indicators into natural resource planning, budgeting, and evaluation, and improve collection and reporting of environmental information.

In general, we found that partners wanted to use indicators in ways that correspond with EII's three main project results: 1) using indicators in *natural resource management* with the purpose of achieving results and reporting on progress toward goals, 2) sharing information about indicators through *networks,* and 3) using indicators for *assessments* that provide general information about environmental trends to a wide variety of audiences.

EII worked to achieve all of these three results, but put greatest emphasis on the first result: using indicators in natural resource management to define, forecast, and evaluate progress toward environmental results. EII worked with partners to explicitly define and articulate their intended outcomes and the assumptions behind their programs, and then build indicators of success. This process uses a results-based management framework to illustrate the links between program activities and outcomes and then uses indicators to measure progress. This process is more time consuming but it results in indicators that are used in ongoing learning and decision-making.

EII used a results framework to help partners:

- Define outcomes
- Identify strategies to achieve outcomes
- Develop indicators to measure progress
- Set targets for indicators
- Communicate results using measurable indicators
- Evaluate and adapt strategies and outcomes as needed

This approach helped partners:

- Build understanding and consent around the program's purpose
- Bring details to broad, fuzzy goals
- Show the links between program activities and outcomes
- Determine the most appropriate indicators to measure success

Lesson 2. Activity and outcome indicators

Building linkages between different types of indicators (*activity* and *outcome* indicators) provides the most useful information for decision makers. Useful sets of indicators provide information both about what we do (activity indicators) and about what we want to ultimately achieve (outcome indicators). Decision makers can use these sets of indicators to better understand and communicate the relationship between management actions and intended results.

Lesson 3. Setting targets

In simple terms, setting a target for an indicator means setting quantifiable expectations for "how much by when." Setting targets is an integral part of results-based management because it builds common understanding and commitment to achieve results. It is relatively easy to set targets for activity indicators (e.g., the work we do), but far more difficult to develop targets for natural resources outcome indicators (e.g., results in water quality, ground water availability, wildlife populations, forest productivity). This difficulty in setting targets arises in part because outcome indicators are influenced by numerous external factors, such as weather, drought, social trends, etc. Agencies are hesitant to set targets for long-term natural resources results that stringly influenced by factors they cannot control. Yet ultimately it is these long-term results that matter most for environmental health and the citizens of Minnesota. The best approach to identifying indicators and targets is to focus on a range of activities, short-term outcomes, and long-term outcomes.

Lesson 4. Leadership and investment

The concept of indicators and results reporting is easy to communicate but difficult to put into operation. Institutionalizing the use of environmental indicators in decision making by developing meaningful indicators and performance measurement systems requires leadership support and action throughout all levels of the administration.

Building a results-based management infrastructure requires:

- **investing in the data collection** needed to describe natural resources conditions and cause-effect relationships. Without this basic information we can not develop targets for indicators based on credible, sound science. Traditionally we have collected information on activities rather than actual results. Indicators of results are difficult and expensive to measure.

- **investing in performance measurement systems** that effectively integrate performance indicators and budgets and are used throughout departments in making decisions about budget priorities and resource allocation.

Lesson 5. Managing Expectations

- Reporting on indicators doesn't guarantee improving natural resource results. Decision making and action are promoted when indicators are part of an evaluation process with explicit outcomes and targets.

- Indicator development requires substance (good science), procedure (process to build consent), and relationship building (trust across different interests).

- Indicators are a tool for improvement — not an ultimate solution. Indicators will not make complex environmental problems more tractable to simple solutions, or make management choices less value laden. But indicators can make complex problems more understandable and they can provide a common data from which to outline a range of policy choices.

- Outcome-based goals, targets, and indicators represent a new approach to management and performance measurement. Expect resistance to a new idea .

- Its easy to list the characteristics of ideal indicators: its far more difficult to find the indicators that meet these ideals and then support them with good data.

Results

Result 1: Environmental indicators for use in natural resource management: defining, forecasting, and reporting on progress toward natural resources results.

During the LCMR funding period EII staff worked with partners to develop indicators for use in natural resource management. These included partnerships with statewide initiatives, state agencies, and regional projects. For example, indicators were developed with the Water Management Unification Task Force, the Forest Resources Council, DNR Metro Region (including Metro Greenways, Neighborhood Wilds, and the Metro Trout Stream Initiative), Cannon River Watershed Partnership, Oak Savanna Landscape Project, Northeast Minnesota Lakeshore Initiative, the Mississippi River Team. (*These results are also described in more detail in the **July 1, 2000 LCMR Work Program Update Report***).

The EII staff continues to work with partners following the LCMR funding period. Three EII staff now employed in DNR's Office of Management and Budget Services, Division of Forestry, and Metro Region work with partners to integrate indicators into the daily use of resource managers and decision makers continues. We describe those ongoing projects below.

DNR 2001 Progress Report

EII staff worked with approximately 100 staff of the Minnesota Department of Natural Resources to develop a set of indicators designed to measure progress toward agency-wide goals. These indicators are displayed and described in the 2001 DNR Progress Report, "Natural Resources Stewardship 2001: Key Indicators of Progress" (*This report is available on the EII website*).

This set of indicators was an important step for the DNR because it focused on describing, where possible, on-the-ground results in natural resources sustainability, in addition to the DNR activities that brought about those accomplishments.

This approach had several benefits for the DNR. It helped build understanding within the organization about interrelated programs, brought detail to broad agency-wide goals, showed links between program activities and outcomes, and set the stage for long-term applications of science-based indicators to measure progress. In sum, this effort enhanced DNR's capacity to integrate results-based management throughout the organization, and built the foundation for ongoing indicator reporting efforts. This work is being continued with a focus on identifying targets for indicators and progress reporting.

Office of Results Management

EII staff worked with the Governor's Office of Results Management newly established in 2001. The Office coordinates the public reporting of progress toward meeting State goals in an effort to strengthen accountability and responsiveness to citizens. The Office is developing a website to report on result indicators for 25 state departments. The office is holding Progress Conferences in which each state department presents its strategic goals and indicators to measure progress toward results.

The EII Project Manager is a member of the Best Managed State Advisory group which works with the Office of Results Management to develop criteria and then review and evaluate department presentations at each Progress Conference. EII staff organized the DNR's presentation for its Progress Conference. EII also organized DNR staff in selecting and displaying the 10 indicators DNR will feature on the Governor's Office Results Website (*see attachment: Minnesota Department of Natural Resources Draft Results Indicators for the Governor's Office Results Website).*

The Office of Results Management is another example Minnesota's work to incorporate the use of indicators and targets to more effectively forecast and measure results. Establishment of this office is an important signal from the Governors's office of the importance of results and performance measurement. It will further encourage environmental agency work to develop and refine environmental indicators within a framework that explicitly defines the links between program activities and outcomes. Working with partners to develop and apply a results-based management frame-

work to link environmental and natural resource activities to outcomes and then use indicators to measure results was one of the major accomplishments of EII. EII's work with environmental programs is enhanced by efforts across all departments to institutionalize results-based performance measurement. EII staff will continue to work with the Governor's Office on integrating indicators and results-based management in natural resource management.

Bear River Demonstration Forest

EII staff were instrumental in identifying stakeholder goals, desired outcomes, and indicators for measuring progress in the Bear River Demonstration Forest. The Bear River Demonstration Forest is a working model for more cooperative and innovative forest management involving federal, state, county, and private forest land managers. The effort aims to increase forest health, productivity, and diversity through the accelerated application of innovative silvicultural practices, thinning, and selective harvest. The use of indicators is integral to documenting progress toward project goals, satisfying the information needs of stakeholders, and educating Minnesotans about alternative forest practices and the benefits they provide.

The EII Project Manager was instrumental in implementing the demonstration forest and creating an organization in which indicators play a key role in defining forest resource goals and measuring project progress. The EII Coordinator leads the Monitoring, Evaluation, and Research Group comprised of stakeholders and researchers. The group has developed a framework to guide environmental monitoring and other data collection efforts that will document management activities and their effects on forest resources over time. EII staff will continue its work to incorporate indicators into natural resource management with demonstration forest cooperators.

Metro Region DNR

EII staff assisted a Metro work group to assess monitoring and evaluation needs and to present recommendations to the Regional Management Team (*this report is posted on the EII website: "Briefing Paper Monitoring and Evaluation 10, July 2000")*. The work group identified several constraints, including the lack of explicit goals and objectives, as key barriers to developing indicators for use in monitoring and evaluation. In response, EII staff assisted the Metro Region in revising their region-wide strategic plan to include outcome-based goals and measurable objectives. The Metro Region is currently providing staff support (FY 2001-2002) for the identification of ways to incorporate indicator development and monitoring and evaluation into ongoing regional activities such as project and program improvements, grants management, natural resource assessment, and information and data gap identification.

Nongame Wildlife Program and Division of Ecological Services

EII staff has helped individual programs better integrate outcome-based indicators into planning and management. For example, the EII has collaborated with the Nongame Wildlife Program (NWP) to: define ten-year priority outcomes for nongame wildlife resources in Minnesota, agree on program strategies to achieve outcomes, and identify indicators to measure progress. While

programs such as the Nongame Wildlife Program have a good history of accomplishments reporting, most reporting has emphasized *activity indicators*. This current work with the Nongame Wildlife Program will help the program better integrate *outcome indicators* into their planning, management, and reporting. This approach is a good example of how results-based management is being effectively integrated at various levels throughout the DNR organization. Our next step is to build on this effort to integrate similar results-based management frameworks into the Ecological Services Division of the Department of Natural Resources.

Result 2: Networks of citizens, resource professionals, and policy makers using indicators to their full potential and having access to succinct, credible, and comprehensive data needed for effective decision making.

EII efforts substantially fostered the growth of the network of citizens, resource professionals, and policy makers using indicators in decision making. EII staff contributed indicator expertise to the **Governor's Water Management Unification Initiative** and the development of the EQB's **Water Plan 2000** for monitoring and conserving water resources. EII staff also helped develop guidelines for the consistent collection and reporting of Geographic Information System data on the conservation practices employed on lands under permanent easement. EII staff provided indicator expertise to the **Governor's Smart Growth Initiative** and DNR's **Conservation Connections** and **Urban-Wildlands Interface Program**, promoting indicators for data collection and reporting.

EII strengthened the flow of information between various forest resource planning processes. EII staff participated in **DNR's Subsection Forest Resource Management Planning** process, the **Forest Resource Council's** assessment of information needs, landscape planning processes, and **Guidelines Implementation Monitoring Technical Committee**, **Great Lakes Forest Alliance** forum on Sustainable Forest Management, and **U.S. Forest Service's Local Unit Criteria and Indicator Development** pilot for Ottawa National Forest. The ***July 1, 2000 LCMR Work Program Update Report*** fully describes the indicators developed and used by each of the network partners mentioned above.

For other EII activities aimed at expanding the use of indicators and strengthening the ties between groups of indicator users see Result 1. EII staff will continue to provide indicator expertise and encourage interdisciplinary partnerships among indicator users.

Result 3: Environmental indicators.

The following set of environmental indicators provide information to produce a fairly comprehensive picture of the state of the environment. Each indicator addresses an important resource or issue and may be used independently to provide timely and useful information. However, none are likely to provide enough information in themselves to be the basis for effective management. Selecting appropriate management action requires not only describing natural resource conditions but also understanding cause-effect relationships.

LAND USE

Land use may be the single most important indicator of overall environmental condition. Land use decisions have far-reaching and long-lasting effects on the environment. Land uses that include removal of natural vegetation and replacement with other covers (e.g., crops, impervious surfaces such as cement and asphalt, buildings, lawns) disrupt the energy and material pathways characteristic of natural ecosystems and create other flows that require intensive management. For example, impervious surfaces in urban areas limit the infiltration of precipitation into soils. Increased runoff requires infrastructure (e.g., storm sewers, retention ponds) that is costly to construct and maintain and may significantly alter the hydrologic regimes of rivers and streams. Agriculture typically replaces native vegetation with monocultures heavily subsidized with artificial fertilizers and pesticides. High rates of soil erosion and ground water contamination that may be associated with agriculture are examples of material flows uncharacteristic of natural systems.

The following land use subcategories further define land use and provide more detailed information:

- General land use
- Forest area and composition
- Urbanization
- Farmland
- Status of special concern habitats

FISH AND WILDLIFE POPULATIONS

Fish and wildlife populations are integral components of Minnesota ecosystems. Species occupy unique and essential positions in food webs that helps structure the ecosystem, contribute to processes that maintain vegetative communities (e.g., by dispersing seeds or controlling damaging insects), and provide us with recreational opportunities, aesthetic experiences, and valuable ecological services (e.g., pollination, pest control).

Population fluctuations and changes in the relative abundance of fish and wildlife species are indirect measures of the health of whole ecosystems. Population trends of species with narrow habitat requirements are diagnostic of changes in habitat availability, habitat quality, or other environmental conditions. Declines in populations of game species often signal overexploitation or loss of habitat. Declines in pollution-sensitive species are often the first indication of environmental contamination.

The ecological roles of many fish and wildlife species is well understood by scientists and widely appreciated by Minnesotans. In addition, hunting and fishing contribute significantly to our quality of life. For these and other reasons, fish and wildlife population trends are effective indicators of environmental condition.

The following indicators are effective measures of trends in fish and wildlife populations.

Breeding bird populations
Walleye abundance
Loon populations

WATER QUALITY AND QUANTITY

Minnesota's lakes, rivers, streams, wetlands, and ground water aquifers are intimately linked with its terrestrial systems. Because water bodies and aquifers are always 'downhill' from terrestrial ecosystems, agricultural fields, and developed areas, they act as 'sinks' for effluents from those systems. In many cases, aquatic systems are largely dependent on input from terrestrial systems. In forested streams, for example, annual influxes of leaf litter support food webs that include a wide range of organisms, from algae and zooplankton, to invertebrates and trout. In other aquatic ecosystems, nutrients needed for fundamental processes such as algal and plant growth are almost entirely derived from terrestrial sources. When nutrient input is excessive, however, eutrophic conditions that limit use for swimming and fishing may result. Many land management activities, including standard agricultural, forestry, and lawn care practices, alter the flow of nutrients into waterbodies.

Waterbodies are also sinks for a wide variety of substances known to be harmful to aquatic life and human health. Significant negative affects on human health and aquatic biota may result when the rate of input of these compounds exceeds the capacity of the system to flush itself or to biologically process them into less harmful forms.

In rivers and streams, flow regime is an important regulator of biological processes and a strong influence on human activities. Lack of flow limits aquatic biota and excessive flow erodes streambanks and damages property and infrastructure. In lakes, climate-related and human-induced fluctuations in water levels affect basic ecosystem properties and uses, such as fish and waterbird breeding habitat, recreation, and property values.

Because aquatic systems are 'sinks' that accumulate and magnify the effects of upland management, measures of water quality and quantity provide information about conditions both within the waterbody itself and in adjacent terrestrial ecosystems.

The following indicators describe water quality and quantity.

Lake, river, and stream water quality
Contaminants infish
Surface water flows
Ground water quality
Ground water abundance

AIR QUALITY

The atmosphere connects the other components of the environment to each other by providing a means for rapid and widespread distribution of energy and material. For example, water vapor and the energy it contains are exchanged between oceans and continents, water bodies and surrounding lands. Particulate material from industrial operations and natural sources that contain nutrients and contaminants are transported great distances before being deposited. These transfers affect ecosystems, modify ecological processes, and influence human health. Acids contained in precipitation have severely damaged New England and European forests. Contaminants bioaccumulate in the tissues of fish and other predators. Smog alerts warn sensitive populations to avoid outdoor activity.

The following air quality indicators further define air quality and provide more detailed information:

Air Quality Index
Acid precipitation
Mercury deposition

The data presented for individual indicators are examples of the types of data available to measure trends in the indicators. Many kinds of information from a variety of sources could be used alone or incombination to inform individual indicators.

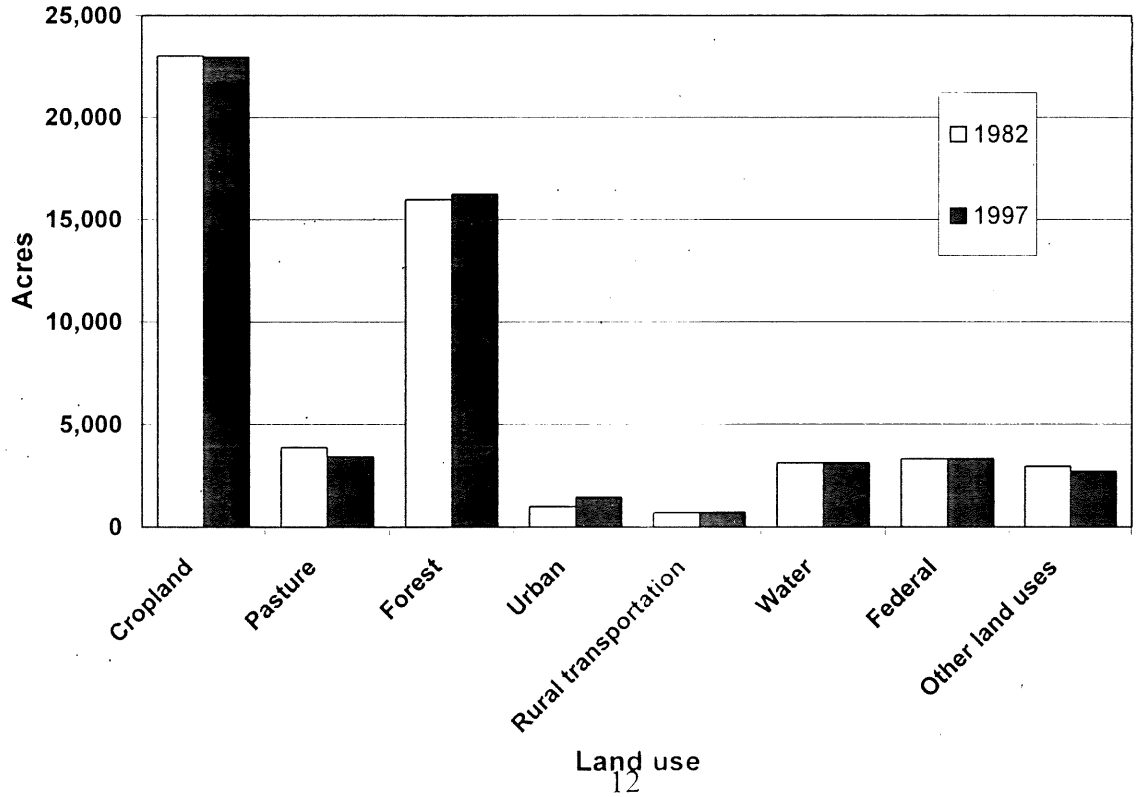
General land use

Although no single agency is responsible for comprehensive monitoring of land use and land cover in Minnesota, there are many useful sources of such information. Two examples are the Natural Resource Inventory conducted by the UDSA Natural Resource Conservation Service and data provided by the Metropolitan Council for the Twin Cities area.

- The USDA Natural Resource Conservation Service's Natural Resource Inventory documents land use on non-Federal lands in Minnesota every five years in a consistent, standardized format. The NRI is conducted to obtain scientifically valid, timely, and relevant data on natural resources and environmental conditions, with the specific goal of supporting agricultural and environmental policy development and program implementation. NRI data elements in use since 1982 include area in cropland (irrigated, non-irrigated) pastureland, forest, farmsteads & ranch headquarters, small built-up areas, large urban and built-up areas, small water body types and size and information on cropping history, irrigation type and source of water, soil erosion, and wetlands. In 1992, NRI began measuring area in rural transportation facilities, large water body types and size, Conservation Reserve Program lands, and documenting wetland classification. Beginning in 1997 NRI included shoreline characterization, CRP practice type and acreage, wildife habitat composition and configuration, wetland and deepwater habitat, wetland size, and conservation practices. See >1997 National Resources Inventory Summary Report= for more details.

- The Metropolitan Council inventories land use in the Twin Cities metropolitan area every few years. Land use/cover categories in this inventory include single family residential, multi-family residential, commercial, industrial, public industrial extractive, public & semi-public, airports, open water bodies, parks & recreation facilities, farmsteads, vacant & agricultural, industrial parks not developed, public & semi-public not developed.

Example: Land use in Minnesota in 1982 and 1997 (USDA Natural Resource Inventory)

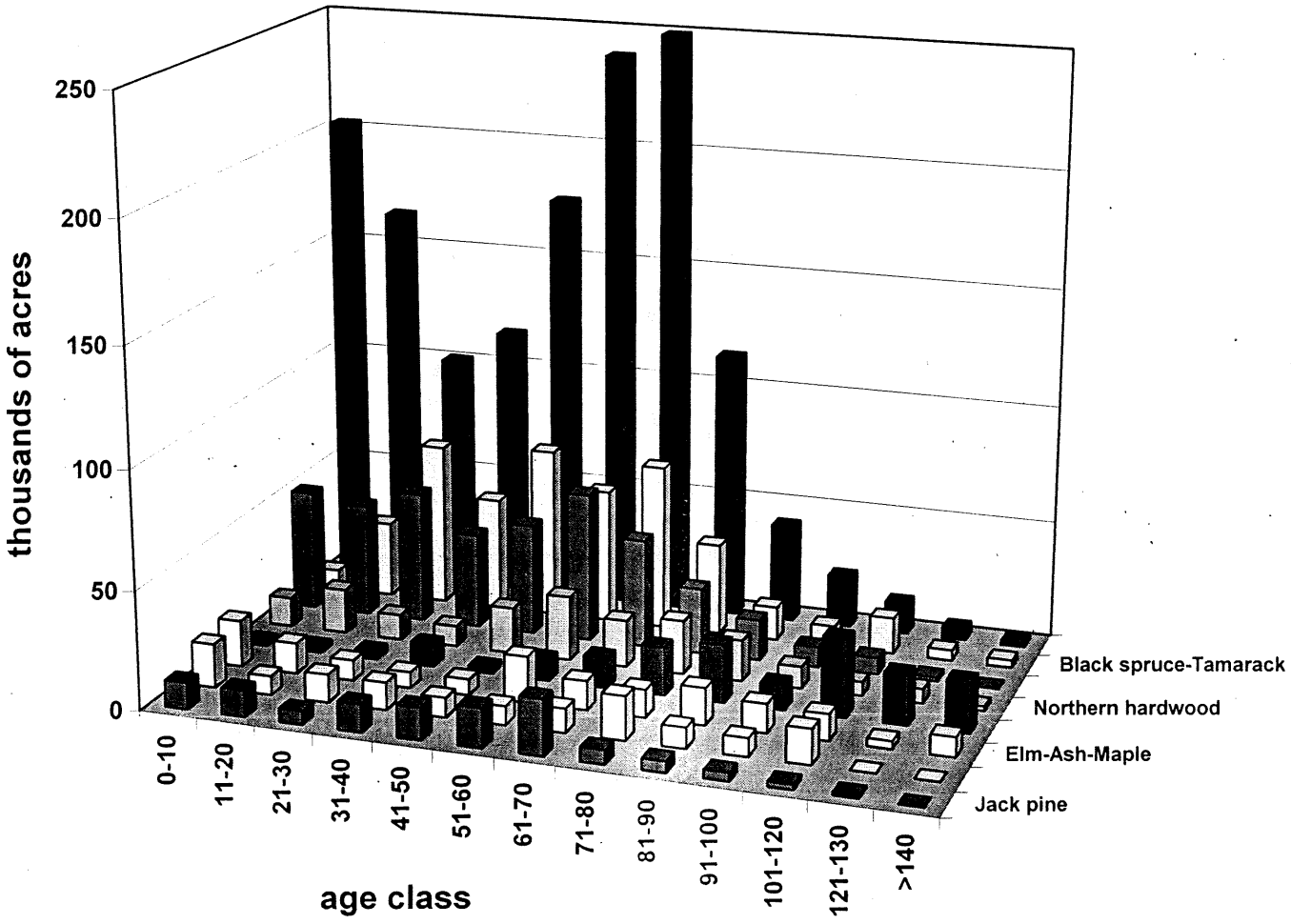


Forest area and composition

Minnesota's forest-based tourism and manufacturing industries require aesthetically appealing recreation areas and sustained inputs of timber and fiber. Diverse and productive forests provide these benefits.

The U.S. Forest Service's Forest Inventory and Analysis (FIA) is a national forest census. FIA reports on status and trends in forest area and location; tree species, size, and health; tree growth, mortality, and removals by harvest; wood production and utilization; and forest land ownership. The program includes information on tree crown condition, lichen community composition, soils, ozone indicator plants, complete vegetative diversity, and coarse woody debris. Managed by the Research and Development organization within the USDA Forest Service in cooperation with State and Private Forestry and National Forest Systems, FIA has been in operation under various names (Forest Survey, Forest Inventory and Analysis) for about 70 years. The program covers forests on all private lands and most public lands within the US. In Minnesota, DNR Forestry field personnel collect and report the field data that is accumulated in FIA databases and reports.

Example: Forest types and age classes in northeastern Minnesota in 1990.

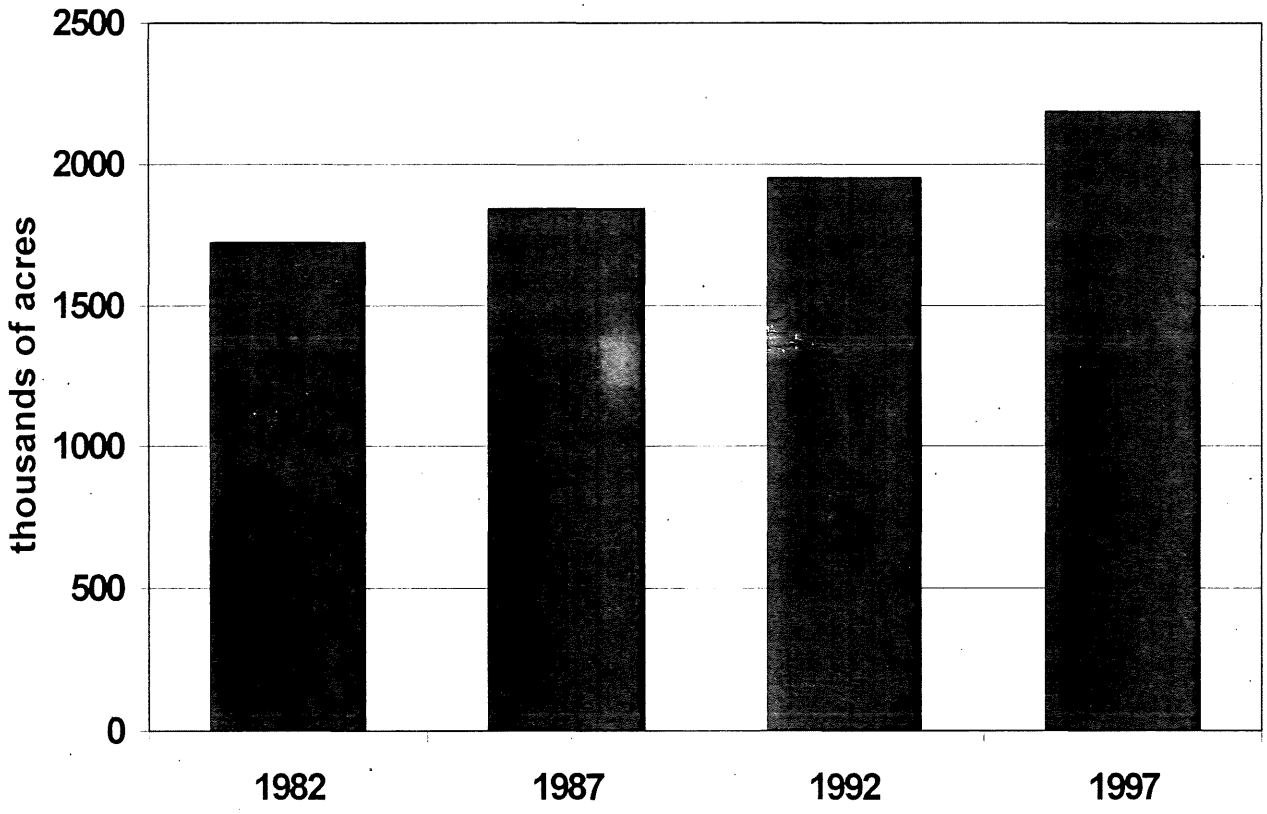


Urbanization

Urbanization is the construction of roads and highways, single- and multiple-family housing, parking lots, commercial buildings, industrial facilities, and other features characteristic of populated areas on lands once used for other purposes. As development occurs, the amount of natural vegetative cover diminishes significantly, often replaced by impervious surfaces and non-native plant species. Urbanization may eliminate or fragment natural areas, lead to degradation of surface and ground waters, and reduce access to outdoor recreation, commercial timber, and minerals.

The rate of urbanization is directly related to population growth, increased affluence and accompanying changes in lifestyle, and highway construction. The recent trend toward low-density development in suburban areas has increased the rate of conversion of former agricultural lands. In 1982, the average population density for urban areas in Minnesota was about 1,733 people per square mile. Urban areas developed since 1982 have a density of 926 people per square mile.

Example: Urban land increased 27 percent in Minnesota from 1982 to 1997.

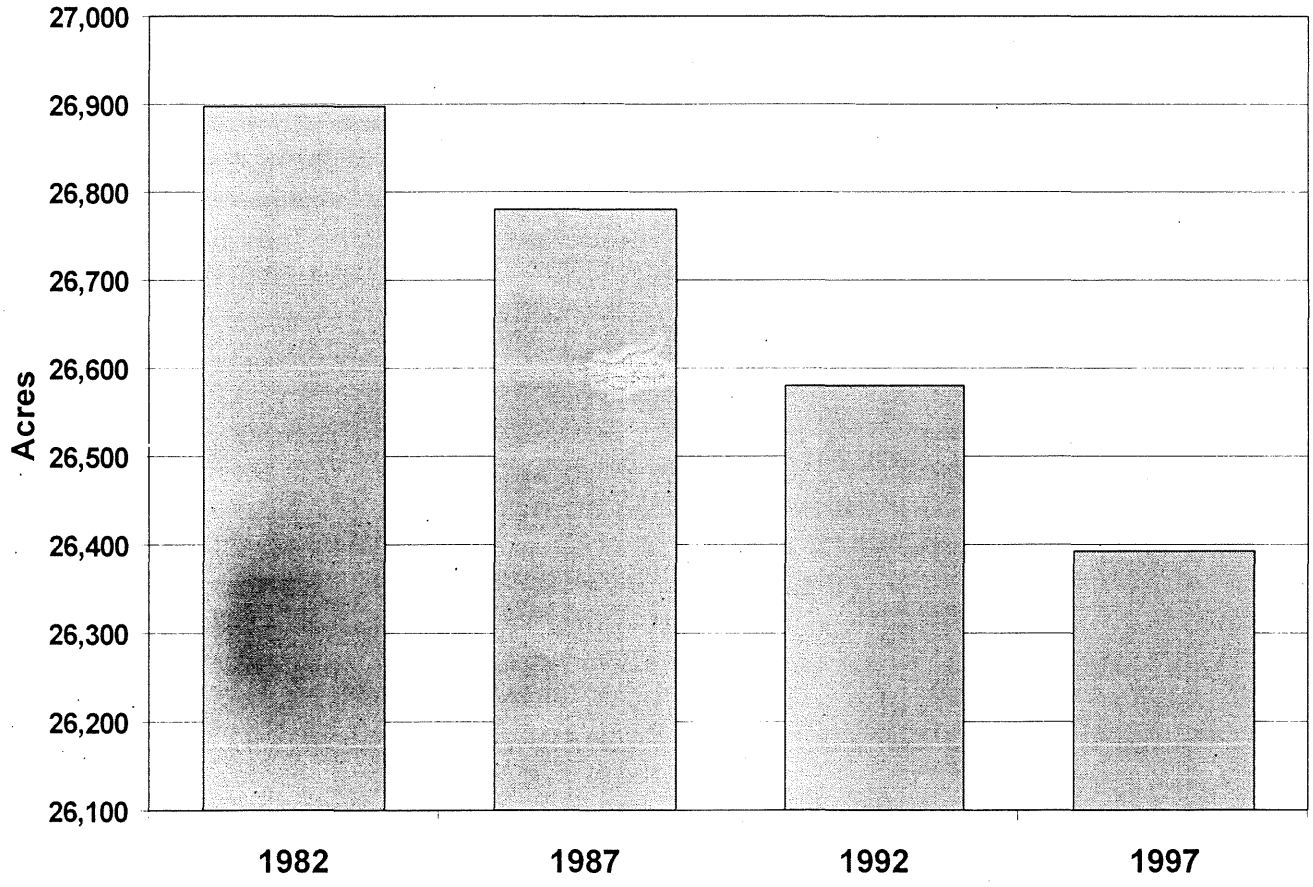


Farmland

Tracking the amount and distribution of agricultural lands is important for many reasons. Agricultural lands provide a significant portion of the state's wildlife habitat and tracts of land for hunting and other outdoor recreation. The agriculture-dominated portion of the state contains Minnesota's remaining privately and publicly owned prairie and other threatened plant communities. Eroding farm fields pollute rivers, streams, and lakes with sediments and excess nutrients. Agricultural drainage systems may contribute to flooding by delivering water to rivers and streams too quickly.

Changes in the amount and quality of farmland are influenced by many factors. Government programs that encourage specific agricultural practices and markets that demand low-cost agricultural products exert tremendous influence the quality of agricultural lands. As the number of family farms decreases and development expands outward from population centers, Minnesota's agricultural lands, which account for nearly one-fifth of the state's economic activity, are increasingly being converted to other uses. The potential positive and negative environmental (and economic) consequences of these changes are significant.

Example: Changes in the amount of farmland in Minnesota 1982 to 1997.



Status of special concern communities

Minnesota is home to nearly 60 ecological community types and 200 sub-types distributed widely across the state. Local examples of these communities vary from undisturbed and intact to severely degraded. Natural communities help maintain the resilience of the ecosystems in which they occur. They provide recreational, aesthetic, and scientific benefits, and provide habitat to common, rare, and endangered plants and animals. High quality examples of natural communities serve as benchmarks for evaluating the health of impacted sites and the building blocks from which to restore larger ecosystems.

Special concern communities are remnants of once abundant natural communities, such as old-growth forest, Big Woods stands, wetlands, native prairie, and undisturbed riparian areas and shorelines. The existence of these communities, their management status, and their quality are measures of the environmental health of Minnesota.

Example:

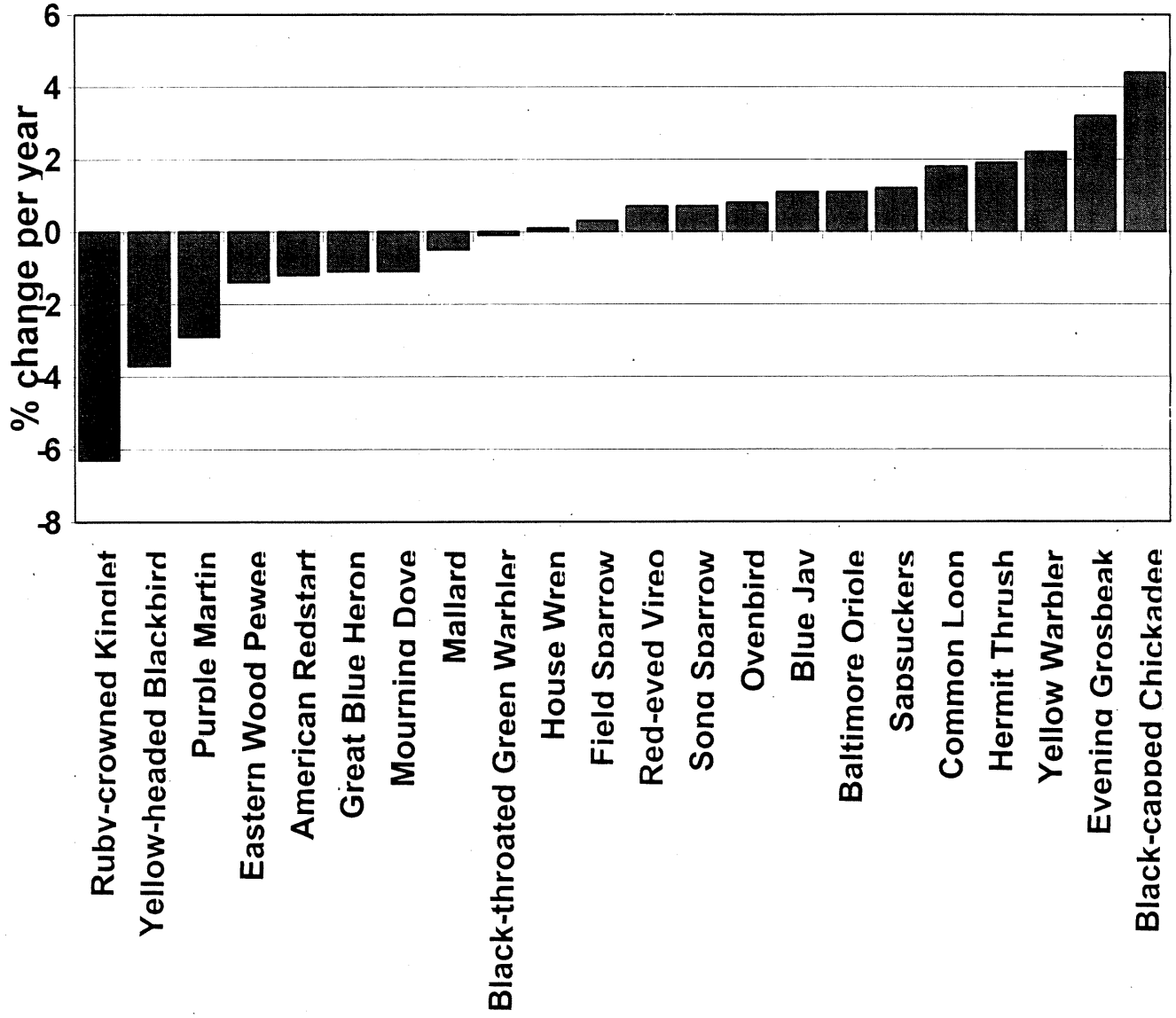
Special Concern Communities	% of Presettlement Amount Remaining
Native prairie	< 1
Big Woods Forest	< 0.1
Oak savanna	< 0.1
Old-growth forest	< 4
Wetlands	<50

Breeding bird populations

The reproductive success and survival rates for many species of birds change rapidly in response to changing environmental conditions. For many species, habitat quality and other conditions in their breeding ranges are of paramount importance in determining population status. Thus trends in the breeding populations of these species are good measures of overall conditions in the ecosystems they inhabit.

Birds offer other advantages as environmental indicators. Unlike many other species, birds are readily identifiable by coloration and/or song. During the breeding season, many species are territorial and males advertise their presence to attract mates. These characteristics make them relatively easy to count accurately by non-professionals. In addition, public interest in birds and willingness to participate in volunteer bird monitoring efforts is high. Volunteer-conducted breeding bird surveys that produce reliable and consistent data are conducted annually throughout the state.

Example: Trends in breeding populations of selected Minnesota birds, 1966 to 1998. Negative values indicate population declines and positive values indicate population increases.

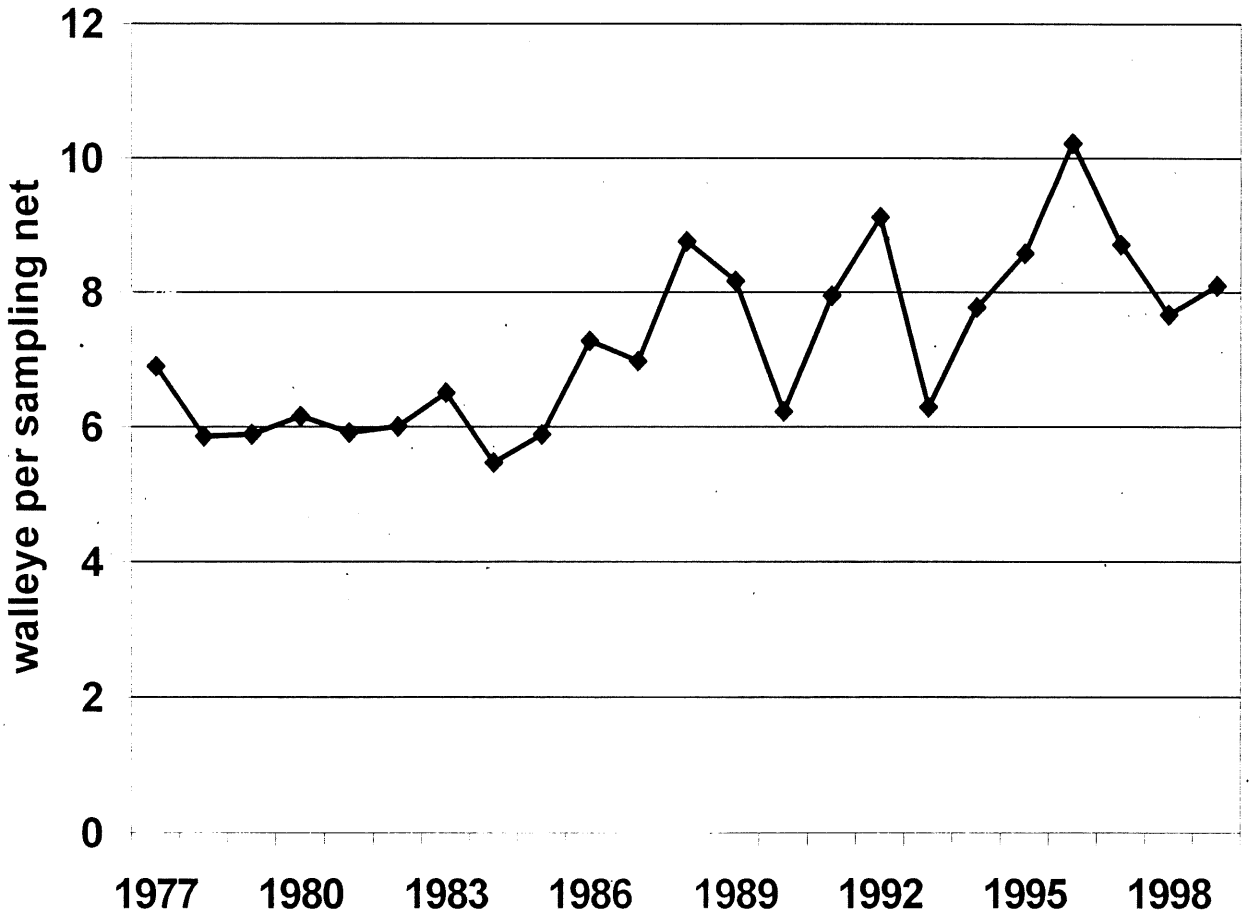


Walleye abundance

As top predators in aquatic systems walleye populations are regulated in part by the abundance of their prey. Other factors that influence walleye population size include the suitability and abundance of spawning habitat, the availability of habitat for protection of young from predation, harvest by recreational anglers, and water quality. Walleye population numbers thus reflect overall conditions in the waters they inhabit and fluctuations in the size of naturally reproducing populations indicate changes in ecosystem characteristics.

There are numerous ways in which to quantify changes in walleye populations. Creel surveys that include information on time spent fishing allow calculation of time required to catch a walleye, an indirect measure of walleye abundance. Lake surveys conducted at regular intervals using standard data collection efforts also provide an index of walleye abundance. Given the large number of lakes that support walleye and the wide range of environmental conditions characteristic of those lakes, it is often possible to link changes in walleye populations to specific factors that could be address by management.

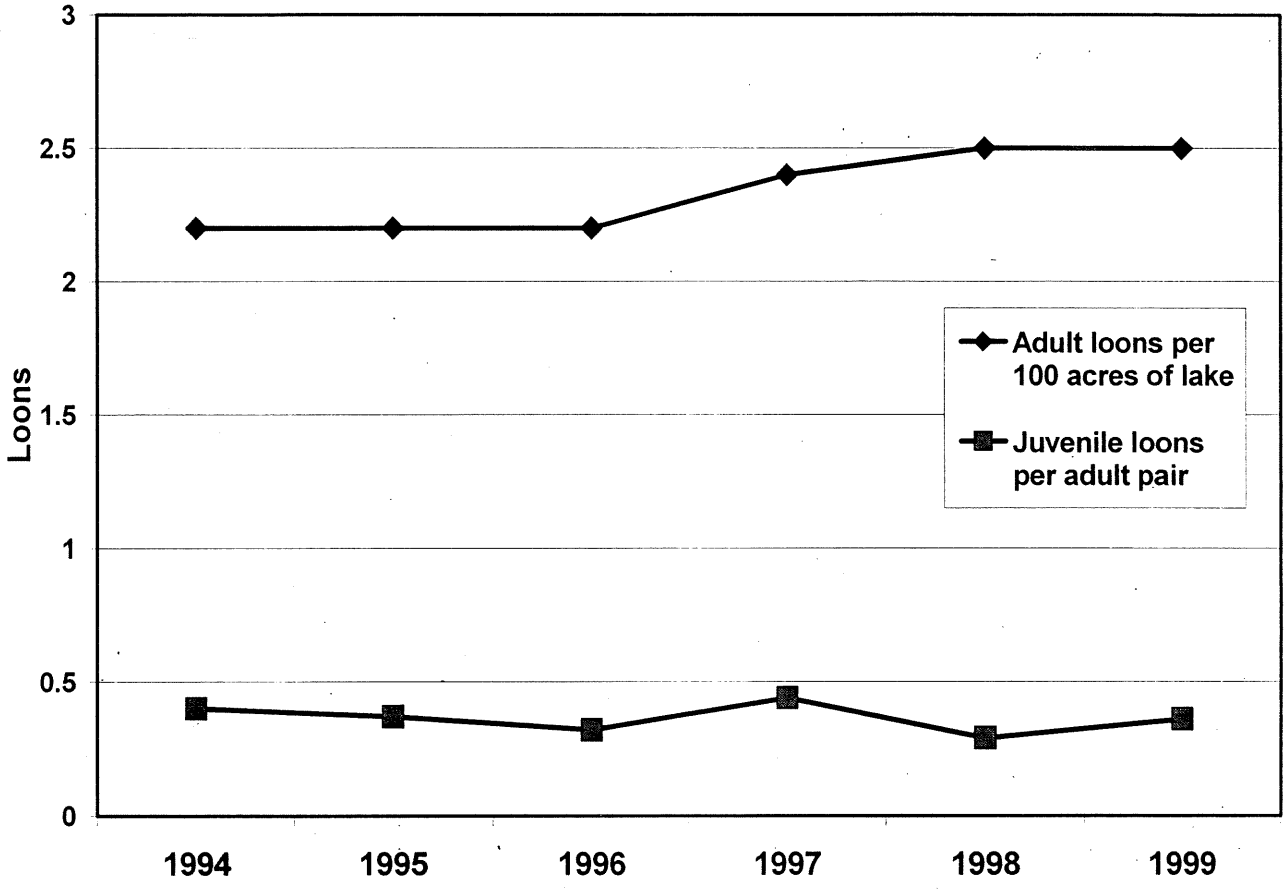
Example: Walleye abundance changes as environmental conditions and angling pressure vary over time. (Data for stocked lakes are depicted here. Data from unstocked lakes are a more sensitive indicators of environemtal conditions.)



Loon populations

Although loons occupy lakes with a wide range of characteristics, they prefer lakes that are clear, support abundant fish populations, and have relatively little disturbance during the breeding season. Under these conditions, loons tend to be more successful at raising young and loon populations are healthier. These conditions also promote healthy populations of other wildlife and are widely preferred by Minnesotans. Thus, fluctuations in loon numbers, the number of lakes used by loons, and the number of lakes on which loon successfully raise young are useful measures of lake quality.

Example: Loon populations are indicative of overall lake quality.

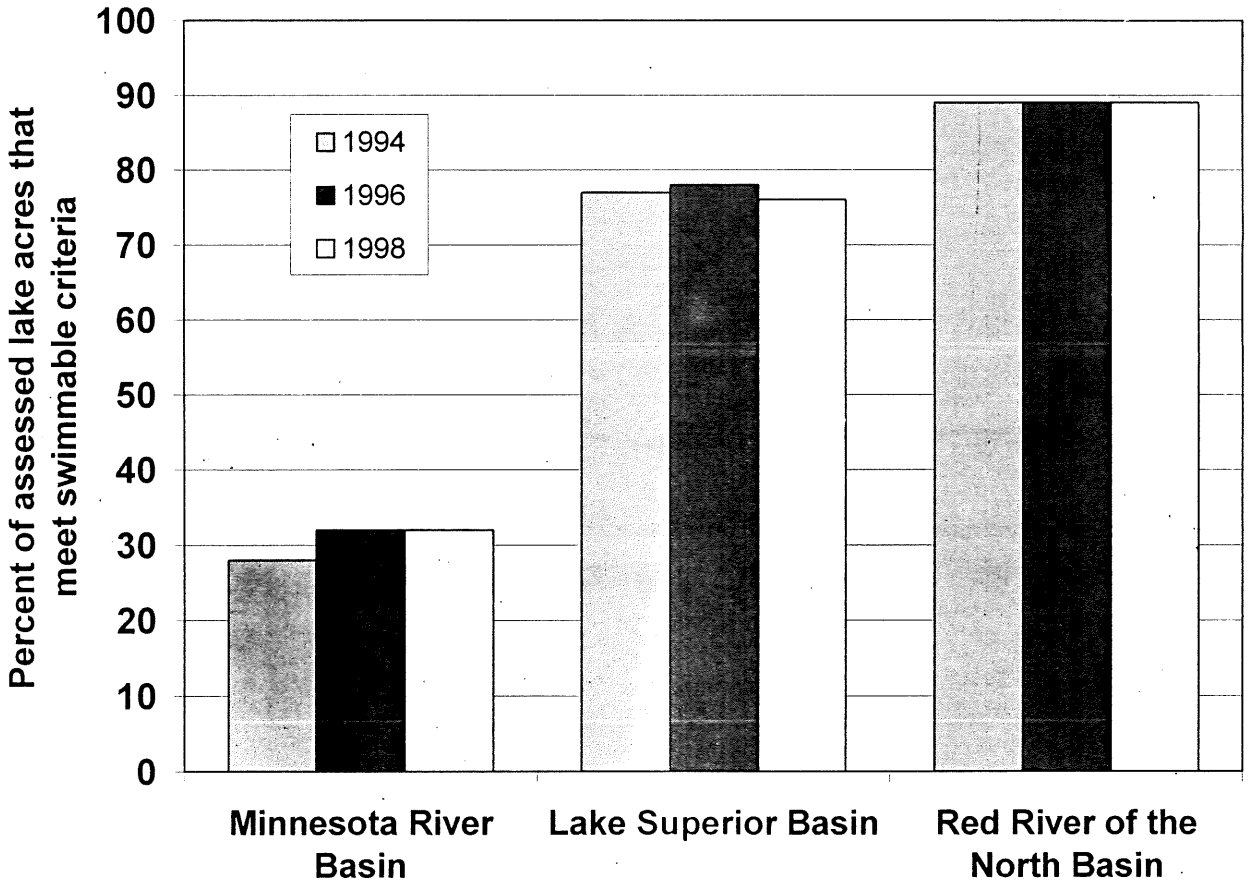


Lake, river, and stream water quality

Swimmable use support is routinely assessed for lakes in Minnesota's 305 (b) Report to Congress and is easily interpreted. Swimmable use is determined in large part by phosphorus content, a primary determinant of algal abundance and water clarity. Natural variation in phosphorus content based on location and regional variation in user expectations are incorporated into the measure. Working definitions for swimmable use are:

- full-support - few algal blooms and adequately high transparency exist to support swimming throughout the summer;
- full-support (marginal) - swimmable use is still fully supported, but the lake is near the phosphorus limit for its ecoregion and small increases in in-lake phosphorus could result in increased algal blooms and perceptible decreases in transparency;
- partial-support (impaired) - algal blooms and low transparency may limit swimming for a significant portion of the summer;
- and non-support - severe and frequent algal blooms and low transparency will limit swimming for most of the summer.

Example: 'Swimmability' is a measure of overall water quality.



Contaminants in fish

Fish and wildlife that are exposed to contaminants in the environment may accumulate those contaminants in their body tissues. The rate of accumulation and the amount accumulated are measures of exposure (an indication of contaminant levels in the environment) and the risk the contaminant poses to human health. Fish accumulate a variety of contaminants, are easy to collect and analyze, and are consumed by many Minnesotans. Statewide programs have measured mercury, PCBs, dioxin or pesticide concentrations in fish on 800 to 900 lakes, rivers and streams. Approximately 2,000-3,000 fish from 70 to 80 lakes and 5 to 10 rivers are sampled annually.

Example: Average concentration of mercury in northern pike and walleye.

Data not available.

Surface water flows

Water regimes in rivers and streams and water levels in lakes are the combined result of climate and natural and modified features of watersheds. A wide variety of factors influence the frequency and magnitude of flows in rivers and the water levels in lakes, including water control structures, hydroelectric power generation, wetland acreage and storage capacity, and impervious surface. The cumulative effect of human activities in watersheds generally is more rapid delivery of greater quantities of water from watersheds into receiving bodies such as rivers and lakes. Consequently water levels fluctuate more rapidly and with wider swings between low levels and high levels that is characteristic under natural flow regimes. The flooding, stream bank erosion, channel scouring, sedimentation, and habitat loss that may occur are characteristic of unhealthy ecosystems and impaired watershed. Water level regimes and how they compare to flows in the absence of artificial disturbances provide useful information on overall environmental condition.

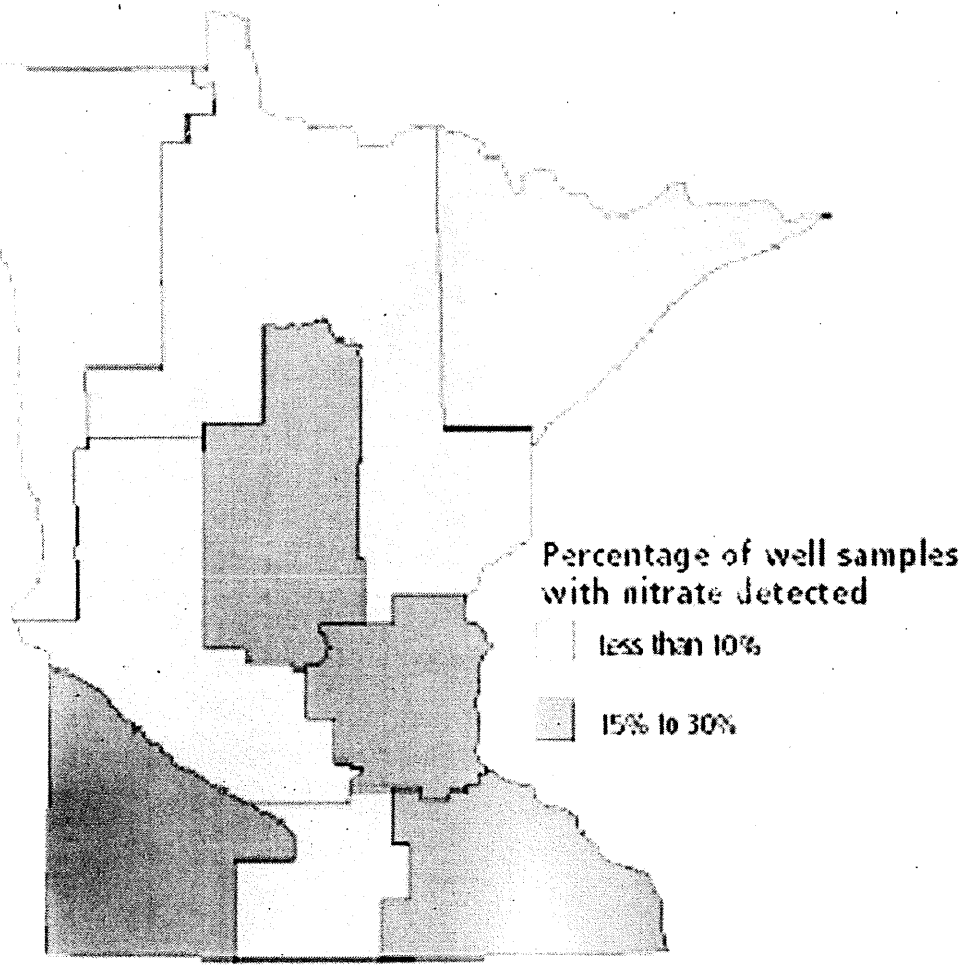
Example: Number of river miles in which flow maximums and minimums are within historical norms.

Data not available.

Ground water quality

Like surface waters, aquifers tend to accumulate contaminants and other materials from the surface. While some aquifers are naturally sensitive to inputs from above because of shallow depth or characteristics of overlying soils, most are protected from excessive inputs by the vegetation on the surface and microbial activities in the soil. Where land use activities include widespread or heavy application of fertilizers and pesticides and the soil column facilitates their downward movement, however, aquifers may become contaminated and unsuitable for human use. Because of their position as sinks for the accumulation of contaminants, aquifers provide useful information about the condition of the ecosystems and human activities above.

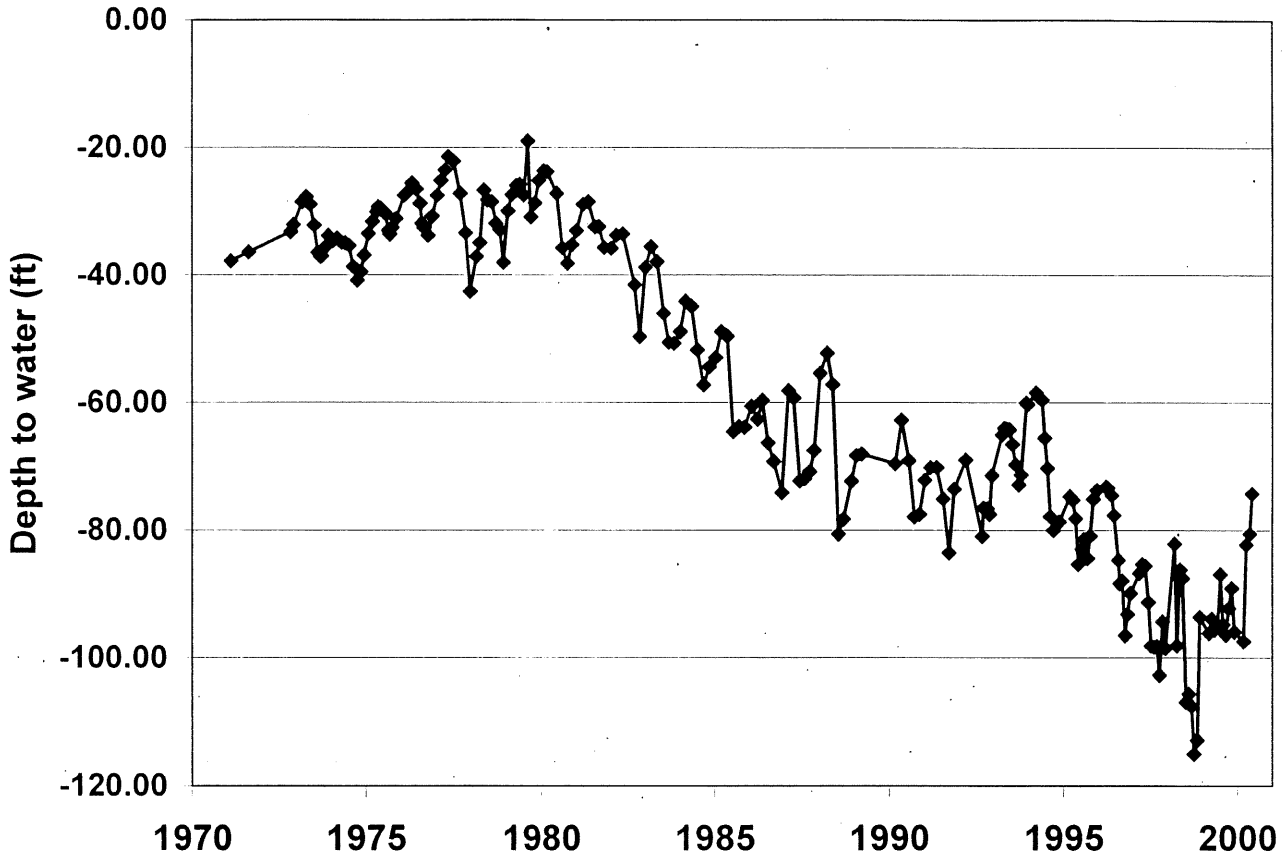
Example: Percent of tested water supply wells with detectable nitrate concentrations.



Ground water abundance

We rely heavily on ground water as an abundant, inexpensive source of clean water for a wide variety of uses. We obtain much of our water from shallow aquifers that are recharged from sources at the surface. The flow of water between the surface and aquifers is influenced by many ecosystem processes and human activities. Long-term observations of depth to water table provides information on the state of those processes and the human activites that interfere with them.

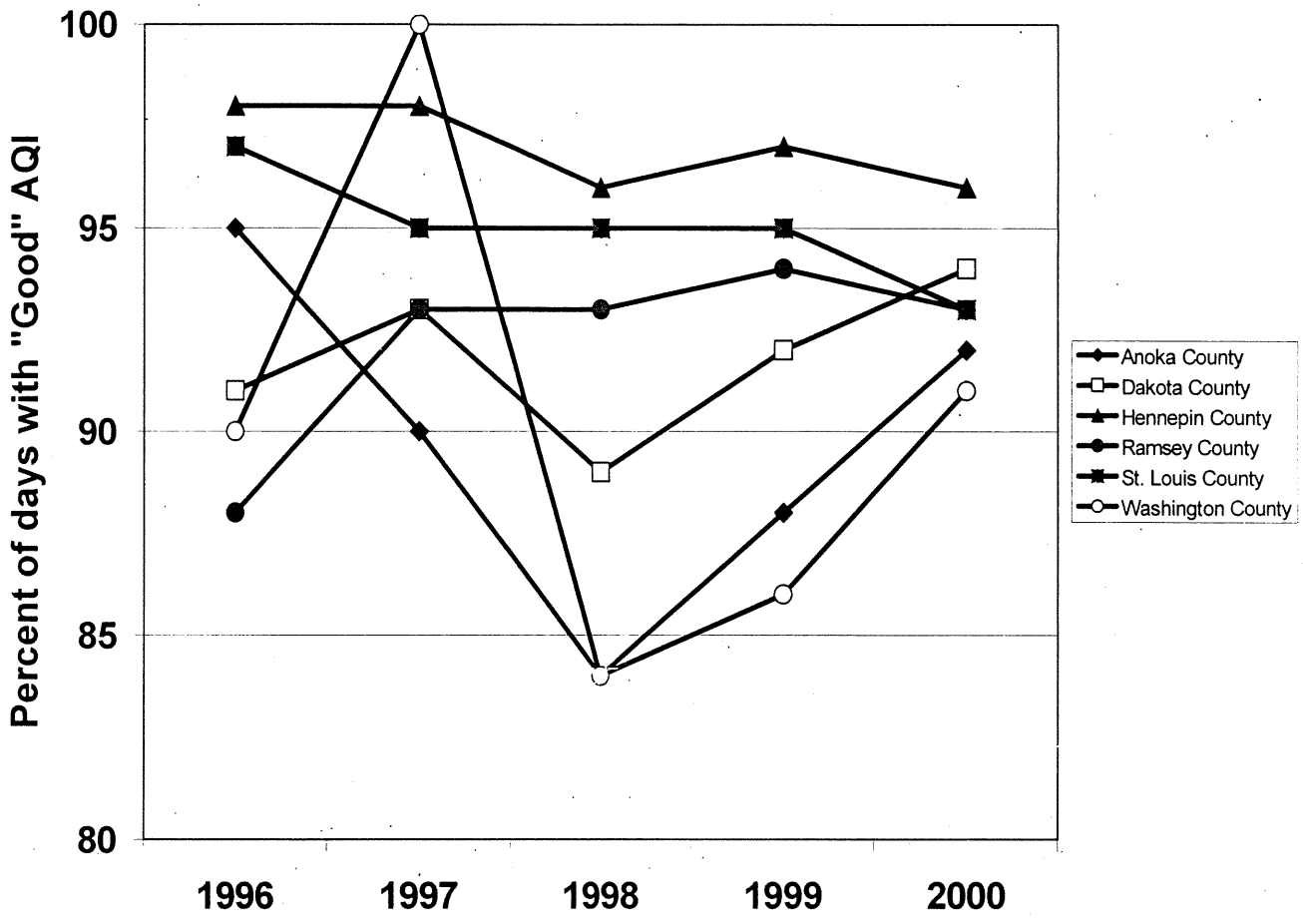
Example: Depth to water measurements for the Mt. Simon aquifer in Scott County indicate declining water storage and supply.



Air Quality Index

The Air Quality Index combines measures of 5 criteria pollutants (concentrations of ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide) into a single easily understood measure. Methods for measuring atmospheric concentrations of these pollutants are well established; measurements are taken routinely (usually daily) in metropolitan areas within the state. The effects of these pollutants on human health are well documented.

Example: Annual summary of air quality for six Minnesota counties using the Air Quality Index.



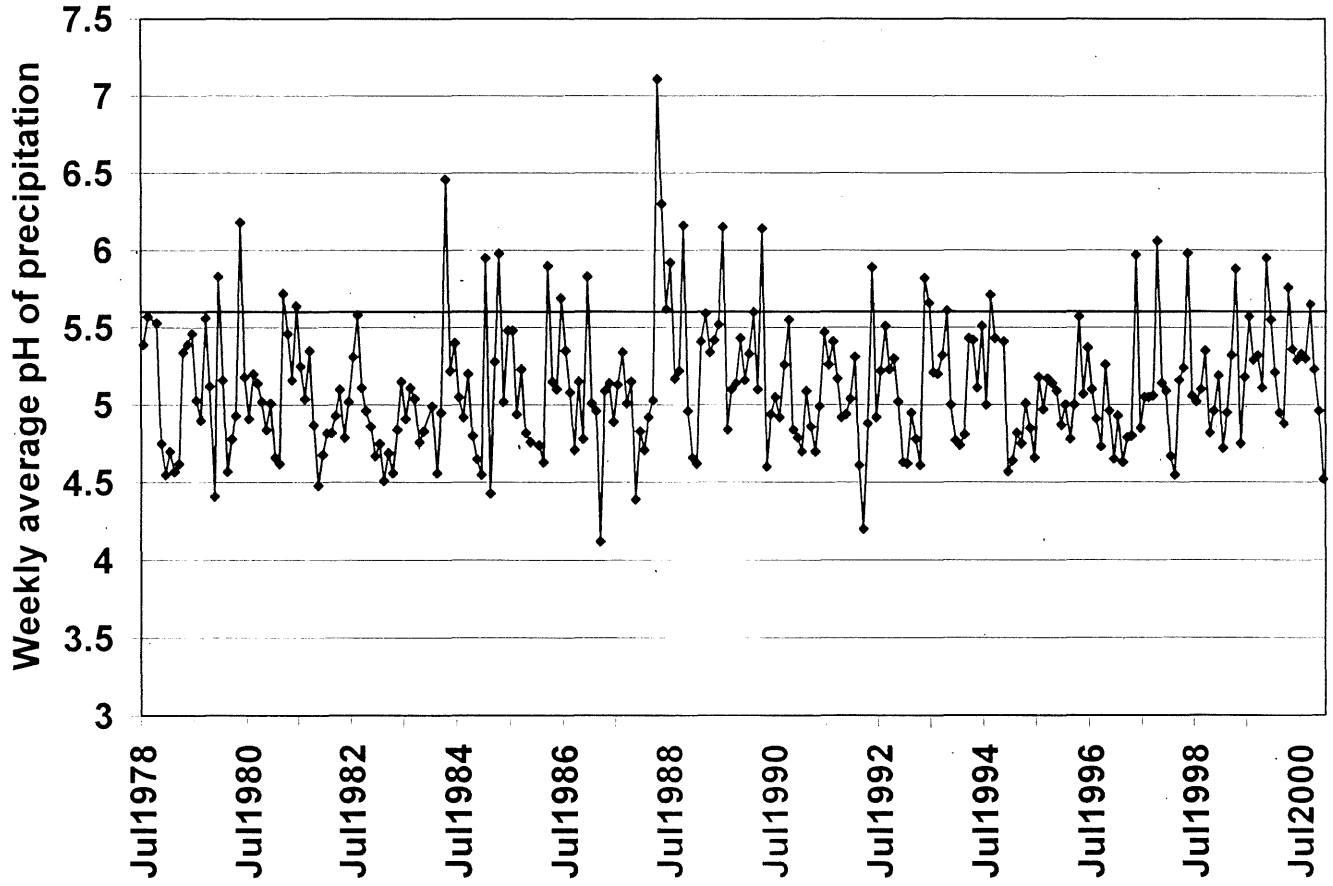
Acid deposition

The primary causes of acid precipitation are emissions of sulfur dioxide and nitrogen oxides from the burning of fossil fuels, particularly during electric power generation. These gases react in the atmosphere with water, oxygen, and other chemicals to form acidic compounds. Winds distribute acidic particles and gases onto buildings, cars, homes, and trees, sometimes at great distances from the source. Dry deposited gases and particles can also be washed from trees and other surfaces by rainstorms. When that happens, the runoff water adds those acids to the acid rain, making the combination more acidic than the falling rain alone.

Acid deposition has a variety of effects, including damage to forests and soils, fish and other living things, materials, and human health. Acid rain also reduces how far and how clearly we can see through the air. The severity of the effects of acid deposition depend on many factors, including how acidic the water is, the chemistry and buffering capacity of the soils involved, and the types of fish, trees, and other living things that rely on the water.

Acid deposition is routinely measured at numerous sites in Minnesota as part of the National Atmospheric Deposition Program. Long-term data allow detection of temporal trends and recent changes in the intensity of acid deposition.

Example: pH of precipitation recorded at Marcell Experimental Forest in northern Minnesota.

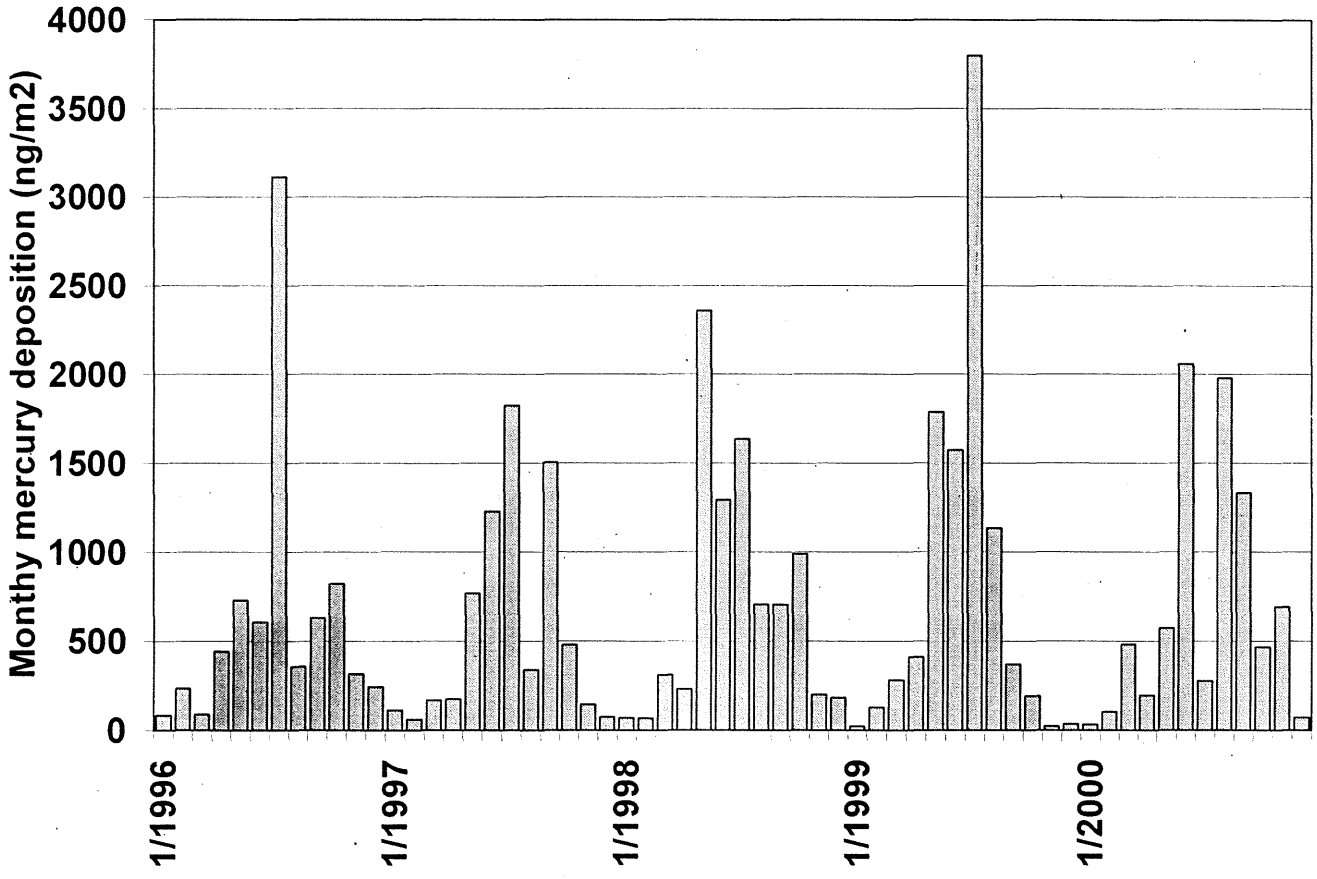


Mercury deposition

Mercury concentrations in the atmosphere have increased three to four times above natural background levels since industrialization. Atmospheric deposition following volatilization during the burning of coal for power generation is thought to be the major pathway for mercury to enter the environment. Mercury is a neurotoxin that bioaccumulates most efficiently in the aquatic food web. Predatory organisms at the top of the food web generally have higher mercury concentrations. Adverse effects of mercury on fish, birds and mammals include death, reduced reproductive success, impaired growth and development, and behavioral abnormalities.

Mercury deposition is routinely measured at 4 sites in Minnesota as part of the Mercury Deposition Network. Data collection allows calculation of weekly concentrations of total mercury in precipitation and the seasonal and annual input of total mercury in wet deposition to ecosystems.

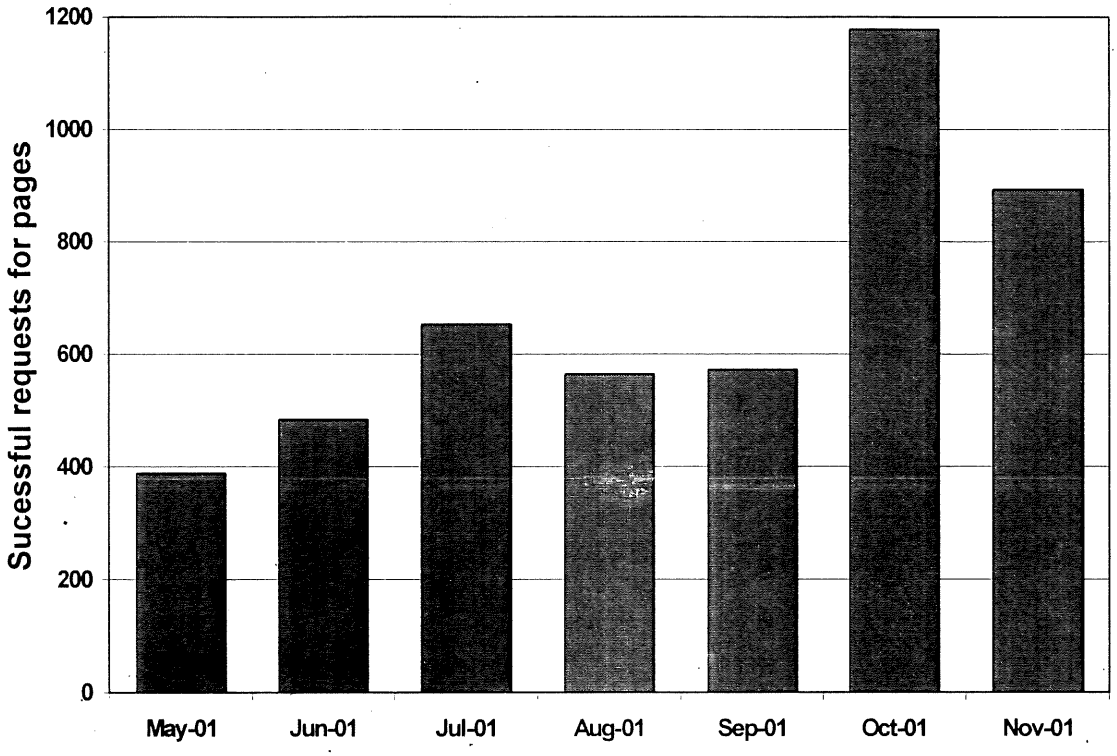
Example: Monthly deposition of mercury from the atmosphere at Marcell Experimental Forest in northern Minnesota.



V. DISSEMINATION:

Selected indicators and informational materials are being disseminated through a variety of mechanisms based on recommendations from our partners: direct mailing, EII website (www.dnr.state.mn.us/eii/), press releases, radio and television, popular articles and newsletters, professional conferences, targeted presentations to selected audiences, the State Fair, school curricula, citizen science programs, and future *Minnesota Milestones* and indicator-based reports.

Although we have undertaken no efforts to advertise the EII website (http://www.dnr.state.mn.us/eii), visits to the site have increased steadily since it was opened to the public in May 2001. The website EII is a convenient and effective way to communicate both overview and detailed information about the Initiative and indicators. Staff will continue to maintain the website and add new materials and revise posted materials as opportunities arise.



VI. CONTEXT:

A. Significance: The EII establishes the first statewide framework for the effective collection, interpretation, and public communication of the environmental information needed for sound environmental decision making. Many excellent "indicator" initiatives have recently emerged in Minnesota. However, none provide the guidance necessary to insure that environmental information is routinely incorporated into decision making at local, regional and statewide levels. EII promotes indicators which provide the information needed by citizens to understand the condition of the ecosystems and natural resources on which they depend, to evaluate whether environmental programs are effective, and to fully understand their roles in conserving and improving environmental conditions.

EII promotes the use of environmental indicators where they have not been used before by tailoring sets of indicators to the information needs of decision makers and demonstrating how they will be useful in measuring progress toward environmental goals. EII strengthens existing monitoring efforts through indicator-based assessments that clarify relationships between program activities and environmental outcomes.

The Environmental Indicators Initiative will ultimately enable citizens, policy-makers, and resource managers to better answer fundamental questions about Minnesota's environment and their roles in conserving and improving it, such as: How clean is the air and drinking water in our urban/developed areas? What is the condition of our many lakes and rivers? Can or do they support safe swimming and healthy fish populations? Are Minnesota's forests and farmlands productive and able to sustain both wildlife and human needs into the future? How are changes in land use and human development likely to affect the recreational and other resource amenities I value? In sum, the Environmental Indicators Initiative is developing the means for providing scientifically sound information to help Minnesotan's make the sound decisions that help sustain environmental health.

B. Time: The EII is entering its sixth and final year of developing and implementing a statewide framework for the monitoring and reporting of environmental indicators.

C. Budget Context:

	July 1995- June 1997 Prior expenditures on this project	July 1997- June 1999 Prior expenditures on this project	July 1999- June 2001 Current expenditures on this project
1. LCMR	$350,000	$250,000	$346,028
2. Other State	$0	$0	$0
3. Non State Cash*	$18,000	$0	$0
4. In-kind Match**	$54,000	$54,000	$54,000
TOTAL	$422,000	$304,000	$400,028

(In-kind match represents U.S. Fish and Wildlife Service salary support)*
*(** Value of voluntary service of Task Force members)*

1999-2001 LCMR BUDGET:

Personnel		**$290,000**
Equipment		**$0**
Acquisition		**$0**
Development		**$0**
Other		**$110,000**
Printing	**$25,000**	
Professional Services	**$62,000**	
Travel	**$10,000**	
Supplies	**$3,000**	
Purchased Services	**$10,000**	
TOTAL		**$400,000**

VII. COOPERATION:

Primary cooperators are members of the EII Task Force. Several Task Force members are managers of related indicator projects or research within their respective organizations. However, zero LCMR funds will be used to support the EII Task Force. Cooperators and staff, along with their affiliations and time allocated to the project (in parentheses), are as follows:

EII Task Force:
Mr. Kim Chapman, The University of Minnesota (5%)
Mr. Mohamed T. Elnabarawy, 3M Company (5%)
Dr. George Host, Natural Resources Research Institute (5%)
Dr. Tim Kelly, Department of Natural Resources (5%)
Ms. Lee Pfannmuller, Department of Natural Resources (5%)
Dr. Carl Richards, Natural Resources Research Institute (5%)
Dr. Kurt Rusterholz, Department of Natural Resources (5%)
Mr. Paul Schmiechen, Pollution Control Agency (Co-Chair 10%)
Dr. Paul Toren, Environmental Quality Board (5%)
Mr. Keith Wendt, Department of Natural Resources (Co-Chair 15%)
Mr. Mark Zumwinkle, Department of Agriculture (5%)

EII Staff:

Dr. Clarence Turner, Ecologist/Coordinator (100%)
Ms. Faith Balch, Ecologist (100%)
Ms. Laura Preus, Ecologist (75%)
Dr. Tom Will, Science Communications Specialist (100%)

VIII. LOCATION: Statewide

IX. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than :
July 1, 2000
June 30, 2001

A final work program report and associated products will be submitted June 30, 2001, or by the completion date as set in the appropriation.

X. RESEARCH PROJECTS:

Environmental Indicators Initiative
MEASURING PROGRESS TOWARD RESOURCE SUSTAINABILITY IN MINNESOTA

- EII Home
- Developing Indicators for Minnesota
- Assessing the Health of Minnesota's Ecosystems
- Using Indicators for Natural Resource Management
- Indicator Network
- Written Products
- Contact EII

Minnesota DNR

How do we get useful information about our environment?

The causes of environmental change are hard to pin down, but environmental issues often call for immediate action. If our natural resource decisions are to be wise and sustainable, we need to base them on sound information about the environmental pieces as they relate to the whole.

Environmental indicators are selected measurements of the environment and our activities that provide information for reporting on environmental conditions, assessing the performance of natural resource programs, or developing an understanding of human-environment interactions. Indicators do not measure every process or every relationship. Like the "vital signs" of medical science, a set of effective environmental indicators should summarize and highlight the most essential conditions and trends. But how do we select the right indicators?

The **Environmental Indicators Initiative (EII)** provides a systems framework for selecting sets of indicators that are scientifically valid and useful to the public. EII's goals are (1) an integrated set of environmental indicators for **assessing the health of Minnesota's ecosystems** and (2) regular environmental monitoring using indicators as a source of information for **natural resource management**.

Funding provided by the Minnesota Environmental and Natural Resources Trust Fund as recommended by the Legislative Commission on Minnesota Resources. Sponsored by the Environmental Quality Board.

Environmental Indicators Initiative

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Minnesota DNR

EII Framework (click to enlarge).

Developing Indicators for Minnesota

Environmental indicators are especially useful in:

- assessing and reporting on the health of Minnesota's ecosystems
- guiding and reporting on the management of natural resources

The Environmental Indicators Initiative (EII) recommends that indicator users

- clearly define their ***desired environmental outcomes*** *(e.g., values, benefits, goals and objectives)*
- select a ***suite of indicators*** that tell a comprehensive story about the environmental conditions and human influences that affect those outcomes

The EII framework (see Developing Indicators for Minnesota: An Overview) is a pragmatic, systems-based tool for selecting suites of indicators to answer the four questions fundamental to all resource sustainability issues:

1. ***benefits*** -- What benefits (e.g., raw materials, aesthetics, recreation) do ecosystems provide us?
2. ***environmental conditions*** -- What ecological and other conditions are required to sustain these benefits?
3. ***human activities*** --What are we intentionally or unintentionally doing to change those conditions?
4. ***management strategies*** -- What can we do to rectify or prevent undesirable change?

No single indicator can adequately describe a complex environmental issue. A well-chosen set of indicators, however, helps citizens understand the relationships among their natural resource goals (*benefits* and the *environmental conditions* necessary to produce them), the actions that change environmental conditions (*human activities*), and the appropriate steps (*management strategies*) needed to sustain the environment or resolve the issue.

Our workshops in the forested regions of the state and our work with partners across the state helped us to:

- better understand the information needs of local environmental decision makers and to develop an indicator framework that would address those needs.
- increase public awareness of environmental indicators and to promote their use in assessing ecosystem health and informing environmental decision making, and
- identify a small but powerful set of indicators for state-wide environmental reporting.

The indicator development activities of other organizations also provide valuable insight into indicators and their uses.

Environmental Indicators Initiative

- EII Home
- Developing Indicators for Minnesota
- Assessing the Health of Minnesota's Ecosystems
  - Ecosystem Profiles & Fact Sheets
- Using Indicators for Natural Resource Management
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- Written Products
- Contact EII

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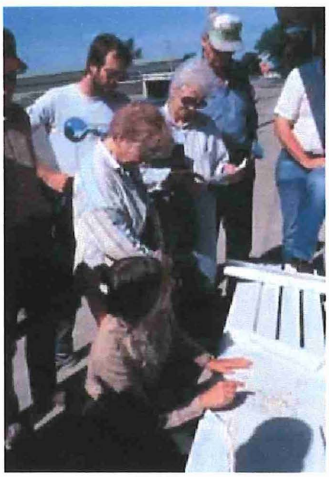
Assessing the Health of Minnesota's Ecosystems



The health of Minnesota's ecosystems and the quality of life of its citizens are interdependent. As the health of ecosystems declines, human health, welfare, and quality of life are threatened. Addressing high-risk environmental problems (e.g., nonpoint-source pollution, toxic contamination of biota, loss and fragmentation of natural lands, and threats to natural resource sustainability) requires complete, integrated information that can best be provided by comprehensive monitoring of whole ecosystems.

The EII organizes environmental indicators by ecosystem and resource category to simplify the indicator selection process and allow us to develop more focused and useful indicators. EII ecosystems are agricultural systems, forests, lakes, prairies, rivers and streams, and wetlands. EII resource categories include air and groundwater. Although ecosystems are seldom discrete entities and ecosystem boundaries are often arbitrarily determined, they generally are distinctive in plant and animal species composition and the benefits they provide. Working landscapes often consist of many interconnected ecosystems.

EII ecosystem profiles describe Minnesota's ecosystems and air and groundwater resources. Each report summarizes important natural resource benefits, the ecological conditions and other properties that make possible those benefits, the human activities that affect them, and significant management strategies (e.g., policies and programs) in place to sustain or restore ecosystem health. In each ecosystem and resource profile we provide examples of environmental indicators that can be used to assess its status. For some of these indicators, fact sheets provide more information.

The ecosystem profiles illustrate our framework for indicator selection. Each characterization also highlights what we should know when developing indicators, including the basic properties of ecosystems (productivity, nutrient cycling, biodiversity, and natural disturbance regimes) that enable ecosystems to adapt to changing conditions and

human uses.

Using basic ecological knowledge and what we have learned from 1) indicator workshops, 2) our work with local partners in the development and use of environmental indicators, and 3) participation in other statewide indicator initiatives, we suggest a small number of highly useful state-wide indicators for assessing the health of Minnesota's ecosystems.

Contact the DNR Information Center for additional written products.

Environmental Indicators Initiative

- EII Home
- Developing Indicators for Minnesota
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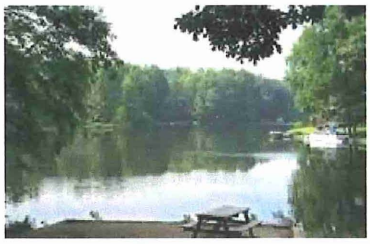
Minnesota DNR

Using Indicators for Natural Resource Management



DNR Indicator Development

- Natural Resource Stewardship 2001. Key Indicators of Progress: A Progress Report from the Minnesota DNR.
- Directions 2000: The Strategic Plan. Minnesota DNR. (PDF)
- Monitoring and Evaluation Briefing Paper. Minnesota DNR Region 6 [Metro Area]. (PDF)

Interagency Indicator Projects

- An Information Framework for Sustainable Forest Management (PDF)
- Review of the Availability and Accuracy of Information about Forests: Phase I Report (PDF)
- Minnesota Watermarks, Gauging the flow of progress 2000-2010
- MPCA-DNR collaboration

Working with stakeholders

- Forest Summit: Indicators and Monitoring for the Demonstration Forest, A framework for discussion. (PDF)
- Cannon River Watershed Partnership Indicator Development: A case study. (PDF)

NOTE: Some documents listed here are in Adobe PDF format. To open them, you will need Adobe Acrobat Reader, which you can download for free from the Adobe website. For printed copies or alternate formats of any of the above documents, contact the DNR Information Center.

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Minnesota DNR

Ecosystem Profiles and Fact Sheets

Lake Ecosystems

Factsheets:
- Indicator Factsheets for Lakes: An Introduction
- Fishing Pressure
- Fishable/Swimmable Water
- Shoreline Vegetation Restoration
- Phosphorus Concentration

Forest Ecosystems

Factsheets:
- Forest Area and Forest Types
- Regeneration of Key Forest Tree Species
- Wood and Fiber Production
- Demand for Forest Products

Wetland Ecosystems

Factsheets:
- Amphibian Health
- Presence of Invasive Exotic Species

River and Stream Ecosystems

Factsheet:
- Index of Biotic Integrity

Prairie Ecosystems

Factsheet:
- Ring-necked Pheasant Populations

Populations

Groundwater Resources

The Atmosphere

Factsheet:

- Concentration of Nitrate in Groundwater

Please revisit this site periodically. Additional factsheets are in preparation!

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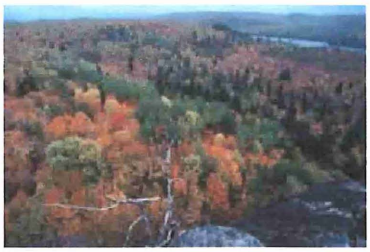
Indicator Network

Indicator Network



- Minnesota Pollution Control Agency
- Minnesota Forest Resources Council
- Designing a report on the state of the Nations Ecosystems, Heinz III Center
- Canadian Model Forest Network
- Cannon River Watershed Partnership
- Local Unit Critieria and Indicator Development Project (LUCID)
- North American Test of Criteria and Indicators of Sustainable Forestry

Other Indicator Reports

- Minnesota Environment 2000, Minnesota Pollution Control Agency
- Minnesota Milestones
- Minnesota Watermarks, gauging the flow of progress 2000-2010
- Smart Signals: An assessment of progress indicators (March 2000)

Environmental Indicators Initiative

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Written Products

- Developing Indicators for Minnesota: An Overview
- Developing Indicators for Minnesota: Executive Summary
- Natural Resource Stewardship 2001. Key Indicators of Progress: A Progress Report from the Minnesota Department of Natural Resources.
- Ecosystem Profiles and Fact Sheets
- Catalog of Databases and Information Sources
- An Information Framework for Sustainable Forest Management
- Monitoring and Evaluation Briefing Paper (DNR Region 6 [Metro Area])
- Review of the Availability and Accuracy of Information about Forests: Phase I Report. (Minnesota Forest Resource Council and EII)

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Minnesota DNR

Contact EII

For additional information, email or call:

Clarence Turner, Coordinator
(651) 297-3357

Laura Preus, Ecologist
(651) 296-1548

Faith Balch, Ecologist
(651) 297-4707

Keith Wendt, Project Manager
(651) 297-7879

Funding provided by the Minnesota Environmental and Natural Resources Trust Fund as recommended by the Legislative Commission on Minnesota Resources. Sponsored by the Environmental Quality Board.

Minnesota Department of Natural Resources

Draft Results Indicators for the Governor's Office Results Website

September 14, 2001

This packet includes draft fact sheets for the following indicators:

- Walleye fingerling production
- Minnesota's share of the yearly Mississippi Flyway duck harvest
- Loon abundance in north central Minnesota lakes
- Parks, WMAs, and SNAs: # of parcels protected (or, # acres)
- # Miles of state bicycle trails
- Percent (# acres) of private forest lands with Forest Stewardship Plans
- # Acres of old-growth forest protected on DNR-administered lands
- # Cords of wood for sale on DNR-administered lands
- # Counties with a County Biological Survey
- # Counties with a County Geologic Atlas

Questions, comments, or suggestions?
Please contact Keith Wendt (651-297-7879; keith.wendt@dnr.state.mn.us) or
Laura Preus (651-296-1548; laura.preus@dnr.state.mn.us) Thank you.

Measuring Results
Minnesota Department of Natural Resources

Goal
High quality fishing and sustainable fish populations

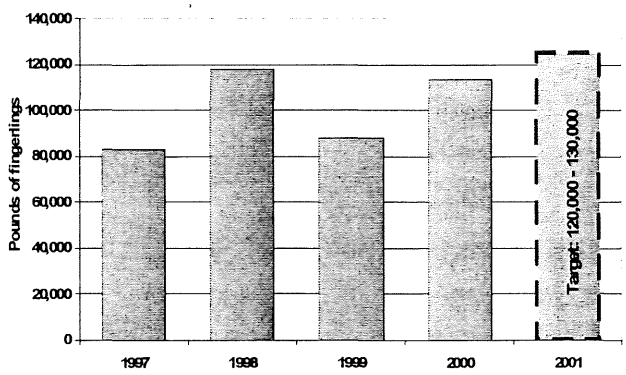
Desired result
High walleye fishing satisfaction

Why is it important?
- Walleye is the most widely sought fish in the state. Minnesota anglers annually harvest about 3.5 million walleye totaling 4 million pounds.
- Walleye fishing is an integral part of the state's natural heritage and also contributes to the tourism economy.
- A U.S. Fish and Wildlife Service Economic Impact Study showed that angler expenditures (for all types of fishing) was nearly $1.9 billion in Minnesota in 1996.

What is being done?
- DNR protects and improves walleye habitat, regulates catch, and stocks walleye where natural reproduction is limited and other desirable species will not be harmed.
- During the past two years, DNR has obtained public input on walleye management for 142 lakes. Each lake has its own target for fish stocking and other management objectives.
- Fish stocking focuses on lakes with the best potential for improved fishing.
- As part of the Accelerated Walleye Program, the DNR produces fingerlings (4- to 6-inch long walleyes) in natural rearing ponds, and then stocks these in lakes across the state. The DNR has recently increased the number of pond acres available to produce walleye fingerlings.

Target
120,000-130,000 pounds of fingerling production by 2001

Indicator of results
Walleye fingerling production



Explanation of indicator:
The target of 120,000-130,000 pounds of walleye fingerling production allows DNR to meet increased stocking quotas on over 140 lakes, with the goal of improving walleye fishing. Walleye fingerling production is strongly influenced by annual weather patterns; these factors must be considered when assessing progress toward DNR's target.

Where can I learn more?
Website links to: 1) DNR home, 2) Fishing page, 3) Enforcement

Related indicators
1) Walleye abundance in stocked lakes,
2) % Angler satisfaction, 3) # Licensed anglers, 4) Lakeshore development trends

Measuring Results
Minnesota Department of Natural Resources

Goal
High quality hunting and sustainable wildlife populations

Desired result
Increase duck hunting harvest in Minnesota

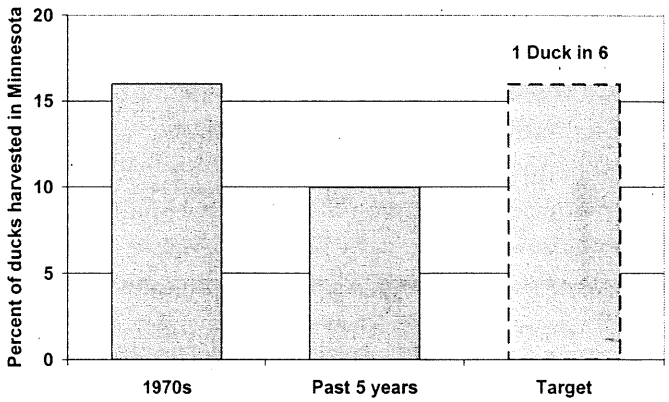
Why is it important?
Minnesota has more duck hunters than any other state. And through their purchase of duck stamps and contributions to conservation groups, Minnesota hunters have made huge investments into boosting duck numbers to near-record levels, yet they aren't getting a chance to hunt their share of those ducks in the fall.

What's the problem?
Proportionally fewer ducks are harvested in Minnesota than in the past for three main reasons:
1. Fall migration habitat, mainly food such as wild rice and water insects, has worsened (so the ducks either don't come here or fly right through).
2. Disturbances to migrating ducks in fall have increased (thus scaring off the ducks that do stop here awhile)
3. There has been better habitat elsewhere, particularly in the wet Dakota prairies, attracting migrating ducks that might otherwise have come to Minnesota.

What is being done about it?
In 2001, the DNR committed to an action plan to:
1. Improve fall migration habitat and food resources mainly by managing water levels on shallow waterfowl lakes where possible
2. Increase number and size of fall migration habitats by buying and restoring wetlands and shallow lakes
3. Eliminate carp in fall migration shallow lakes to improve plant growth to attract ducks
4. Reduce disturbances to migrating ducks (so they don't leave too quickly) by improving and enlarging refuge and nesting areas

Target
Increase Minnesota's share of the Mississippi Flyway duck harvest from 1 duck in 10 to 1 duck in 6 (this 60 percent increase would restore Minnesota's harvest to 1970s levels).

Indicator of results
Minnesota's share of the yearly Mississippi Flyway duck harvest



Explanation of indicator:
Minnesota hunters are no longer harvesting their fair share of migrating ducks:
- In years past (1970s), Minnesota hunters harvested on average one-sixth of the ducks harvested in the Mississippi Flyway each year.
- During the past five years, however, that share has dropped to roughly one-tenth of the total flyway harvest.

Duck harvest levels are influenced by a variety of factors, including fall migration patterns and climate. These factors must be considered when assessing progress toward DNR's target.

Where can I learn more?
Website links to: 1) DNR Home, 2) Waterfowl Action Plan, 3) Hunting page, 4) Enforcement

Related indicators
1) Minnesota breeding duck populations,
2) % Hunter satisfaction

Measuring Results
Minnesota Department of Natural Resources

Goal
Sustainable nongame wildlife populations

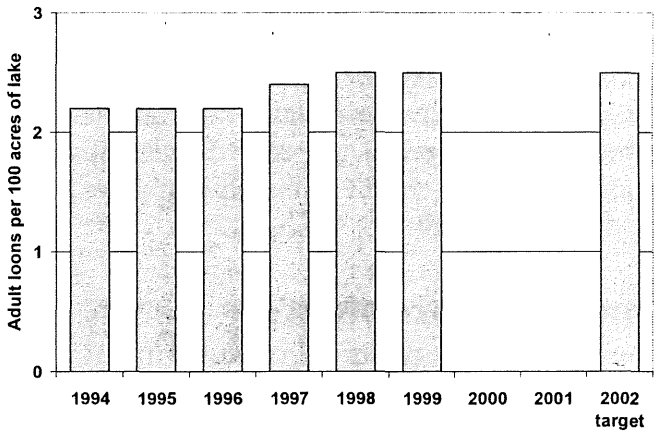
Desired result
Sustainable and healthy loon populations

Why is it important?
- The Common Loon is Minnesota's state bird and a recognized indicator of the state's high quality environment.
- Minnesota is the summer home to roughly 12,000 adult loons—the largest population of loons in the continental United States.
- Loons thrive in clear lakes with healthy fish and undisturbed shorelines with plenty of natural vegetation. This makes them a valuable indicator of the health of the state's lakes.
- Lakeshore development, air-borne mercury deposition, and lead used in fishing sinkers put pressure on Minnesota's loon populations.

What is being done?
- The DNR's Minnesota Loon Monitoring Program uses nearly 1000 volunteers to collect loon monitoring data on six 100-lake "index areas" in central and northern Minnesota.
- Yearly monitoring of loon populations can help detect problems that may arise from loss of shoreline habitat or reductions in lake water quality.
- The DNR uses education and technical assistance to promote natural shoreline management on lakes—which means healthy habitat for Loons. Natural shoreline vegetation creates scenic views, helps reduce erosion, improves water quality, and attracts wildlife

Target
Maintain stable loon populations (approximately 2.5 adult loons per 100 acres of lake in Aitkin/Crow wing Area)

Indicator of results
Loon abundance in north central Minnesota lakes (Aitkin/Crow Wing area)



Explanation of indicator:
Volunteers use a standard protocol to record loon abundance on Minnesota lakes. This indicator helps assess the stability of loon populations over time. The Aitkin/Crow Wing index area is of interest because the lakes are on predominantly private lands in a region of rapid population growth.

Where can I learn more?
Website links to: 1) DNR home, 2) Nongame Wildlife Program

Related indicators
Lakeshore development trends

Measuring Results
Minnesota Department of Natural Resources

Goal
High quality outdoor recreation opportunities

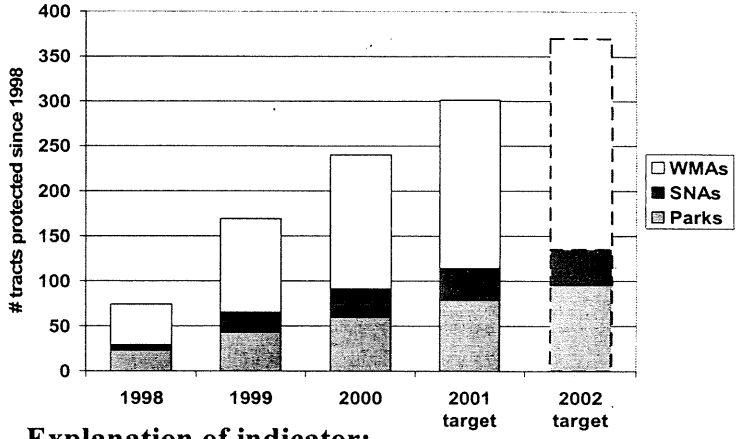
Desired result
Access to healthy recreation lands and waters

Why is it important?
- Healthy natural land and waters with abundant outdoor recreation opportunities support Minnesota's high quality of life.
- Natural amenities and outdoor recreation opportunities are one big reason people come to Minnesota—we offer beautiful places and plenty of recreation.
- Access to recreation lands and waters is key to meeting the outdoor recreation demands of a growing population and tourism industry.
- A Minnesota Office of Tourism study determined that 7 of the state's top 30 attractions are state parks.

What is being done?
- DNR acquires, develops, and manages a variety of recreation lands and waters. These include, among others, State Parks, Scientific and Natural Areas (SNAs), Wildlife Management Areas (WMAs), and State Forests.
- The DNR's local grants unit administers matching grant programs and appropriations that annually provide about $20 million in assistance to local governments and private organizations for recreation and natural resource projects.

Target
- 17 tracts of land covering 2,500 acres protected for Parks in 2002
- 4 tracts of land covering 1,600 acres protected for SNAS in 2002
- 48 tracts of land covering 5000 acres protected for WMAs in 2002

Indicator of results
Parks, WMAs, SNAs: # tracts protected
(Note: data are cumulative since 1998)



Explanation of indicator:
State Parks, WMAs, and SNAs are unique natural and cultural treasures that meet the needs of a diverse and widely distributed public.
- There is a State Park within 50 miles of every Minnesotan.
- Wildlife Management Areas occur in 86 of the state's 87 counties.
- Statewide, Scientific and Natural Areas protect over 130 sites with unique natural features.
- Parks, SNAs, and WMAs, representing some of the state's highest quality natural environments, make up less than 3% of Minnesota's land base.

Where can I learn more?
Links: 1) DNR Home; 2) State Parks, 3) Scientific and Natural Areas, 4) Wildlife Management Areas, 5) State Forests, 6) Lands and Minerals

Related indicators
1) Resource management activities; 2) # Park Visits; 3) % Satisfaction

Measuring Results
Minnesota Department of Natural Resources

Goal
High quality outdoor recreation opportunities

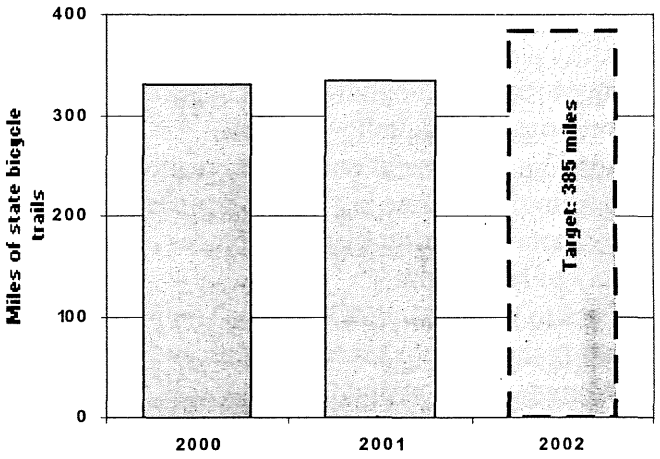
Desired result
Access to high quality trails

Why is it important?
- Trails offer something for everyone, in every season of the year. Trails give people access to the outdoors, including historic sites, parks, forests, lakes and creeks, and charming small towns in rural areas.
- Trails help small towns develop tourism: visitors support local cafes, bed-and-breakfast inns, resorts, and campgrounds.

What is being done?
- The DNR operates and manages over 1000 miles of state trails. These include popular trails in regions across the state, such as the Gateway, Root River, Paul Bunyan, Heartland, and Sakatah Singing Hills trails.
- Well-maintained trails helps outdoor enthusiasts participate in their favorite activities, including biking, skating, hiking, horseback riding, skiing, and snowmobiling.
- The DNR works with partners and Grant-in-Aid Programs to develop trails for snowmobiles and recreational motor vehicles.

Target
385 miles of paved state bicycle trails by 2002

Indicator of results
 # Miles of state bicycle trails



Explanation of indicator:
State bicycle trails are suited for a variety of activities including biking, skating, walking, and running. Some are specifically designed to meet the needs of people with physical disabilities. The DNR is developing and maintaining many of these bicycle trails along abandoned railroad grades in regions throughout the state. These trails are popular and serve both tourists and local residents: ten state trails together have almost 1 million seasonal user hours, and are located within 10 miles of the homes of about 2 million people

Where can I learn more?
Website links to: 1) DNR home, 2) State Trails

Related indicators
% Satisfaction with trails

Measuring Results
Minnesota Department of Natural Resources

Goal
Enlarged and protected forest land base

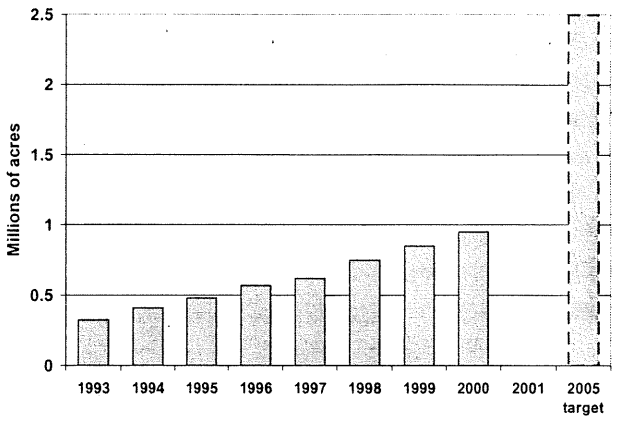
Desired result
Forest stewardship on private lands

Why is it important?
- Minnesota's forest stewardship depends on the involvement of all forest landowners—public and private alike.
- Private individuals or organizations (excluding industry) own 40 percent of Minnesota's timberland.
- Private lands produce more timber than all public lands and industry holdings combined.
- Private forest lands are under increasing development pressure. Urban development is now the major cause of forest loss.

What is being done?
- The DNR promotes forest conservation by providing financial and technical assistance to private landowners.
- Launched in 1990, the voluntary Forest Stewardship Program brings professional, natural resource management expertise to private non-industrial forest landowners. DNR offers technical assistance to landowners that develop their own individualized goals and plans.
- The DNR also provides private landowners with up to 50% of the cost for tree planting done in accordance with approved forest stewardship plans. To date the DNR has helped private landowners reforest about 120,000 acres.

Target
50 percent (2.5 million acres) of non-industrial private forest lands under Forest Stewardship plans by 2005.

Indicator of results
 # Acres of private forest lands with Stewardship Plans



Explanation of indicator:
Stewardship Plans promote sustainable management of private forest lands. Landowners that participate in Forest Stewardship Plans are more likely to pursue sustainable forest management goals including: sustainable timber harvesting, improving wildlife, preserving water quality, and applying agro forestry practices.

Minnesota is a national leader in Forest Stewardship enrollment: we have the highest percentage of available acreage under Forest Stewardship Plans among twenty northeastern states.

Note: data shown here are cumulative acres of forest land with stewardship plans.

Where can I learn more?
Website links to: 1) DNR home, 2) Division of Forestry

Related indicators
1) # Acres reforested, 2) Forest conversion rates

Measuring Results
Minnesota Department of Natural Resources

Goal
Healthy and resilient forest ecosystems

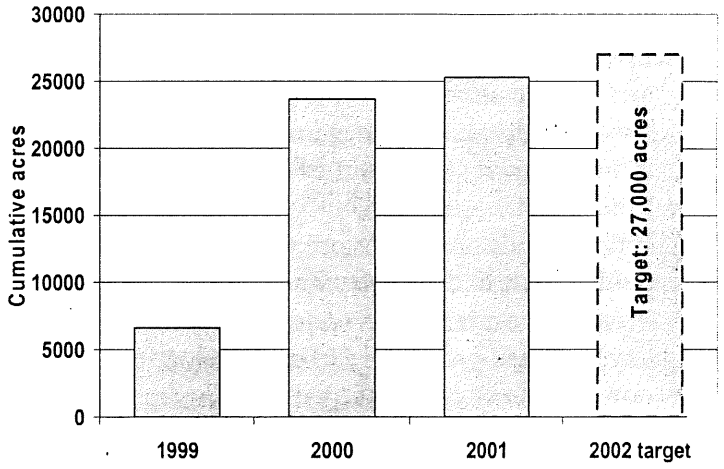
Desired result
Protection of the highest quality old-growth forests on DNR-administered lands

Why is it important?
- Old-growth forests (typically more than 120 years old) provide special habitat for plants and wildlife, serve as scientific benchmarks, and have aesthetic appeal.
- Before European settlement, about half of Minnesota's forests were old growth. Today less than four percent of the state's forests are in old-growth condition.

What is being done?
- In 1994, DNR, forest industry, and environmental interests set a goal to protect the highest quality remaining old growth on state lands (estimated to be about 27,000 acres).
- In 1998, following DNR inventory and evaluation of candidate old-growth forests, DNR regional staff began designating the highest quality sites for protection.

Target
Protect 27,000 acres representing the highest quality old-growth forests on state lands by 2002

Indicator of results
 # Acres old growth protected on DNR-administered lands



Explanation of indicator:
DNR is designating specific locations and acres of old-growth forest that will be protected on state-administered lands. This means that these designated areas will not be harvested; they will be managed to maintain old-growth characteristics. A 27,000 acre network of old-growth forest sites will represent approximately 0.7% of DNR-managed forest lands.

Note: Data presented here are cumulative acres of protected old growth forest.

Where can I learn more?
Website links to: 1) DNR home, 2) Forestry

Related indicators
1) Ecological regions with completed old-growth designation, 2) Historic loss of old growth

Measuring Results
Minnesota Department of Natural Resources

Goal
Numerous forest-based economic opportunities

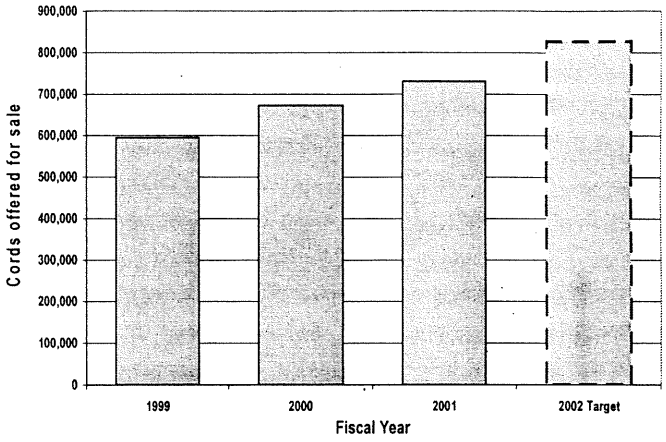
Desired result
Predictable and sustainable supply of quality wood

Why is it important?
- Minnesota's forests are key to the state's environmental and economic health. The current value of forest products manufactured in Minnesota is about $7.7 billion per year. Forest industries account for about 4% of Minnesota's gross state product (1992 data) and 3 percent of employment (1997 data).
- Forest industries rely on a sustainable supply of quality wood provided by multiple land owners. DNR administers about 23% of the state's forests. Federal agencies manage 21 %, counties manage 16%, and forest industry and other corporations own about 8 percent of the forest. The remaining 32% is owned by more than 147, 000 individuals

What is being done?
- Forest management planning, with citizen and stakeholder input, helps the DNR manage the state's forests for aesthetic, environmental, recreational, and economic values. Each year, as part of this larger picture, the DNR offers timber for sale on DNR-administered lands. DNR also works with individual landowners to support sustainable forest management practices. A predictable and sustainable supply of wood is one important element of Minnesota's many forest-based economic opportunities.

Preliminary Target
Supply ~827,000 cords for sale on DNR-administered lands

Indicator of results
Cords of Timber Offered for Sale on DNR Lands



Explanation of indicator:
This indicator gives insight into the productivity of DNR-administered forests and the DNR's ability to meet preliminary targets for predictable and sustainable supplies of quality wood. Long-term sustainable forest management is best measured through the use of multiple indicators, including forest productivity, aesthetics, and forest diversity.

Where do I learn more?
Website links to: 1) DNR home, 2) Forestry

Related indicators
Timber price trends

Measuring Results
Minnesota Department of Natural Resources

Goal
Local communities have the information and resources to identify and manage unique natural resources

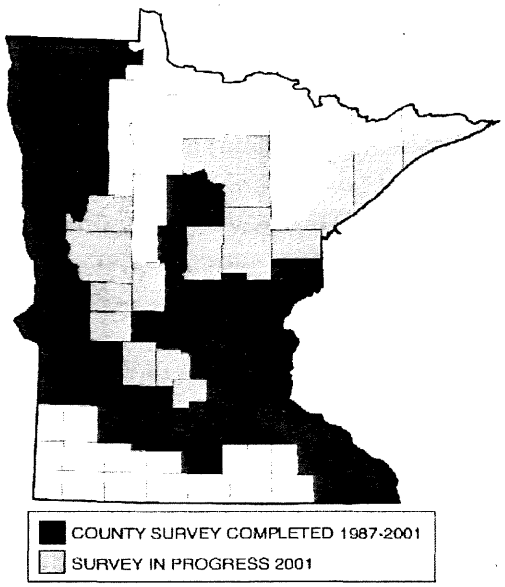
Desired result
Local communities use rare features surveys to plan for and protect remaining natural areas.

Why is it important?
- Urban development is rapidly increasing in Minnesota; poorly planned it can contribute to loss of natural areas, degraded water quality, and reduced outdoor recreation opportunities.
- Natural resource information and technical assistance helps local communities plan for growth while protecting high quality natural areas.
- Minnesota has a diversity of native plants, animals, and rare features that make up a rich natural heritage.

What is being done?
- The Minnesota County Biological Survey (MCBS) is a systematic survey of the state's rare biological features.
- MCBS has recorded 12,781 locations of rare features, and has documented 14 species of native plants and 2 species of amphibians not previously recorded in the state.
- MCBS has published rare features maps for 23 counties to assist in land management.
- In the 7-county metro area, MCBS information has helped protect rare features at Cedar Creek, Seminary Fen, Pine Bend Bluffs, Wood Rill Scientific and Natural Area, Blakeley Wayside, Lost Valley Prairie, and others.
- Stearns county used MCBS data to identify priorities and expand the Quarry Park and Nature Reserve which harbors rare populations of a rein orchid, Red-shouldered Hawk, and Arcadian Flycatcher.

Target
Complete rare features surveys for 58 counties by 2003

Indicator of results
 # Counties with a completed survey
Counties with surveys completed by 1999: 35
Counties with surveys completed by 2001:50
Counties with surveys completed by 2003: 58



Explanation of indicator:
MCBS inventories are completed in 50 counties and are underway in 12 others. MCBS inventories help statewide organizations and counties protect unique natural areas thus ensuring that examples of rare features are not lost from any region of the state. One fourth of all identified rare features are now represented at least once in the state's 130 Scientific and Natural Areas.

Where can I learn more?
Website links to: 1) DNR home, 2) Eco Services

Related indicators
1)Urban land expansion; 2) # Acres in land protection projects; 3) # Acres in native prairie bank; 4) # Rare features protected by SNAs

Measuring Results
Minnesota Department of Natural Resources

Goal
Local communities have the information, expertise, and resources to plan for and manage their natural resources

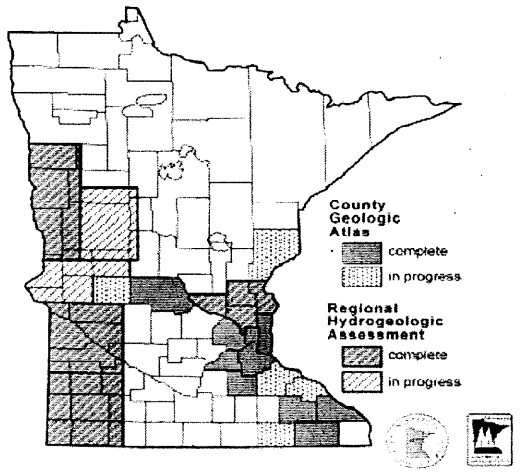
Desired result
Local communities use water trend information and hydrogeologic data to plan for their water resources and develop sustainable water supplies.

Why is it important?
- Minnesotans depend on the state's water for basic needs: domestic consumption, agriculture, and industry.
- Use of water is increasing at a rate faster than population growth.
- Water supplies are adequate at present but shortages occur during periods of drought, and will be more frequent in the future if use trends continue to increase.
- Water-based recreation is highly prized in Minnesota. Pumping for increased use decreases the supply to wetlands, lakes, rivers, and unique resources such as trout streams and fens.

What is being done?
- DNR has a partnership with the Minnesota Geologic Survey to collect geologic and hydrologeologic data and develop maps. DNR provides local communities with information on geologic and ground water conditions.
- DNR measures water levels in wetlands, lakes, and wells to keep track of changing supply as climate and withdrawal vary.
- DNR monitors 700 observation wells and supports a network of stream gauges in cooperation with other state and federal agencies.
- DNR provides information and technical assistance to help communities find reliable sources of water while protecting significant surface water resources.

Target
Complete two County Geologic Atlases and one Regional Hydrogeologic Assessment by 2002.

Indicator of results
 # Counties with a County Geologic Atlas or a Regional Hydrogeological Assessment
10 Atlases have been completed and 6 are underway. 4 Assessments have been completed and 2 are underway.



Explanation of indicator:
A County Geologic Atlas is a systematic study of a county's geologic and ground-water resources. A Regional Hydrogeologic Assessment is similar but less detailed; however, it also includes information on ground water sensitivity to pollution. Atlas and Assessment reports present practical information in an understandable and accessible format. This baseline information helps local communities manage water use and sustain high quality water supplies. Atlas or Assessment reports are available for areas that include 75% of the state's population and 37% of the state's area.

Where can I learn more?
Website links to: 1) DNR home, 2) Waters

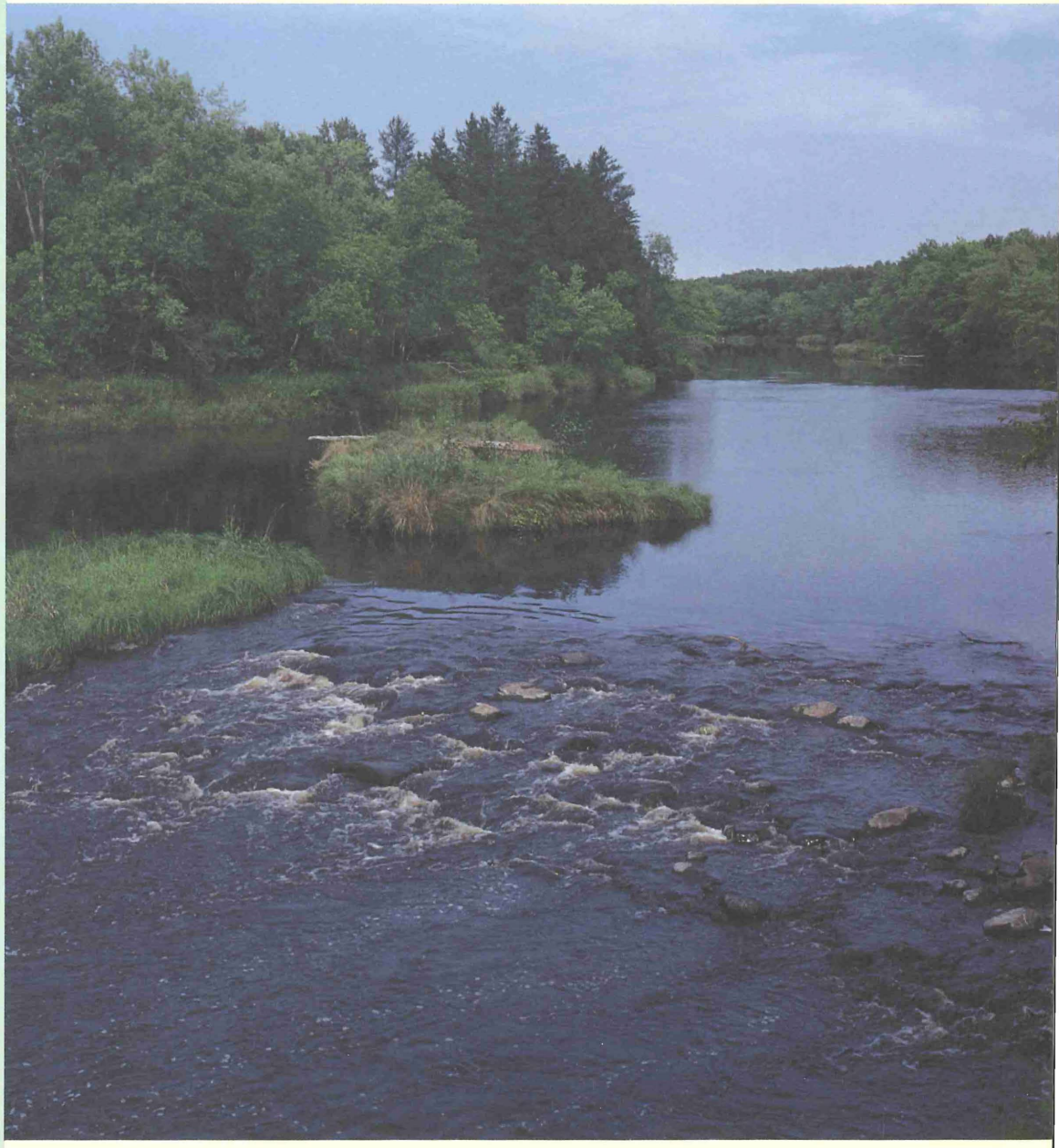
Related indicators
1) Water levels in observation wells; 2) Per capita water use

A progress report

from the Minnesota Department of Natural Resources

Minnesota
DEPARTMENT OF NATURAL RESOURCES

Natural Resources Stewardship 2001: Key Indicators of Progress



January 2001

Commissioner's Message

A new century is beginning. It brings opportunity, challenge, and a hope that DNR can bring people together to sustainably manage our valued natural resources. This new century will bring increasing demands on natural resources. Public expectations will call for greater accountability in reaching a broad range of social, economic, and environmental goals. Our work will not be easy.

This challenging environment demands that we more effectively measure the results of what we do. We have chosen to do so through performance measurement, the focus of this report. Performance measurement means assessing how well our activities (what we do) connect with environmental outcomes (for example, healthy lakes, wildlife numbers, productive forests, and satisfaction with recreation experiences). Understanding these linkages will help us and our partners evaluate our performance, document the return on the public's investment in natural resources, and modify our management so we constantly improve what we do.

Measuring performance—in particular, natural resource outcomes—is not easy. Many resources we manage have time horizons stretching into decades. For example, newly planted forest stands require decades to mature. What we do today may not have measurable outcomes for years. Circumstances beyond our control, ranging from the weather to the global economy, influence natural resource outcomes and the success of our efforts. So do the activities of the many other agencies, interest groups, and citizens with whom we work to accomplish our goals. But we firmly believe that this extra effort in assessing outcomes will pay off many times over in improving our ability to manage Minnesota's natural resources.

I am pleased to present this outcome-based progress report. It uses measurable indicators to present a balanced picture of natural resource conditions, DNR activities, and progress toward achieving desired outcomes. Measurable indicators provide the information needed to answer difficult sustainability questions, address trade-offs, and focus scarce resources on the highest priorities. As we develop improved strategies, such as our Conservation Connections initiative, we will continue to create and use credible indicators to earn public confidence in our work. Our goal is to increase public understanding and participation in deciding the future of our forests, waters, fields, and open spaces.

The governor's Big Plan directs agencies toward outcome-based management: "The state must reaffirm its commitment to quality service for its citizens, with success measured by actual outcomes rather than process, and to cost-conscious state government." This report initiates our effort to track performance measures by focusing on outcomes as well as our activities, and to use the information it provides to continuously evaluate and improve DNR management. This is wise management, more accountable to citizens and to our mission.

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Acknowledgments

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Environmental Indicators Initiative (EII) Faith Balch, Laura Preus, Clarence Turner, Keith Wendt, Tom Will. Funding for the EII was approved by the Minnesota Legislature, ML 1999, Chapt. 231, Sec.16, Subd.12(c) as recommended by the Legislative Commission on Minnesota Resources from the Minnesota Environmental Trust Fund.

Special contributions by:

Joe Stinchfield, Terri Yearwood, and the many DNR staff who provided data and review

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About this Report

Purpose and audience

This report describes DNR progress toward achieving healthy natural resources. It also describes public benefits that depend on those resources remaining healthy. This report uses approximately 120 measurable indicators to paint a picture of natural resource conditions, DNR management activities, and the results we hope to accomplish through our management efforts.

This report is not a "report card" for all of Minnesota's natural resources. Nor does it describe all of DNR's work. Rather, it describes how DNR activities influence natural resource conditions and associated benefits. No one organization can be solely accountable for the condition of Minnesota's environment. We emphasize the importance of education and partnerships as key DNR management strategies. Ultimately citizens, local government, numerous agencies, and organizations together will shape the future of Minnesota's environment.

Better information provides a foundation for better decisions, a healthier environment, and sustainable natural resource use. DNR will distribute this report to legislators, stakeholders, and DNR staff. The report will be available on the DNR website. We hope this report will stimulate discussion and lead to improved understanding of the state of our natural resources, our long-term goals, and progress toward attaining those goals.

Measuring and improving performance

DNR's mission is to work with citizens to protect and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life.

The DNR mission is supported by two broad goals:

1) to maintain, enhance, or restore the health of Minnesota ecosystems so that they can continue to serve environmental, social, and economic purposes; and
2) to foster an ethic of natural resource stewardship among all Minnesotans.

Performance management helps us achieve our mission. Performance management means:

1) setting outcome-based goals and quantifiable targets;
2) working in partnership with citizens and other agencies to achieve these goals;
3) periodically checking progress using measurable indicators; and
4) evaluating and modifying our approaches to better reach important outcomes.

The first step is to describe long-term goals along with short-term targets. Targets are specific and measurable milestones that help us gauge progress toward long-term goals. In many cases, DNR has not yet set targets. We will continue work to develop realistic targets and to identify data that measure attainment of goals and targets.

Indicators presented in this report keep us up to date and help us check our progress. They allow us to better focus our efforts and constantly improve what we do. The indicators:

- characterize natural resource status and trends;
- identify key pressures that can degrade resource quality;
- describe DNR activities aimed at improving resources; and
- chart progress toward desired outcomes in natural resources and public benefits.

When viewed together, indicators paint a picture of critical natural resource trends and how DNR and partners respond to environmental challenges. Indicators help us improve our performance management and our ability to communicate progress to our stakeholders. Indicators help build understanding of the complex relationships between human activities and natural resource conditions. This understanding is a foundation for a natural resources stewardship ethic.

Report structure

The report has the five main resource themes of *Directions 2000,* the DNR agencywide strategic plan. Those chapters are: Water Resources, Forest Resources, Agricultural Areas, Urban and Developing Areas, and Recreation. Each presents measurable indicators of progress toward strategic goals identified in *Directions 2000.*

This report also includes a chapter on the DNR organization and emphasizes key themes related to effective management. One-page profiles of place-based partnership efforts are distributed throughout the report. These partnerships are long-term commitments to find new ways to improve the environment.

Report preparation

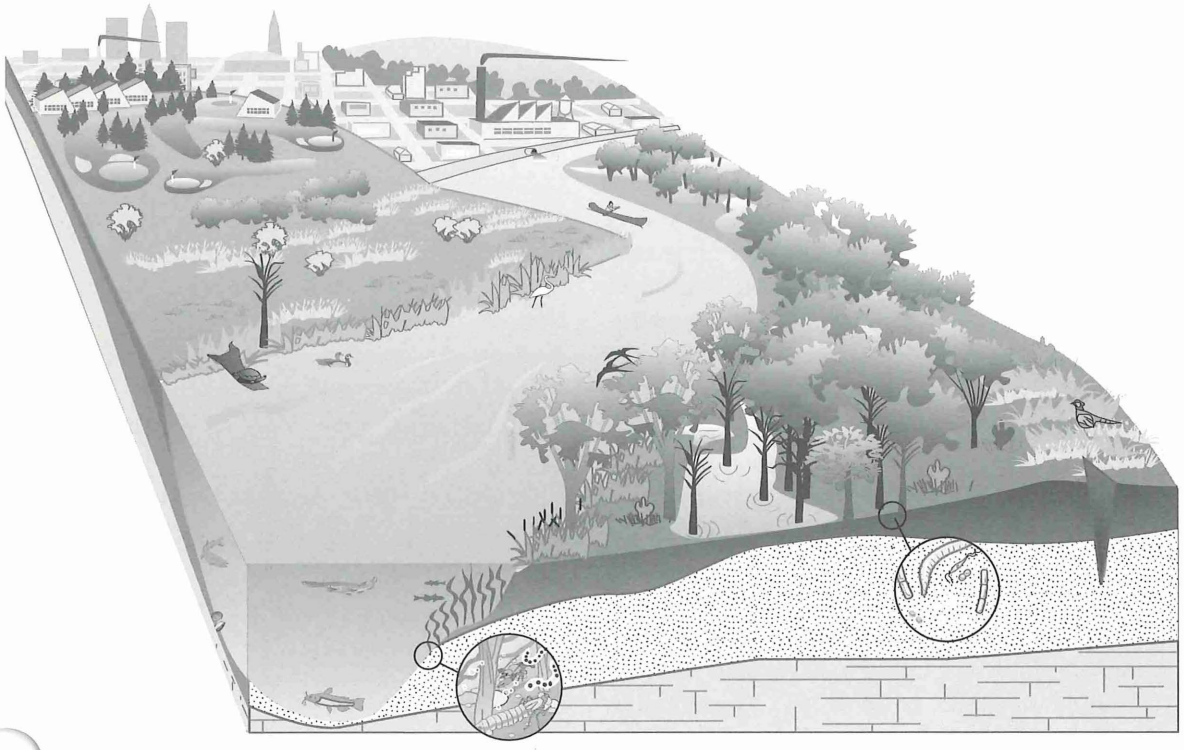
The indicators in this report were developed through a multistep agencywide process. The Environmental Indicators Initiative (EII), housed in DNR's Office of Management and Budget, worked with DNR operations managers to compile the final report. Funding for the EII was approved by the Minnesota Legislature, M L 1999, Chap. 231, Sec. 16, Subd.12(c) as recommended by the Legislative Commission on Minnesota Resources from the Minnesota Environmental Trust Fund. The EII develops environmental indicators for assessing status and trends of Minnesota's ecosystems and natural resources, and promotes the use of indicators in setting resource priorities and evaluating performance.

DNR will update this report periodically. We will track existing indicators over time in order to chart and report future progress. We will add new indicators to fill information gaps. We will evaluate and use indicators to foster discussion about measuring progress.

For more information

This report provides an agencywide picture of DNR activities and natural resources trends but does not describe all DNR activities. For more information about specific divisions or programs, visit the DNR website at www.dnr.state.mn.us. For additional information about using indicators to measure DNR progress, or to comment on this report, contact Laura Preus (EII ecologist, 651-296-1548), Clarence Turner (EII coordinator, 651-297-3357), or Keith Wendt (manager, OMB—Science Policy Section, 651-297-7879).

Water Resources



Tom Klein

Directions 2000

Strategic outcomes for waters

- Healthy aquatic ecosystems with high ecological health and integrity
- Water resources that are conserved and allocated among competing uses in the best interests of the public and long-term sustainability

Introduction

Minnesota's lakes, rivers, streams, wetlands, and ground water aquifers are a defining component of the state's varied ecosystems and a major resource for tourism and economic development. DNR works to protect this aquatic heritage while providing opportunities for recreation and economic benefit.

DNR's greatest water management challenges are wise allocation of water under increasing and varied demands, and protection of water resources from damage. In the past we treated water management issues as isolated problems and managed wetlands, surface water, and ground water as separate resources. Today DNR views these as interdependent systems that can be degraded by cumulative effects, leading to diminished water quality, loss of fish and wildlife, and water use conflicts.

The Minnesota Legislature has passed laws protecting water resources, and communities engage in many kinds of water stewardship. DNR works with other state agencies and local governments to administer the state's water laws and help communities manage water resources. DNR emphasizes building partnerships and participating in statewide plans such as the Minnesota state water plan and the Minnesota Pollution Control Agency's (MPCA) basin planning process. Other state agencies play key roles in water management, including the Minnesota Department of Health, the Minnesota Department of Agriculture, and the Minnesota Board of Water and Soil Resources (BWSR).

Lakes

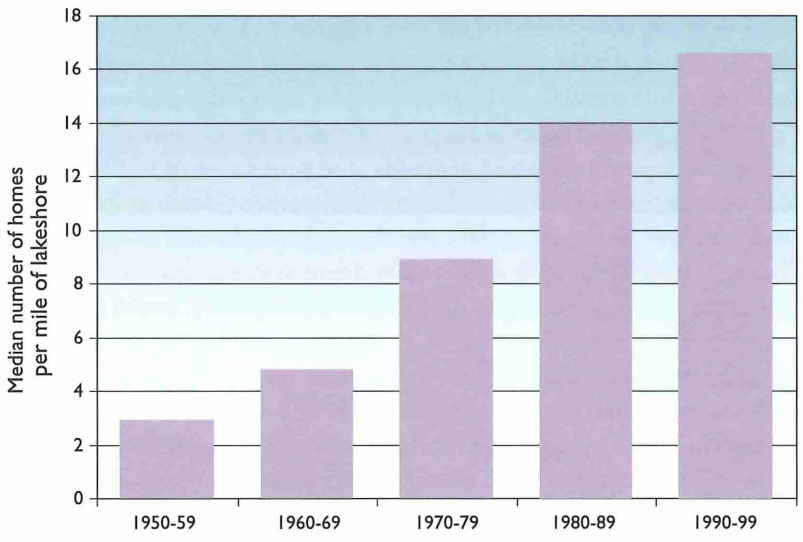
Minnesota is known for its lakes. A 2000 DNR survey found that Minnesota citizens view the protection of lakes and rivers as one of DNR's most important activities. According to the Minnesota Interagency Lakes Coordinating Committee, while the overall quality of Minnesota lakes is good, we face significant challenges. Lakeshore development is degrading lake quality. Accompanying loss of habitat can harm fish and wildlife. Anglers are catching the same numbers but in some instances smaller sizes of fish. Exotic species in our lakes are difficult to contain and usually cannot be eradicated. Despite stable trends in boating, people are increasingly bothered by perceptions of boat crowding, perhaps due to increases in boat speed, boat size, and use of personal watercraft. Water quality is variable, but generally good. According to MPCA, of the lakes included in their most recent assessments, 66 percent of lake acres are "fully swimmable." Nonpoint sources are a major source of pollution for the state's impaired lakes.

DNR works with landowners, local governments, and other agencies to address these challenges. DNR activities include providing technical assistance, education, and regulation related to shorelands, aquatic plants, zoning, water allocation, lake levels, access, fisheries, and wildlife.

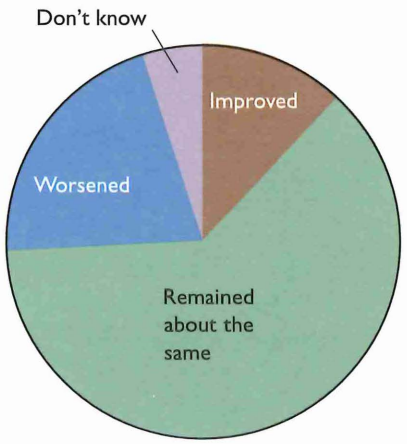
Sustainable watershed management

Citizens, local communities, and agencies across the state continue to form and build partnerships to sustain local watersheds. DNR strives to complement existing work, develop projects where necessary, and provide technical assistance to citizen-led projects.

In spring 1991, DNR launched a comprehensive watershed management initiative to support citizen watershed partnerships to resolve water quality and water quantity concerns. Using knowledge gained from previous community efforts, we launched several pilot projects around the state (e.g., the Tri-County Leech Lake Watershed Project, page 19). DNR continues to build and support citizen-focused watershed projects. Long-term monitoring will assess how well these projects are improving citizen participation and resource quality. Examples of watershed partnerships are highlighted in selected stories throughout this report.



Lakeshore development. A survey of more than 500 walleye lakes in north-central Minnesota shows increased lakeshore development. Developed lakeshores have less aquatic vegetation than undeveloped shores. Loss of vegetation may diminish water quality, habitat for native plants and animals, and scenic value.



Perceptions of lake quality. About one in five Minnesota lake users responding to a 1998 statewide survey perceived the lake they used most to be in a state of decline. About three in five thought it was remaining the same, and about one in 10 thought the lake they used most was improving.

Progress toward protecting the natural characteristics of lakes and lakeshores

The thin boundary along the lakeshore that unites land with water and people with nature provides a complex management challenge. Lakeshore owners want to build cabins, install docks, and clear shoreline; at the same time, they want to maintain scenery and habitat. It is difficult to balance such divergent goals. For example, a recent DNR study showed that developed shorelines have two-thirds less aquatic vegetation than undeveloped shorelines. As vegetation decreases, so do populations of fish such as bluegill and northern pike. Natural shoreline vegetation supports good water quality, native plants and animals, and scenic views.

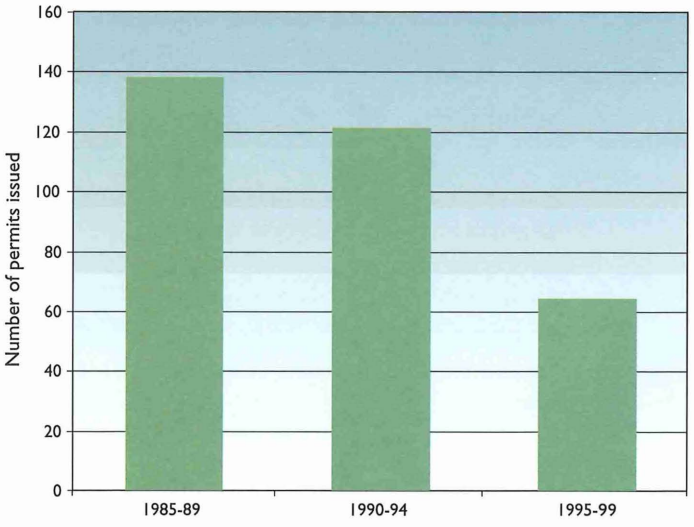
Natural shoreline vegetation supports good water quality, native plants and animals, and scenic views.

There is no simple solution to these conflicting pressures and goals. A 1998 Minnesota lakes survey suggests, however, that many lake users support achieving balance through education, management, regulation, enforcement, and incentives. About two-thirds of the state's lakeshore is privately owned, so private landowners are key to protecting this resource.

DNR works with landowners and local communities by issuing shoreland permits and developing education programs and workshops. DNR also engages in shoreland restoration efforts on public lands, and protects shorelands through Aquatic Management Areas.

Shoreland permitting

Permits are required for many shoreland alterations, such as installing retaining walls and riprap or removing aquatic vegetation to create swimming areas and beaches. The permitting process controls removal of aquatic plants and educates citizens about the importance of aquatic vegetation. DNR also enforces shoreland regulations through aerial surveys of lakes, rivers, and wetlands. Although about 10,000 property owners obtain alteration permits each year, many landowners are increasingly choosing to restore or retain shoreline vegetation and aquatic plants for the benefit of healthy lakes and scenery. Permits are required to restore or plant aquatic vegetation to ensure that harmful exotic species are not introduced. DNR helps landowners understand this permit system through education materials and the DNR website.



Shoreland alterations from riprap, retaining walls, and similar projects. Since 1985 permit requests and DNR permits issued for shoreland projects such as retaining walls have decreased, as these data from five Minnesota counties indicate. While some of these engineering activities may be occurring under more general permits, it appears that more lakeshore owners are choosing to retain or restore vegetation along shorelines.

At a Glance

DNR activities:

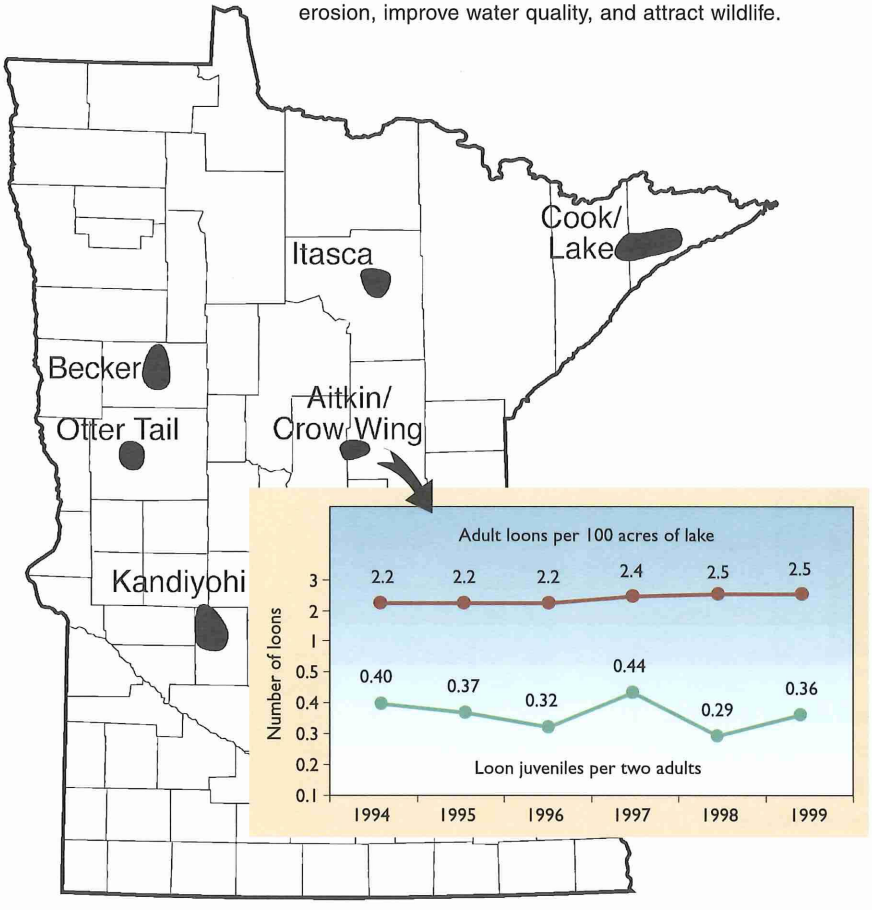
- Shoreline permitting
- Lakescaping workshops
- Native vegetation restorations

Desired outcomes:

- Lakeshore-owner stewardship
- Native plant coverage and habitat
- Enhanced fish and wildlife (e.g., loons)

MNDNR

Lakescaping to protect shorelines. Volunteers on North Long Lake replace a lawn-covered lakeshore with native vegetation. Native plants create scenic views, help reduce erosion, improve water quality, and attract wildlife.



Education and technical assistance

DNR uses education and technical assistance to promote natural shoreline management. DNR helps people understand and nurture the relationship between aquatic and near-shore vegetation and healthy lakes, fish, and wildlife. For example, we recently partnered with local communities to hold 14 "Lakescaping for Wildlife and Water Quality" workshops, reaching 470 participants across the state. A multiorganizational team provided education and technical assistance, while citizens presented demonstrations of lakescaping in 13 communities. More than 200 property owners expressed interest in using their property as a demonstration site.

Other restoration efforts complement these education programs. The Aquatic Plant Restoration Program coordinates with partners to conduct research, provide support for restoration (e.g., work with horticulturists who supply native plants), and develop education material such as plant and restoration guides. On public lan[illegible] DNR has completed about 50 shoreland reste tion projects.

Immediate benefits of education efforts include reduction in shoreline vegetation removal and other shoreline alterations. Long-term benefits of education and restorations include the presence of natural shoreline vegetation, healthy habitat, and protected fish and wildlife populations.

Wildlife

The common loon is one example of the many native plants and animals that require healthy shoreline habitat and good water quality. Minnesota is the summer home of roughly 12,000 adult loons. DNR works with hundreds of volunteers to monitor loon populations on about 600 lakes in central and northern Minnesota. This monitoring will help detect problems that may arise from loss of shoreline habitat or reductions in lake water quality.

Loon monitoring. Hundreds of volunteers across the state work with DNR to gather information on Minnesota's state bird. Loon populations appear healthy and stable all six 100-lake census areas. The Aitkin/Crow Wing area lakes are on predominantly private lands in a region of rapid population growth.

Rivers and Streams

Rivers and streams, linking Minnesota's lakes and wetlands, flow in three major directions—to Hudson Bay, the Atlantic Ocean, and the Gulf of Mexico.

A long history of alteration has transformed these waterways' natural character across the state. Channelization and dam construction have changed stream flow. Removal of riparian vegetation has caused erosion. Human activities on land have contributed pollution. And harmful exotic species have spread through waterways. These changes threaten the health of rivers and streams and reduce their ability to provide benefits such as fish and wildlife habitat, flood damage protection, and sustainable water supplies.

Citizens and local and state governments are working together to maintain or restore healthy rivers through sound watershed management. DNR works in partnerships, provides technical assistance, implements regulations, and engages in activities such as stream channel restorations to restore vital river and stream characteristics.

Wild and Scenic Rivers

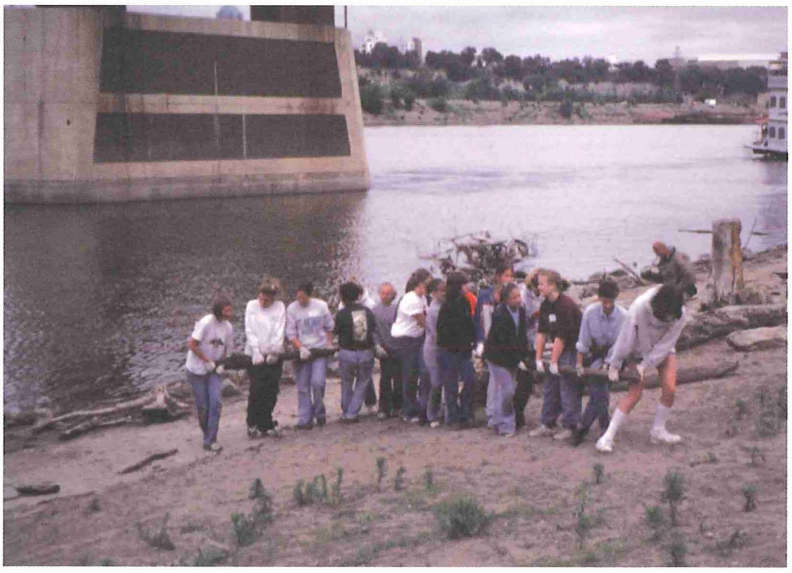
Minnesota's Wild and Scenic Rivers Act protects rivers with outstanding natural, scenic, geographic, historic, cultural, and recreational values. Six rivers have designated segments: the Cannon, Kettle, Minnesota, Mississippi, North Fork Crow, and Rum. The St. Croix is federally designated.

Each river's management plan establishes rules and goals to protect the river. DNR works with partners to carry out and update these plans. In 2000 we completed a cooperative plan for the lower St. Croix River. We are currently developing a management plan for the Mississippi River based on input from citizens and local governments.

Yet these approaches can do only so much. The Wild and Scenic Rivers Act focuses on regulating land use, but does not address broader stewardship issues. DNR and partners need to evaluate unmet needs for sustaining healthy rivers and consider a wider range of tools and management approaches.

Susan Miller

Mussels are indicators of river health. Despite some water quality improvements in recent decades, surveys in southern Minnesota reveal that mussels are still on the decline. For example, divers recently found only seven mussel species at a Mississippi mussel bed that once contained as many as 30 different species. Navigation projects, invasive species (zebra mussels), and commercial harvest have all contributed to the decline.



MNDNR

Adopt-A-River Program volunteers help clean up our rivers. These citizen-led efforts help protect and beautify the state's waters—ultimately enhancing wildlife habitat and recreation such as boating and fishing. About 1,976 volunteers participated in this program during 1999, contributing about 5,700 hours of cleanup time.

Progress toward enhancing the natural characteristics of rivers and streams

Stream channel restoration

In past years, streams have been straightened to improve drainage. Such channelization can increase floods, destabilize stream beds, make banks prone to erosion, and diminish aquatic habitat. Today local communities and DNR are partnering to restore stream channels to establish healthy stream characteristics such as stable banks and flows, erosion-controlling riparian vegetation, high water quality, and natural meandering shapes. DNR is also researching stream habitat suitability for native plants and animals, and using this information to help guide river management and restoration decisions.

Twenty-nine percent of Minnesota streams have been channelized

The Whitewater River in southeastern Minnesota was straightened decades ago to enhance wetland drainage. Over time, erosion and sedimentation greatly reduced the ecological health of the river. In 1998 DNR restored part of the river to its original bed and constructed an additional meandering channel. Stream bank vegetation has improved, and anticipated long-term benefits include improved water quality, moderation of flood peaks, reduced erosion, and improved fish and wildlife habitat. Since damage occurred over generations, the full benefits of restoration will require years. Long-term monitoring will be needed to track progress.

Refer to the Urban and Developing Areas Chapter (page 50) for a description of trout stream restorations.

At a Glance

DNR activities:

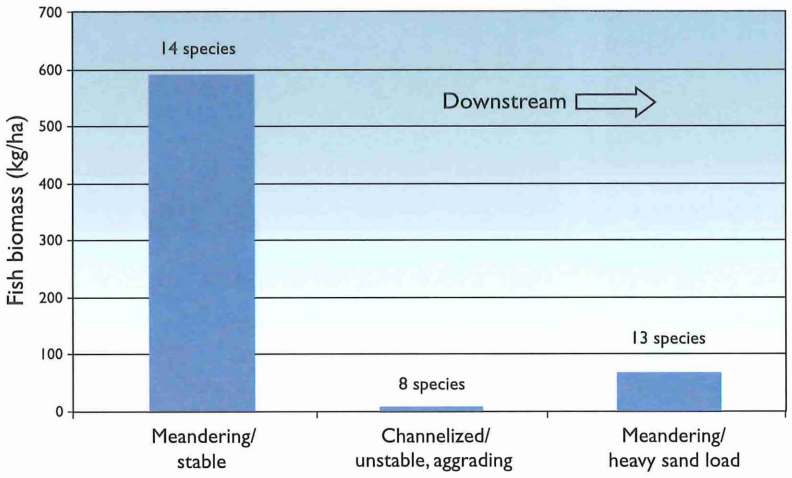
- Stream channel restorations
- Dam removals

Desired outcomes:

- Improved natural characteristics
- Enhanced fish and wildlife
- Restored flows
- Aesthetic and recreation benefits

MNDNR

River restoration. Benefits of restoring the Whitewater River include a more natural meandering channel and associated improvements in stream bank vegetation.



Fish habitat. Fish numbers and diversity are highest in meandering portions of the Whitewater River.

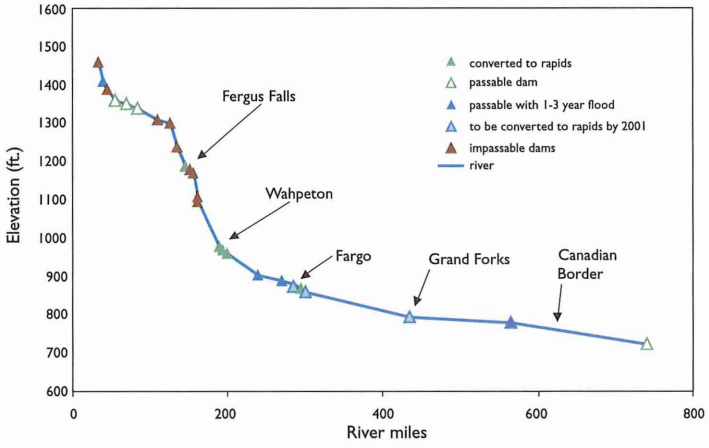
Dam removals

Many of Minnesota's 2,500 dams are aging, unsafe, unsound, or no longer performing needed services. Some have accumulated so much sediment that they no longer retain water as intended. While structurally sound dams have important functions and in some cases play a role in restricting expansion of harmful exotic species, in other cases dams can have long-term detrimental effects. Dams often block fish migration and reduce reproduction by barring access to breeding habitat. They can also restrict expansion of native mussel populations with distinct habitat needs.

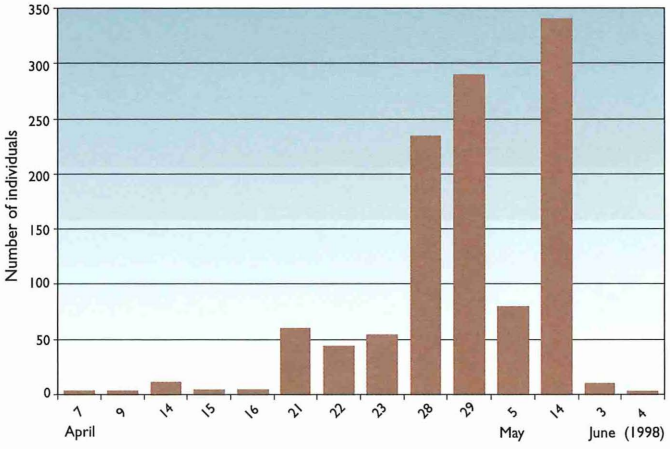
DNR works with communities to assess costs and benefits of removing dams. Dam removal enhances fish migration and reproduction, and provides aesthetic and recreational benefits such as rapids, canoe routes, and improved fishing.

Communities with DNR assistance have removed a dam on the Pomme de Terre River in Appleton, created natural fish passages at Breckenridge, and modified the Midtown Dam on the Red River in Fargo–Moorhead. The success of these projects has resulted in the completed or planned conversion of at least 10 other dams around the state to natural channel designs.

Minnesota has more than 2,500 dams. Many are becoming old, or unsafe, or are no longer performing needed services.



Dam conversions along the Red River of the North. Communities have been working with DNR to convert dams to rapids. Well-designed dam conversions and partnerships along the length of the river could make the Red River passable to fish from Hudson Bay to Fergus Falls within a decade.



Fish numbers at Breckenridge Dam fishway. Surveys show that fish previously blocked by a dam can now migrate upstream. Dam conversions and constructed rapids enhance fish and wildlife populations and provide recreational benefits such as improved fishing and new boating routes.

Progress toward protection against flooding and related damages

Flooding is a natural part of river systems, but flood extremes can harm people and property. While the ultimate causes of flooding—climate and precipitation—are beyond our control, we can reduce flood damage by protecting healthy watersheds and striving to limit damage when flooding does occur.

DNR monitors 38 gauges around the state to provide data for flood forecasting. DNR promotes sound land use in flood plains to reduce flood damage. We help local governments plan, carry out, and pay for flood damage reduction measures.

During the 1990s DNR provided $1.3 million to communities in the Root and Cedar river watersheds to build flood control structures, define flood hazard areas, and purchase and remove flood-prone buildings. In Austin alone, costs savings during the 2000 floods due to removal of flood-prone buildings approached the sum of grant money that was used to acquire the structures.

DNR assistance supports local and regional efforts to address flooding and manage for healthy river systems. For example, community efforts to remove houses in a flood-prone area in East Grand Forks led to recognition of a broader opportunity to develop the East Grand Forks Greenway. DNR provided technical assistance for this community-based project, which over the long term should help limit future flooding, provide recreation, and restore natural areas. DNR also has supported broader regional efforts, such as the recently concluded Red River mediation agreement.

Refer to related sections on watersheds and wetlands for broader descriptions of efforts to protect healthy watersheds and thus minimize the potential for flooding.

At a Glance

DNR activity:

Technical and grant assistance to communities

Desired outcome:

Prevention and reduction of damages from flooding

MNDNR

Oslo, Minnesota. The devastating Red River flood of 1997 spurred efforts for greater coordination of flood protection throughout the Red River valley.

Wetlands

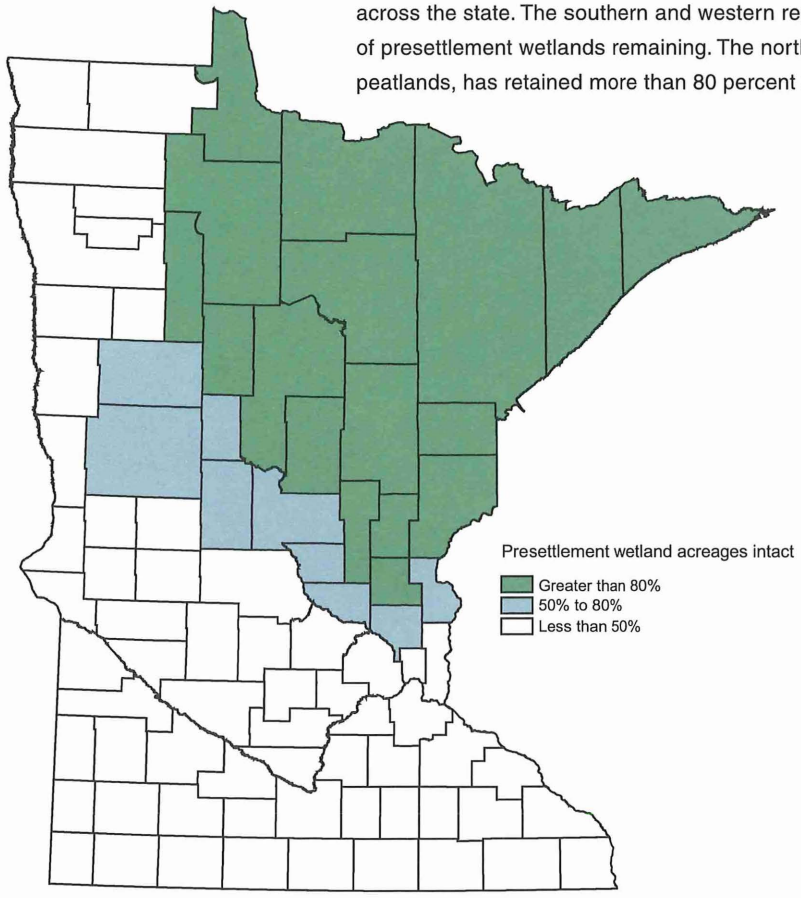
Wetlands reduce flooding, enhance water quality, control erosion, provide habitat, and offer open space, beauty, and recreation opportunities.

Loss of wetlands to agriculture and urban development led to the 1991 State Wetlands Conservation Act (WCA) and a "no net loss" policy for wetlands. The WCA directs us to first avoid disturbing wetlands; second, to minimize impact on wetlands; and third, to replace lost wetland acres, functions, and values. Development that harms a protected wetland must compensate for the damage, usually by restoring or creating a wetland. Ten years later, the challenge remains—to protect remaining wetlands and the overall quality of this unique resource.

Local governments, the Minnesota Board of Water and Soil Resources (BWSR), and other state and federal agencies share responsibility for managing Minnesota wetlands. DNR develops and enforces regulations, builds partnerships for planning and managing wetlands, and restores and improves wetlands.

Progress toward no net loss of wetland acreage

DNR regulates use of a small percentage of Minnesota's wetlands. Our jurisdiction includes about 275,000 acres of wetlands larger than 2.5 acres in incorporated areas and 10 acres in unincorporated areas. In recent years DNR has helped local governments reduce wetland impacts by reviewing more than 400 wetland replacement plans per year. Specially trained wetlands enforcement officers enforce wetland regulations and educate communities on the law. Collaborative planning and education also contribute to wetland protection. Since WCA rules were passed in 1993, thousands of acres of wetlands have been saved or restored.



Remaining wetlands in Minnesota. Wetlands are distributed unevenly across the state. The southern and western regions have less than 50 percent of presettlement wetlands remaining. The northern region, with its extensive peatlands, has retained more than 80 percent of presettlement wetlands.

At a Glance

DNR activities:

- Wetland permitting
- Wetland law enforcement

Desired outcome:

No net loss of Minnesota wetlands

DNR records acres lost and replaced on DNR-regulated wetlands. Since 1992, 1.6 acres of wetlands were created or restored for every acre of DNR-regulated wetlands lost.

Has the overall goal of no net loss been met statewide? We may not know for some time. A single set of wetland acreage numbers is not available. A U.S. General Accounting Office report (RCED-98-150;07/01/98) explains that no reliable method currently exists to provide credible wetland loss data. The fact that state and federal governments allow certain types of wetland losses through legislatively created exemptions also may compromise the goal of no net loss.

Wetland management is not "one size fits all" there are large differences in wetland distribution across Minnesota.

Progress toward enhancing wetland quality

Engaging in partnerships

Through a cooperative effort, DNR, with citizens, local governments, and other state agencies developed the Minnesota Wetlands Conservation Plan in 1998 to: 1) recognize regional differences in wetland management, 2) simplify the permitting system, 3) gather information, and 4) create a common set of strategies for conserving wetlands. The planning process identified ways to make wetland programs more effective and efficient, and included a memorandum of agreement for implementing the plan.

Since then DNR has worked with local governments and others to promote regional and local wetland protection. For example, in 2000 DNR published a guidebook for managing wetlands in the Anoka Sand Plain. DNR recognizes that wetland management is highly specific to region and landscape conditions, and is working with local communities. DNR also partners on programs associated with the North American Wetland Conservation Act. This has provided funding and assistance for 23 wetland projects across the state.

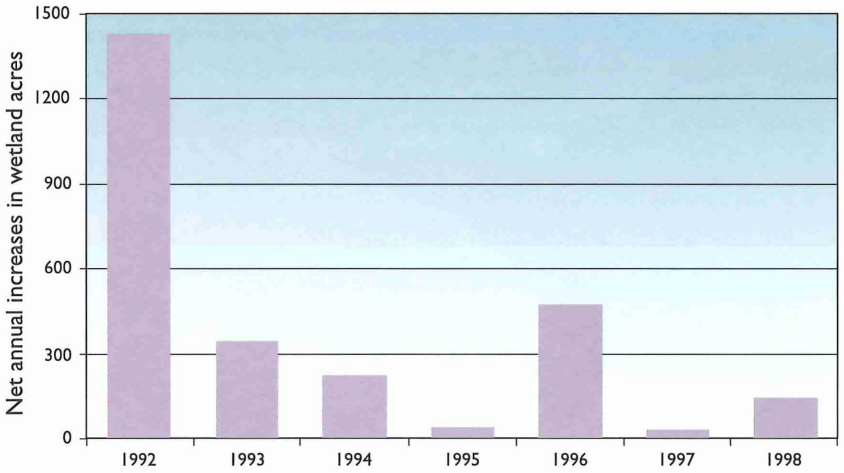
At a Glance

DNR activities:

- Partnerships and coordination
- Wetland restorations
- Habitat management

Desired outcomes:

- Sound land use decisions
- Sustainable wetlands
- Protected wetland benefits (e.g., duck populations)



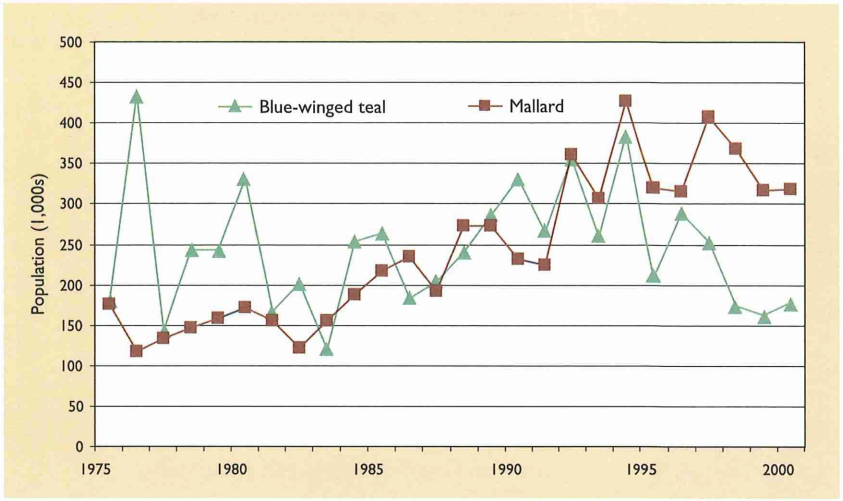
No net loss of wetlands. Activities on DNR-regulated wetlands have increased overall wetland acreage. Since 1992, public road projects and improvements such as lake accesses have caused the most loss of DNR-regulated wetlands. Wetland creation and restoration projects have resulted in overall gains each year.

Enhancing wetland habitat for wildlife

DNR works in partnership to manage wetlands and associated uplands for a variety of wetland-dependent wildlife, with a strong emphasis on waterfowl. Restorations of previously drained wetlands on DNR-owned lands enhance their value for wetland-dependent wildlife. DNR partners with conservation and other groups and agencies to acquire and manage wetlands and nearby uplands for wildlife. In addition to wetland restoration, we manage water levels on many wetlands to simulate natural water regimes and stimulate the growth of emergent and submergent aquatic plants to improve water clarity and food availability for wildlife. Other management practices include restoration of native plant cover in adjacent watersheds, and installation of exotic fish control barriers and waterfowl nesting structures. (See Heron Lake Watershed, page 47.)

Since 1995 DNR, working with partners, has restored 151 wetlands, averaging about 30 each year. We have managed water levels on 1,972 wetlands, averaging about 325 each year. And since 1986, an estimated 55,900 acres have been protected through acquisition by DNR.

DNR maintains a research program to further the understanding of the habitat and management needs of wetland-dependent species. Recent research has focused on the effects of commercial use of prairie wetlands for minnow production; evaluating the effects of various management techniques on breeding duck populations; and ongoing surveys, assessments, and monitoring of duck and goose populations that breed in or migrate through Minnesota. (See page 44 for a discussion of wetlands in agricultural areas).



Minnesota breeding duck populations. Breeding ducks rely on wetland habitat. (See page 69 for a discussion of waterfowl hunting.)

Harmful Exotic Species

Harmful exotic species spell trouble for Minnesota's waterways. They displace native species and harm wildlife. They interfere with swimming, boating, and fishing.

Minnesota's waters harbor 10 prohibited exotic species: curly-leaf pondweed, Eurasian watermilfoil, flowering rush, grass carp, purple loosestrife, round goby, ruffe, sea lamprey, white perch, and zebra mussel. Ten of the state's 81 watersheds were free of prohibited exotic species as of 2000, but all are at risk. At least 14 prohibited exotic species present in other states and provinces have not yet been reported in Minnesota waters.

Because exotic species are practically impossible to eliminate, DNR strives to 1) prevent introductions of new species to the state, 2) prevent spread, and 3) reduce ecological, social, and economic impacts.

Eurasian watermilfoil occurs in 121 waters throughout Minnesota.

Progress toward limiting the spread of harmful exotic species

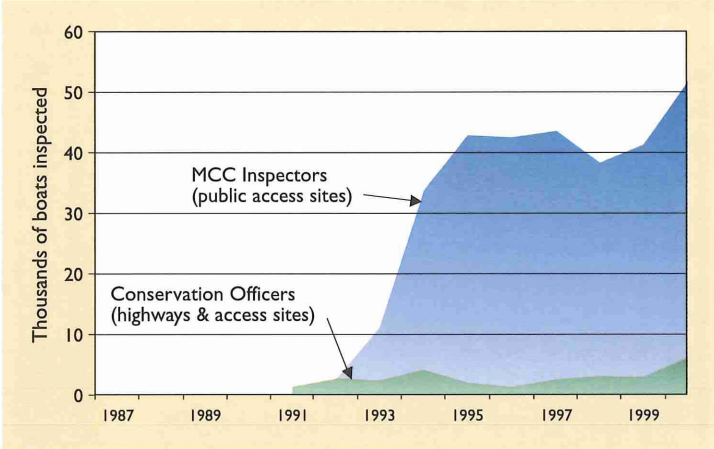
DNR studies and monitors harmful exotic species, cooperates on management plans, develops rules and enforces regulations to limit spread, controls some populations, and coordinates with others such as Minnesota Sea Grant to educate the public on preventing spread of exotics. A 2000 statewide DNR survey showed that 96 percent of Minnesotans view the DNR effort to prevent the spread of harmful exotic species such as Eurasian watermilfoil as "important" or "very important."

Eurasian watermilfoil

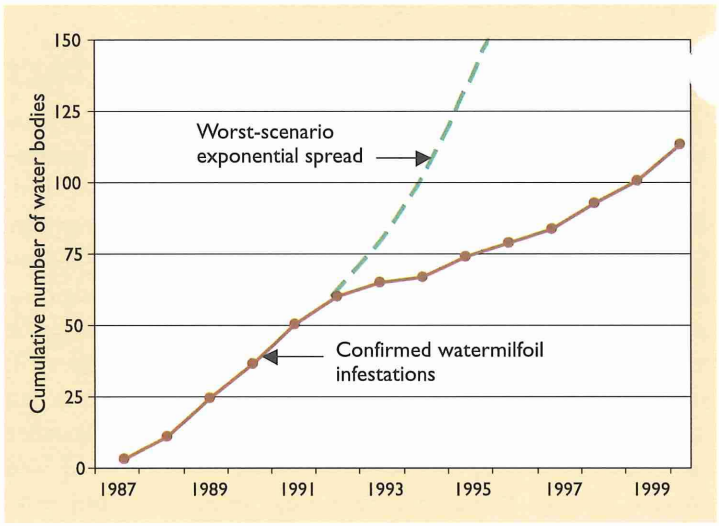
Eurasian watermilfoil spreads among lakes primarily via plant fragments on boats and trailers. It has been a problem for Minnesota since discovered in Lake Minnetonka in 1987.

DNR began a public awareness program in 1989 and inspections of boats on highways in 1991 and at public accesses in 1992. DNR educates people about exotics when installing signs at public accesses, inspecting boats, participating in community events, and helping support TV and radio ads. Access site surveys primarily at infested waters show that boaters familiar with exotic species laws increased from 79 percent in 1995 to 96 percent in 1999.

By the end of 2000, Eurasian watermilfoil infested 121 water bodies in Minnesota. While the cumulative number of infested lakes is increasing, the rate of spread between unconnected waters appears to have slowed. This suggests that education and enforcement may be limiting the spread of Eurasian watermilfoil.



DNR boat inspections. Eurasian watermilfoil spreads primarily via plant fragments on boats and trailers. DNR inspects watercraft at public access sites and along highways to educate boaters and enforce exotic species laws. Public awareness campaigns complement these efforts.



Eurasian watermilfoil. Eurasian watermilfoil has the potential to spread far and wide because every newly infested lake becomes a source of contamination. Because exotic species are almost impossible to eradicate once they are established, DNR emphasizes curtailing spread.

At a Glance

DNR activity:

Boater education and enforcement

Desired outcomes:

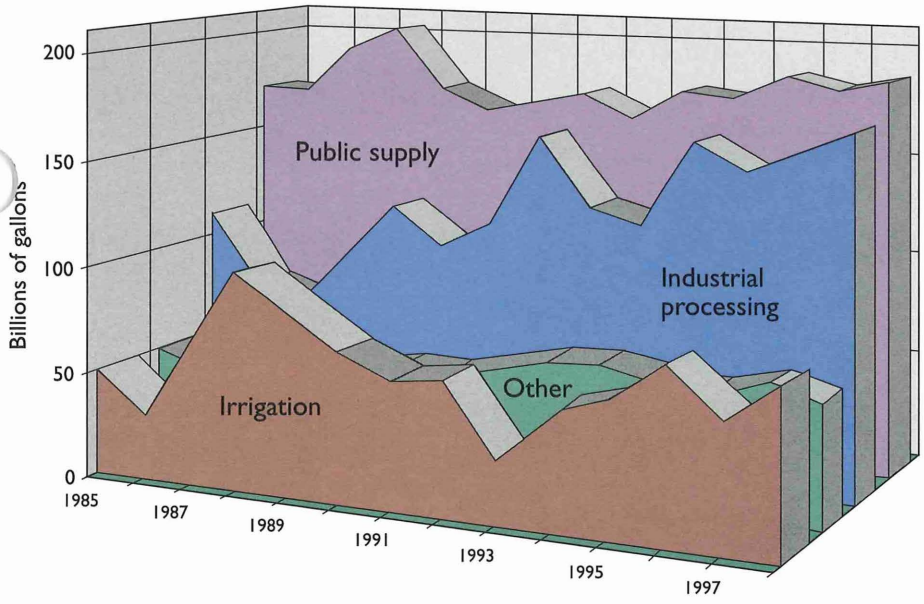
- Public awareness
- Fewer harmful exotic species transferred by boaters
- Fewer new introductions of harmful exotic species

Water Supplies

Minnesotans depend on the state's water for basic needs: domestic consumption, agriculture, and industry, including cooling water for power generation. Minnesota has abundant but not limitless water. Water concerns include adequacy of supply, well interference (when withdrawal from one well reduces water levels in another), water quality (especially nitrate pollution), and interactions of ground and surface waters.

Water supplies are adequate at present but may not be during periods of drought or in the future if use trends continue. From 1989 to 1998, Minnesota's population increased by 10 percent while water use increased by 17 percent. Depletion of aquifers would cause water use conflicts and damage to sensitive environmental areas—wetlands, lakes, rivers, and unique resources such as trout streams and fens.

DNR works with local governments and other state and federal agencies to protect water quantity and quality. DNR water management is guided by an overall goal of conserving and allocating water supply among competing uses in the best interests of the public and long-term sustainability of the water resource.



Water use in Minnesota. Water use has increased over time, despite variation between wet and drought years. Power generation, which is not shown in graph, accounts for 60 percent of overall water use. It is primarily nonconsumptive, meaning that water is returned to its source.

Progress toward protection of water supplies while meeting water use needs

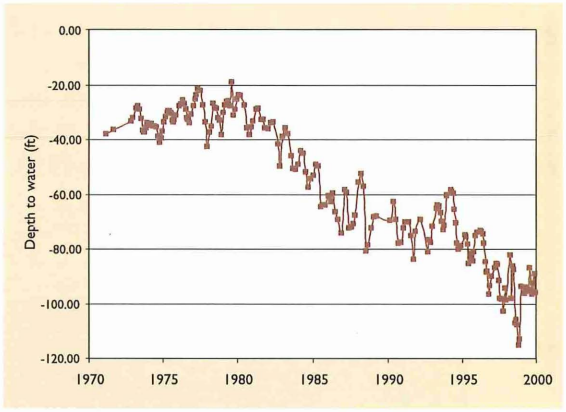
DNR focuses water supply management in three main areas: 1) water supply monitoring and assessment, 2) partnerships in research and technical assistance, and 3) water supply permitting and conservation.

Water supply monitoring and assessment

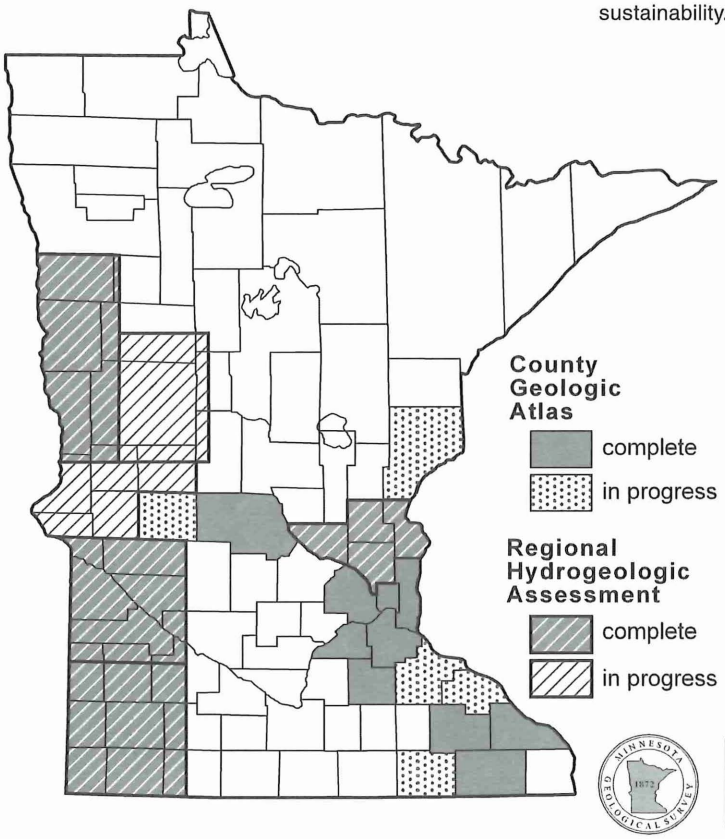
DNR monitors 700 observation wells and hundreds of river flows with stream gauges. While water levels vary widely with climatic variations, long-term monitoring helps measure overall trends. By comparing water allocation permits and water levels, DNR can anticipate shortfalls and work with partners to find adequate water supplies.

Research and technical assistance

DNR has a long-term partnership with the Minnesota Geologic Survey to collect geologic and hydrologic data and to develop hydrogeologic maps. DNR provides communities and counties with information on water features and sensitivity of ground water to pollution to help them assess human impacts on water resources. For example, DNR uses dyes to trace ground water flow and identify aquifers sensitive to pollution in the karst regions of southeastern Minnesota. Education about these relationships helps prevent damage to sensitive water supplies.



Ground water monitoring. This DNR observation well i Savage, Scott County, shows declining depth to water i the Mt. Simon aquifer. Where such declines occur, DNR works with local communities to address water supply sustainability.



Information for local communities. DNR and the Minnesota Geological Survey help communities manage water resources for long-term sustainability by working together to provide county and regional hydrogeologic information. GIS layers and maps for some areas are available via the DNR website.

At a Glance

DNR activities:

- Water supply monitoring and assessment
- Partnerships in research and technical assistance
- Water supply permitting and conservation

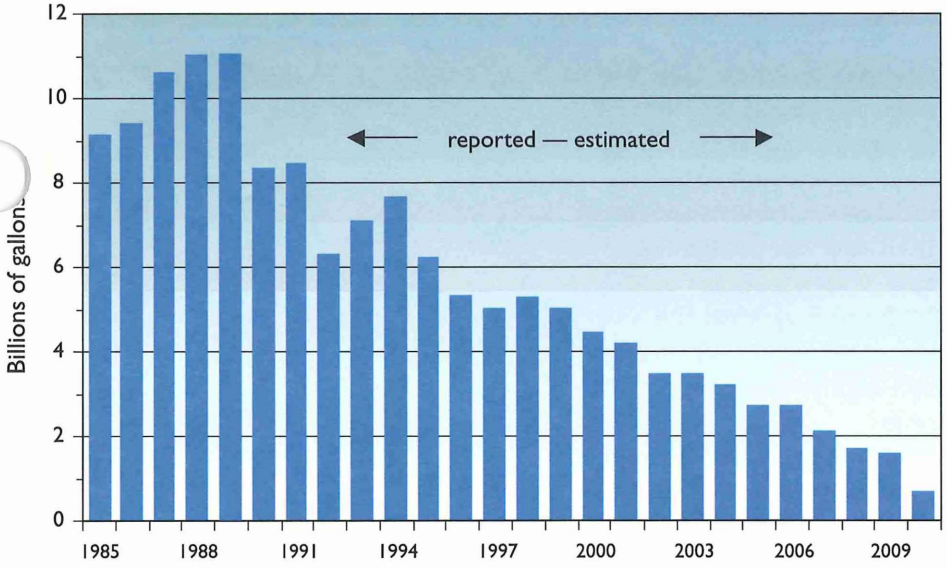
Desired outcomes:

- Improved water conservation practices
- Sustainable water supplies
- Satisfaction with management of water use conflicts

Water supply permitting and conservation

DNR has primary responsibility for issuing water appropriation permits. The goal is to use regulation in ways that meet user needs while protecting supply. DNR manages (conserves) ground water use during periods of water shortfall by discontinuing permits for low-priority uses as determined by statutes. DNR also cooperates in local planning, exploration for new water supplies, management of old wells, and promotion of water conservation.

DNR fosters shared responsibility for water conservation in coordination with regulation. Water use for air conditioning is a good example of this coordinated approach. Air conditioning systems in large buildings once discharged water after a single use. This "once-through cooling" (OTC) is a wasteful process. Following the 1988 drought, the Minnesota Legislature created incentives to encourage owners of OTC systems to convert to water conservation systems by 2010. DNR has promoted water conservation through its permitting practices associated with this law. As a result, OTC water use decreased from 11 billion gallons per year in 1989 to 5 billion gallons in 1999. By 2010, OTC use will decline to 1 billion gallons per year. Water conservation practices such as this help conserve water supplies for the future.



Reductions in water use for "once-through cooling" (OTC) systems. Building owners are converting wasteful air conditioning systems to more efficient cooling systems. These water conservation practices are especially important in urban and developing areas. DNR fosters shared responsibility for water conservation in coordination with regulation.

Outlook

Citizens, community groups, local units of government, state and federal agencies, and DNR have all contributed to protecting Minnesota's water resources. Communities facing complex water management decisions have benefited from DNR's technical and financial assistance and work to simplify water permits. We have supported sound water management by participating in locally led watershed partnerships. These steps have helped protect the state's ground water and helped maintain or enhance the natural characteristics of rivers, wetlands, and lakes.

Yet Minnesota's water resources are threatened by increasing demands, competing uses, shoreland development and alteration, and nonpoint-source pollution. Among the ongoing challenges:

- Many small, individually minor land use changes, when taken as a whole, may significantly degrade water resources. These "cumulative impacts" are difficult to address. For example, one lakeshore owner removing shoreline vegetation may not be significant. But if all lakeshore property owners do the same, shoreland habitat disappears, fish and wildlife diminish, and overall lake quality declines. Solutions require collective action through partnerships.
- Joint action with other agencies and partners will be needed to reinforce conservation efforts and develop new restoration options to protect the ecologic and economic future of large rivers such as the Mississippi and Minnesota.
- Sustainable management of wetlands is a continuing challenge. We have incomplete data on the loss of smaller, temporary wetlands that are not within the protected wetland category. Loss and deterioration of these wetlands poses concern for wildlife habitat and water quality.
- Water resources are dynamic; ground water, lakes, wetlands, rivers and streams respond to both short- and long-term cycles in climate and use. Ensuring the sustainability of water supplies and healthy aquatic habitats requires thorough understanding of the effects of the hydrologic cycle on water resources.

Addressing these challenges will require coordinated efforts from citizens, communities, other agencies, and DNR. DNR will continue its work with other agencies to implement the 2000 Minnesota State Water Plan and collectively set targets for statewide indicators of aquatic ecosystem health and water quality and supply.

DNR will continue researching, monitoring, and adapting water management programs. DNR will collect and analyze habitat, hydrologic, and watershed-level data. These expensive efforts are the basis for DNR technical assistance to communities. DNR needs to refine education and regulation to better reduce cumulative impacts to water resources. Indicators of water supplies, rivers, wetlands, and lakes will help track the effectiveness of these programs in maintaining high-quality water resources.

Tri-County Leech Lake Watershed Project

Jurisdictions join to protect a recreational paradise

A decade ago, responsibility for managing the ecosystem health of the Leech Lake watershed was uncertain. This magnificent watershed—home to 273 lakes, six streams, and some of the best muskie waters in the nation—flowed under the jurisdiction of three counties, the U.S. Forest Service, an American Indian reservation, three soil and water conservation districts, several state agencies, and numerous municipalities and townships. No single group had total authority, and there was no comprehensive plan for guiding development in ways that protected the very resources that attracted people to the area.

Uniting the waters for conservation

Recognizing the importance of managing the watershed under a common umbrella, DNR proposed in 1992 that agencies, citizens, businesses, conservation groups, and others work together to create a positive future for the water-linked resources. The result—the Tri-County Leech Lake Watershed Project—has transformed a patchwork of regulatory activity into a unified source of vision and action. It has assessed water quality, stormwater runoff, and recreational facilities. It helped create a school forest that won a "Forest of the Millennium" award in 2000. It produced water workshops and festivals. It encouraged private owners of riparian lands to develop Forest Stewardship Plans for more than 5,000 acres.

A primary focus has been ensuring that wastewater treatment facilities can protect the watershed in the face of growth. The project evaluated existing wastewater management and funded numerous improvements. In 1997, after a concerted effort, it won a $1.2 million grant to construct a much-needed facility in the community of Federal Dam.

In 1996 the project established the Leech Lake Area Watershed Foundation, which helps landowners set aside natural areas through donation or sale of land or development rights. In 1999 the foundation implemented the state's first shoreland conservation easement at Little Boy Lake near Longville. To date, the foundation has helped protect more than 37,000 feet of watershed shoreline.

MNDNR

Protecting a watershed. Leech Lake River enters Leech Lake at Federal Dam, the site of a wastewater treatment facility and natural shoreline project.

Protecting Minnesota's Natural Heritage

Information and assistance for communities

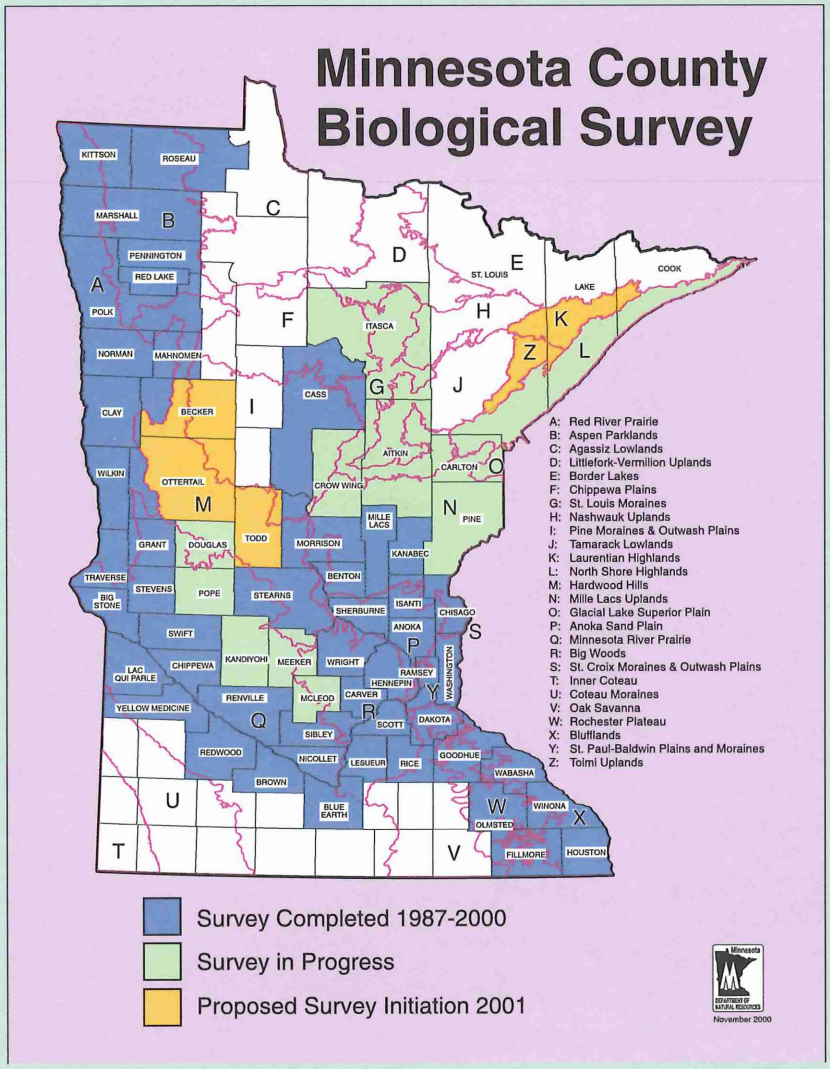
Fifty years from now, will Minnesota communities still harbor treasures of native habitat? ...places where children and adults can see blankets of trillium blooming under a basswood canopy... watch trout darting in a cool, clear stream... or hear the fluting of a Western Meadowlark floating over prairie grasses?

To assure that they will, DNR is helping communities identify and protect the rich natural heritage that remains.

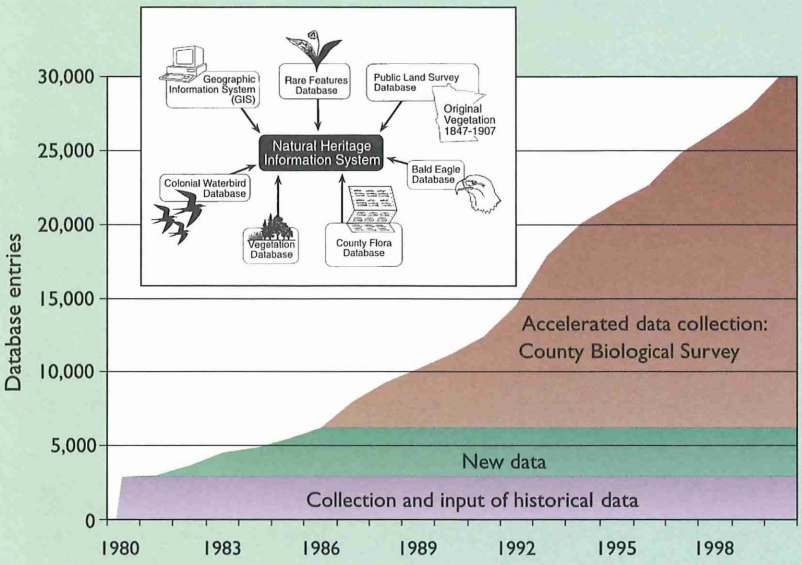
Initiated in 1987, the **Minnesota County Biological Survey** (MCBS) conducts a systematic county-by-county inventory of the state's natural features. Using air photos, satellite imagery, and intensive ground surveys, MCBS staff identify significant natural areas and collect and interpret data on the distribution and ecology of rare plants, rare animals, and native plant communities.

MCBS data are stored in the DNR's **Natural Heritage Information System** (NHIS)—the state's most comprehensive source of information on the location of rare species, native plant communities, important animal concentrations (such as nesting colonies or display grounds), and unusual geologic features (such as glacial formations).

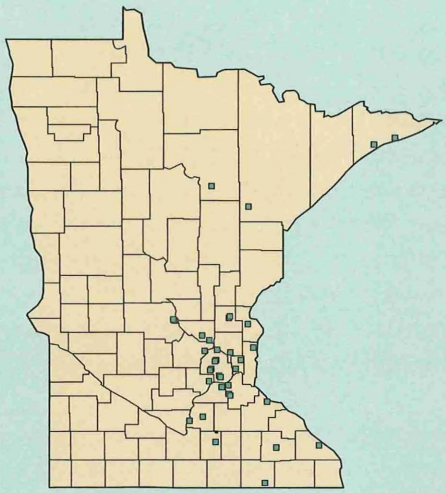
NHIS data are used to document areas most deserving of protection by DNR programs such as the Native Prairie Bank, Reinvest in Minnesota, and Scientific and Natural Areas programs. DNR and other land managers also use these data to inform management plans to enhance habi-



Minnesota County Biological Survey progress. Inventories have been completed in 49 counties and are underway in 13 others. Rare features maps for 23 counties are available to the public.



Rare Features Database. Shaded areas mark milestones in the collection of nearly 30,000 location-based entries of approximately 500 rare animal and plant species, native plant communities, important animal concentrations, and unusual geologic features. The inset illustrates relationships among natural heritage databases.



Natural and Scenic Area Grants project locations. As of 1999, 36 projects protect a total of 1,138 acres.

tat. DNR staff bring MCBS county maps to informational meetings with communities or private landowners. The maps help these groups decide which lands are most important to include in land protection and restoration plans, including local greenway or Conservation Connections projects.

The goal of DNR's **Scientific and Natural Areas Program** is to ensure that examples of each rare feature are not lost from any landscape region of the state. Sites are dedicated as SNAs because their natural attributes provide inherent opportunities for scientific, educational, and recreational nature observation. One fourth of all the rare features tracked in the Rare Features Database (part of the NHIS) are represented at least once in an SNA. There are 133 SNAs that protect a total of about 178,000 acres throughout the state.

DNR's **Natural and Scenic Area Grants Program** augments other protection efforts by providing grants of up to $500,000 in matching funds to local governments and school districts to protect and enhance undeveloped open spaces and scenic vistas. Communities can use the money to buy land or perpetual easements. Established by the Minnesota Legislature in 1994, the program has disbursed $3.8 million in funding for 36 projects.

Moving from information to protection

Stearns County requested an MCBS inventory for help in preparing its county comprehensive plan. Using the MCBS heritage data, Stearns County Parks prioritized about 400 acres adjacent to Quarry Park and Nature Reserve for protection. DNR worked with the county to protect the prioritized area as an SNA, and a Natural and Scenic Area grant helped the County acquire a 30-acre parcel. The Quarry Park and Nature Reserve, now a 622-acre multi-use complex, harbors rare populations of tubercled rein-orchid (a state endangered species), Red-shouldered Hawk, and Acadian Flycatcher.

Hope for the Big Woods

Protection from further degradation

Imagine a forest so vast you could walk for days without emerging from the shelter of tall trees. Such was the Big Woods, once a two million acre expanse of hardwoods in south-central Minnesota. Then came the settlers. With ax and plow, they carved the forest into farmland, highways, and towns. Today, all that remains of the Big Woods is a few protected pockets of public land and numerous but isolated small private woodlots.

In eastern Rice County, Big Woods remnants face both a growing threat and an exciting new source of hope.

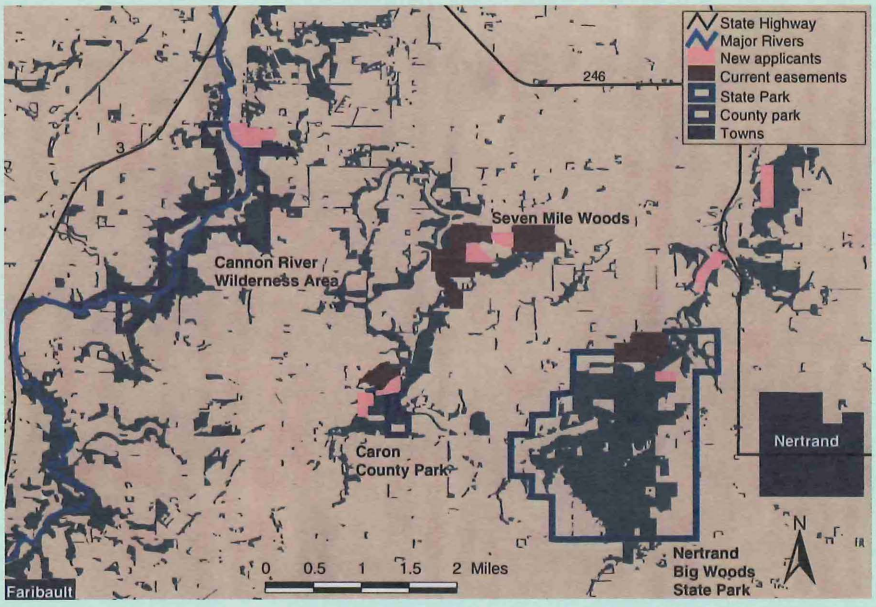
The threat is one of further loss and fragmentation as increasingly commute-tolerant exurbanites spill out of surrounding communities to stake a claim for their own "little house in the big woods." Between 1984 and 1994, 540 houses were built in rural Rice County, many on forest fragments.

The hope comes in the form of the Big Woods Project, a group of Rice County citizens, DNR staff, and other public and private partners united in 1992 to protect the remnant forest from further degradation and—where possible—improve its ability to function as a healthy ecosystem.

DNR's involvement has emphasized encouraging and supplementing citizen-led efforts with staff support and information. We have contributed seedlings and staff assistance to volunteer tree-planting efforts at Nerstrand Big Woods State Park and elsewhere. DNR is helping Rice County landowners develop forest stewardship plans. We provided the match needed to obtain a federal Forest Legacy grant to encourage landowners to shelter land from development.

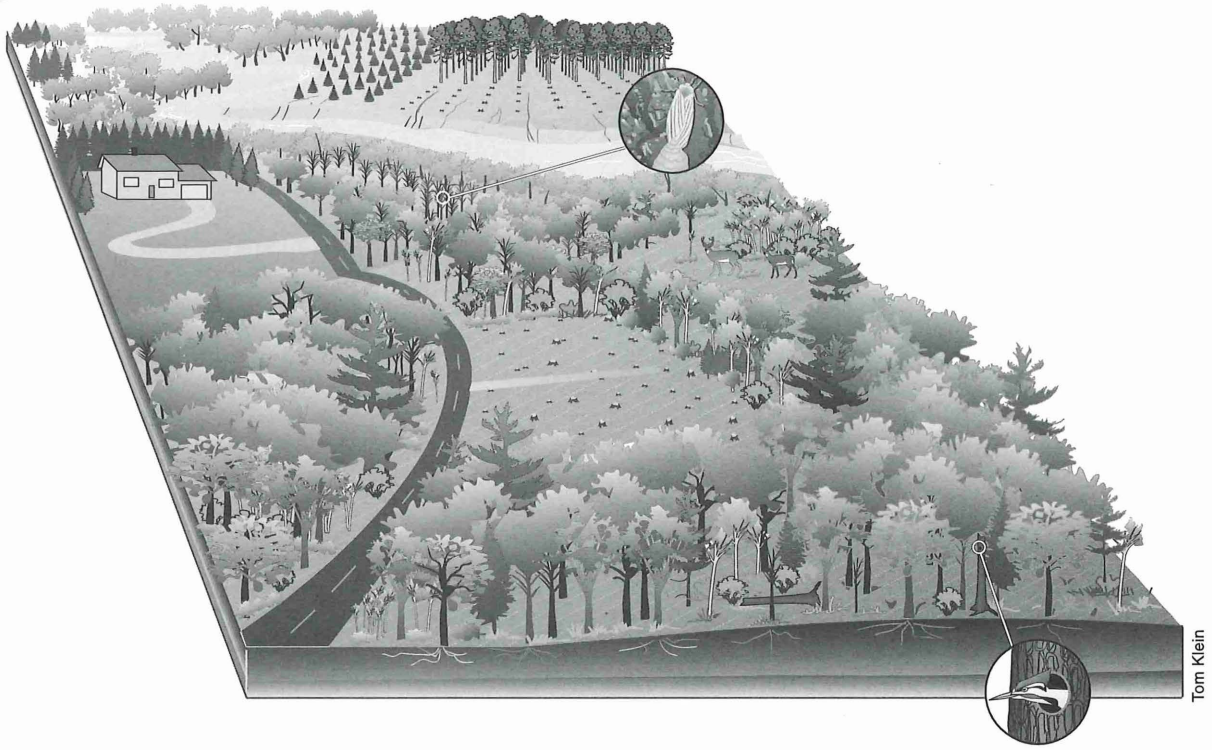
Through cooperation and hard work, DNR and partners have made measurable progress toward reducing habitat loss and enhancing habitat integrity on Big Woods remnants in Rice County:

- More than 34,000 trees have been planted at Nerstrand Big Woods State Park since 1993.
- Private forest land covered by stewardship plans has grown from 217 acres in 1990 to 18,933 acres in 1999.
- Private owners donated a 128-acre tract to be used as a forest stewardship demonstration site.
- The project has produced several publications for landowners encouraging wise stewardship of Big Woods lands. A newsletter provides updates on project activities.
- The project received state funding to reduce soil erosion in the Cannon River Valley.



Conservation connections in northeastern Rice County. The Forest Legacy Program has approved funding for conservation easements on 930 acres of private forest land. The distribution of easements with respect to forested (dark green) and public lands is a prime example of DNR's Conservation Connections concept.

Forest Resources



Tom Klein

Directions 2000

Strategic outcomes for forests

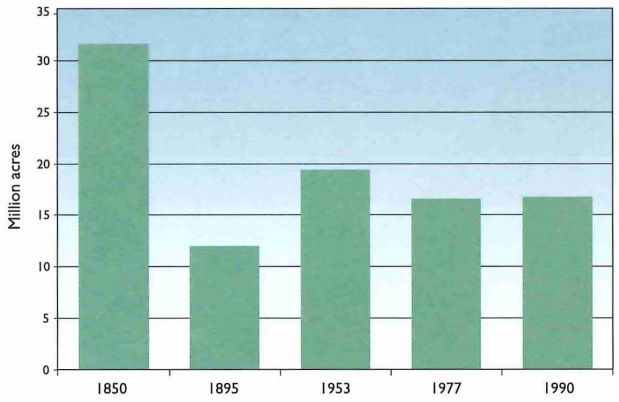
- Enlarged and protected forest land base
- Healthy and resilient forest ecosystems
- Numerous forest-based economic and recreational opportunities

Introduction

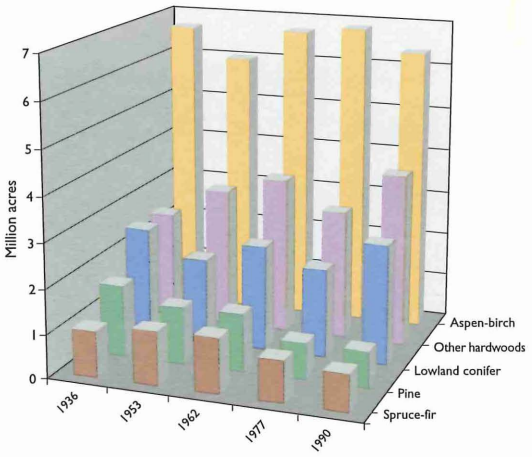
Minnesota's forests are key to the state's environmental and economic health. They provide clean water, watershed protection, wood products, fish and wildlife habitat, biodiversity, recreational opportunities, and many other benefits.

Minnesota forests have changed greatly in the past 150 years. Between 1850 and 1900, much of the state's original 31 million acres of forest were harvested for lumber or cleared for settlement. By 1900, only 12 million acres remained. Today nearly one-third of Minnesota, approximately 16.7 million acres, is forested. Pine and northern hardwood communities are less abundant and aspen is more abundant than during the 1800s. Some forest types and age classes are now rare. For example, the maple-basswood forests that once occupied much of south-central Minnesota now exist only as small, isolated parcels.

DNR helps protect forest plant and animal communities while ensuring sustainable forest-based economic and recreational opportunities. DNR administers about 23 percent of the state's forests. Federal agencies manage 21 percent, counties manage 16 percent, and forest industry and other corporations own about 8 percent of the forest. The remaining 32 percent is owned by more than 147,000 individuals.



Forest lands. About half of presettlement forests have been converted to other uses. Today about one-third of Minnesota's 54 million acres is forested.



Forest composition changes. Although Minnesota forest composition has been relatively stable for more than 50 years, there are fewer pine forests and more aspen forests than in presettlement landscapes.

Critical trends and issues

DNR is concerned about conversion of rural lands from farm and forest to housing and commercial development. As this occurs, forests become fragmented, forest cover decreases, habitat conditions change, and forest management, including sustaining water quality and opportunities for recreation, becomes more difficult.

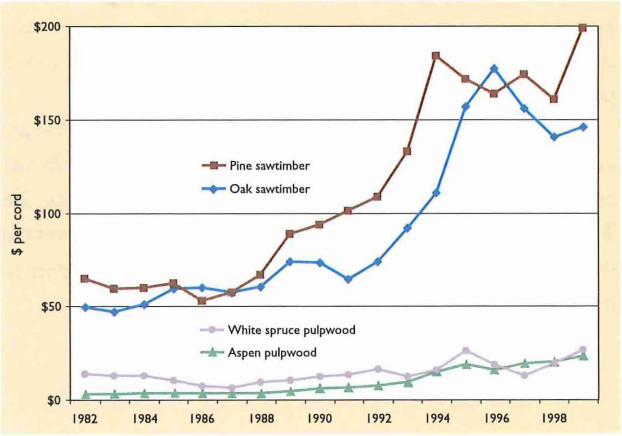
In the next 25 years, DNR anticipates that forested lands will continue to be developed, leaving fewer large blocks of forest land for timber production, wildlife habitat, and recreation. Expectations of new forest residents could limit management options. In the Pequot Lakes area, for example, residential development drawn to the area by nearby state forests has increased the need for wildfire protection and residents now challenge use of management practices such as prescribed burns and clear-cutting. A growing demand for forest recreation (e.g., off-highway vehicle use, horse riding, hiking, mountain biking, snowmobiling, and cross-country skiing) challenges forest managers.

Growing population and per capita consumption have increased worldwide demand for wood products. Growing demand and technology advances have improved industry's ability to use aspen. This has fostered substantial capital investments, especially during the 1980s, to increase the capacity of forest products mills in Minnesota. Timber harvesting increased substantially since the early 1980s and mills have expanded in the 1990s to remain competitive.

Timber harvests are projected to increase slightly. For example, harvest of birch and spruce was projected to increase by 151,000 cords and 41,000 cords, respectively, by 2001. Overall timber harvesting was expected to increase by 532,000 cords during that same period.

The current value of forest products manufactured in Minnesota is about $7.7 billion per year, up from $4 billion in the mid-1980s. Forest industries account for about 4 percent of Minnesota's gross state product (1992 data) and 3 percent of employment (1997 data).

The following section presents indicators of progress toward sustaining forests in Minnesota. It paints a picture of the challenge to achieve sustainable forest that balances social, economi and ecological objectives.



Price trends. High demand for forest products and reductions in harvestable timberland have boosted prices for sawtimber and pulpwood. These data are average prices paid to Minnesota public agencies.

Progress toward an enlarged and protected forest land base

To sustain forests and their benefits, DNR seeks to maintain existing forest cover and expand forest land where possible. DNR provides private landowners with technical assistance and financial incentives to promote connectivity of forest lands. In southeastern and central Minnesota, where forests have been converted to other uses, DNR's Conservation Connections agenda will help integrate efforts that protect forests by increasing the size of forest fragments and connecting them with corridors.

Technical and grant assistance to private landowners

The Forest Legacy Program, a cooperative effort of the USDA Forest Service, DNR, and the Minnesota Forest Stewardship Committee, protects environmentally important private forest lands from conversion to nonforest uses by providing financial, technical, and education assistance to communities and private forest landowners. Donated and purchased easements allow landowners to continue using their forests while preventing conversion to agriculture, housing, or commercial developments. Minnesota's first Forest Legacy Area was established in Rice County. It includes some of the largest, highest quality maple-basswood forest stands remaining in Minnesota. (See "Hope for the Big Woods," page 22.) Fourteen other areas in the state are candidate Forest Legacy Areas.

About 40 percent of Minnesota's forest land is privately owned. More timber comes from this land than from all public lands combined. Rising timber prices and demand create pressure to harvest these lands. DNR, in cooperation with other agencies, provides technical and cost-share assistance to nonindustrial/private landowners to encourage sound management. DNR focuses on landowners who own between 100 and 500 acres of forest. Forest consultants funded by DNR provide plans for owners of larger parcels. (See Urban and Developing Areas Chapter for programs that help people restore urban forests and shade trees.)

At a Glance

DNR activities:

- Technical and grant assistance to private landowners
- Reforestation
- Fire management

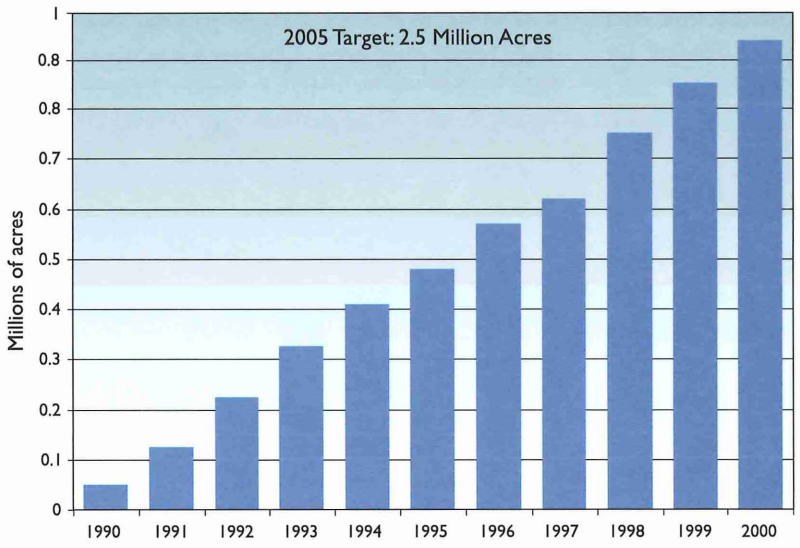
Desired outcomes:

- Protected forest land base
- Reduced fragmentation
- Increased forest cover

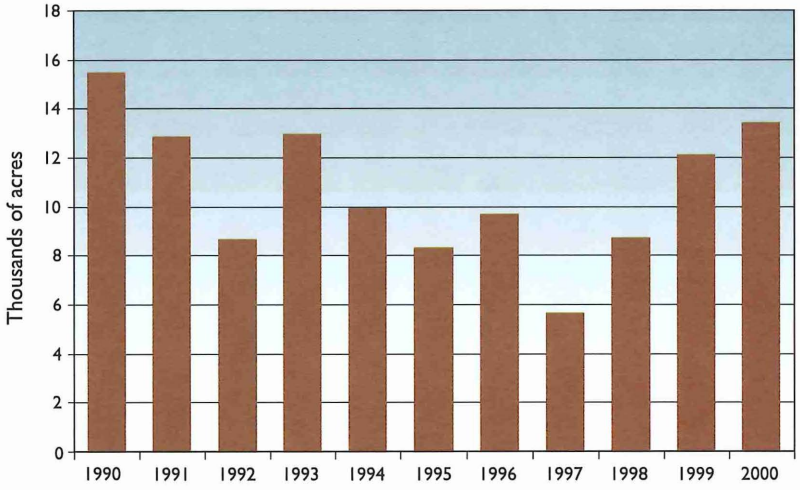
Although landowners are not required to comply with the recommended practices in forest stewardship plans, studies show most landowners with a forest plan manage their land for sustainable use. DNR's goal is to provide forest stewardship plans to owners of 2.5 million acres of nonindustrial private forest land by 2005.

Reforestation

Lands where tree cover has been removed provide good opportunities for reforestation. DNR provides private landowners up to 50 percent of the cost for tree planting done in accordance with approved forest stewardship plans. This incentive has stimulated tree planting on more than 117,000 acres since 1990.



Forest stewardship plans. Stewardship plans promote sustainable management of private forest lands. Data shown here are cumulative acres of forest land with stewardship plans.



DNR-assisted reforestation on private lands. Tree planting on formerly forested private lands is a key strategy for enlarging Minnesota's forest.

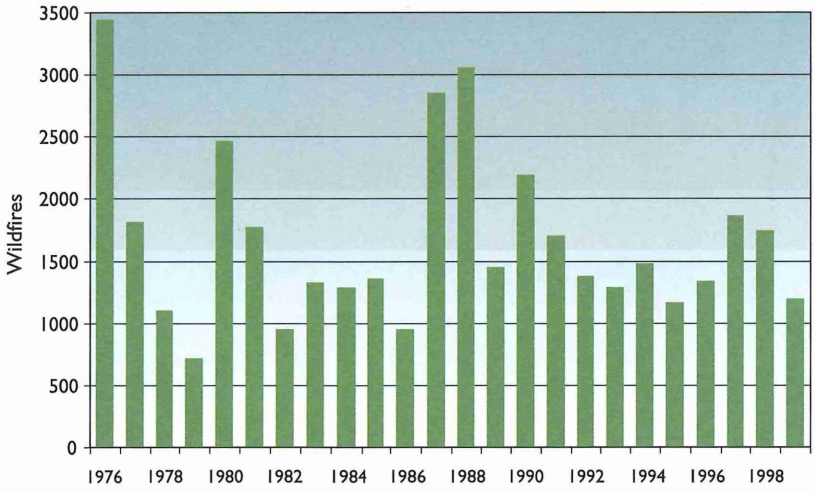
Fire management

DNR's wildfire prevention and suppression efforts are guided by laws designed to protect public safety, property, and natural resources. After natural disturbances such as blow-downs and insect infestations, DNR conducts prescribed burning, constructs firebreaks, and performs salvage harvesting to reduce the risk of wildfires, protect lives and property, and maintain timber availability. Fire management is increasingly important where residential and commercial development has expanded into forests.

New information has changed the way people think about fire and natural resource management. People now understand that fire plays an essential role in shaping Minnesota ecosystems. Fire helped create and maintain diverse forest types and habitats. Fire increasingly is being used as a management tool. Prescribed burning revitalizes brushlands, reduces forest fuel loads, removes exotic species and other undesirable vegetation, and prepares sites for reforestation. In 1999, a dry year that limited use of prescribed fire, DNR burned 4,305 acres of brushland and 4,797 acres of forest. This is approximately half the area that is burned in years of normal weather.

Deborah Rose

Prescribed fire. Controlled burning mimics natural fire and helps maintain open habitats in forested areas.



Wildfires suppressed by DNR. Wildfires are more frequent in dry than in wet years. The data include fires started by natural causes and by people. During the 1990s the average fire burned about 20 acres.

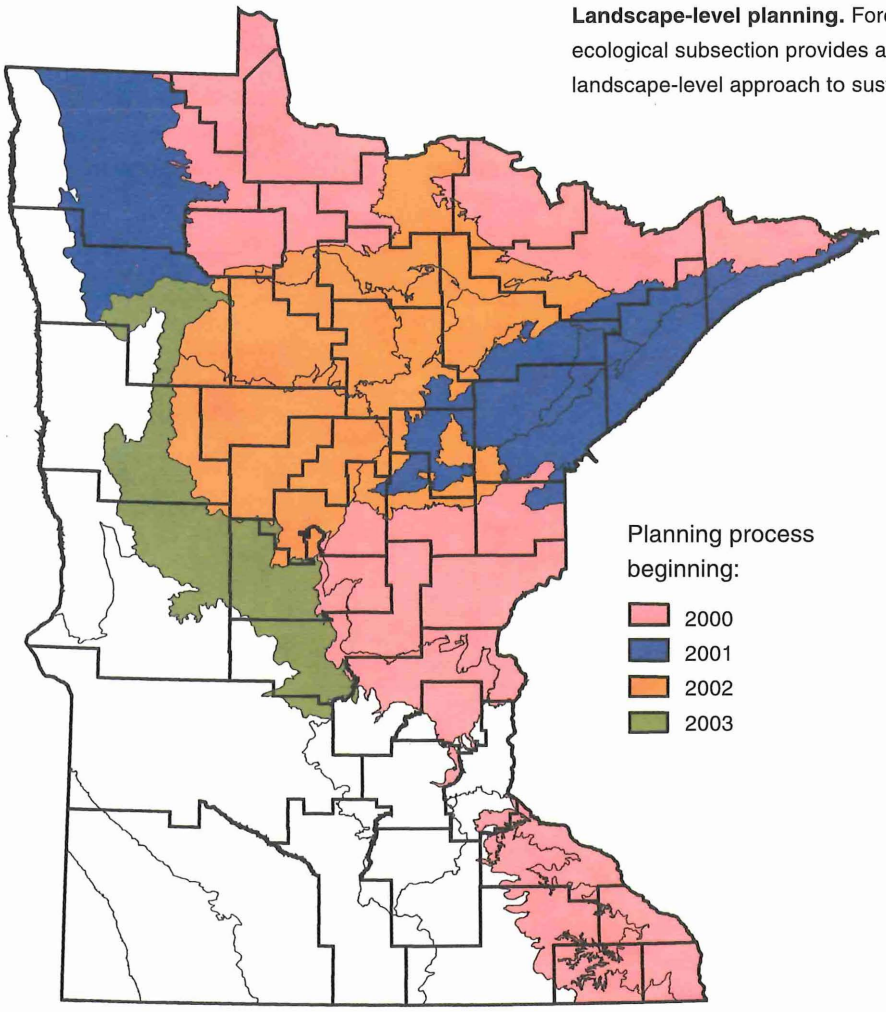
Progress toward healthy and resilient forest ecosystems

DNR's ecosystem approach works to coordinate forest management activities on large forested areas across many ownerships. By managing for diverse forests, DNR seeks to provide timber, habitat, recreation, and opportunities for education.

Forest management planning

DNR once directed timber harvests on state lands through five- or 10-year management plans for each of 40 administrative forestry areas. Opportunities for public input were limited. With growing public interest in DNR timber management planning and expanded sustainability objectives, DNR adopted Subsection Forest Resource Management Planning (SFRMP) in 2000. This approach uses larger, ecologically defined areas instead of administrative units, and provides more public input opportunity.

SFRMP focuses on 1) identifying a desired forest composition 50 or more years into the future, and 2) identifying stands for treatments (e.g., harvest, thinning, regeneration, prescribed burning) that will bring the subsection closer to the desired composition. SFRMP recognizes that management must consider wildlife habitat, biodiversity, aesthetics, and recreation in addition to timber. In the future, subsection plans may address other aspects of forest management (e.g., recreation facilities, land acquisitions and sales) and other DNR programs, including private forest management and fire management. DNR will initiate three or four subsection plans each year and will complete all subsection plans within five years.



Landscape-level planning. Forest planning by ecological subsection provides a comprehensive, landscape-level approach to sustaining forest resource

At a Glance

DNR activities:

- Forest management planning
- Forest information
- Forest guidelines implementation
- Protection of significant ecological features

Desired outcome:

Healthy, diverse forests fully capable of sustaining balanced multiple uses and benefits

Soil Drainage Class	Land Type Associations			
	Lake Plains	Till Plains	End Moraines	Outwash Plains
Excessive or Somewhat Excessive	No data	No data	Best	Not suited
Well or Moderately Well	Not suited	Fair	Good	Best
Somewhat Poor or Poor	Not suited	Fair	Fair	Not suited

Suitability of landscapes for white pine. The ecological classification system summarizes forest site characteristics and ecological potential. For example, in the Northern Minnesota Drift and Lake Plain Section, well-drained end moraines and outwash plains are the best locations for reestablishing white pine.

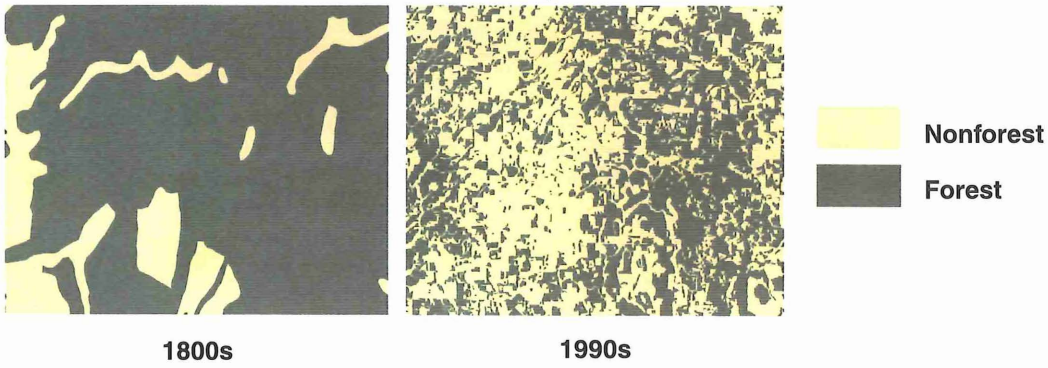
Forest information

Good forest management rests on a foundation of sound technology and accurate forest information developed carefully through research and monitoring. The following tools and information sources help improve sustainable forest management:

Ecological Classification System. The Ecological Classification System (ECS) identifies areas with similar management opportunities and constraints by considering data on climate, geology, hydrology, topography, soils, and vegetation. DNR uses ECS units for forest planning, old-growth protection, improving timber productivity and forest health, and protecting rare plant and animal species.

Forest information on the Internet. The Internet is a useful tool for delivering forest information. DNR's website links site-specific information to interactive maps that allow individuals to customize their information requests. Features include: maps and satellite images of the July 4, 1999, Boundary Waters blow-down; on-line air photos covering 45 forested counties; information on fuel conditions and locations of current and recent fires; and a ChangeView program that highlights areas of major forest land changes, including areas of forest cover loss and gain. DNR gives interactive map-based access to annual timber harvest plans and invites public comment on planned forest management activities.

Criteria and Indicators. DNR is working closely with international, national, and regional efforts to identify criteria that define sustainable forestry and indicators that measure progress toward sustainable management. In conjunction with the Minnesota Forest Resources Council (MFRC), DNR is developing indicators that measure progress toward MFRC goals and provide information necessary for sound management.



Change in forest cover in southern Cass County. Spatial analysis tools identify past and present forest landscape patterns that influence wildlife populations, forest productivity, and timber production. DNR is testing spatial analysis tools to model the consequences of alternative management actions on forest diversity and productivity.

Spatial analysis. DNR, MFRC, The Nature Conservancy, Minnesota Forest Industries, and the Audubon Society are cooperating to develop tools for measuring spatial characteristics of forested landscapes (e.g., forest connectivity, patch size, fragmentation). These tools will help us identify spatial patterns that influence wildlife, biodiversity, and forest productivity, and assess how the forest might change with different management approaches.

Forest harvest guidelines

The Generic Environmental Impact Statement on Timber Harvesting and Forest Management in Minnesota (1992) and the Minnesota Sustainable Forest Resources Act (1995) that established MFRC were significant steps toward sustainable management, use, and protection of the state's forest resources. In 1998, MFRC adopted guidelines for voluntary practices that will reduce adverse impacts of harvest and management. DNR applies MFRC guidelines to all state-managed forest lands. MFRC tracks both attendance at training workshops and awareness of the guidelines. More than 1,000 loggers and resource managers attended workshops in 1999. DNR is monitoring how use of guidelines helps protect the forest. MFRC will use this information to improve the guidelines. Monitoring began in 2000. Long-term monitoring will be needed since forest responses to the guidelines will occur over many years.

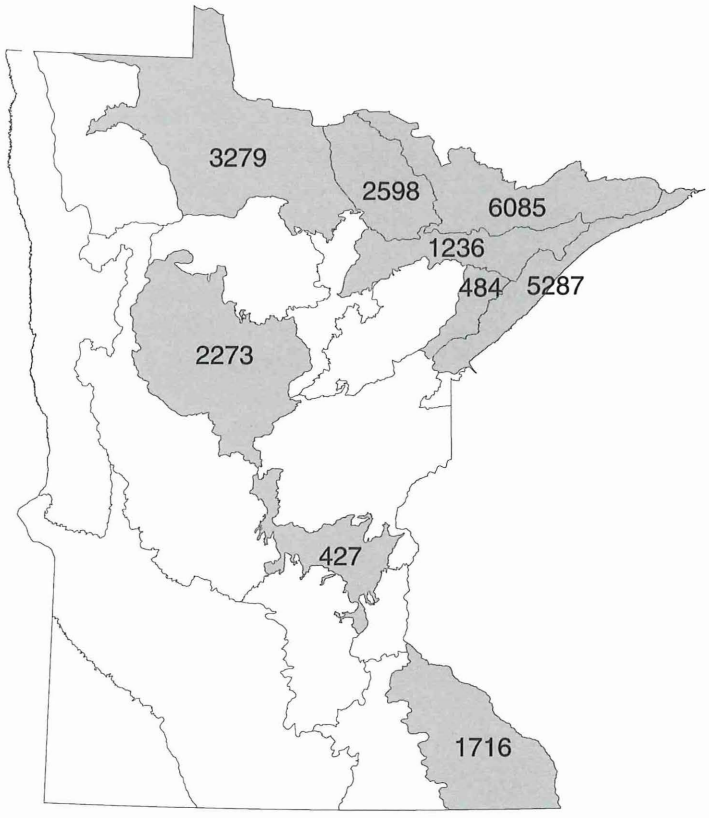
Protecting significant ecological features

Brushlands and open habitats. Historically, natural disturbances such as fire and windstorms played a critical role in creating and maintaining a great variety of forest habitats. Brushland ar open habitats alternated with young and matu forest habitats. Brushland habitats are essential for sharp-tailed grouse and more than 100 other animal species that are dependent on open areas within forests. Without management to limit tree invasion, such as prescribed burning and shearing, brushland quality will decline. DNR uses the ECS to focus brushland management efforts in ecologically appropriate areas.

Managing for older forests. Old-growth forests contain large, old trees (typically more than 120 years old), fallen logs, large snags, and trees of different heights. Old-growth forests provide special habitats for plants and wildlife, serve scientific and educational purposes, and have aesthetic and spiritual appeal. Before European settlement, about half of Minnesota's forests were old growth, but harvesting and wildfire reduced that to less than 4 percent today.

In 1994 DNR and stakeholders set a goal to protect the highest quality old growth on state lands (estimated to be about 27,000 acres). Since then, DNR has examined more than 43,000 acres of forest for old-growth designation. In 1998, DNR began designating stands for protection and releasing nonqualifying stands for other uses. To date, DNR has designated 23,000 acres of old growth. DNR will complete a statewide network of designated old-growth sites in 2002.

DNR plans to manage at least 10 percent of DNR-administered timberlands in each ecological subsection on extended rotations. Extended-rotation forests are harvested when trees are older than normal rotation age. Delaying harvest produces many of the characteristics and benefits of old growth. For example, corridors of extended-rotation forest linking patches of old-growth forest help sustain plants and animals associated with large tracts of mature forest. (See page 74 for more information about habitat linkages with the Conservation Connections Program.) DNR will determine extended rotation areas during the Subsection Forest Resource Management Planning (SFRMP) process.

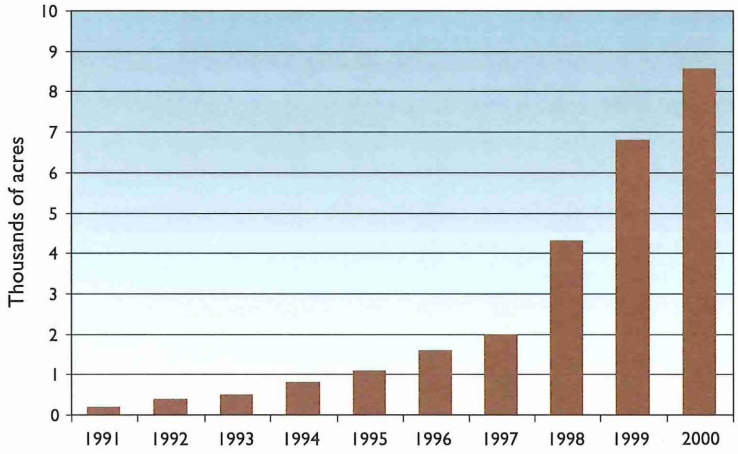


Old-growth forest on state-administered lands. The 1994 DNR Old-growth Forests Guideline established 27,000 acres as an old-growth forest protection target. The numbers in shaded ecological regions are acres of designated old growth (totaling 23,000 acres). In unshaded regions, evaluation is in progress with final designation to be completed by 2002.

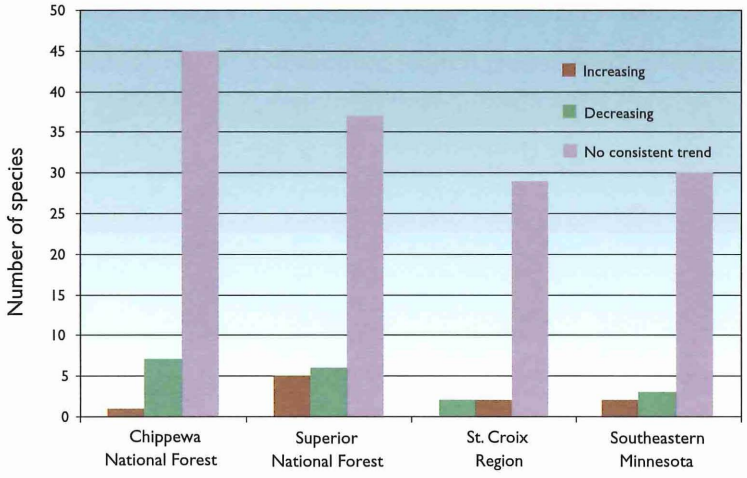
K. Rusterholz

Old-growth forest in Tettegouche State Park.

White pine restoration. Logging, farming, disease, insects, and other disruptions have significantly reduced white pine acreage in Minnesota. DNR is working to restore white pine as a healthy component of Minnesota's northern forests. The DNR-led white pine initiative, begun in 1998, has accelerated restoration on all ownerships. About 1.4 and 2.8 million white pines were planted in 1996 and 1998, respectively. White pine planting on county-owned lands has more than tripled since 1998. In the seven years before the initiative, DNR planted about 270,000 seedlings per year on state forests; DNR now plants about 714,000 seedlings annually. DNR also has increased white pine seedling production and seed acquisition for planting on state and private lands. DNR personnel, Minnesota Conservation Corps youth, and volunteers provide follow-up care to improve seedling survival.



Cumulative acres of white pine planted in state forests. Using the ECS and GIS mapping, DNR targets specific lands to reestablish white pine.



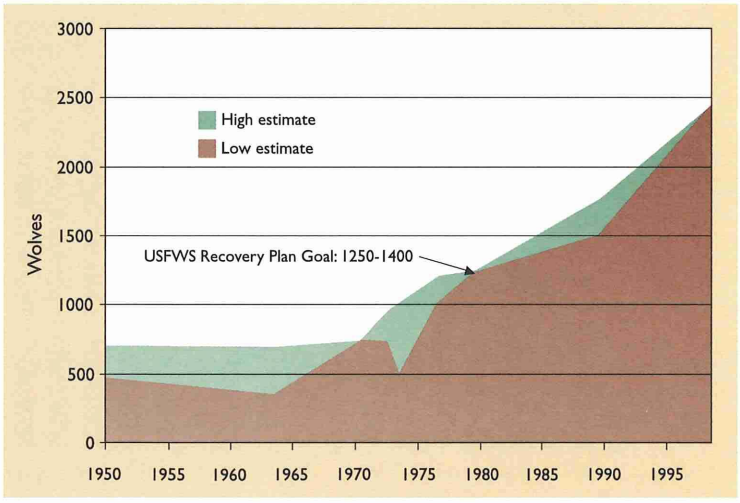
Trends in forest bird populations. Because bird numbers naturally fluctuate from year to year, long-term monitoring is needed to detect management-induced changes. Birds have been monitored since 1991 in the national forests, since 1992 in the St. Croix region, and since 1995 in southeastern Minnesota.

Forest wildlife. Wildlife is a vital component of healthy forests. DNR manages Minnesota forests to maintain diverse and abundant wildlife populations, including deer, grouse, threatened and endangered species, and a variety of nongame birds, mammals, reptiles, and amphibians. Forest birds, wolves, and bald eagles are discussed briefly here. See the Recreation Chapter for more information on game species.

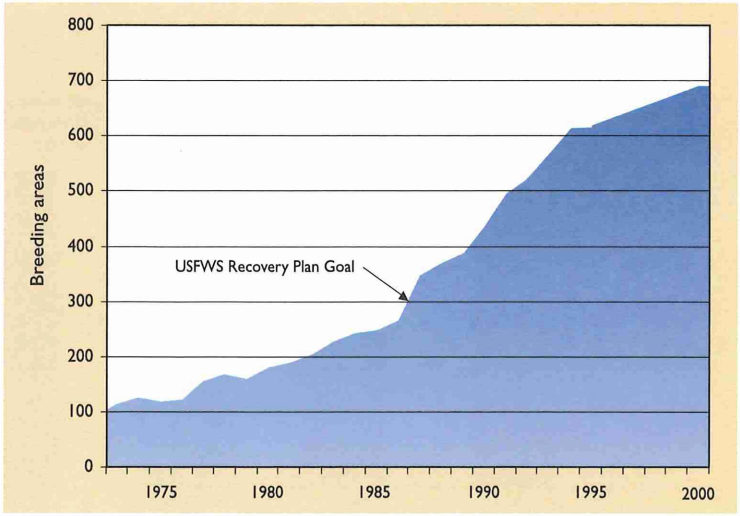
Among other values, forest birds help control pests that reduce forest productivity. Because each bird species has unique habitat requirements, bird diversity reflects forest diversity. Changes in the diversity or abundance of forest bird species may indicate problems with the health of Minnesota forests. The Natural Resource Research Institute, in cooperation with DNR, has monitored forest songbird populations for nearly 10 years in Chippewa and Superior National Forests, the St. Croix region, and southeastern Minnesota. Most forest bird populations have remained constant over this period. Most of the species that are decreasing in abundance are ground nesters. The species warrant close attention.

Gray wolf management under the federal Endangered Species Act (ESA) began in 1974. Since then, wolf numbers and range have expanded in Minnesota. Delisting (removal from protection of the ESA) and transfer of management responsibility to DNR requires the state to develop a management plan acceptable to the U.S. Fish and Wildlife Service. Wolf management legislation enacted in 2000 defines conditions under which wolves may be killed, establishes penalties for illegal killing, mandates a depredation reduction program, and requires DNR to adopt a management plan for the long-term survival of the wolf in Minnesota. DNR has provided the U.S. Fish and Wildlife Service with information needed for delisting and will submit a wolf management plan in early 2001.

Many agencies have contributed to the recovery of bald eagles in Minnesota. In the 1960s, management of eagle breeding areas in the Chippewa National Forest helped increase eagle numbers. Bans of DDT and other chemicals in the 1960s also contributed greatly to eagle recovery. In the 1970s, rehabilitation of injured eagles, elimination of lead shot for waterfowl hunting, and new trapping regulations further helped. Eagles are now widespread in Minnesota and the population is large enough to supply chicks for reintroduction elsewhere. DNR prepares management plans for bald eagle nests throughout Minnesota, surveys eagle wintering areas in southeastern Minnesota, monitors blood mercury levels in eagle nestlings, and acquires nesting areas threatened by development.



Wolves in Minnesota. All wolf population size and range goals of the U.S. Fish and Wildlife Service recovery plan for Minnesota, Wisconsin, and Michigan were achieved by 1999.



Eagle nesting areas. Occupied bald eagle nesting areas are a good measure of the status of bald eagles in Minnesota. The recovery plan goal of 300 occupied breeding areas was exceeded in 1987.

Progress toward numerous forest-based economic and recreational opportunities

Timber management

DNR uses varied management techniques to achieve timber and nontimber forest objectives on state-administered lands. Different timber harvest methods benefit different forest values. Trade-offs need to be debated to inform management decisions. Clear-cutting prepares a site for regeneration of a new, even-aged stand. Clear-cutting with reserves provides wildlife habitat during regrowth. Selective thinning removes specific trees, increases the growth of remaining trees, and can change stand structure and composition such as promoting longer-lived or uneven age forest types. The new subsection planning process (see page 28) works to select the appropriate mix of harvest treatments to achieve a desired forest composition.

Forest regeneration maintains forest cover and helps ensure future timber harvests. DNR foresters plant seeds and seedlings and promote natural regeneration after harvest on state-owned lands. Since 1996, more acres of state-administered land have been reforested than have been harvested.

Most state-administered trust fund lands are in forested areas of the state. Since 1992, timber sales from these lands have generated more than $15.7 million for the school trust funds, increasing from $299,000 in 1992 to about $3.7 million in 2000.

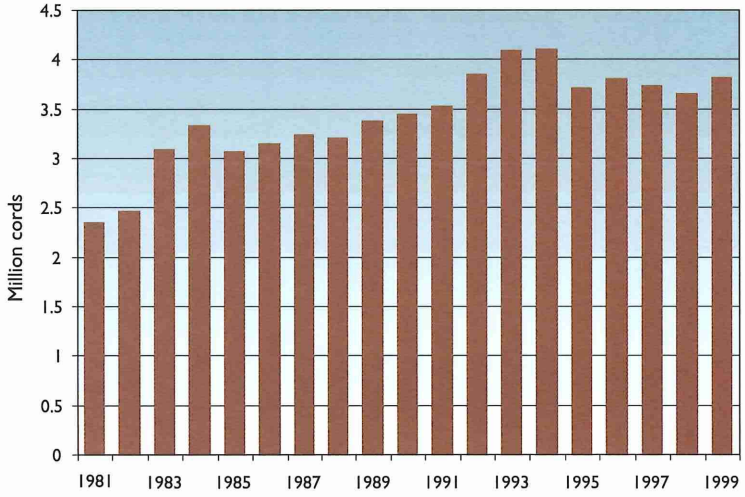
At a Glance

DNR activities:

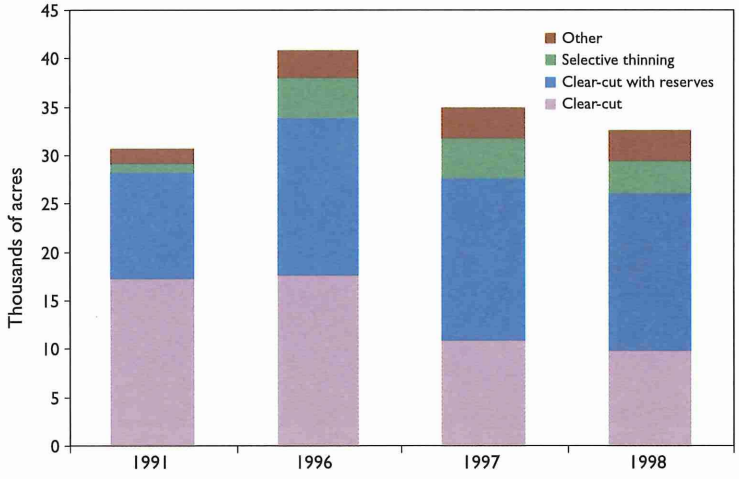
- Timber management
- Mineral leasing and mine reclamation
- Forest-based recreation

Desired outcomes:

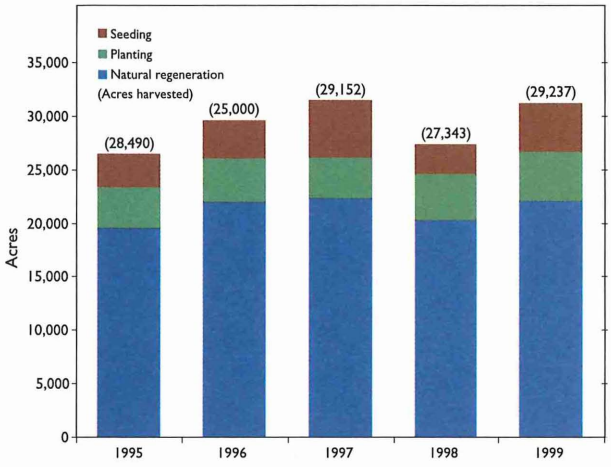
- Long-term sustainable yield of forest resources
- Improved local economies and enhanced recreational opportunities



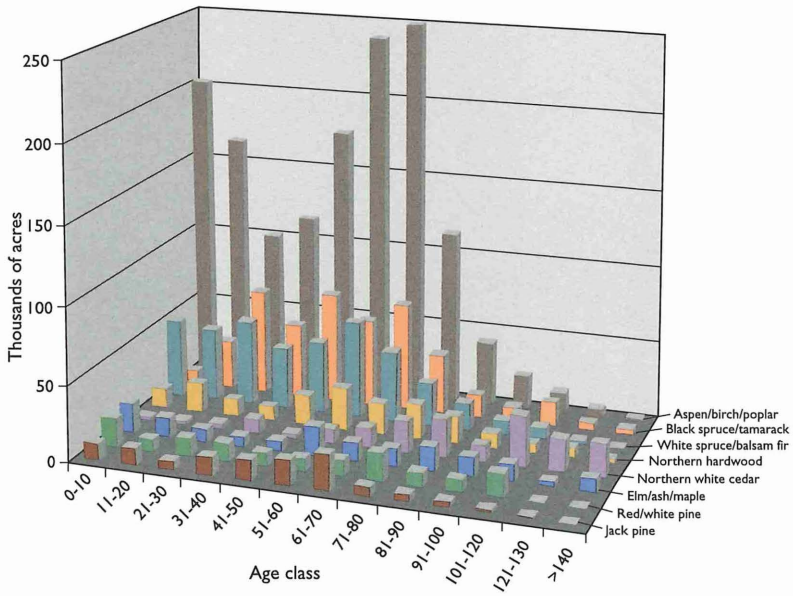
Statewide timber harvest. Harvest has increased about 60 percent since 1981. Harvest levels are influenced by both economic and noneconomic factors.



Timber harvesting methods on state-administered lands. DNR is doing less "traditional" clear-cutting and more clear-cutting with reserves. Leaving reserves–scattered clumps of live trees and snags–provides nesting and feeding habitat for many wildlife species. This technique more closely approximates historical disturbance patterns.



Reforestation following harvest on state-administered lands. Control of deer browsing, herbicide application, or other actions are sometimes necessary to ensure tree regeneration. Numbers on the graph show the acres of state-administered land harvested each year. Bars show acres reforested.

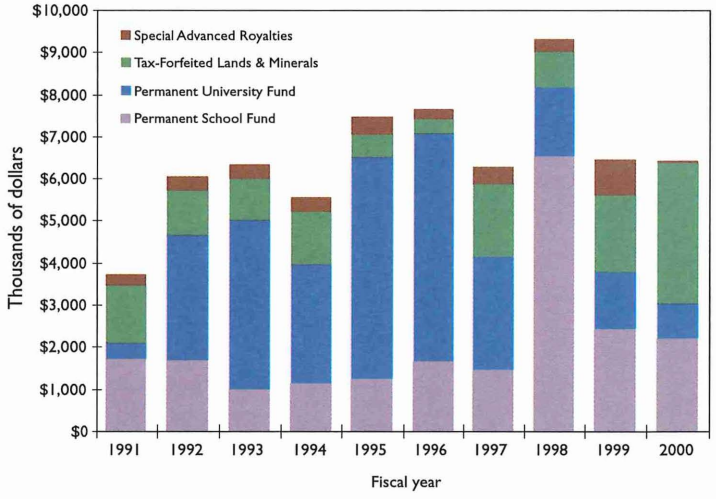


Forest age structure in northeastern Minnesota. One of the most important indicators of forest condition is forest age. The age of a forest determines the quality and quantity of timber available, the types of habitat available for wildlife, and the kinds of recreational opportunities possible.

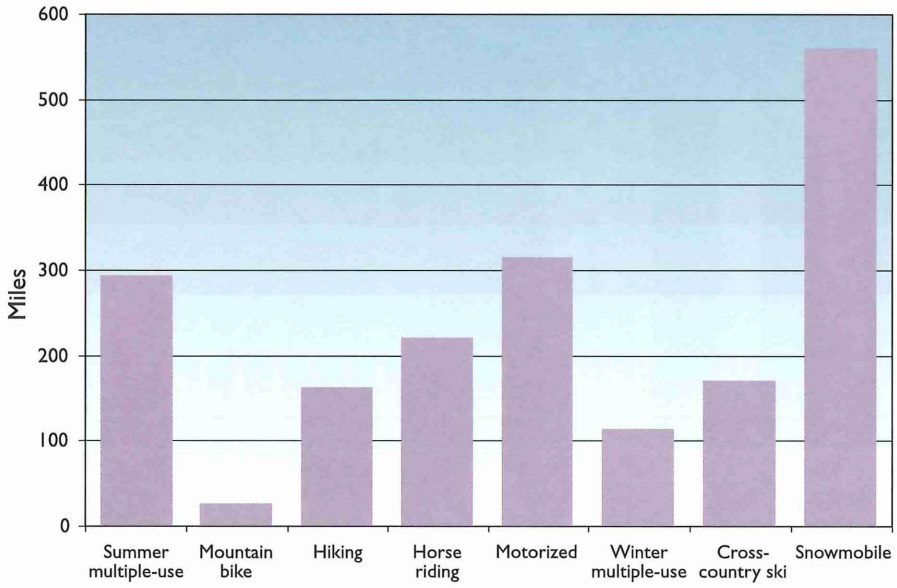
Mineral leasing and mine reclamation

Nearly all the land for which the state holds mineral rights are in the forested portion of the state. While the potential for discovering new mineral deposits on these lands is high, the lands already support a taconite and iron ore industry that generates millions of dollars in state revenue each year. Value-added processing of taconite and new uses for other mineral resources will diversify and buffer the minerals industry from market fluctuation and expand its contribution to the state's economy.

For more than 20 years, DNR and mining companies have cooperated to ensure that lands disturbed by mining are returned to environmentally sound condition and subsequent use. Reclamation efforts focus on reestablishing vegetative cover and creating and enhancing wetlands and watershed features. DNR and the University of Minnesota are examining how to locate mining and reclamation activities to help satisfy the future needs of Iron Range communities.



Revenues from state mineral leases. Most revenue from state-administered land comes from taconite leases on the Mesabi Range.



Recreational trails in state forests.

Forest-based recreation

State forests play a growing role in providing outdoor recreation opportunities, including camping, hiking, hunting, and off-highway vehicle (OHV) riding, that complement services provided by the private sector and other public agencies. Recreation is increasingly a major consideration in determining management strategies for Minnesota forests. (See Recreation Chapter for more information on outdoor recreation.)

DNR operates 46 state forest campgrounds with more than 1,000 campsites (up from 550 in 1985 and 20 percent of all DNR campsites), day use areas, and trails. More than 1,000 miles of forest roads provide public access to the forest for hunting, hiking, berry-picking, and other activities. Campground use has increased from about 60,000 camper nights per year in the mid-1980s to more than 95,000 in recent years.

DNR manages wildlife by ensuring that forest communities are diverse enough to provide essential habitat and by regulating the harvest of games species. Habitat management and population monitoring help maintain species at population levels that are consistent with other forest management objectives (see page 32 and the Recreation Chapter).

Off-highway vehicles

About 350,000 off-highway vehicles (OHVs), including motorbikes, all-terrain vehicles, and four-wheel drive trucks, are used for recreation in Minnesota. OHV use on state lands has increased. DNR's management of OHV recreation strongly emphasizes creating safe riding opportunities that minimize impacts to natural resources and conflicts with other users. Improved management includes 1) identifying state forests open to OHV use and enforcing access rules; 2) planning trails cooperatively with local interests (19 OHV trail systems currently are being developed); 3) providing financial assistance and guidelines for trail acquisition, development, and maintenance; and 4) creating two OHV recreation areas in former St. Louis County mine lands.

Outlook

DNR's management of Minnesota forests is adapting to the needs of stakeholders and citizens based on an increasing understanding of forest ecosystems. Progress in sustaining forest resources includes:

- more public involvement in forest planning and more integrated resource management through landscape-based planning;
- greater attention to wildlife habitat, soil productivity, cultural resources, water quality, and aesthetics through Minnesota Forest Resource Council (MFRC) harvest guidelines;
- stronger protection and restoration of unique forest features such as old-growth forest, white pine, and rare species;
- sustained timber harvest and reforestation on state-administered and private lands; and
- better information systems, such as the ECS, forest spatial analysis tools, satellite imagery, and web-based information.

Sustaining forest resources has become more complex as society simultaneously seeks additional benefits and applies more pressure to forests. Managing conflicts will become increasingly important as demands for both recreation and timber harvesting on state forest lands grow and as we better understand the long-term implication of forest management decisions. Minimizing forest fragmentation and loss will be challenging in the face of urban and lakeshore development. Meeting demands for higher quality timber will be difficult if forest productivity declines.

Sustainable forest management will require increased emphasis on working collaboratively toward common solutions. It will also require that DNR test and adopt alternative forestry practices (e.g., selective harvest techniques) that restore diversity and productivity to forest ecosystems and help balance social, economic, and ecological objectives.

Clay County Beach Ridges

Meeting both economic needs and environmental concerns

On the edge of the Red River Valley in west-central Minnesota, long, low ridges stretch across the flatlands of Clay County. Remnant shoreline of a giant glacial lake, the ridges offer two valuable gifts. Below the surface are increasingly rare pockets of gravel, the raw material for highways, building foundations, and other essential components of modern life. Atop this aggregate resource lie some of the best native prairie remnants in Minnesota.

For years the prairie rested relatively undisturbed. Then, in the 1990s, expansion of Fargo and Moorhead brought a need to mine the ridges as well as other development pressures that threatened key portions of what remained of Minnesota's native prairie.

Transforming controversy into public responsibility

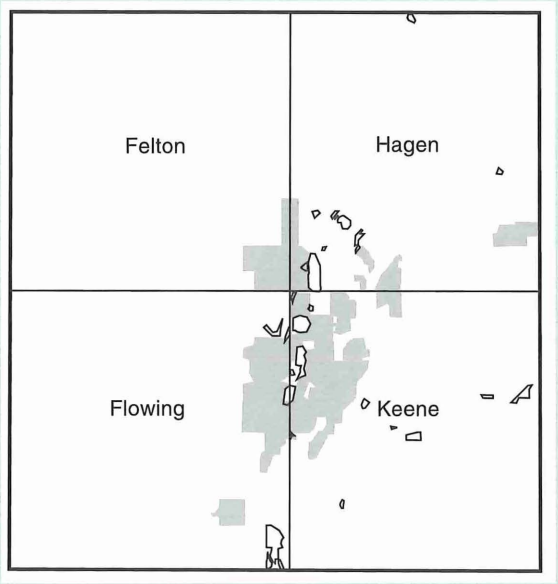
With gravel suppliers and prairie preservationists both staking claims, concerned parties came together to form the Clay County Beach Ridges Forum. Under DNR's leadership, the forum brought perspectives, needs, and agendas to a common table. Forum members spent two years gathering information about the aggregate and prairie resources. They developed recommendations for sustaining both the ecosystem and the gravel-based economy.

Throughout the process, DNR served a key role as a facilitator and guide. We provided background on the aggregate and prairie resources. We participated in producing educational materials and maps. We partnered with others to carry out reclamation projects and site-specific gravel evaluations.

Future challenge—balancing development and natural heritage

The legacy of the forum is a foundation for the difficult discussions that continue today. Since the forum ended, the demand for gravel has increased commensurate with a growing population, and the amount of remaining prairie continues to decline. The stakes are even higher now. Many former forum members again have come together to focus on Felton Prairie—a place that harbors the best of the remaining prairie and the best of the remaining gravel—to craft a mutually satisfactory plan.

The balance will be tenuous. Because needs and visions at places like Felton are so dynamic, there can be no final solution that carries a guaranteed outcome. Resolution of difficult resource issues demands a continuing process and a long-term commitment. DNR has made the commitment to Felton and our partners—no matter what the outcome.

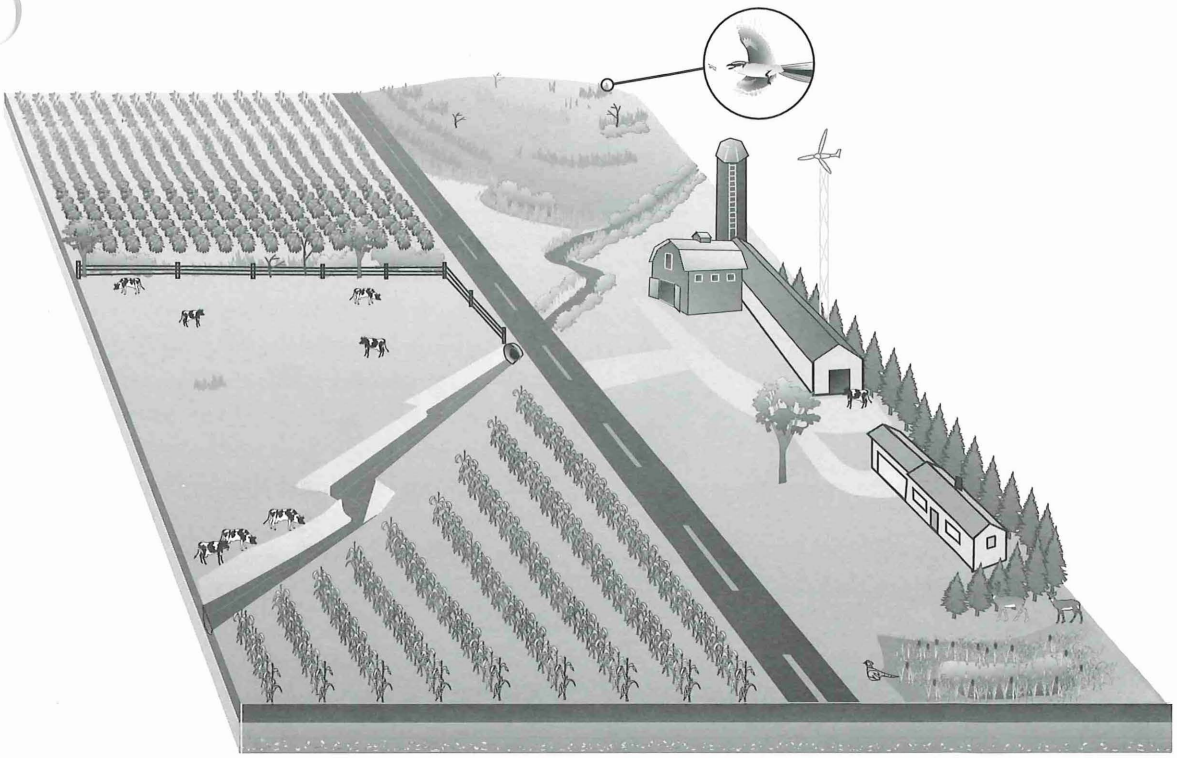


Prairie and gravel resources at Felton Prairie. Shaded areas denote prairie remnants classified as high or medium quality; outlined areas indicate gravel pits. Felton Prairie is the best example of dry tall grass prairie left in the state and perhaps in the entire Midwest. In Clay County, 17 prairie animals and 19 plants have been identified by the state as threatened, endangered, or species of special concern. Clay County also contains some exceptionally high-quality aggregate deposits not commonly found elsewhere.

Accomplishments

- **Gravel pits reclaimed as prairie.** Two gravel pits in Buffalo River State Park were replanted with native species; a third reclamation has been initiated at Felton.
- **Assessment of the natural resource base.** Knowledge of the extent and quality of the underlying gravel and the uniqueness of the overlying prairie can lead to better management decisions.
- **Increased public awareness.** Area residents, industry, and government entities now know more about aggregate mining, prairie heritage, and issues of conflict.

Agricultural Areas



Tom Klein

Directions 2000

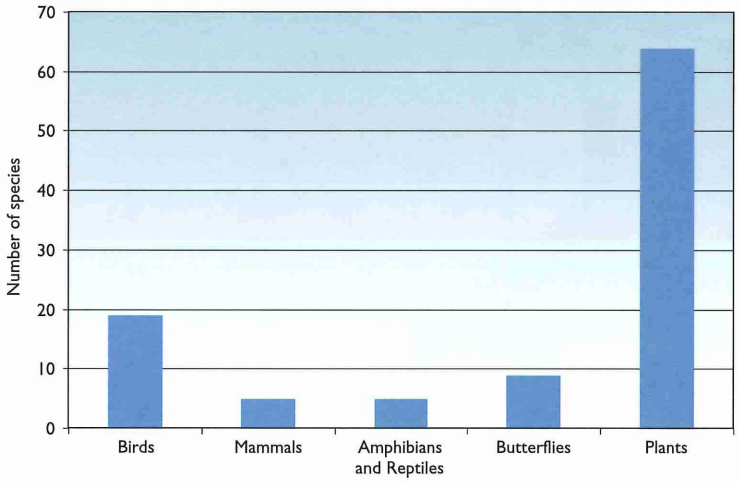
Strategic outcomes for agricultural areas

- Healthy, resilient grasslands and aquatic ecosystems and high-quality surface and ground waters
- Preservation of farmland and wildlife habitat and numerous recreational opportunities
- Environmentally sound mineral resource use

Introduction

Agriculture and related industries account for nearly one-fifth of Minnesota's economic activity. Agriculture is the second-largest employer in Minnesota, providing more than 468,000 jobs. Agriculture occupies more than 26 million acres (approximately 48 percent of the state), down slightly from the early 1980s.

Before European settlement, native prairie, including wetlands, covered 18 million acres—more than one-third of Minnesota. Almost all of the grasslands were converted to agriculture and many wetlands were drained. Now Minnesota has about 150,000 acres of native prairie and less than half of the wetlands once found in the agricultural portion of the state. Populations of grassland-dependent species and wetland breeding birds have declined, and use of the area by migratory waterfowl has been irregular. The remaining prairies are home to more than 40 percent of Minnesota's state-listed (threatened, endangered, and special concern) species.



Prairie species threatened in Minnesota. Agriculture replaced vast areas of native vegetation that provided habitat for prairie species.

Protecting and enhancing ecosystems in agricultural areas will require concerted effort across ownerships, organizations, and landscapes. Approximately 70 percent of Minnesota's remaining prairie is privately owned. Twenty-five percent is in wildlife management areas, state parks, USFWS lands, or The Nature Conservancy preserves. SNAs make up the remaining five percent. Although state-sponsored prairie restoration projects have helped grassland species, long-term sustainability may be influenced more by federal farm programs and agricultural economics than by DNR directed programs.

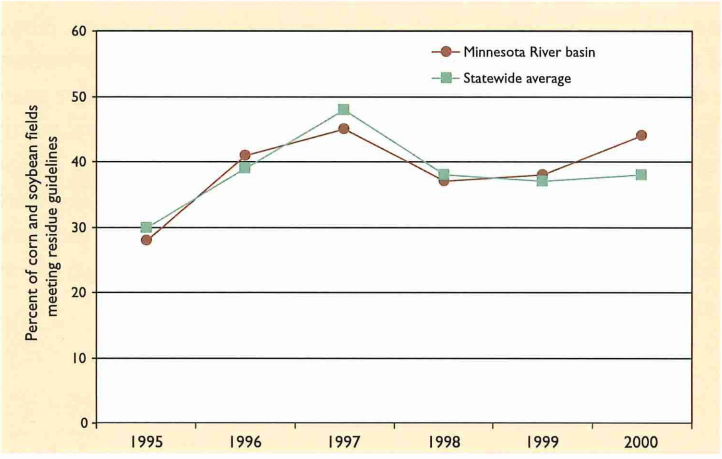
Critical issues and trends

Agricultural lands increasingly are converted to other uses as the number of family farms decreases and development expands outward from population centers. Consequently, wildlife habitat and access to large tracts of land for hunting and other outdoor recreation are decreasing, and sustaining wildlife populations and recreation opportunities is becoming more difficult.

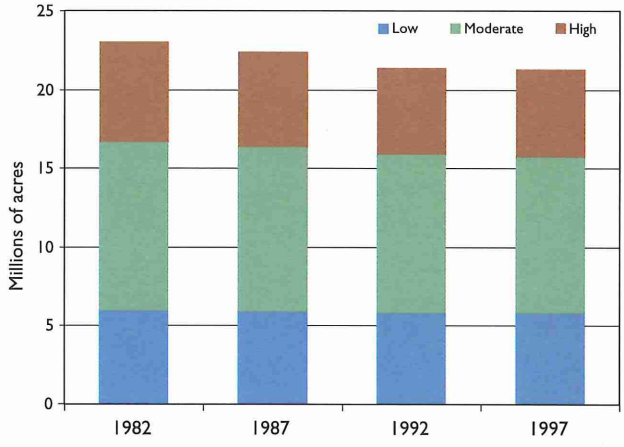
Despite improvements in crop residue management, eroding farm fields pollute rivers, streams, and lakes with sediments and excess nutrients. Agricultural drainage systems may contribute to flooding by efficiently delivering water to rivers and streams. Maintaining fish populations and habitat is difficult under these conditions.

DNR and the agricultural community share an interest in land and water management in agricultural regions. Both are concerned about land uses that contribute to declining water quality and flooding. Both want to minimize habitat fragmentation and loss to development.

In agricultural areas, DNR's influence on natural resources is secondary to that of farmers, government programs that encourage specific agricultural practices, and markets that demand low-cost agricultural products. To protect natural resources and provide recreational opportunities, DNR must work cooperatively with all agricultural interests.



Acres of cropland meeting crop residue guidelines in the Minnesota River basin and the state. Leaving crop residue on fields enhances soil fertility and helps prevent erosion.



Acres of Minnesota cropland with high, moderate, a low erodibility, 1982-1997. Soil erosion reduces soil fertility and degrades rivers, streams, and lakes.

Progress toward healthy and resilient grasslands and aquatic ecosystems, and high-quality surface and ground waters

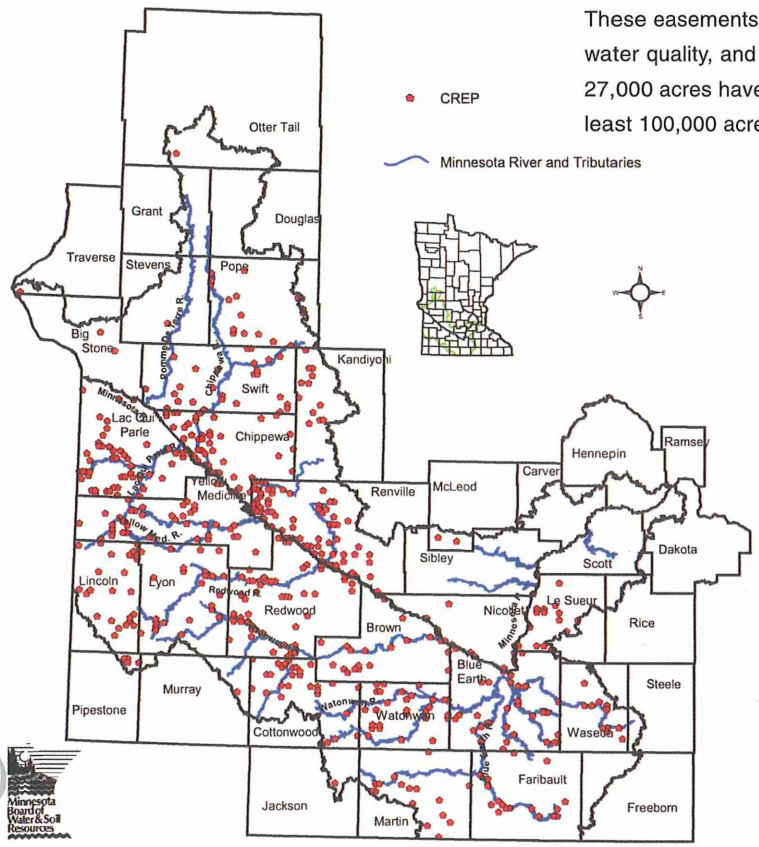
DNR manages relatively little public land in the agricultural region, but has a significant presence in the region. DNR works extensively with other agencies, citizens, businesses, and interest groups on a broad range of resource issues.

Progress in meeting water resource management goals is reported in the Water Resources Chapter. The following section describes major efforts that complement water resource efforts.

Multipartner conservation efforts. The federal Conservation Reserve Enhancement Program (CREP), an enhancement of the Conservation Reserve Program (CRP) directed at the Minnesota River basin, pays farmers to place marginal croplands (e.g., flood-prone fields, riparian areas) in permanent conservation easements with tree, shrub, and grass cover. CREP provides 2.3 federal dollars for every state dollar spent, allowing enrollment of 100,000 acres (about 1 percent of the watershed). Program benefits include:

- guaranteed compensation (average $2,200 per acre) for farmers
- up to 20 percent reduction in nonpoint-source pollutants to the Minnesota River
- lower capital and operating costs for municipal treatment plants
- a focused strategy directed at the source of 85 percent of the sediment reaching Lake Pepin
- 100,000 more acres of wildlife habitat

Because of the effort's short deadline (enrollment ends in 2002) and high priority, DNR hired 20 temporary employees to help BWSR identify eligible lands, contact landowners, and enroll lands. So far, 735 easements covering 26,723 acres have been obtained.



CREP easements in the Minnesota River basin. These easements reduce soil erosion, improve water quality, and increase wildlife habitat. To date, 27,000 acres have been enrolled; the goal is at least 100,000 acres by 2002.

At a Glance

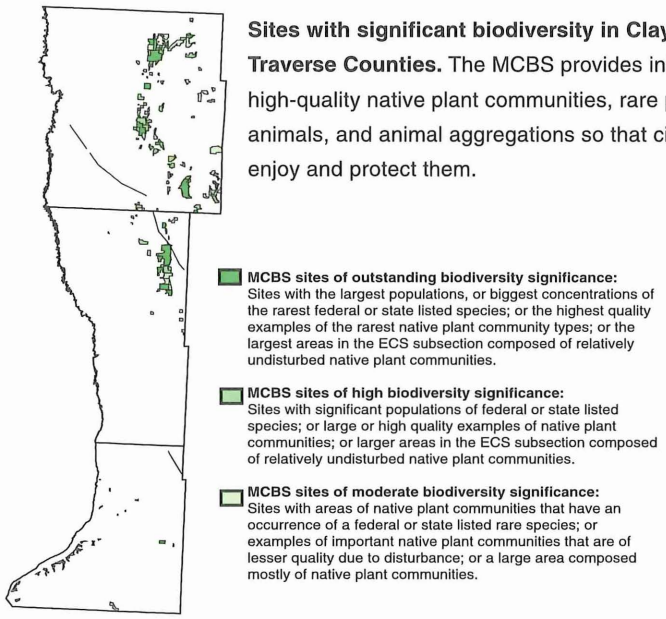
DNR activities:

- Multipartner conservation efforts
- Prairie preservation
- Financial and technical assistance

Desired outcomes:

- High lake and river water quality
- Restored and protected prairie
- High quality wildlife habitat

Prairie preservation and conservation of open space. Since 1987, the Minnesota County Biological Survey (MCBS) has provided information to help decision makers protect and manage rare plant communities such as prairie. DNR has initiated surveys in more than half of the predominantly agricultural counties. Where MCBS data are not available, DNR field personnel provide information about local habitats and wildlife.



Sites with significant biodiversity in Clay, Wilkin, and Traverse Counties. The MCBS provides information on high-quality native plant communities, rare plants and animals, and animal aggregations so that citizens can enjoy and protect them.

MNDNR

Tallgrass aspen parkland in northwestern Minnesota.

Railroad rights-of-way often contain native prairie remnants. Several prairie species once widespread in Minnesota now occur almost exclusively on railroad rights-of-way. Corridors like these are important travel lanes for species and gene flow. Because most railroads parallel highways, citizens have easy access to the ecological and historical heritage associated with these remnants.

Surveys of 3,240 miles of railroad rights-of-way have identified 487 miles of native prairie. Four percent of the surveyed rights-of-way contain prairie in very good condition. Prairie in good or fair condition is found on 12 percent of the rights-of-way. DNR and railroad officials continue to explore cooperative prairie management.

DNR works with the Minnesota Department of Transportation on Prairie Passage, a multistate partnership creating a network of protected prairies and cultural and historic sites from Minnesota to Texas. Prairie Passage is helping restore wildflowers and grasses along roadsides, in natural areas and in communities for wildlife, erosion control and aesthetics. Brochures, maps, interpretive sign and other materials will help visitors rediscover their prairie heritage and promote tourism, education, and small businesses. More than 600 acres in Camden and Blue Mounds state parks and along Minnesota 23 and U.S. 75 have been seeded to prairie.

Landscape-scale preservation. Tallgrass aspen parkland in northwestern Minnesota is a mosaic of prairie and aspen woodland where drought and fire are frequent enough to prevent succession to forest, but not so frequent as to eliminate trees altogether. The large areas of parkland offer a unique opportunity to protect enough of an intact ecosystem to ensure that natural processes can continue to maintain it and support populations of wide-ranging species like sandhill cranes, moose, and wolves.

Near Caribou and Beaches Lake Wildlife Management Areas (WMA), private land alternates with publicly owned wildlife areas. Much of the private land is subject to agricultural development. Wetlands on adjacent public lands are at risk from nearby drainage. Together, The Nature Conservancy and DNR have acquired more than 20,000 acres of this unique landscape as WMAs.

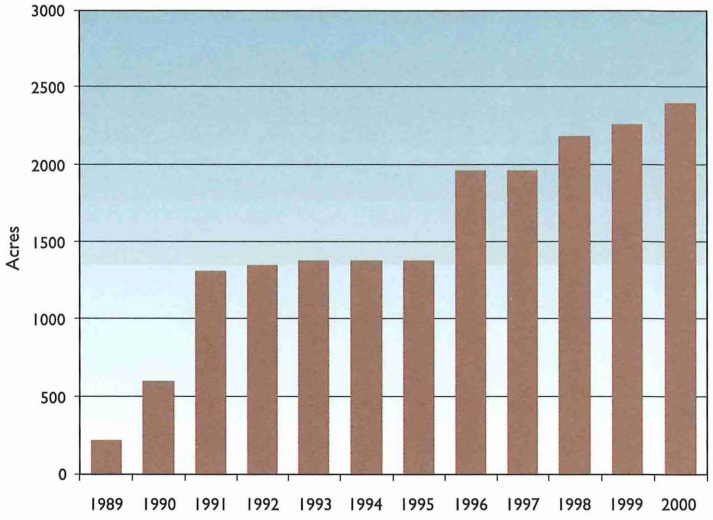
Financial and technical assistance. DNR field personnel provide a wide range of assistance to landowners and local decision makers, including the use of no-till drills for seeding, advice on burning and mowing to maintain habitats, and land cover information for open-space planning.

In 2000, DNR initiated the Prairie Stewardship Planning Assistance Program to help landowners access prairie management information, expertise, and funding. This free service offers assistance from consultants and organizations, including prairie restoration companies, native-seed producers, and farm management and wildlife specialists. In its first year, an estimated 50 landowners will participate.

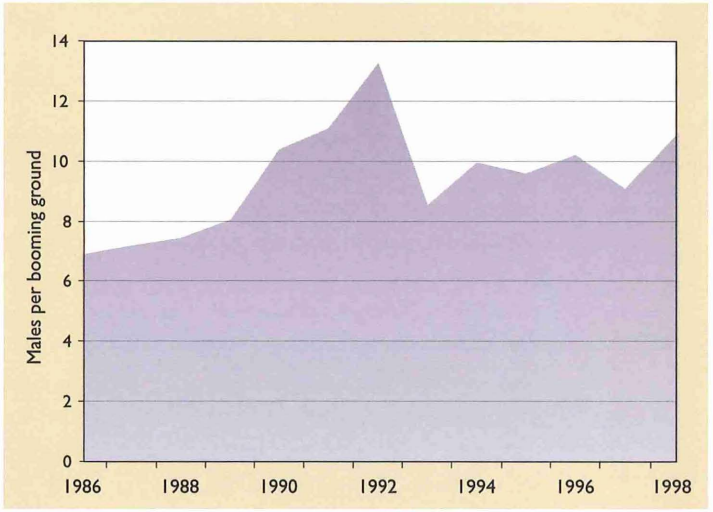
The Native Prairie Tax Exemption Program encourages prairie preservation by exempting approved native prairie from property taxes. Approximately 12,000 acres owned by 400 landowners are enrolled.

The Native Prairie Bank Program protects ative prairie through conservation easements that low the land to remain in private ownership. Recent appropriations will add 3,500 acres (in about 30 easements) to the 2,400 acres (in 21 easements) already protected.

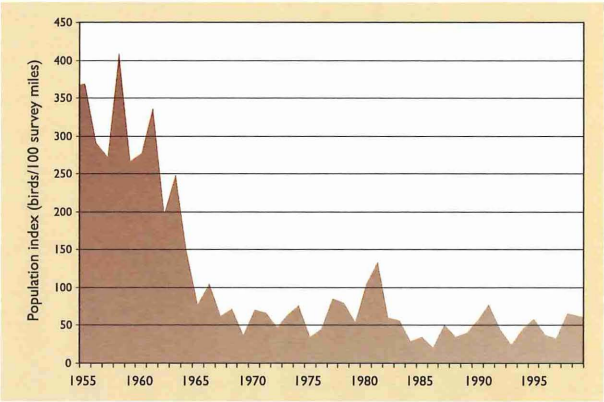
DNR promotes landscape and watershed projects that encourage community stewardship of whole landscapes. Locally-led teams, involving DNR interdisciplinary staff and community members, work to support land management practices that improve water quality and biodiversity, provide ecological information for decision-making, and promote environmental education and recreation compatible with healthy landscapes. The Oak Savanna Landscape Project, for example, helped restore prairie and savanna on the Spring Valley School District's environmental learning site in Mower County. In Rice County, a soil erosion reduction project in the Cannon River Valley is underway as a result of the efforts of the Big Woods Project team. In the Heron Lake watershed, citizen partners are restoring water quality and wildlife habitat (see page 47).



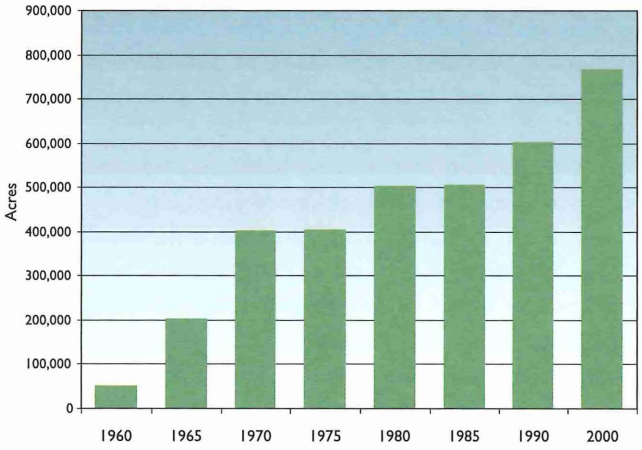
Land enrolled in the Native Prairie Bank. Conservation easements on private lands protect native prairie and their unique combination of plant and animal species.



Prairie chickens in Minnesota. Prairie chickens are a good indicator of grassland habitat. Surveys indicate prairie chicken populations are increasing slightly. During 1995-1998 the average number of booming grounds surveyed was 128, up from 66 in 1988.



Ring-necked pheasants in Minnesota, 1955-1999. Pheasant populations reflect the influence of agriculture on habitat. The decline in the 1960s followed conversion of grasslands, wetlands, and pastures to row crops.



WMA land, 1960-2000. WMAs include both DNR and other lands and cover more than 1.5 million acres statewide. Acreages shown here were acquired specifically for WMAs.

At a Glance

DNR activities:

- Habitat management
- Wildlife management
- Wetland restoration and protection

Desired outcomes:

- High quality outdoor recreation
- Healthy wildlife populations

Progress toward preserving farmland wildlife habitat and expanding recreational opportunities

Wildlife habitat in agricultural areas was once much more abundant than today. In the late 1950s, grasslands were common when the Federal Soil Bank paid farmers to retire croplands. In the 1960s, federal programs fostered conversion of wildlife habitat to row crops. Current cropland retirement programs (e.g., CRP, CREP) have increased wildlife habitat by about one million acres in Minnesota. However, much of this habitat exists in small, isolated patches that cannot support the wildlife populations characteristic of the 1950s.

WMAs protect large and small tracts of wildlife habitat. Connecting WMAs via habitat corridors will increase the ability of public and private lands to support wildlife.

WMAs provide recreation for hunters and wildlife watchers. WMAs are managed for wildlife and are available for public use year-round. Approximately 72 percent of WMA acreage is in agricultural areas.

Before the mid-1970s, deer populations in agricultural areas followed dramatic boom-and-bust cycles. During many years of low deer population hunting seasons were closed. Since then, more intensive regulation of deer harvest has caused deer populations and harvest in agricultural areas to increase and stabilize. Harvest from agricultural areas grew from an annual average of 27,000 in the 1970s to 117,000 in the 1990s. It now accounts for 60 percent of the statewide deer harvest.

DNR and partners are restoring and enhancing native prairie and prairie wetlands in Minnesota as part of the Prairie Pothole and Upper Mississippi River and Great Lakes Joint Ventures. Partners acquire prairie wetlands and adjacent prairies, restore drained wetlands in proximity to prairies, buffer existing prairies through acquisition of adjacent tracts and seeding with suitable native grasses, and restore prairie communities with native grass plantings. In the year ending in September 2000, DNR and partners restored, protected, or enhanced nearly 23,000 acres in Minnesota.

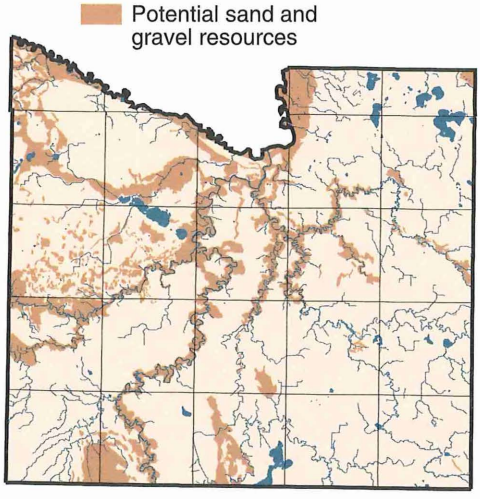
MNDNR

Spotting wetlands drainage. Wetland draining that might go unnoticed from the road is more readily identified from the air by DNR pilots. Ditches and spoil piles, usually constructed during dry periods, are visible against the background of dead vegetation in the photo on the left. The photo below shows the same marsh under cultivation the following spring. The ditch drained a 60-acre lobe of a larger wetland. DNR Enforcement pilots dedicate more than 100 hours of flight time per year to enforcing wetland regulations.

Progress toward environmentally sound mineral resource use

DNR is mapping potentially valuable aggregate lands outside the Twin Cities metropolitan area, giving highest priority to areas where urbanization or other factors threaten aggregate resources. Maps allow counties to include aggregate resources in land use planning, to promote environmentally sound development, and to preserve aggregate resources for future needs. Private landowners, environmental groups, and the construction industry also use this information.

Aggregate resource maps for Wright, Sherburne, Isanti, Clay, Blue Earth, and Nicollet counties are now available. Mapping of aggregate resources for Benton and Chisago counties will be completed in 2001.



Blue Earth county aggregate map. Maps like this help planners anticipate the effects of future development on the availability of aggregate resources.

At a Glance

DNR activity:

Aggregate resource mapping

Desired outcome:

Preservation and use of aggregate resources

Outlook

DNR programs to maintain natural resources in the agricultural region complement those of other state and federal agencies and agricultural and conservation organizations. They demonstrate DNR commitment to working with local governments, interest groups, landowners, and the public:

- Efforts to enroll lands in CREP easements benefit fish, wildlife, farmers, and recreationists by helping landowners in the Minnesota River watershed buffer and protect rivers, streams, and wetlands.
- Preservation of prairie, wetland, and other natural areas on public and private lands ensure that significant pieces of our natural heritage are available for generations to come.
- Wildlife habitat management and restoration are helping to maintain hunting and wildlife viewing opportunities, but many species have not recovered from the effects of widespread land management changes accompanying modern intensive agriculture.
- Locally led watershed and landscape partnerships improve water quality and resource sustainability.

Challenges to natural resource management in agricultural areas are substantial. DNR needs to help strengthen the role of conservation in agricultural land use by supporting innovative conservation efforts, from citizen-led watershed partnerships to individual actions that reduce soil erosion, enhance fish and wildlife habitat, and improve water quality. DNR needs to help restore and connect isolated and degraded habitat, using new initiatives like Conservation Connections. We expect that resource management options will grow as communities in agricultural areas seek greater economic stability and improved quality of life through diversification, and as outdoor recreation-based tourism becomes increasingly important in accomplishing this.

By improving its capacity to identify significant resource trends and measure progress, DNR will be able to better manage needs and opportunities in the agricultural region. We seek to better understand how to minimize the impacts of urban and commercial development on wildlife, habitat, and mineral resources. DNR needs better indicators of wetland health and broader cooperative monitoring efforts in order to assess effectiveness of wetland management efforts. DNR needs to participate in initiatives that strengthen natural resource stewardship among landowners and make landscape-scale approaches to stewardship more attractive and effective. DNR needs better approaches to meeting recreation demand in a region with little public land.

Heron Lake Watershed

DNR partners with citizens to restore an ecosystem

With its clean waters and abundant fish and wildlife, Heron Lake watershed in southwestern Minnesota was once known as the "Chesapeake Bay of the Midwest." At times up to 700,000 Canvasbacks flocked to its marshes; over 50,000 nesting Franklin's gulls were joined by white pelicans, trumpeter swans, and sandhill and whooping cranes. Hunters nationwide were drawn by the multitudes of wildlife.

The landscape is different now. As agriculture intensified, wetlands were drained, streams were channelized, and pesticides polluted the watershed. Ditching carried water laden with sediment and excess phosphorus, resulting in algal blooms, oxygen depletion, and decreased water clarity. Flooding increased, and dikes reduced Heron Lake's area by one fourth. Prairies disappeared, bulrushes died, and wildlife was in serious decline.

Action was needed. In 1989, dozens of public and private groups at the local, state, and national levels joined forces to begin restoring this national treasure. They agreed on a common goal: improving the lake's water quality. DNR's role in meeting project objectives focused on providing ecosystem-level technical advice on watershed hydrology, recommending phosphorus control strategies, assisting directly with land acquisition, restoring important habitats, reestablishing fish and wildlife populations, and providing public recreational opportunities.

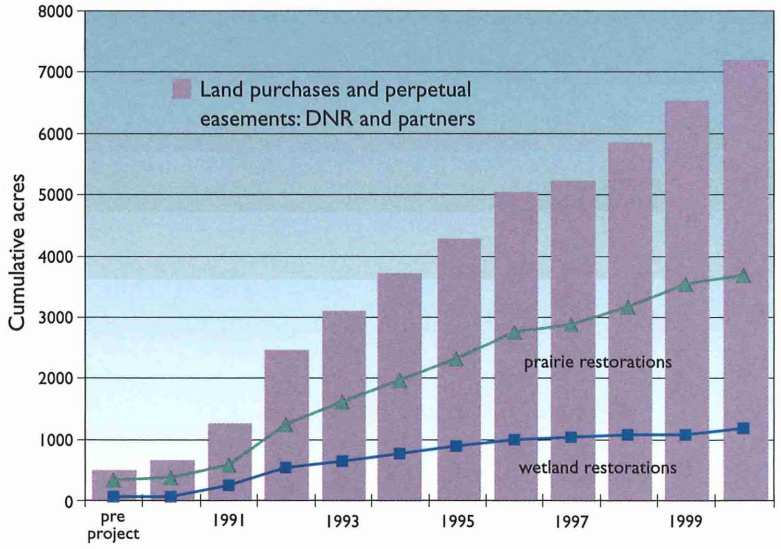
Other accomplishments

In addition to acquiring land and restoring habitat, watershed partners have:

- formed the Clean Water Partnership (1992)
- established Heron Lake Environmental Learning Center
- enrolled 235 landowners in Best Management Practice programs
- worked to reduce phosphorus in Worthington wastewater
- installed an electric fish barrier at the Heron Lake outlet
- reduced populations of rough fish and supplemented northern pike populations
- begun establishing emergent and submergent vegetation in North and South Heron lakes through water level management

Indicators of progress

DNR has helped the partnership acquire over 7,000 acres for habitat stewardship; 24 percent of these acres are held as perpetual conservation easements. On these lands we have converted farmland to native prairie, restored or enhanced existing wetlands, planted trees, and established wildlife food plots. These activities are bringing a watershed back to life by providing wildlife habitat, improving water quality, and helping to control flooding. Phosphorus concentration—a key indicator of overall watershed health—is being monitored in Heron Lake to assess one outcome of these partnership management strategies. Reducing phosphorus concentration inspires hope of eventual ecosystem recovery.



DNR either holds the fee title or facilitated Reinvest in Minnesota (RIM) easements for 79 percent of the above stewardship acres.

Miller Creek Renaissance

Development need not devastate a trout stream

A cold-water trout stream is a highly prized resource. Native brook trout in particular need streams with a source of unpolluted water and conditions that keep temperatures low—like adequate streamside shade and a minimum of runoff from impervious surfaces.

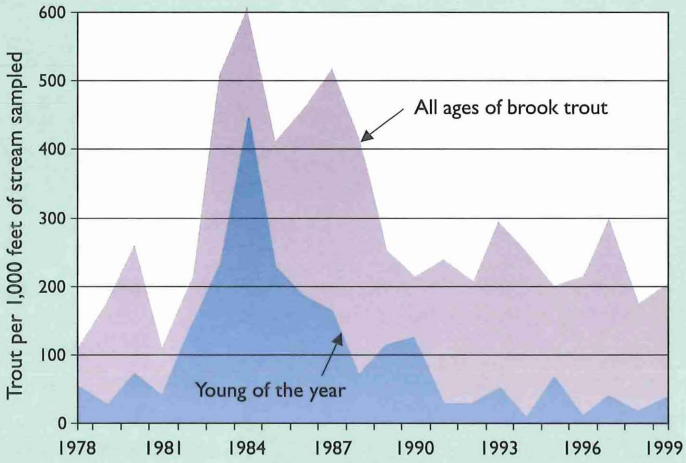
Temperatures up, trout down

Miller Creek, which flows from a bog nine miles outside of Duluth into St. Louis Bay, is just such a stream. Dependent on rain and snow rather than ground water for most of its flow, the creek is highly susceptible to disruption. Streets, shopping malls, an airport, and other products of urban development began altering its ambience several decades ago. Shade-giving trees were cut. Water running off the impervious concrete, blacktop, and buildings flanking its banks brought grime, road salts, and warmer water temperatures. Brook trout populations dwindled; their days appeared numbered.

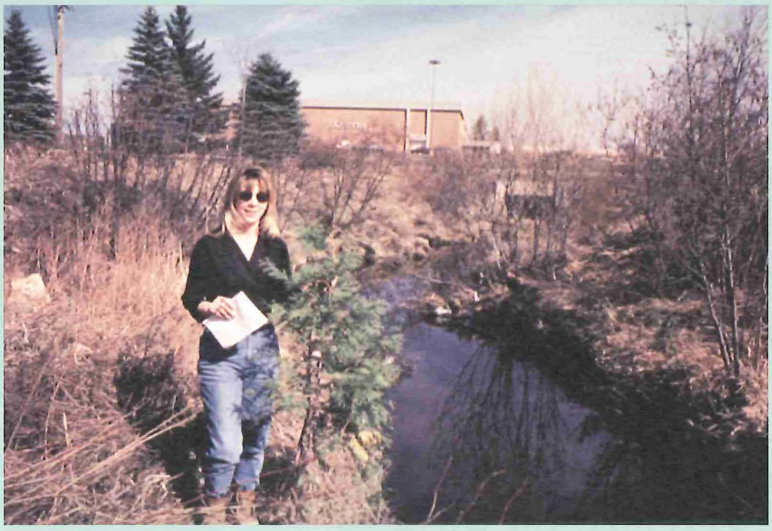
Conservation teamwork

In 1994, local residents, businesses, schools, conservation organizations, and DNR and other public agencies joined together to form the Miller Creek Task Force. The group took on the challenge of protecting the stream from further harm while seeking to restore its waters and banks. Aided by a grant from the Legislative Commission on Minnesota Resources, the group has monitored stream temperatures, planted trees, repaired eroded banks, and constructed fish habitat in the creek.

The Miller Creek effort demonstrated the snowball enthusiasm effect of diverse groups rallying together behind a resource. In 1998, Duluth and Hermantown formally agreed to work together to protect the creek. Cleanup, repair, and restoration efforts continue with broad support from cities and citizens.



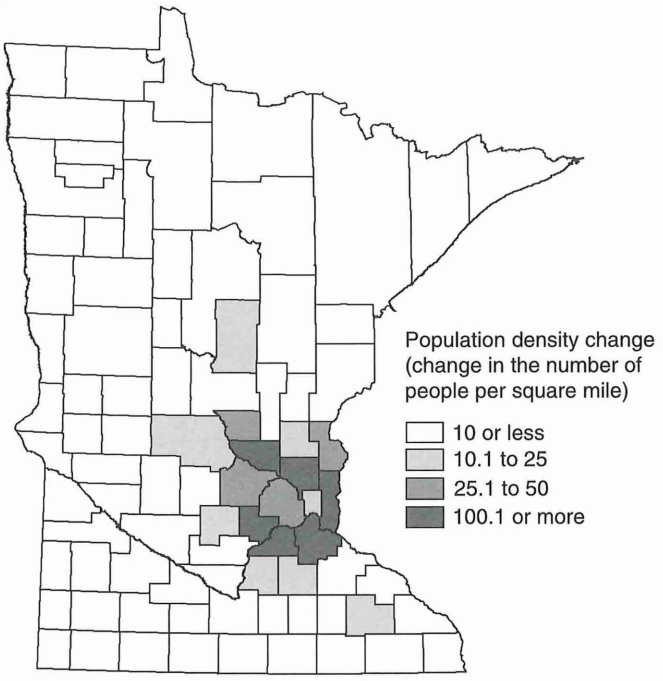
Native brook trout hold steady despite development. Brook trout have not been stocked in Miller Creek since 1972. These sampling data come from a point three-quarters of a mile downstream of Miller Hill Mall where native brook trout are plentiful—a reach targeted for protection through streamside restoration efforts. Locations upstream or downstream harbor significantly fewer trout.



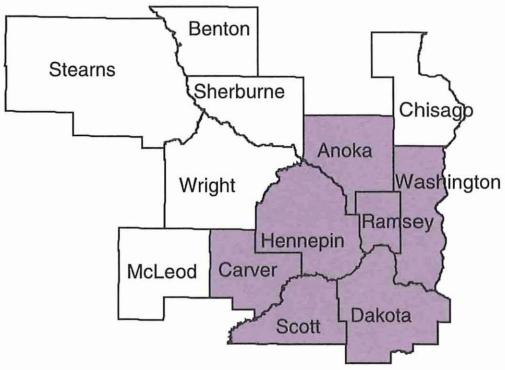
Paul S---strom

Restoring shade. A South St. Louis Soil and Water Conservation District conservation specialist inventories trees just upstream of Miller Hill Mall. The white cedar planted in 1992 is part of a primarily volunteer effort begun in 1991 and continuing every year since. The goal is to protect downstream temperatures by reestablishing big shade-producing trees in this intensively developed corridor.

Urban and Developing Areas



Projected population density change, 1996–2025. Projected population density changes help prioritize areas where DNR can work with local government, private landowners, and others to protect natural resources.



East-central growth corridor. Development is widespread or increasing in these counties. The seven-county Twin Cities metro area is shaded.

Directions 2000

Strategic outcomes for urban and developing areas

- The natural environment has the long-term capacity to produce ecological, social, and economic benefits
- Local communities have the information, expertise, and resources to plan for and manage their natural resources

Introduction

Healthy natural resources are a vital asset to the overall quality of life in urban and developing areas. Fishable and swimmable lakes and streams, urban parks and green spaces, and recreation trails attract businesses and families to Minnesota communities. The Twin Cities and Duluth areas attract tourists and convention business in part due to their beautiful natural environment.

Urban land increased 23 percent in Minnesota from 1982 to 1992 primarily through conversion of agricultural lands. Developing areas in Minnesota include growth centers around existing urban areas, (the focus of this chapter), lakeshore development (Waters Chapter, page 3) and scattered rural development (Forest and Agricultural Areas chapters, pages 23 and 39).

Urbanization can destroy or fragment natural areas, degrade surface and ground water, and reduce access to outdoor recreational areas, commercial timber, aggregate, and minerals. Low-density development is particularly disruptive. In 1982, the average population density for urban areas in Minnesota was about 1,733 people per square mile. Urban areas developed since 1982 have a density of 926 people per square mile.

This section presents selected indicators that measure progress toward maintaining a healthy natural environment and providing natural resource information and expertise to local communities. Many of the examples are from the east-central growth corridor.

DNR focuses on three important resources in urban areas: surface and ground water, natural areas and open space, and community forests.

At a Glance

DNR activities:

- Evaluate water appropriations and assess ecosystem impacts
- Provide technical assistance to local government
- Restore riparian areas

Desired outcomes:

- Stream and lake water temperatures within targets
- Sensitive ecosystems protected
- Stream flow protected
- Sedimentation and pollution controlled

Progress toward maintaining surface and ground water resources

Minnesota's water resources provide safe drinking water, generate power, and meet industrial needs. Urban lakes, streams, and wetlands provide recreational opportunities and fish and wildlife habitat.

Poorly planned development can harm water resources by increasing the amount of water that enters rivers, lakes, and wetlands as runoff. Runoff carries pollutants and sediments and increases water temperature. National studies show that as watershed imperviousness approaches 10 percent, streams degrade quickly.

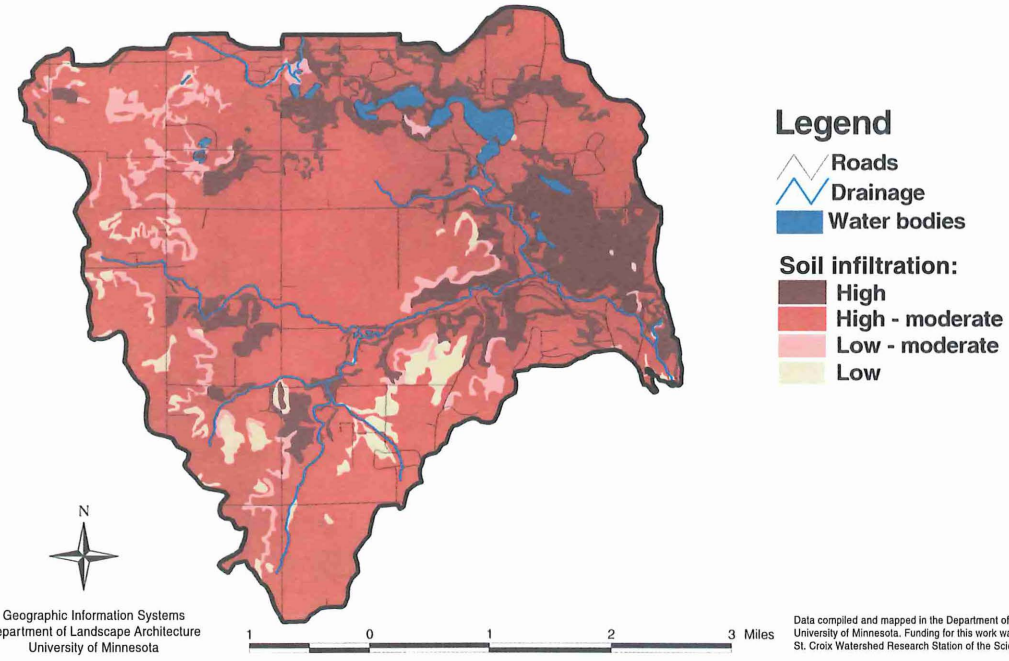
DNR works with state agencies and local government to evaluate impacts of development on ground and surface waters. DNR provides information to developers and land managers on best management practices, ordinances, and land use plans that protect surface and ground water.

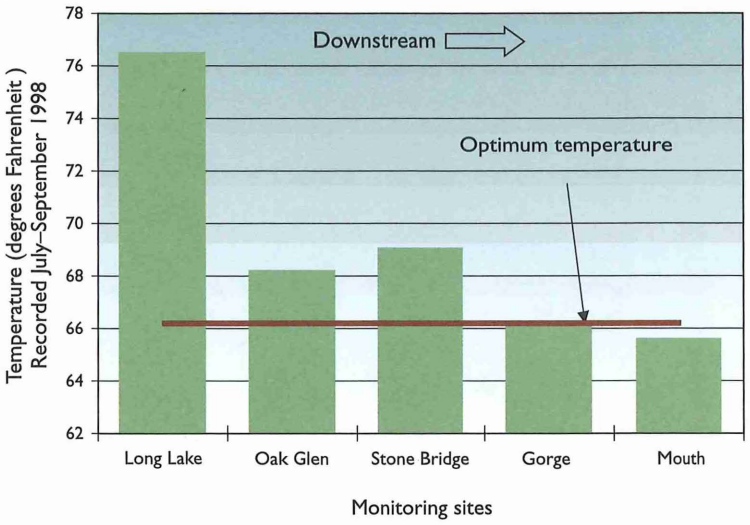
Trout streams and fens are particularly sensitive to land use changes in the watershed. Success in protecting these sensitive ecosystems is a good indicator of DNR's progress in maintaining healthy watersheds.

Urban trout streams

Fifteen streams and six lakes in the Twin Cities metropolitan area support trout. At least four other trout streams no longer support trout due to deteriorated water quality and habitat. DNR helps local governments develop comprehensive watershed plans and works with partners to restore streams. Four stream restoration projects have improved approximately three miles of trout stream habitat in the metro area. Projects planned for 2001 include about one mile of stream channel restoration and five miles of riparian buffer improvements. In the past year, 412 volunteers with the Metro Trout Stream Watershed Protection Initiative contributed more than 2,000 hours to water quality monitoring and stream restoration projects.

Soil infiltration capacity for Valley Creek watershed, Washington County. Valley Creek trout steam has a naturally reproducing population of brook, rainbow, and brown trout. DNR helped local governments and citizens develop a watershed plan to protect the stream. The plan utilized a hydrologic database developed by the University of Minnesota and the Science Museum of Minnesota. Water quality declines as impervious surfaces increase. Currently, Valley Creek watershed has 4 percent imperviousness.





Reducing water temperature in Brown's Creek to restore trout habitat. Sixty-six degrees Fahrenheit has been shown to be the optimum water temperature for the growth and survival of juvenile brown trout. Despite ground water flow, water temperature between Oak Glen and Stone Bridge is higher due to runoff. DNR is working with the City of Stillwater and other partners on stream restoration projects to reduce stream temperatures. Efforts are underway to standardize monitoring methods among the organizations collecting data.

MNDNR

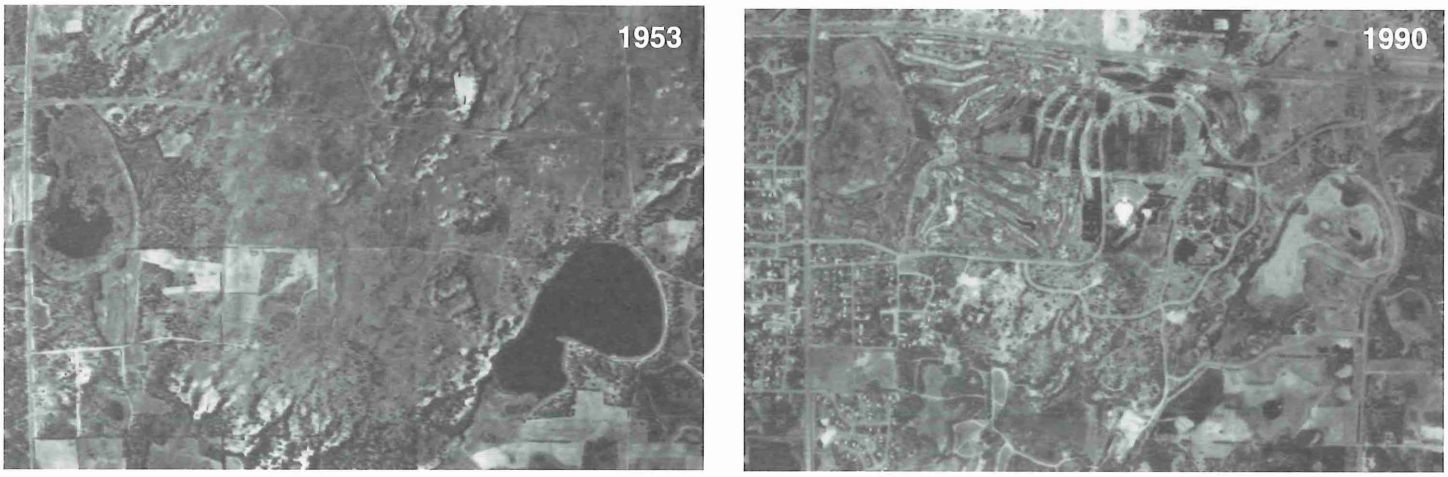
Citizens stabilize eroding stream banks at Brown's Creek. Bank restoration helps prevent sediment and sand from settling in the stream bed, resulting in better trout reproduction.

Calcareous fens

Calcareous fens are unique wetlands formed where cold, mineralized ground water reaches the surface. Rare plants flourish under these conditions. Many Twin Cities metropolitan area fens have been degraded or destroyed. Development miles from a fen can alter the amount, source, and quality of water entering the wetland. Community wells can reduce ground water inputs and road construction can channel polluted storm water into the fen.

The 1991 Minnesota Wetlands Conservation Act gives special status to calcareous fens. DNR's County Biological Survey has an inventory of remaining calcareous fens in the Twin Cities metropolitan area. DNR works with citizens, local governments, and other state agencies to protect these wetland communities.

DNR's efforts to protect Savage Fen is one example of fen management. Savage Fen is a 425-acre wetland complex in Scott County. DNR developed a Savage Fen Resource Plan that includes information on effects of current ground water appropriations on the fen, projections of future water appropriation needs and potential environmental impacts, and strategies for local community actions to reduce impacts to the fen complex. For example, DNR is evaluating water appropriation proposals in Burnsville, Savage, Prior Lake, and Shakopee. DNR and the City of Savage are cooperating to locate new wells in deeper aquifers, and on storm-water management and wetland fill projects to ensure that they will not harm the fen. In 1998 DNR denied permission to construct a county road through the fen but is assisting in a study to identify transportation alternatives that meet development needs of Scott County and Savage while protecting the fen.



MNDNR

Ecosystem fragmentation. Dry oak savanna and dry prairie barrens near Bunker Lake in Anoka County were severely fragmented between 1953 and 1990.

At a Glance

DNR activities:

- Technical and grant assistance to communities
- Native vegetation restoration
- Natural resource management plan development
- Public lands and waters acquisition and management

Desired outcomes:

- Large, intact natural areas
- Restored natural communities
- Vegetative corridors that buffer and connect natural areas

Progress toward protecting and restoring natural areas and open space

Improperly planned development can destroy and fragment natural areas and reduce plant and animal populations, recreation options, and quality of life. In a 1999 survey of Twin Cities metropolitan area voters, 88 percent of respondents said that protecting natural areas plays a very important role in preserving the quality of life in their area

DNR's strategy for protecting natural and open space is to: 1) provide grants to local government to inventory, protect, and restore natural areas; 2) develop natural resource protection and restoration plans; and 3) acquire and manage public lands and waters.

Provide grants to local government

DNR grants provide incentives to local governments to inventory, protect, and restore natural areas. Natural and Scenic Area grants, for example, help governments and school districts acquire natural and scenic areas. In the last biennium, DNR awarded 25 grants, of which 14 protected 312 acres in the east-central growth corridor. For example, 53 acres of upland prairie and red and white pine forest were protected and incorporated into a cluster development in Marine on St. Croix. In Sherburne County, 29 acres and 1,200 feet of shoreline containing oak woodland, brushland, and prairie were acquired along the Mississippi River.

Develop natural resource protection and restoration plans

DNR develops management plans to help communities and landowners protect and restore natural areas. In the last biennium, DNR developed management plans within the east-central growth corridor for three sites comprising about 1,165 acres. For example, DNR helped develop a management plan for 700 acres of private property in Dakota County that is part of a 1,300-acre natural area containing important natural communities, rare plants, and wildlife habitat. The plan protects natural features and restores disturbed areas. More than 340 volunteers helped remove exotic species, inventory rare species, and plant vegetation to restore prairie and oak savanna areas on the site.

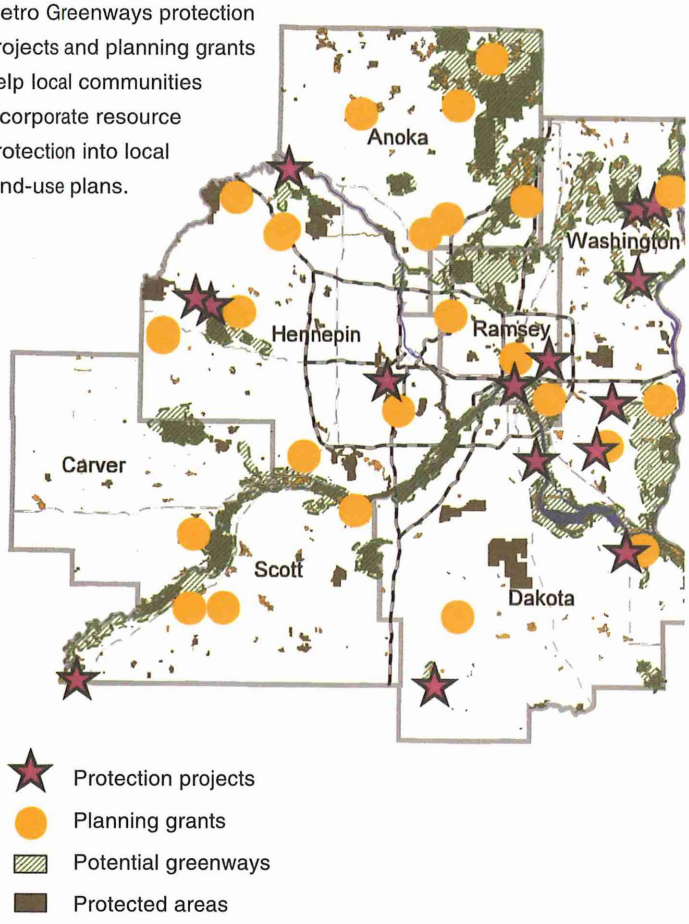
In the Twin Cities metropolitan area, DNR's Neighborhood Wilds works with local governments and nonprofit organizations to help neighborhoods protect, manage, and restore natural resources that cross property boundaries. Projects include areas where improved landscaping and management could benefit nearby natural areas. For example, five households are controlling buckthorn and restoring oak savanna on 25 acres near Afton State Park. In the last biennium, DNR helped 14 neighborhoods develop and carry out natural resource plans.

Conservation Connections is a statewide DNR program that provides a framework for implementing the governor's Smart Growth initiative. DNR will work with communities and private landowners to attain a statewide network of public and private parks, recreational areas, forests, wildlife habitat, natural areas, and other open spaces connected by land and water corridors. Each region will develop its own approach to Conservation Connections (refer to page 74).

In the Twin Cities metropolitan region, DNR's Metro Greenways is working with partners to identify and develop a network of natural areas and greenways. DNR identified nine sites with almost 500 acres for funding in the first year. The first protected site, a 192-acre natural area around Chub Lake in Dakota County, was designated a WMA.

The Metro Greenways planning grants program provides matching grants to local governments and other agencies to inventory and map natural resources and develop greenway and natural resource plans. In the past biennium, the program awarded 28 grants totaling $479,451. Because the program requires a match from recipients, it has had a nearly $1 million impact on greenway planning in the metro area.

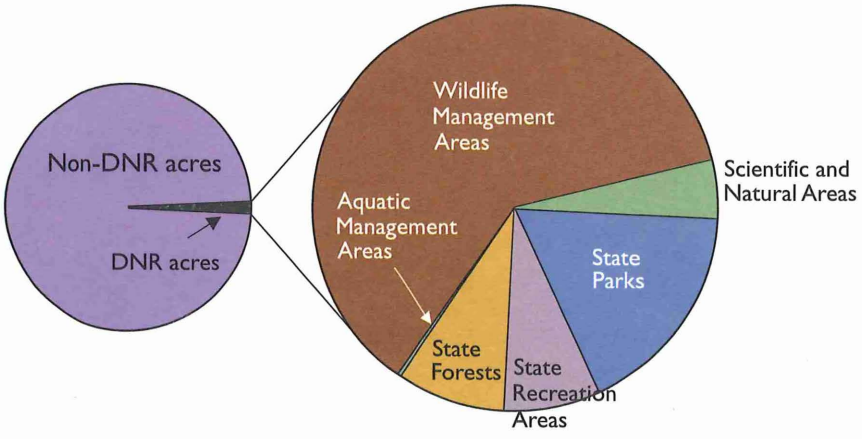
Metro Greenways projects. Metro Greenways protection projects and planning grants help local communities incorporate resource protection into local land-use plans.



Acquire and manage public lands and waters

DNR-administered lands provide wildlife habitat, sustain biological diversity, provide educational and scientific research opportunities, and offer a variety of recreation opportunities. Other public entities (federal, county, and city) also hold public land for such purposes. DNR manages about 77,700 acres of public land in the east-central growth corridor and is seeking additional land for WMAs.

DNR assures access to lakes and rivers through the construction of boat access sites and shore fishing sites. We also help local governments develop surface water use zoning guidelines to regulate watercraft.



DNR land in the east-central growth corridor. DNR lands are 1.76 percent of the total land in these counties.

Progress toward sustaining healthy community forests

Community forests (all the public and private trees within a city or town) provide recreational opportunities, reduce air pollution, and provide wildlife habitat. DNR helps communities acquire the expertise they need to better manage their forest resources.

The Community Forestry Program, a cooperative effort of the DNR, USDA Forest Service, local government, and other state and private organizations, works with communities to increase their capacity to manage their urban forests and reduce tree loss due to development. In 2000, DNR and numerous collaborators developed a guidebook, *Conserving Wooded Areas in Developing Communities*. We are working with the adjoining cities of Hugo and Lino Lakes to incorporate the book's recommendations and other natural resource guidance into ordinances and land use planning.

Since 1991, DNR's Minnesota ReLeaf grant program has provided matching funds to 436 communities to plant predominantly native trees, protect native forests from oak wilt and development, and complete forest assessments and management plans. In 1999 and 2000, we helped 85 communities with 56 tree-planting projects, 42 forest health projects, and 16 inventories.

Oak wilt, an infectious disease, is a major cause of oak mortality. DNR is monitoring more than 8,000 infection centers in 79 townships. Our goal is to lower infection levels to one infection center per square mile or less. As of 1997, we had treated 5,164 infection centers and had reduced oak wilt from 2.97 infection centers per square mile to 1.8 centers per square mile. DNR has reduced oak wilt risk on almost 15,000 acres of oak forest.

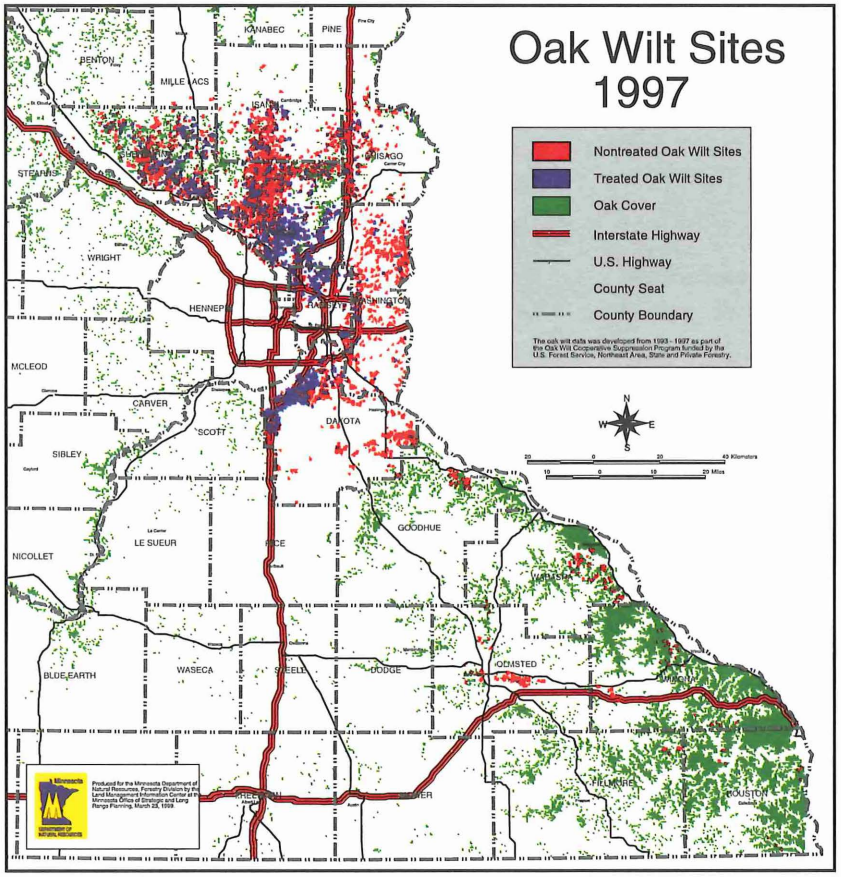
At a Glance

DNR activities:

- Best management guidelines development
- Technical assistance and grants to communities
- Oak wilt treatment

Desired outcomes:

- Reduced tree mortality
- Increase in native tree species
- Improved forest management expertise for communities



Reduced oak wilt infection centers. Oak wilt infection centers have been reduced from 2.97 centers per square mile to 1.80 infection centers per square mile. DNR's goal is no more than one infection center per square mile.

Progress toward providing resource information and expertise to local communities

Local governments make land-use decisions that play a vital role in shaping the future of urban and developing areas.

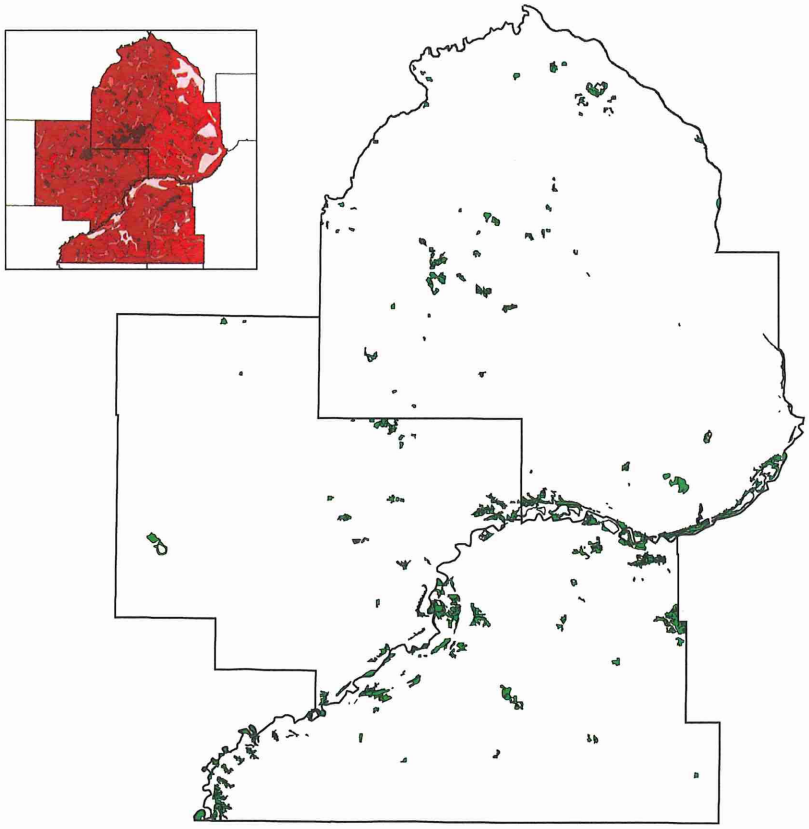
The programs described above demonstrate how DNR works with local governments and private landowners to protect specific resources (surface and ground water, natural areas and open space, and community forests). This section gives examples of DNR activities that provide citizens and local governments with information, training, and technical assistance needed to develop and implement land use plans that protect natural resources.

Community-based planning

DNR provides technical advice to 12 of 17 Community-Based Planning Act pilot projects throughout the state. The 1997 act integrates sustainable development principles into local comprehensive plans. DNR reviews draft comprehensive plans to identify important natural resource considerations absent from the plans, and informs community planners of technical information or services that DNR can provide.

Natural resource mapping

County biological surveys. DNR'S Minnesota County Biological Survey (MCBS) program assesses and maps rare plants, animals, and natural communities. In the last biennium, at least seven counties and 12 cities and townships within the east-central growth corridor incorporated MCBS data into their comprehensive, park, or open space plans. For example, Stearns County used MCBS data on rare species locations and potential natural areas in developing its comprehensive plan. MCBS staff helped Stearns County Parks acquire land and develop a management plan for Quarry Park and Nature Preserve, which contains rare species such as the tubercled rein-orchid, Red-shouldered Hawk, and Acadian flycatcher. DNR's SNA program used the data to protect a portion of Sedan Brook Prairie, one of the few remaining prairies in western Stearns County.



MCBS Map of Carver, Scott, and Hennepin counties. These counties cover 1,300 square miles and include Minneapolis and the rapidly developing southern and western suburbs. Remaining natural communities such as high-quality forests, wetlands, and prairies cover only 2.3 percent of the land area. The inset map shows the extent of natural lands before European settlement.

At a Glance

DNR activities:

- Natural resources and land cover mapping
- Wildlife management
- Technical assistance

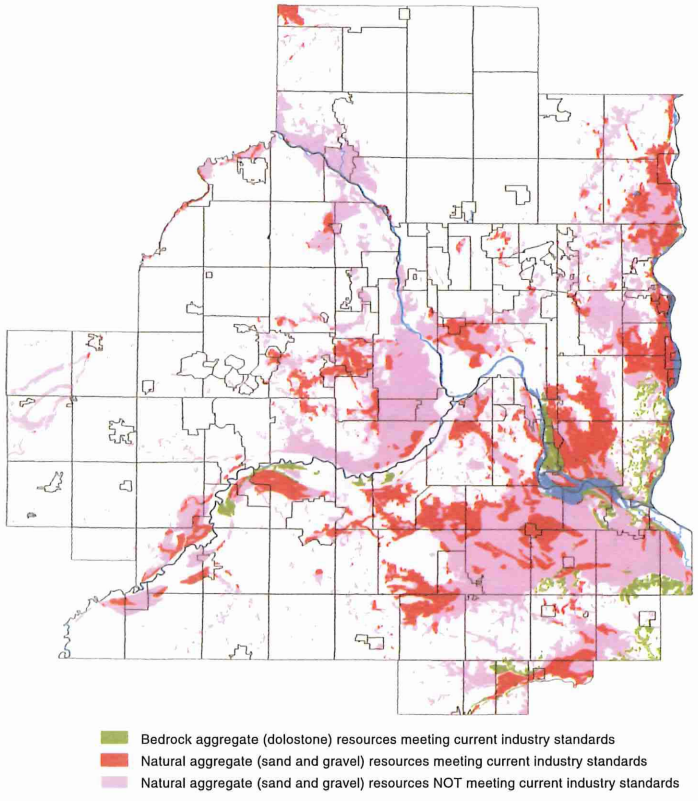
Desired outcomes:

- Land use plans that protect natural resources
- Increased citizen and local government expertise in protecting and managing natural resources

Aggregate resource mapping. In the Twin Cities seven-county metropolitan area aggregate resources (sand, gravel, and crushed rock) are projected to be exhausted by 2029. Bringing aggregate from outside the Twin Cities will increase truck traffic and construction costs. To help counties plan for these changes, DNR has mapped aggregate resources in Wright, Sherburne, and Isanti counties. Benton and Chisago counties are currently being mapped (refer to age 45).

Metro Land Cover Classification System (MLCCS). DNR, in partnership with Great River Greening, the National Park Service, Dakota County and other land management agencies, developed a new land cover classification system that better identifies vegetation type and impervious surfaces. Metro Greenways has adopted the system and the Metropolitan Council recommends it as a "best practice" for land cover inventories. Great River Greening is using the information created from an MLCCS inventory to model potential restoration areas and develop greenway plans to improve the Mississippi Corridor through St. Paul.

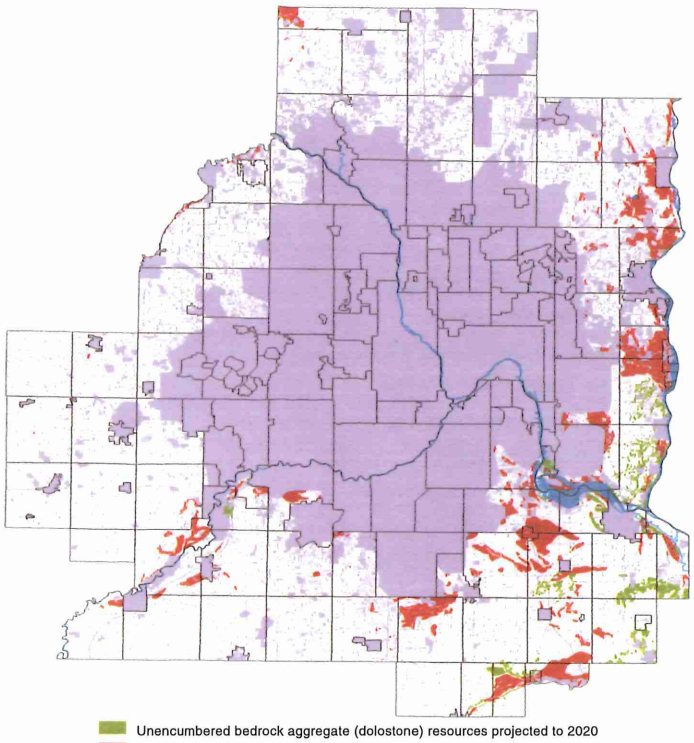
Distribution of aggregate materials in the Twin Cities seven-county metropolitan area.



Bedrock aggregate (dolostone) resources meeting current industry standards
Natural aggregate (sand and gravel) resources meeting current industry standards
Natural aggregate (sand and gravel) resources NOT meeting current industry standards

Projected urbanization and aggregate resources in the Twin Cities seven-county metropolitan area, 2020

Urbanization depletes aggregate resources through increased consumption and loss of access to aggregate-bearing lands.



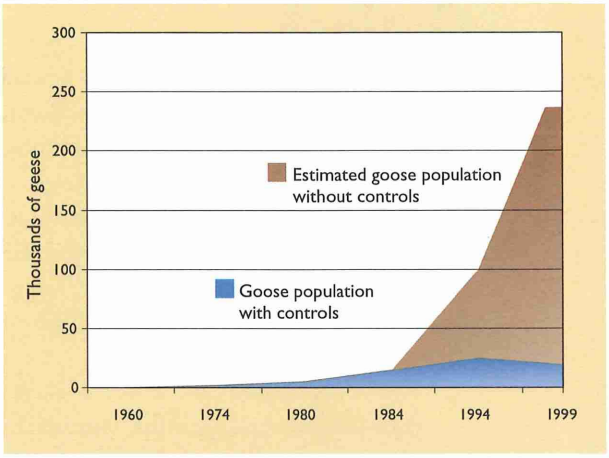
Unencumbered bedrock aggregate (dolostone) resources projected to 2020
Unencumbered natural aggregate (sand and gravel) resources projected to 2020
Urbanized areas projected to 2020

Metropolitan Council
Improve regional competitiveness in a global economy

Minnesota Geological Survey
University of Minnesota

MNDNR

Goose droppings impair water quality and interfere with recreation. The University of Minnesota Extension Service harvests geese for donations to Twin Cities metropolitan area food shelves. Local units of government use special goose hunts as a management tool.

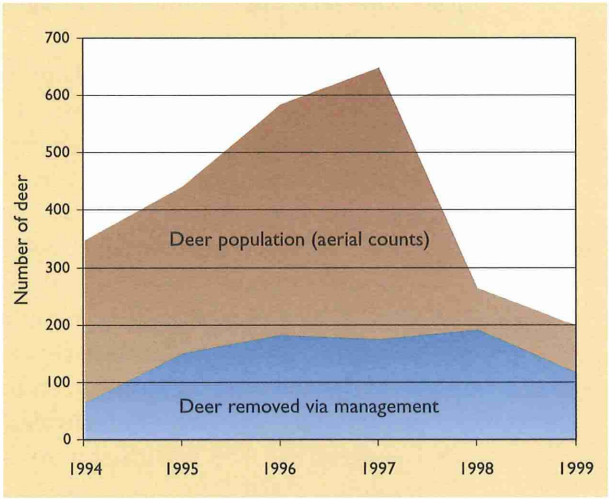


Twin Cities goose populations. The Twin Cities metropolitan area goose management program, developed in partnership with the University of Minnesota and local governments, has resulted in a breeding population of approximately 20,000 geese as opposed to the potential population of 236,000 geese (based on a model by Jim Cooper, University of Minnesota).

Urban wildlife management

Urban areas offer good habitat for white-tailed deer and Canada geese. Lack of predators, reduced hunting, and minimal winter stress reduce mortality. High deer populations increase deer-car accidents and damage vegetation in natural communities and developed areas. Goose droppings impair water quality and interfere with recreation.

DNR works with local governments and others to develop deer management plans tailored to community needs and desires. The Metro Bowhunters Resource Base (MBRB), a coalition of archery and hunting organizations, works with more than a dozen communities and landowners to conduct special bow hunts during the archery season. MBRB is demonstrating that archery is a safe, effective, and cost-efficient tool for urban deer management. Capable Partners, which offers hunting opportunities to hunters with disabilities, also helps communities manage deer and goose populations.



Deer population management in Minnetonka. The City of Minnetonka has conducted a deer removal program using special DNR permits. Deer populations increased until 1997, when they began to drop in response to management.

Outlook

Local governments, other state agencies, land use planners, developers, private landowners, and DNR are working together to develop and share the information and technical assistance needed to protect, restore, and manage natural resources. Creative approaches are needed to guide development patterns in ways that do not fragment and destroy valuable natural resources. The challenges this brings to DNR are:

- New cooperative efforts are needed to mitigate and prevent harmful, cumulative effects of urban expansion and development of natural lands.
- Protecting natural resources requires planning and implementing strategies across many governmental units and land ownerships.
- The primary forces that shape low-density sprawl are powerful and not easily modified.

DNR firmly believes that informed citizens make wise decisions. To this end, DNR is implementing the following strategies:

- DNR is placing more emphasis on fostering partnerships with local governments. The objective is to strengthen DNR's ability to serve as technical advisors early in the land use decision-making process. DNR will accelerate these kinds of partnerships by coordinating with the governor's Smart Growth Initiative.
- DNR is using grants, natural resource information, and technical assistance as our primary tools to assist local governments and private landowners in land stewardship actions.
- Recognizing the limitation of its staff resources, DNR is focusing assistance efforts on communities in rapidly developing areas. It is helping such communities identify and protect their highest priority resources, such as ecologically significant natural lands, unique wetlands, and surface and ground water resources.
- Conservation Connections, Metro Greenways, and locally led watershed partnerships such as Miller Creek Task Force and the Metro Trout Stream Watershed Protection Initiative will serve as models for DNR's partnership work.

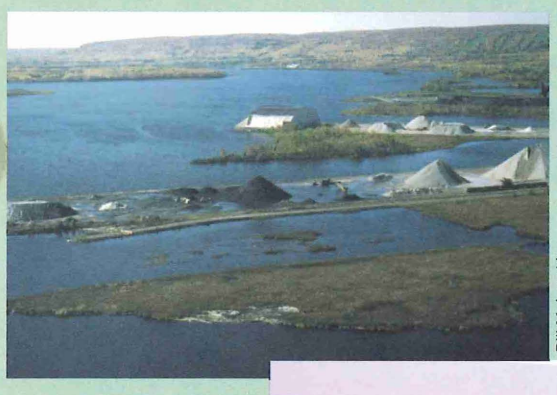
As DNR seeks more effective ways to assist local communities, we will need to develop more accurate techniques to monitor the effectiveness of these local assistance efforts.

Grassy Point

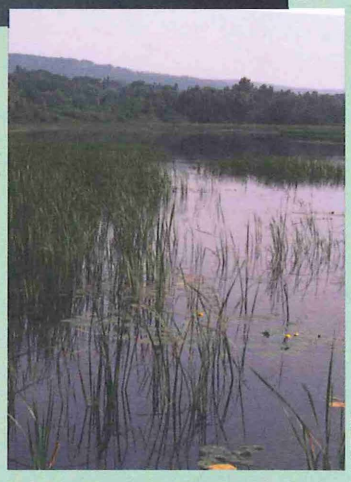
A second chance for a ravaged wetland

It's far wiser to plan protection for valuable habitat than to ignore human impacts and later try to erase the residue of unplanned activity. Once an ecosystem has been degraded, can it be restored to health?

Grassy Point, a 100-acre spit extending into the St. Louis River amidst the industrial traffic of Duluth harbor, offers hope. Home to a diverse mix of marsh types not found elsewhere in the entire St. Louis River system, the point has harbored turtles, fish, and an abundance of birds. But it has seen hard times. Tons of sawmill waste were left behind from milling at the site in the late 1800s and early 1900s. More recently, Grassy Point has suffered garbage dumping, invasion by purple loosestrife, and fill from road construction.



Bill Majewski



MNDNR

A thumb of greenspace in a river of commerce. In the aerial view of the St. Louis River, Grassy Point is in the foreground. The structure in the background is a bulk cargo dock. The Grassy Point wetlands provide a haven for nesting Great Blue Herons and Least Bitterns... and a place where people from nearby West Duluth neighborhoods and beyond can find solitude, wildness, and an opportunity to cultivate an ethic of renewal and restoration.

Restoration vision

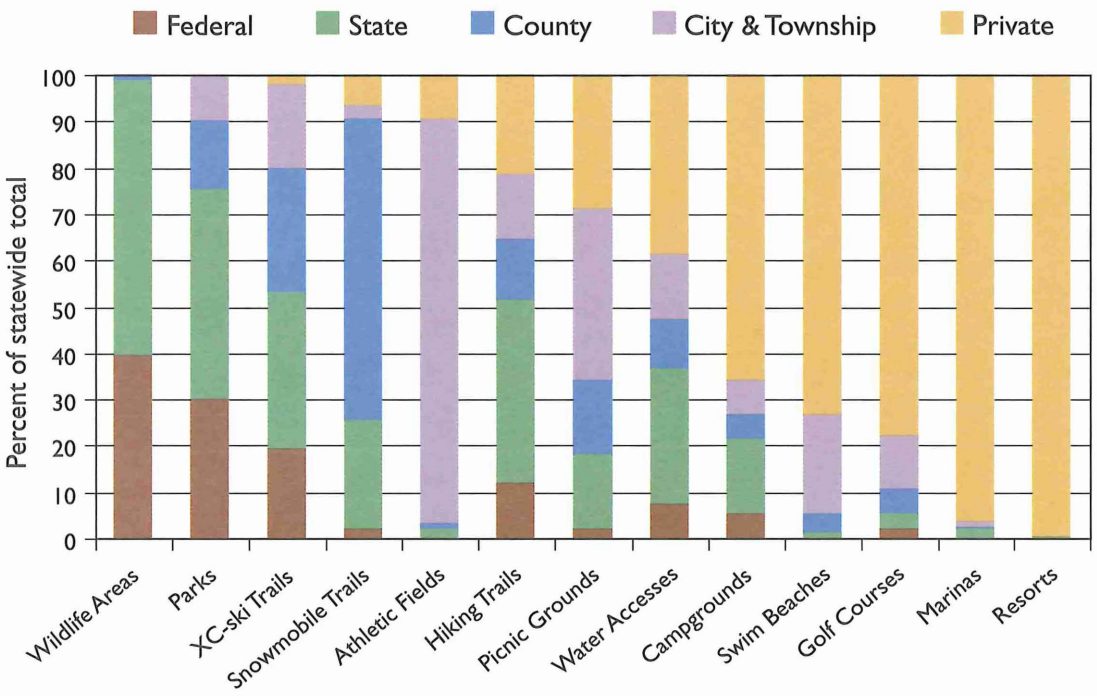
In the mid-1980s, increased recognition of the value of healthy wetlands sparked an interest in restoring Grassy Point. The first major improvement, ironically, resulted from additional development. Keene Creek, which had been diverted years earlier, was rechanneled by a road-building project back into the Grassy Point wetlands. Soon after that project was completed, DNR began working with citizens and local, state, and federal agencies on two strategies: restoring a healthy ecosystem and increasing public access and stewardship for Grassy Point.

Grassy Point has already come a long way toward fulfilling the vision of project planners. Area residents increasingly visit the point to experience the sights and sounds of a diverse wetland. The Keene Creek excavation has provided habitat for a number of fish species. DNR continues monitoring of fish populations to assess the effectiveness of the wetland restoration, and St. Louis River Watch monitors water quality in the Keene Creek/Grassy Point area.

Accomplishments and activities

- **A new channel.** In 1995-96, workers removed 11,000 cubic yards of wood waste to carve a second channel for Keene Creek to reach the St. Louis River.
- **Improved public access and protection.** Gates were added to discourage garbage dumping, and a parking area and park benches were built. Boat access to the St. Louis River is planned.
- **Fill removal.** Street construction fill is being removed.
- **Trail construction.** The bike and pedestrian trail between Irving Park and Grassy Point was completed. A wetland trail using floating or elevated boardwalks and elevated wildlife viewing platforms is being planned.
- **Purple loosestrife control.** Beetles that feed on loosestrife were released in 1995.

Recreation



Providers of Minnesota recreation facilities. DNR shares responsibilities for providing outdoor recreation opportunities. Coordination among state, federal, county, and local governments; private landowners; conservation clubs; and citizen volunteers helps serve the full spectrum of recreation demand.

Directions 2000

Strategic outcomes for recreation

- Healthy natural resources able to produce outdoor recreation benefits over the long term
- Quality recreation opportunities through access and education
- Safe recreation opportunities

Introduction

All levels of government are involved in providing outdoor recreation opportunities, from federal to state to local. The private sector is a major provider too, as demonstrated by Minnesota's thriving recreation-oriented tourism industry. Because this industry generates a substantial amount of revenue, outdoor recreation contributes substantially to the state's economy. But most importantly, outdoor recreation generates a wealth of personal, social, economic, and environmental benefits for Minnesotans.

Meeting the outdoor recreation needs of Minnesotans and others is a major part of DNR's mission. DNR seeks two major outcomes in meeting recreation needs: 1) the public has a satisfying and safe outdoor recreation experience, and 2) lands and waters, the base upon which many recreation opportunities depend, remain healthy over the long term.

Many DNR programs and activities bear on outdoor recreation. They can be grouped into five categories: 1) providing access to recreation lands and waters, 2) sustaining healthy recreation lands and waters, 3) managing fish and wildlife for recreation, 4) providing information and education, and 5) promoting safety. *Directions 2000* provides a more detailed picture of DNR recreation goals and strategies.

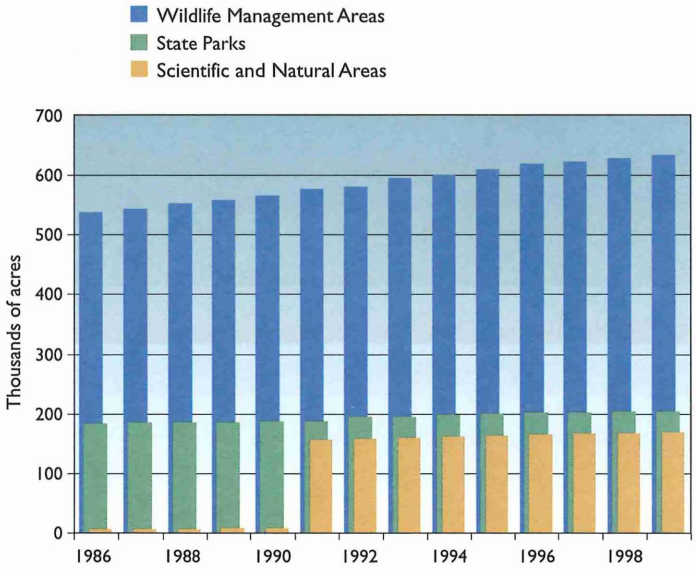
Progress toward providing access to recreation lands and waters

DNR supports recreation in many ways. We provide a variety of recreation areas and facilities. We also survey customers, tailor management to meet changing recreation needs, and work with other recreation providers to ensure a full spectrum of recreation opportunities.

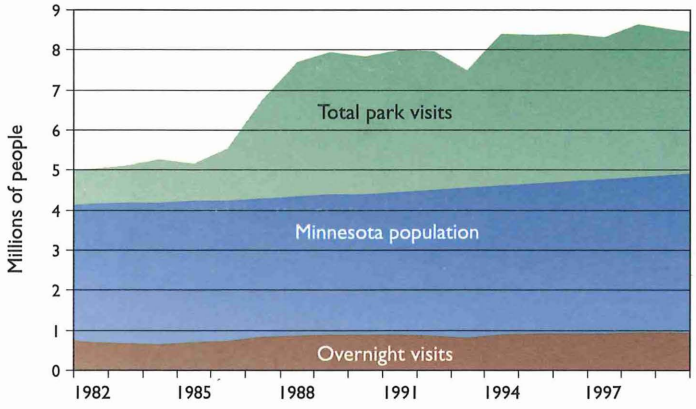
Providing recreation areas and facilities

State lands and waters have been an important component of Minnesota's recreation system since Itasca State Park was established in 1891. The 1975 Outdoor Recreation Act (ORA) organized state-administered public recreation lands. DNR has management responsibility for state parks, state recreation areas, state trails, state SNAs, state wilderness areas, state forests, state wild and scenic rivers, state water access sites, state WMAs, state aquatic management areas (AMAs), and other units such as state safe harbors. These areas are widely distributed. For example, there is a state park within 50 miles of every Minnesotan.

DNR develops facilities on public lands and waters to promote safe and high-quality recreation. Campgrounds, state trails, public water access, fishing piers, and other facilities help people get outdoors and enjoy Minnesota's resources. We are responsible for more than 1,000



Cumulative acres of state parks, WMAs, and SNAs. State lands and waters provide important areas for recreation and resource protection (See Forest Resources Chapter for a summary of forest land).



Increases in Minnesota state park visits. Minnesota state parks had 8.6 million visits in 1998. Park visitation has grown faster than Minnesota's population. Visitor satisfaction remains high.

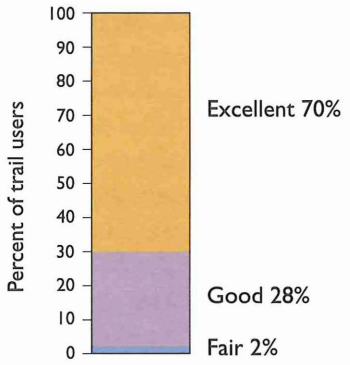
At a Glance

DNR activities:

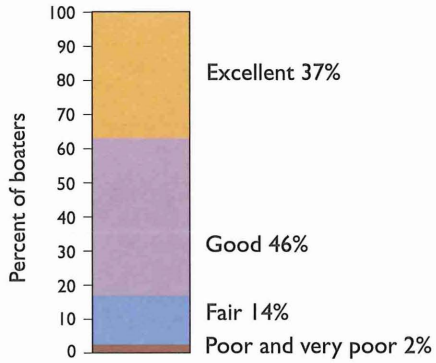
- Development and maintenance of facilities on state lands and waters
- Recreation demand research
- Financial and technical assistance to partners

Desired outcomes:

- Use and satisfaction with facilities
- Participation in recreation by many different groups



Trail users express high satisfaction with Minnesota state trails for their use and enjoyment. Biking is the most common trail use. Other popular activities include skating, walking, and running.



Minnesota boaters give high marks to public access facilities for launching and landing a boat. The current high ratings are a continuation of such ratings since 1985, when boaters rated the facilities virtually the same.

miles of state trails, 1,550 public water access sites, 220 fishing piers and shore fishing sites, and 24 designated canoe and boating routes.

Use of recreation facilities and user satisfaction are good measures of access and high-quality recreation. State park attendance is growing to over 8 million per year. Park satisfaction has remained consistently high, according to visitor surveys; in 1998, nearly 70 percent of visitors had their "expectations exceeded," or were "completely satisfied" with the trip. Another 26 percent were "mostly satisfied." Only one percent were dissatisfied to any extent. Trail use and ratings are high as well. A recent survey of nine state trails showed a total annual use of approximately 900,000 user hours. Public accesses are also used frequently. Minnesota is a boating state with approximately 793,000 licensed boats, fourth in the nation.

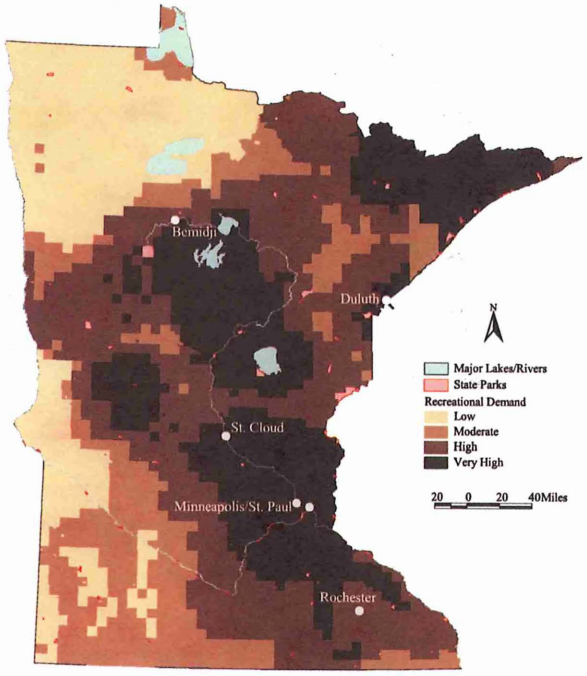
Meeting dynamic recreation demands

Outdoor recreation demand is dynamic; it constantly shifts as social structure, preferenc and demographics change. DNR uses a three-pa approach to meet dynamic recreation demands.

The first part of our approach is to track demographic trends, survey recreation users, and assess types of use and satisfaction with facilities. We survey customers statewide for awareness and satisfaction every four years; our most recent survey was completed in 2000. We also recently collaborated on statewide lakes and trails surveys. The information we gather helps us clarify the expectations of various groups and alerts us to changes in recreation demand.

MNDNR

Bikers on the Root River State Trail near Lanesboro, Minnesota. State trails provide access to natural settings and promote enjoyment of the outdoors.



Outdoor recreation demand for 2025. Growing population and tourist centers require DNR to keep up to date on changing trends. A diverse public means that many types of facilities are required to meet a variety of recreation demands.

The second part of DNR's approach is to develop facilities and programs that meet the needs of distinct user groups where possible. For example, after identifying a need to improve access for people with disabilities, we instituted a program to meet universal design standards and to communicate accessibility information. In 2000 we initiated "Open the Outdoors," a summary of accessibility information on the DNR website.

Our facilities and programs are also evolving to accommodate the increasing representation of persons of Southeast Asian ethnic background among hunters, anglers, and park users. Southeast Asian families often recreate in groups of 60 to 100 people, and parks need more group areas to accommodate these visitors. In 1998 our outreach activities for this user group included 28 field trips at state parks that served 1,647 people. We also recruit and train Southeast Asian conservation officers who serve as liaisons between DNR and the Southeast Asian community.

Other groups with specific interests communicate trends in recreation, such as those related to OHVs. We try to serve these interests in ways that are consistent with resource protection and public safety. For example, we are opening two new facilities specifically for OHVs, and are in the process of designating OHV use areas in state forests (see also page 36). DNR needs to work with many groups to balance a variety of recreation interests that range from using OHVs to biking to hiking.

The third part of our approach is to partner with local governments and other recreation providers to meet a broader spectrum of recreation demand. DNR financial and technical assistance helps communities and clubs develop and maintain recreation facilities. For example, we provide grants to local communities for developing snowmobile and cross-country ski trails. We advertise these grants through our *Financial Assistance Directory* and the DNR website.

In some cases, recreational development (e.g., trails) may be the catalyst to link various habitats and open spaces into a healthier, more connected environment. DNR and local communities can use these partnerships to both promote quality recreation and sustain healthy lands and waters for the long run.

DNR also works with local governments on other kinds of large-scale community projects, such as developing safe harbors along Lake Superior's North Shore. The Silver Bay safe harbor and marina opened in 1999, and a safe harbor and boat access will open at Taconite Harbor in 2001.

Progress toward sustaining healthy recreation lands and waters

DNR strives to sustain a healthy natural resource base upon which many recreation opportunities depend. State laws provide guidance for the conservation of state recreation lands and waters. The ORA directs that state parks, for example, be managed to protect natural and cultural resources, while providing for the use, enjoyment, and understanding of such resources without impairment for the enjoyment and recreation of future generations.

DNR sustains healthy lands and waters in many ways. DNR makes widespread use of partnerships to conserve lands and waters. (See Conservation Connections page 74 and the Water Resources Chapter). DNR also protects recreation lands and waters in three ways: 1) DNR management plans guide use and development of recreation facilities; 2) DNR mitigates damages when they occur; and 3) DNR enforces natural resource laws.

At a Glance

DNR activities:

- Management plan development
- Plant community management
- Recreation impact minimization
- Law enforcement

Desired outcomes:

- Healthy recreation lands
- Few problems with overuse
- Protected resources
- Law-abiding citizens

Preparing management plans and managing lands

DNR works with citizens and local governments to prepare management plans that balance recreation with resource protection. Plans establish long-range visions to guide development of facilities and resource management. They seek to meet multiple recreation demands while protecting natural and cultural resources. Minnesota's state parks, state trails, and WMAs, for example, have management plans that are periodically updated.

DNR works to improve resource conditions on state lands. In 1999 we carried out 322 projects on state parks, including exotic species removal, prescribed burns, seed collection and plantings, and restorations. These activities enhance native plant communities and provide habitat for animals. They also provide recreation opportunities such as wildlife viewing and nature observation (see page 70). And ultimately they protect Minnesota's natural diversity. For example, state parks harbor 343 different types of rare species, plant communities, and unusual geologic features.

Robert Dana

Dakota skipper. Species that are listed as endangered, threatened, or of special concern benefit from habitat protection and resource management on state lands.

State park management

A recent legislative audit concluded that DNR effectively manages state parks and that state park visitors are satisfied with their recreation experiences. The audit criticized DNR, however, for giving higher priority to recreation and education than to preservation of natural resources. Since the audit, we have increased the time devoted to resource management in state parks by 25 percent. We have also shifted positions to include four more parks resource managers, and have developed two projects to mitigate damage from recreation overuse.

Preventing and mitigating damage from recreation overuse

Intensive recreation can degrade both natural resources and the recreation experience. DNR strives to ensure that recreation causes minimal damage to the environment. For example, field staff evaluate and resolve problems with soil erosion along heavily used trails and soil compaction and vegetation loss at campsites. DNR seeks to prevent problems—for example, by designing and constructing trails in ways that minimize soil erosion.

Long-term monitoring is critical to determine the effectiveness of efforts to protect natural resources on recreation lands. Clear measures of progress are difficult to develop. They are often site specific. For example, the absence of resource deterioration can be a measure of success in a heavily used park. We need to develop clearer statewide measures of resource protection on recreation lands and waters.

nforcing natural resource laws

Consistent and active enforcement of natural resource laws protects recreation lands and waters. It also promotes responsible behavior and better recreation opportunities for everyone.

DNR enforces a wide range of natural resources rules and regulations, some of which pertain specifically to recreation (e.g., rules pertaining to recreation areas under DNR jurisdiction, and regulations related to fishing, hunting, and the use of recreation vehicles). DNR conservation officers primarily use one-on-one interactions to promote stewardship and protect resources.

DNR uses a triad approach that coordinates enforcement with education and information delivery to protect resources and promote safety. Measuring how well enforcement actions protect lands and waters is complicated by the difficulty in quantifying the deterrent effect of our efforts. Enforcement actions provide just one measure of activities that likely deter resource damage. During fiscal year 1999-2000, DNR issued about 16,000 summons and warnings for all types of violations. This is an increase of more than 3,000 over prior years. In 1999 DNR also made nearly 300 arrests through the Turn in Poachers Program alone.

MNDNR

Volunteers help protect a stream bank in Temperance River State Park. This new boardwalk provides a clear pathway and helps stabilize stream bank soils and vegetation. More than 6 million people use Minnesota state park trails each year. Without careful trail design and maintenance, long-term use could harm surrounding resources.

At a Glance

DNR activities:

- Habitat management
- Stocking
- Regulating catch
- Research and monitoring
- Information and education

Desired outcomes:

- Sustainable fish populations
- High fishing satisfaction

Progress toward managing fish and wildlife for recreation

Fishing

DNR promotes fishing opportunities on 5,400 lakes and 15,000 miles of streams, including 3,600 miles of trout streams. We maintain 3,000 public water access sites and more than 200 fishing piers and shore fishing sites.

To promote quality fishing, DNR maintains healthy waters, protects and improves habitat, regulates catch, enforces laws, stocks lakes and streams, conducts research, monitors fish populations, and provides information and education. We also monitor catch rates and angler attitudes. A 1998 statewide survey of licensed anglers, for example, showed that 54 percent were satisfied or very satisfied with their overall experience during the previous year, 26 percent were neutral, and 21 percent were dissatisfied to any extent. DNR will continue to chart attitudes over time.

Fishing pressure is generally increasing. The U.S. Fish and Wildlife Service estimated angling occasions in Minnesota at 26 million angler-days in 1996. Fishing-related activity generates about $1.9 billion each year in direct expenditures to the state's economy.

Overall, angling has not been shown to deplete fish populations to the point where reproductive success is threatened. However, in some cases high fishing pressure can decrease catch rates and average fish size. In Minnesota, average size has declined the most for black crappie, bluegill, yellow perch, and northern pike. Walleye, muskellunge, largemouth and smallmouth bass, and stream trout populations have a stable average size or are improving. Walleye seem to be fairly resilient to fishing pressure. A growing catch-and-release ethic is helping maintain or improve populations.

DNR uses experimental regulations on about 90 lakes and 12 streams. These more restrictive regulations are intended to improve catch rates and average fish size. Results of these efforts may not be evident for about five years. DNR then will apply the most effective regulations on other waters.

While anglers pursue a wide variety of fish, each with special habitat requirements, four species are especially important in measuring success. Walleye reflect conditions in warm water fisheries throughout the state, muskie are trophy fish with particular habitat needs, brown trout populations reflect conditions in environmentally sensitive cold water streams, and steelhead trout populations reflect conditions in the unique Lake Superior fishery.

Electronic licensing system

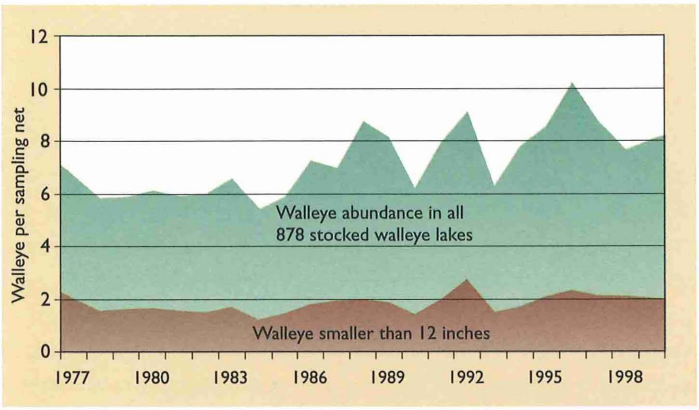
In 2000 DNR launched an electronic licensing system (ELS) allowing the purchase of licenses from a local agent or by phone. ELS gives more accurate information about resource users and their needs. It also streamlines business practices and cuts administrative costs. DNR will begin selling licenses via DNR's website in 2001.

Licensing agents use ELS to provide quality service to hunters and anglers. On the day prior to the firearms deer hunting opener, ELS processed 67,471 transactions—more than two licenses per second—with only a few hunters reporting problems.

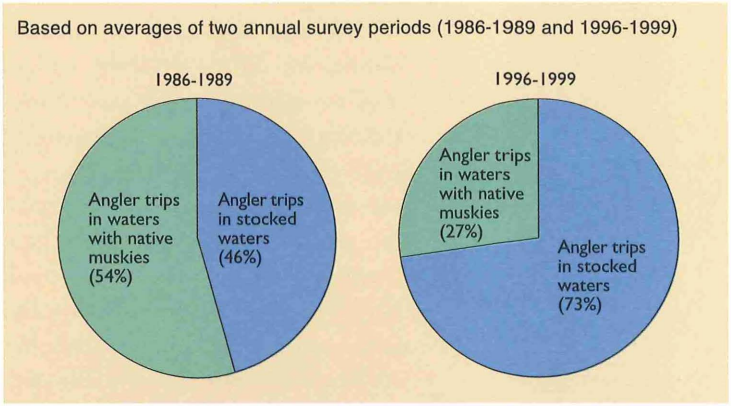
Walleye. Walleye is the most widely sought fish in Minnesota. It is found in 1,700 lakes and 100 streams. Minnesota anglers annually harvest about 3.5 million walleye totaling 4 million pounds.

DNR protects and improves walleye habitat, regulates catch, and stocks walleye where natural reproduction is limited and other desirable species will not be harmed. Fish stocking is most useful in specific instances, such as in lakes without spawning habitat and lakes with habitat that could support self-sustaining fisheries. DNR is increasing annual walleye fingerling production from 80,000 pounds to 120,000 pounds. Stocking will focus on lakes with the best potential for improved fishing.

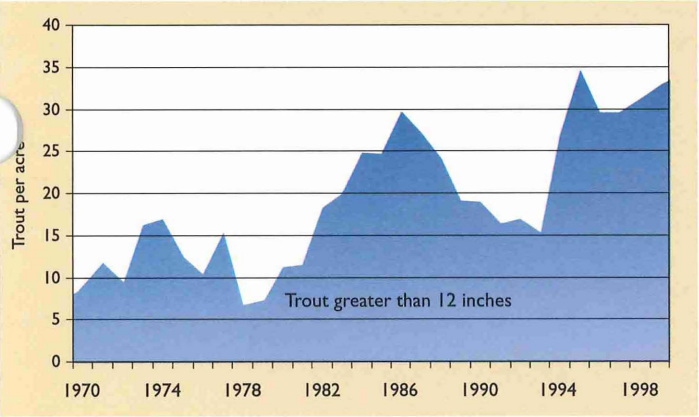
Muskie. DNR maintains healthy native muskie populations and stocks muskies in lakes with suitable habitat. This has increased the number of lak with muskie angling opportunities. In a 1998 su vey, anglers at a fishing event gave muskie fishing opportunities high rankings (8 on a scale of 1-10).



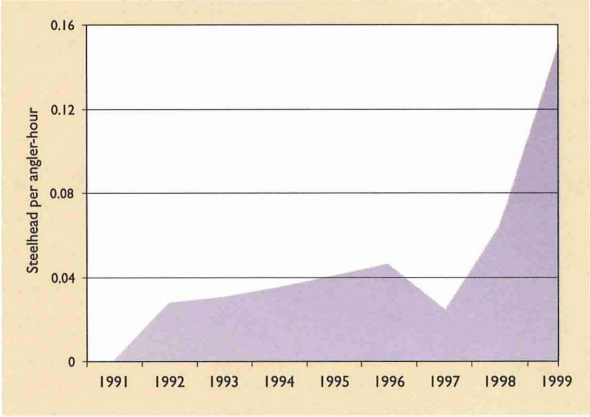
Walleye increases in stocked lakes. Walleye populations have increased in stocked lakes since 1977. The goal of the stocking program is to increase walleye abundance and improve fishing success.



Muskie fishing in stocked lakes. Nearly three-fourths of muskie fishing trips are to stocked waters. Muskie stocked years ago are now reaching trophy size. A growing catch-and-release ethic helps protect this prized fish.



Brown trout increases in southeastern Minnesota. Brown trout were introduced to the state's cold water streams in the late 1800s. For decades, trout populations were maintained by costly annual stocking. Populations are now mostly self-sustaining. Periods of decline likely reflect in-stream conditions during drought years.



Lake Superior steelhead. Steelhead catch rates on Lake Superior tributaries increased throughout the 1990s. DNR developed a management plan and implemented restrictive harvest regulations in 1992.

Brown trout. Brown trout populations and average size have dramatically increased in southeastern Minnesota over the past 30 years. Perpetual easements secured by DNR allow public access to 26 percent of trout streams on private lands. Easements also allow DNR to improve stream habitat. Together with improvements in agricultural land use, these streams now support healthy trout populations and have improved water quality and flow.

Steelhead. Though it is still too early to say for certain, the North Shore steelhead fishery appears to be recovering. After steelhead numbers declined in the 1980s, DNR developed a management plan and worked with anglers to implement harvest restrictions in 1992. These limits probably led to the increases of steelhead populations in the late 1990s. Long-term monitoring will track how steelhead fare in the future.

At a Glance

DNR activities:

- Habitat management
- Regulating harvest
- Research and monitoring

Desired outcomes:

- Sustainable game populations
- High hunting satisfaction

Hunting

Hunting opportunities abound throughout Minnesota. DNR directly manages habitat in WMAs, wetlands, and state forests to provide hunting opportunities, and gives technical assistance to other public and private land managers interested in improving wildlife habitats. We manage wildlife populations by protecting and improving habitat on public land, monitoring wildlife populations, adjusting hunting regulations, and conducting research. We also enforce wildlife laws to protect wildlife and public safety. And we work with local government and conservation groups to protect wildlife habitat and provide hunter safety education (see page 72).

In 1999 we improved habitat, trails, and facilities on 1,300 WMAs; protected hunting seasons from court challenges; reviewed 1,300 proposed projects for their effect on wildlife habitat; helped 2,800 individuals resolve wildlife depredation problems; and completed more than 600 wildlife survey routes.

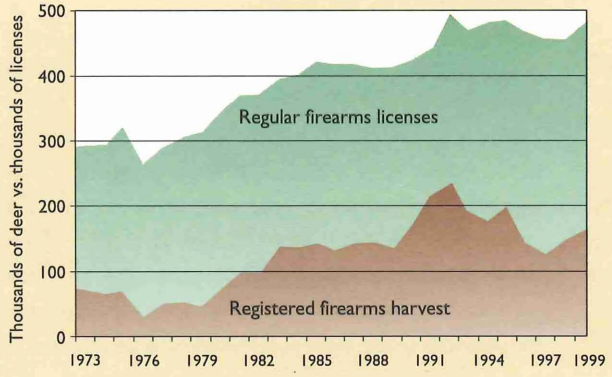
Hunter satisfaction is a good measure of DNR progress in promoting quality hunting. A 2000 DNR statewide survey shows that among Minnesotans who hunted in the previous year, 72 percent were satisfied or very satisfied with hunting in Minnesota, 10 percent were neutral, and 18 percent were dissatisfied to any extent. DNR will continue to survey attitudes over time.

Four wildlife species provide good measures of DNR success in managing wildlife habitat and game populations. White-tailed deer are found in a variety of habitats statewide. Wild turkeys live in hardwood forests near farm fields, while ruffed grouse live in the birch-aspen forests of northern Minnesota. Waterfowl depend heavily on high-quality wetland areas.

Deer. The white-tailed deer is the most popular game species in Minnesota. Each year, roughly 500,000 hunters harvest approximately 175,000 deer. Whitetail numbers have tripled since the 1970s and are managed through hunting and habitat alteration to maintain populations at established goal levels. The antlerless deer permit system helps control farmland deer numbers and lessen the likelihood of declines in forest populations. It allows DNR to intercede when populations have become too large or to allow increases of populations that have declined due to weather or other factors.

The DNR goal is to maintain a deer population that provides quality hunting opportunities without excessive deer numbers creating damage or nuisance conditions. DNR uses a system of 120 permit areas to manage deer. In each permit area, DNR allocates hunting permits based on estimat of deer population and desired population siz. Deer densities also vary with factors other than hunting pressure. Habitat availability and landscape type (e.g., forest, farmlands, urban areas) are of primary importance. Weather, especially the length and severity of winters, strongly influences deer herds, particularly in northern Minnesota.

Wild turkey. Thought to be native to southeastern Minnesota, wild turkeys had nearly disappeared from the state by 1900. DNR transplanted wild turkeys to southeastern Minnesota in the early 1970s. Additional transplants have helped the birds spread throughout most of south-

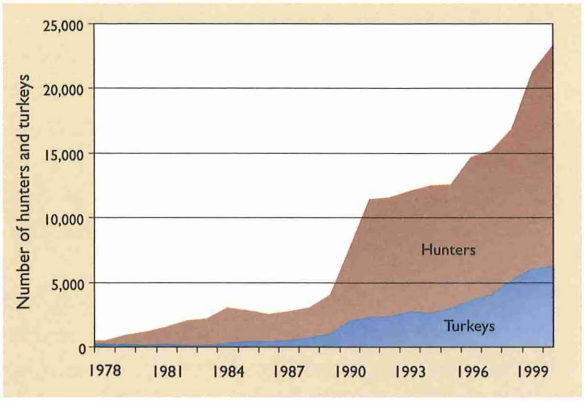


Firearms license sales and deer harvest. Over the past 25 years, deer license sales have continued to increase. Meanwhile, the deer harvest has more than doubled. Weather and habitat quality contribute to short-term variations in deer numbers. Recent mild winters helped the northern herd recover from severe winters in 1995-96 and 1996-97.

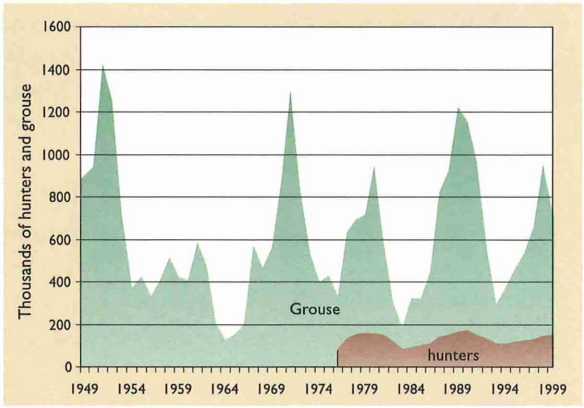
ern Minnesota and to the west and north. Today more than 20,000 hunters harvest more than 5,000 of the state's estimated 40,000 wild turkeys each spring. Roughly one hunter in three successfully bags a wild turkey.

Ruffed grouse. Minnesota has higher ruffed grouse harvests and more public ruffed grouse hunting land than any other state. Hunter fees help DNR increase grouse habitat on state forest land. DNR and partners monitor more than 130 ruffed grouse routes throughout the species' Minnesota range. By monitoring grouse, we have found that population declines that occur about every 10 years are due to natural cycles, not hunting. This knowledge has allowed us to increase the hunting season from just 16 days in 1948 to more than 100 days today.

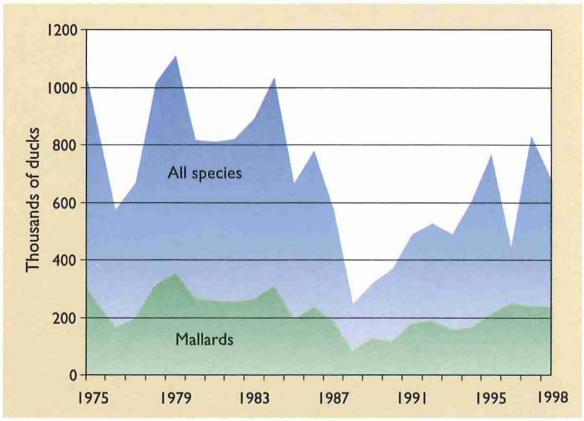
Waterfowl. Minnesota has a long and rich waterfowl hunting tradition. Minnesota ranks number one nationally in the total number of duck hunters and is usually one of the top three or four states in terms of total duck harvest. As one of the nation's most prolific waterfowl production states, Minnesota has stressed management of wetland and associated upland nesting habitats and has regulated hunting to reduce harvest pressure on local breeding duck populations. In recent years, continental duck populations have increased to historic highs, yet hunting seasons in Minnesota have been disappointing. The lack of ducks migrating through Minnesota in recent falls may be due to long-term habitat degradation, recent wet cycles that have damaged wild rice crops in northern wetlands and created ideal habitat conditions in the prairies west of Minnesota, and changing migration patterns. To address this, DNR is working on a three-pronged plan. The goal will be to increase the amount and quality of fall migration habitat, improve security for migrating waterfowl through establishing additional refuges or other secure areas, and increase hunter satisfaction by adjusting regulations or other factors. (Also see discussion of wetlands, pages 11-13).



Wild turkey harvest. As wild turkeys spread, so do hunting opportunities. Hunter surveys show that lack of interference by other hunters is critical for a safe, quality hunting experience. DNR limits permits to ensure healthy turkey populations and to prevent hunter crowding.



Ruffed grouse harvest and population cycles. Grouse populations naturally rise and fall in 10-year cycles. Minnesota has excellent grouse hunting due to the quality of habitat provided on public lands.



Waterfowl harvest (total and mallard). Minnesota duck harvests declined during the drought years of the late 1980s, then improved in the 1990s as wetter conditions and more liberal regulations prevailed. However, duck harvests in recent years have not risen to earlier levels, despite higher continental waterfowl populations and more liberal regulations.

At a Glance

DNR activities:

- Protection of natural areas
- Species conservation
- Wildlife education

Desired outcomes:

- Healthy plant communities and wildlife
- Participation in wildlife viewing

Wildlife viewing and nature observation

Minnesota is of special interest to wildlife watchers because it represents the intersection of three major North American biomes: tallgrass prairie, hardwood forest, and boreal forest. There is an abundance of popular species such as Bald Eagle, and a great diversity of rare, sought-after wildlife such as Great Gray Owls.

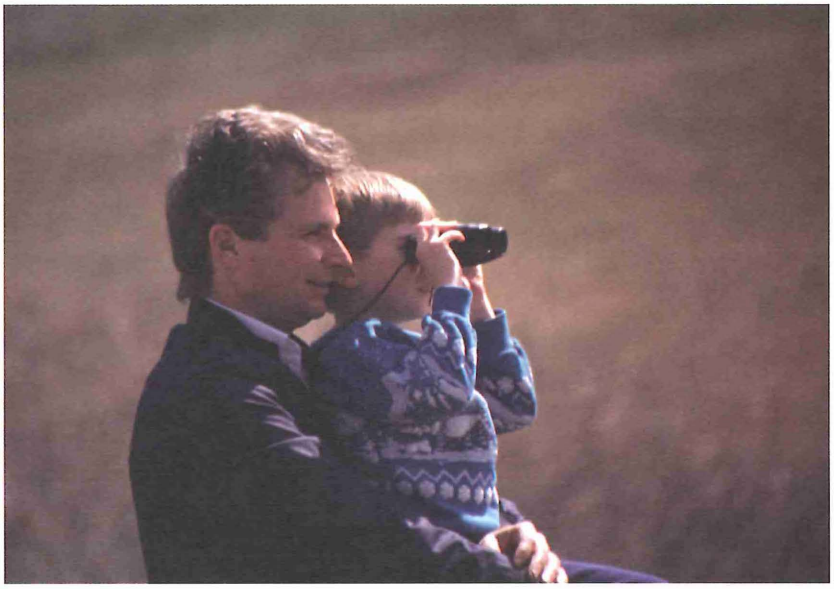
Nature-based tourism is the most rapidly growing segment of the national tourism industry. Minnesota is a leader in this trend; the number of wildlife watchers in the state has increased by 155 percent between 1985 and 1995. U.S. Fish and Wildlife surveys indicate that wildlife tourism, including birding, bird feeding, and wildlife photography, was a $383 million-per-year industry in Minnesota in 1996.

DNR supports wildlife tourism by protecting natural areas, conserving native species, and working with partners such as the Minnesota Office of Tourism to promote opportunities for wildlife viewing and nature tourism.

Public lands and natural areas managed by DNR are a major resource for nature-based tourism. Many of the most sought-after wildlife species and pristine outdoor experiences occur on state lands, such as WMAs, state parks, state forests, and SNAs.

DNR conserves native species by managing and restoring populations of birds, mammals, reptiles, amphibians, fish, mollusks, butterflies, and other animals not traditionally hunted or harvested. Many are in need of special conservation efforts. The Nongame Wildlife Program undertakes a comprehensive conservation program that includes survey, research, habitat management and preservation, species reintroduction, technical assistance, wildlife tourism, endangered species management, and education. This program, funded primarily by donations, works with many partners to meet its conservation goals. (See pages 6 and 33 for indicators related to loons and eagles.)

DNR seeks to meet the needs of wildlife watchers and wildlife tourism businesses through education materials and workshops. For example, our *Travelers Guide to Wildlife in Minnesota* encourages wildlife tourism by identifying 120 sites of high interest to wildlife enthusiasts. DNR also initiated a cooperative effort with the Minnesota Office of Tourism to conduct 1 "Profiting from Wildlife Tourism" workshop across the state during 1999 and 2000. Minnesota will be hosting future national gatherings on wildlife tourism.



Carrol Henderson

Wildlife watching is popular among all ages. State lands harbor a variety of plants and animals that will be enjoyed for years to come. DNR works with partners to protect these areas and support a growing nature-based tourism industry.

Progress toward providing information and education

Information

The DNR Information Center provides a wide range of information on recreation and Minnesota's natural resources. We answer approximately 160,00 telephone calls and 20,000 e-mail questions and requests annually. The DNR website also has become an important information resource; there was an average of about 62,000 requests for website pages daily in 2000. The site provides information on recreation facilities, handicapped accessibility, and natural resource features. The DNR is rapidly expanding the site's collection of recreation maps, including WMAs.

Education

Promoting a natural resources stewardship ethic among all Minnesotans and especially recreation users is one of DNR's main goals. DNR reaches recreational users through state fair displays, school curricula, and the day-to-day work of field staff. For example, conservation officers teach people about resource protection when they attend community events, check licenses, and provide safety training.

DNR has numerous education programs focused on the state's recreation lands and waters. For example, we set education priorities for each state park. Attendance at the 25 state park visitor centers totaled 710,523 in 1998. Eighteen parks have full-time, year-round naturalists, and eight have seasonal naturalists; 132,000 park visitors attended more than 6,000 scheduled naturalist presentations in 1998. In addition, 55,800 schoolchildren and teachers participated in 1,600 environmental education programs.

DNR also emphasizes water-related stewardship. Our MinnAqua education program promotes stewardship and introduces youth to fishing. Each year MinnAqua provides fishing instruction to 25,000 Minnesotans.

The numbers of people participating in DNR programs are good measures of progress toward providing education. Measures of outcomes are also important; DNR often uses satisfaction surveys following education delivery to learn how to improve our programs. Measures related to awareness and stewardship actions following education delivery are difficult to track, but would provide valuable information.

Education as cornerstone

Environmental education is a cornerstone for fostering a strong natural resources stewardship ethic among all Minnesotans, one of DNR's two overarching sustainability goals. This ethic will become increasingly important as a growing human population puts additional demands on the state's resources. Providing natural resources stewardship education is a primary and cross-cutting function for the DNR.

One goal of education is to better prepare citizens and communities to make natural resource decisions. Although DNR devotes considerable effort to natural resources stewardship education, these efforts have lacked adequate coordination and guidance.

DNR's "Cornerstones" task force, comprised of DNR staff and non-DNR educators, recommended measures to strengthen DNR education efforts (summarized in a DNR report, *Cornerstones 2000).* The report recommended a broad range of measures including: building consistent messages and measurable outcomes, enhancing investments to meet education demands, expanding working relationships with pre-K-12 providers, targeting education efforts to critical audiences, collaborating with other education providers, and reflecting a day-to-day commitment to sustainability in our agency practices and policies. DNR is implementing many of the recommendations of this report.

At a Glance

DNR activities:

- Publications and website
- One-on-one interactions
- Education programs and interpretive centers

Desired outcomes:

- Participation in programs
- High satisfaction
- Stewardship behaviors by recreation enthusiasts

Progress toward promoting safe recreation

Safety education and enforcement

High-quality recreation includes responsible behavior. DNR uses education and enforcement to help recreation enthusiasts have a safe experience and to protect natural resources.

Volunteer instructors have trained about 840,000 students since DNR conducted its first firearm safety class in 1955. Since 1989, more than 25,000 bow hunters have been certified. Today more than 4,000 volunteer instructors annually train 22,000 youth and adults in firearm safety. These courses have helped reduce firearms accidents. In 1998 there were no hunting-related firearms fatalities—the first fatality-free year since official recording began in 1947.

Other classes keep the public informed about hunting and resource laws. Hunting clinics address topics for individual species (e.g., wild turkey, bear). Advanced seminars focus on hunter conduct and attitudes. These programs help people understand hunting and outdoor issues and hunt safely and successfully.

DNR manages safety programs for snowmobiles, all-terrain vehicles (ATV), off-highway motorcycles (OHM), and boat and water use. Increases in the number of recreational vehicles (e.g., ATVs) keep education programs in high demand. Volunteer instructors teach an average of 350 snowmobile safety classes each year. In 1999, at the direction of the legislature, DNR initiated a snowmobile safety course for young adults. In the first two years, about 2,000 people were trained. We educate and certify users of ATVS, OHMs, and motorized watercraft through independent study courses and written tests.

Statistics related to education and enforcement (e.g., number of students trained, number of warnings issued) are indicators of DNR's role in promoting safety. Indicators related to actual safety can be less useful because they reflect a variety of factors (e.g., number of participants, weather, and length of season). However, DNR maintains records of recreation-related accidents and fatalities because they help highlight potential problem areas.

At a Glance

DNR activities:

- Safety education and training
- Enforcing laws

Desired outcomes:

- Citizens trained in safety
- Law-abiding and safe user groups
- Minimal accidents

MNDNR

More than 4,000 volunteer instructors annually train 22,000 youth and adults in firearm safety.

Outlook

Recreation is a highly visible part of DNR services. For many citizens, pleasing recreation experiences are the measure of DNR success. DNR continues to provide quality recreation opportunities for a broad range of outdoor activities. DNR continues to survey the recreation landscape to provide new opportunities that serve emerging recreation interests and new communities. Surveys of facility users indicate a high degree of satisfaction with DNR performance in meeting recreation needs.

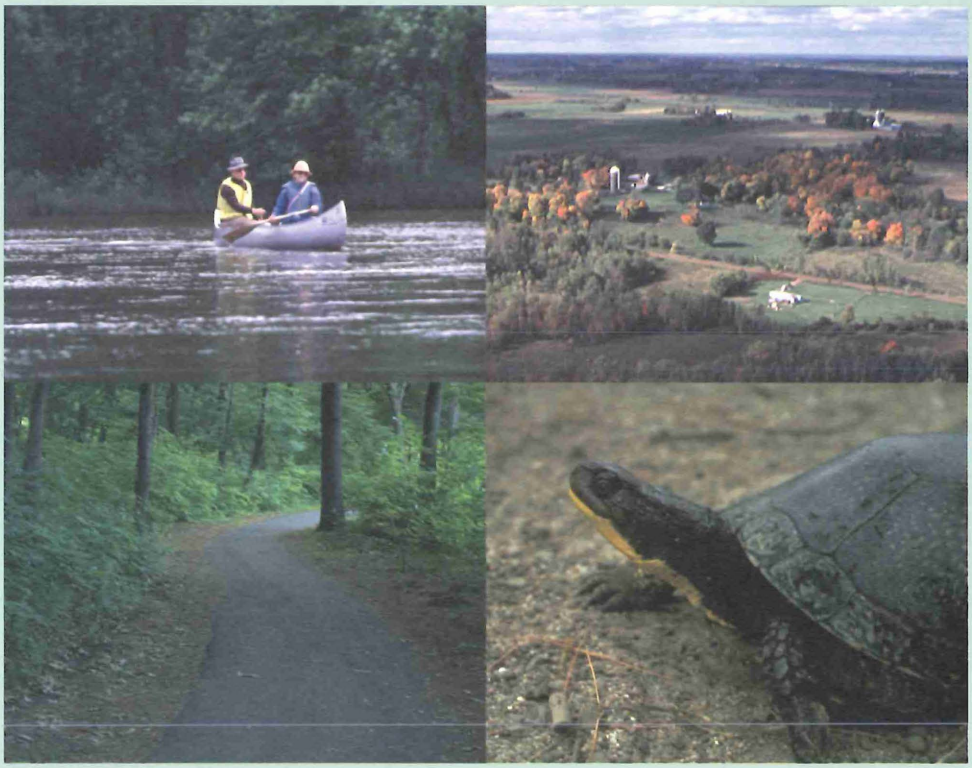
The future will see growing needs that challenge DNR's ability to meet recreation demand. These needs also will challenge DNR's ability to sustain a healthy environment where people recreate in large numbers. Challenges exist in four key areas:

- Rapid land use change will bring new populations to many areas and at the same time reduce open space needed to provide quality recreation opportunities.
- New forms of recreation (such as ATVs) and new user groups will place pressure on recreation lands and sensitive environmental areas and also bring new demands for outdoor recreation services.
- DNR will need to respond to new recreation demands with existing staff and budgets and must coordinate different and often competing activities. Managing conflict will be essential since not all uses are compatible with the same land. For example, motorized recreation and other types of "quiet" recreation often conflict.
- There are limits to what recreation users will tolerate in terms of crowding or resource deterioration. These limits can be reached suddenly and with little warning.

DNR will continue to work with partners to address future challenges in outdoor recreation. This will include monitoring resource impacts and user satisfaction, keeping citizens informed and involved, and carefully targeting resources to address the most critical needs.

Conservation Connections

Putting the pieces together



MNDNR

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Minnesota's open lands—our natural areas, parks, and working forests and grasslands—often seem hemmed in by pavement, buildings, and other habitat disruptions. Living things and natural processes increasingly are impounded on islands of habitat too small to support healthy populations for any length of time.

Dot to dot

Conservation Connections, begun in 2000, is a DNR-led effort to help connect these islands with corridors of habitat. By linking fragmented lands and waterways like the lines in a dot-to-dot puzzle, such corridors extend the habitat available to each living thing and so increase its ability to thrive.

Ultimately, Conservation Connections is envisioned to be a statewide network of natural areas, wildlife habitat, working forests, parks, farmlands, and other open spaces interconnected by land and water corridors.

Alert, advise, empower

Because Minnesota land is held in many hands, Conservation Connections is rooted in collaboration. DNR's role is primarily to alert, advise, and empower. We seek to educate citizens on the value of linking habitat; provide grants and technical support to help communities gather needed people and resources; and provide maps and advice for designing the most effective connections. Our next step is to extend our technical and financial assistance to local governments and communities through Alliance Grants for

- comprehensive natural resource inventories;
- community-based plans for protecting, connecting, and restoring natural habitat and open spaces; and
- community workshops to identify and set resource protection priorities.

Although Conservation Connections is still in its infancy, potential benefits abound—healthier plant and animal communities, cleaner air and water, and enhanced recreation and economic opportunities. As awareness of the value of habitat resources and connections grows, DNR anticipates widespread interest in establishing critical links throughout the state. The resulting network of natural lands and corridors will yield many long-term benefits for future generations.

The DNR Organization

Divisions	Bureaus	Regional Offices
Ecological Services	Engineering & Field Services	I. Bemidji
Enforcement	Human Resources	II. Grand Rapids
Fisheries	Information, Education and Licensing	III. Brainerd
Forestry	Management and Budget Services	IV. New Ulm
Lands and Minerals	Management Information Systems	V. Rochester
Parks and Recreation		VI. Metro
Trails and Waterways		
Waters		
Wildlife		

Overview

DNR's organizational infrastructure and human resources provide the means to manage natural resources. The department is organized into nine divisions and five supporting bureaus. DNR divides the state into six regions; all divisions and bureaus are represented in each regional office. Regions supervise staff in 123 area offices. Central office supports the field organization and operates and staffs many field programs.

Recently, DNR has undertaken several organizational changes to improve effectiveness:

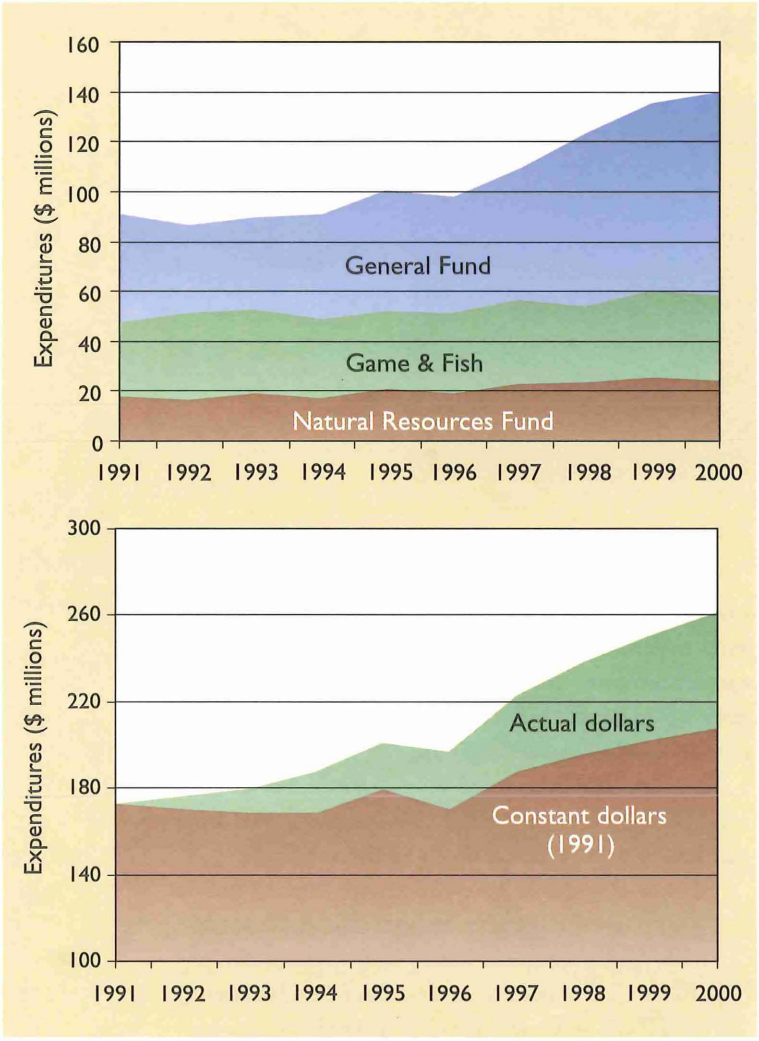
- Split the Division of Fish & Wildlife into three divisions: Fisheries, Wildlife, and Ecological Services.
- Consolidated the Office of Planning and the Financial Management Bureau to form the Office of Management and Budget Services.
- Consolidated the License Bureau and Information and Education Bureau to form the Bureau of Information, Education, and Licensing.
- Consolidated the Division of Minerals and the Bureau of Real Estate Management to form the Division of Lands and Minerals.
- Consolidated the Bureaus of Engineering and Field Services.

DNR conducted an in-depth assessment of the efficiency of DNR's regional organization and will continue to staff six regional offices.

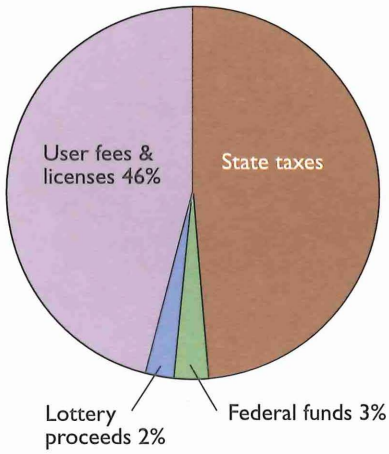
The mission of the DNR is ***to work with citizens to protect and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life.***

DNR efforts to fulfill this mission will be guided by an increased focus in three areas:

1) *Fiscal Responsibility*—DNR will ensure programs are financially responsible and ensure that funds are spent wisely and appropriately.
2) *Clear Communications and Decision-Making*—DNR will work with stakeholders to improve our communication and delivery of information and ensure accountability for efficient and effective public service.
3) *Human Resources Management*—DNR will constantly seek improvements to the quality of the work force to ensure that staff meets increased public demands for current and new services.



DNR 10-year budget history. When adjusted for inflation, DNR expenditures show an increase of 2.06 percent per year from 1991 to 2000.



DNR funding sources. DNR's FY 1999 operating budget was $246 million; tax supported expenditures were 1 percent of total General Fund expenditures. The average citizen paid about $25 for DNR programs, including $13.27 of individual income tax and $5.34 of sales tax.

Fiscal Responsibility

DNR's operating budget for the FY 2000-01 biennium is approximately $597 million, spread over 30 separate funds in 330 accounts. The state's General Fund accounts for approximately 49 percent of our budget. Much of the remainder is covered by "dedicated funds," such as the Game and Fish Fund and the Natural Resources Fund, that are earmarked for specific resource management activities. The Natural Resources Fund includes sub-funds for recreation related to water, snowmobiles, ATVs, off-highway motorcycles, off-road vehicles, and nongame wildlife. All major dedicated funds contribute proportionally to the general operations of the agency.

Revenues generated approximately 57 percent of the DNR operating budget in FY 2000. These revenues are derived from a wide variety of activities and sources and are deposited to a complex accounting structure. The major categories of revenues are:

- fishing and hunting licenses
- taxes, including sales tax and unrefunded gas tax
- vehicle registrations (watercraft, snowmobile, ATV, off-highway motorcycle, off-road vehicle)
- sale and use of natural resources (timber and mineral leases, land sales and leases, and water appropriations)
- use permits, such as park vehicle permits
- federal grants and cooperative agreements
- special revenue funds

DNR monitors its expenditures closely through a system of quarterly reviews at the commissioner level. We are working to develop an improved automated revenue management system to address the growing complexity of tracking and accounting for our funding sources.

Clear Communications and Decision-Making

DNR constantly seeks to improve our work with stakeholders. Good communication means actively listening to citizens and partners. It ensures accountability for efficient and effective public service.

DNR is committed to standing behind collective decisions and clearly communicating DNR's role in resource partnerships to citizens, legislators, local government, the media, the private sector, stakeholders, and other agencies. We consider all relevant information in making decisions. When we are not the deciding party, we advocate our interests. Within the limits of our staff, we are receptive and responsive to all inquiries. We accept criticism and respond to that criticism as appropriate.

In carrying forward our commitment to improved communication and decision-making, the department recently adopted two policies.

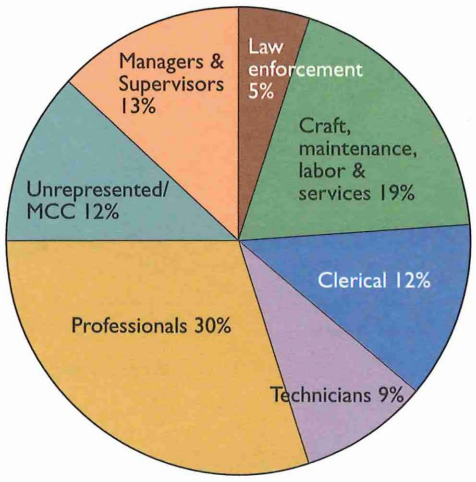
The Land and Easement Acquisition Policy directs department staff to consult with county governments when land and easements acquisitions are proposed. The intent of the policy is to build on the good working relationships the DNR has with county governments throughout Minnesota. The objective is to be honest and forthright and to allow county governments to assess the impact of land acquisitions by the DNR.

The DNR Communications Policy was established to guide all department communications with the media and clarify internal responsibilities and coordination. The policy is based on the principles of openness, courtesy, respect, and truthfulness. It recognizes that DNR communication with the public not only reinforces and enhances our mission, but also is a crucial part of fulfilling our mission. This policy outlines staff responsibilities for internal communication coordination and provides procedures for media contacts and news releases.

We will continue to adopt necessary policies and procedures to enhance our communications and decision-making.

Human Resources Management

DNR has more than 3,100 employees throughout the state. Employees in the central office manage statewide programs, work with the legislature, and support regional and field staff. Regional management teams implement natural resource management programs and provide administrative support for each of the six regions. Area management teams and watershed or landscape teams work at the local level to carry out natural resource management mandates and collaborate with local communities to meet mutually agreed-upon goals.

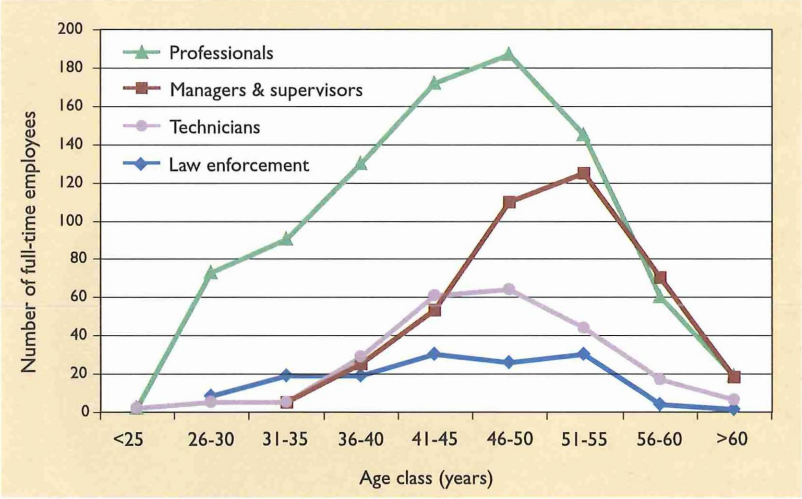


DNR employees by broad occupation (full and part time), fall 2000. Nearly one-third of the DNR work force serves in the professional category. That category faces the greatest percentage losses to retirement over the next few years.

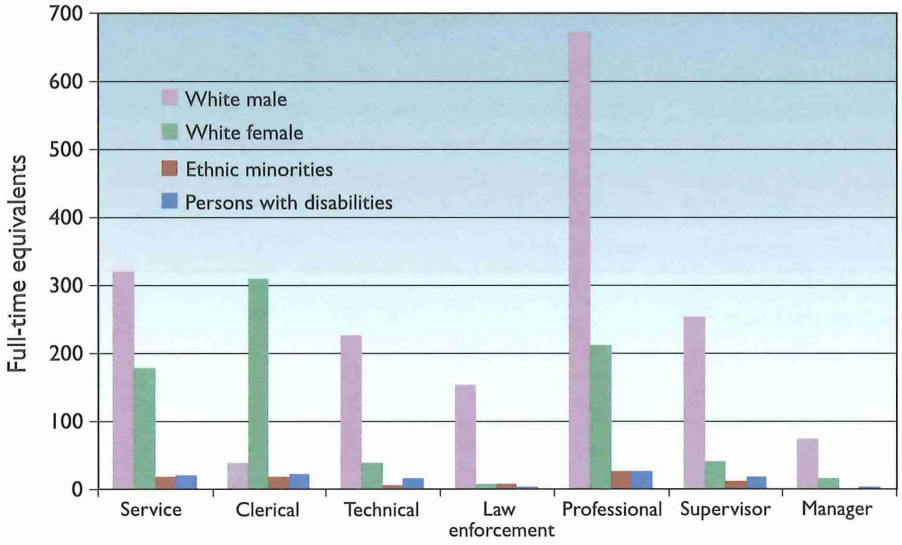
Critical Human Resource Issues Facing the DNR

Aging of the DNR Work Force. More than 35 percent of DNR employees are in the 46-55 age bracket. Many of these employees will retire in the next few years, taking with them a wealth of technical, organizational, and operational knowledge that cannot be easily replaced. Another 35 percent of DNR employees are in the 36-45 age bracket. While these employees are not expected to retire soon, many are involved in labor-intensive work. This work becomes more difficult and more likely to cause injuries as a person ages.

Having a Work Force that Mirrors the Public Served. Population projections for Minnesota for the next 20 years show a marked increase in minorities. Members of these communities use the state's natural resources; however some—in particular, new immigrants—may not be familiar with natural resources laws and regulations. Diversifying the DNR work force is critical to ensure that our programs and services are relevant for all citizens in our state and that policies are appropriately communicated to all who are affected by them.



Employee age distribution by occupation type. More than 70 percent of the DNR work force is in the 36-55 age bracket. This creates need for accelerated succession and work-force planning.



DNR employees statewide by protected group and white male status (full time and seasonal), August 2000. DNR's recruitment, hiring, and retention goals for females, ethnic minorities, and persons with disabilities are designed to create a work force that mirrors the population we serve.

To help address these issues, DNR has increased succession and work-force planning. We merged our Southeast Asian outreach, Southeast Asian environmental education, Hispanic outreach, and affirmative action and diversity programs, a move that directs additional resources, skills, and support to meet our recruitment, hiring, and retention goals for work-force diversity.

DNR adopted leadership themes for 2000-2001 that are used to build division and regional directors' performance objectives so that they can continue strong leadership and enhance our ability to manage the state's natural resources.

Some of these themes are:

How are you providing responsible leadership?

providing guidance, fostering creativity, supporting collaboration, modeling interest-based conflict management, carrying out succession and work-force planning

How are you serving diverse members of our community?

Americans with Disabilities Act access issues, affirmative action hiring opportunities, public involvement processes in planning and management

How are your ensuring that our employees work in a safe and harassment-free work environment?

holding routine director and management team discussions regarding employee safety and health, promoting and endorsing safety training, holding inspections, investigating accidents

The Task Ahead

As the DNR steps into the next century with the responsibility of sustainably managing Minnesota's natural resources, it faces new challenges and opportunities. Our natural resources are increasingly influenced by global forces: global economics, global climate change, and unprecedented global social mobility.

As a natural resource organization, we must develop more effective tools to anticipate and respond to changing conditions that will influence the future health of natural resources. Performance evaluation is one such tool.

This report documents what DNR and partners are doing to maintain a healthy natural environment. It records things we're doing well and our successes in sustaining our natural resources. It also records trends that pose troubling challenges for the future.

Indicators as Information Tools

Information is key to sound natural resource management. The Information Age has made vast quantities of data available. Indicators help us simplify and summarize those data into more concise measures.

Good indicators have several qualities. They are sensitive to natural resource change. They reflect public values. They are easily understood. They can be tracked over time.

This report uses indicators to help clarify and document natural resource trends and issues. Our goal is to routinely incorporate indicators into day-to-day decision making at all levels of our organization, using the information they provide to continuously improve our management approaches.

A First Step

DNR is committed to being a leader in developing indicators that integrate economic, social, and environmental values. We will continue to participate in interagency efforts such as the governor's Smart Growth initiative and the water management unification task force, and work to develop criteria and associated indicators for evaluating environmental policies and programs.

Development and use of performance indicators is in its infancy. We must enhance the effective use of indicators in two major ways:

1) DNR and partners need to cooperatively develop new indicators that gauge changes in natural resource conditions more accurately than existing indicators. We will need to foster partnerships to share the costs of environmental monitoring.
2) DNR needs to develop interim targets to measure progress toward long-term goals. For example, in five years, how many pheasants should we see harvested? How many acres of land should be enrolled in forest stewardship plans to ensure long-term sustainable forests? How many miles of trail should we construct over the next 10 years to meet outdoor recreation demand? We'll need to work closely with stakeholders to develop such targets.

Partnerships

Our role is to promote a stewardship ethic. The conservation, restoration, and sustainable use of natural resources rest with all citizens. We believe that citizens will make sound resource-use decisions if they have the right information. We believe that indicator information will help citizens better understand the linkages between human activity and resource conditions.

DNR will rely on an informed citizenry to help us better manage natural resources. We welcome a broader participation in assessing program effectiveness. We expect that future partnerships with citizens and stakeholders will result in a healthier environment. We expect that these partnerships will enhance the many benefits important to the economy of the state and the lifestyles of our citizens.

Appendix: Indicators Used in this Report

In this report we use approximately 120 indicators to describe natural resource conditions, DNR activities, and the results we hope to accomplish. These indicators highlight what is most central to DNR's mission and goals, including a wide range of partnership efforts and progress toward healthy natural resources and public benefits. We are committed to using indicators for sound natural resource management.

Water Resources Chapter

Lakes

Lakeshore development—homes per mile of lakeshore (p. 4)

Water quality—percent of lakes that are swimmable and fishable (p. 4)

Overall lake quality—lake user perceptions (p. 4)

Natural characteristics of shorelines—number of shoreline alteration permits issued (p. 5); number of lakescaping workshops and number of participants (p. 6); number of shoreline restorations (p. 6)

Wildlife—loon population trends (p. 6)

Fishing—fish populations and angler satisfaction (described in Recreation chapter pp. 66-67)

Rivers and streams

River protection—number of community-based plans updated for wild and scenic rivers (p. 7)

River health—mussel trends (p. 7)

Riparian alterations—percent of Minnesota streams that have been channelized (p. 8)

Restored natural characteristics—Whitewater River restoration (p. 8); fish numbers and diversity p. 8); location of dams removed along the Red River of the North (p. 9); fish passage (p. 9)

Flood damage reduction—number of flood gauge monitoring sites (p. 10); dollars provided for flood damage reduction and estimates of cost savings (p. 10)

Wetlands

Wetland status—distribution of remaining wetland acres in Minnesota (p. 11)

Wetland acreage—net change in acres on DNR-regulated wetlands (p. 12)

Wetland quality—number of wetland restorations (p. 13); number of wetlands with water-level management (p. 13); number of acres protected through acquisition (p .13)

Wildlife—breeding duck population trends (p. 13); waterfowl harvest (described in Recreation chapter p. 69)

Exotic species

Education and enforcement—number of boat inspections for exotics (p.14)

Awareness—percent of boaters aware of exotic species laws (p. 14)

Trends in exotics—number of water bodies infested with Eurasian watermilfoil (p. 14); number of watersheds still free of exotics (p. 13)

Water supply

Water use in Minnesota—number of gallons used by category over time (p. 15)

Water supply monitoring—number of observation wells (p. 16)

Water levels—depth to water in DNR observation well (p. 16)

Research and technical assistance—completion status of County Geologic Atlas maps (p. 16)

Water supply conservation—reduction in wasteful water use (p. 17)

Forest Resources Chapter

Enlarged and protected forest land

Forest status—percent of forest land owned by public and private (p. 23); acres of forest land (p. 24); acres of forest in five forest types (p. 24); forest age structure in northeastern Minnesota (p. 35)

Forest management—acres of forest land with stewardship plans (p. 26); acres of private land reforested with DNR assistance (p. 26); acres of state-administered land reforested following harvest (p. 35)

Fire management—number of wildfires suppressed by DNR (p. 27); acres treated using prescribed fire (p. 27)

Healthy, resilient forests

Old-growth—acres of old-growth forest protected by designation (p. 31)

White pine—acres planted to white pine (p. 32)

Forest wildlife—changes in forest bird populations (p. 32); gray wolf population size (p. 33); occupied bald eagle nesting areas (p. 33)

Forest economics and recreation

Forest industry—prices paid to public agencies for sawtimber and pulpwood (p. 24); value of forest products manufactured in Minnesota (p. 24); forest industry contribution to gross state product (p. 24)

Timber harvest—acres of forest harvested statewide (p. 34); acres of state-administered land harvest by harvest method (p. 34); projected timber harvest (p. 24)

State revenues—revenues generated from sale of timber on trust fund lands (p. 34); revenues from state mineral leases (p. 35)

Forest-based recreation—campsites in state forest campgrounds (p. 36); camper nights spend in state forest campgrounds (p. 36); miles of recreational trails in state forests (p. 36); off-highway vehicles registered for recreational use (p. 36)

Agricultural Areas Chapter

Resilient grasslands and water resources

Characteristics of agricultural areas—acres of agricultural land (p. 39); acres of cropland meeting crop residue targets in Minnesota River basin and statewide (p. 40); acres of Minnesota cropland with high, moderate, and low erodibility (p. 40)

Stewardship—number and acres of CREP easements obtained (p. 41); number of landowners participating in prairie Stewardship Planning Assistance Program (p. 43)

Prairie preservation—acres of prairie in state (p. 39); ownership of prairie (p. 40); acres enrolled in Native Prairie Bank (p. 43); acres enrolled in Native Prairie Tax Exemption Program (p. 43)

Wildlife—male prairie chickens per surveyed booming ground (p. 43); number of prairie chicken booming grounds surveyed (p. 43); number of prairie species threatened (p. 40)

Recreation in agricultural areas

Wildlife—ring-necked pheasant abundance index (p. 44); white-tailed deer harvested from agricultural areas (p. 44)

Recreation access—acres of land in WMAs (p. 44)

Habitat restoration—acres of wetlands and adjacent uplands restored or enhanced (p. 44)

Urban and Developing Areas Chapter

Land use

Land use and land cover—percent change in urban land (p. 49); watershed soil infiltration capacity (p. 50)

Sensitive aquatic communities

Rare wetlands—acres of calcareous fen communities (p. 51)

Trout streams—number of streams supporting trout (p. 50); miles of stream habitat restored (p. 50); target water temperature and temperature changes in response to restoration (p. 51); number of trout volunteers involved in stream restoration and monitoring (p. 50)

Natural areas and open space

Large intact natural areas and vegetative corridors—land acreage protected through natural areas and greenway plans (p. 53); DNR land as percent of total land acreage (p. 53)

Natural area restoration—acres covered by restoration and management plans (p. 52)

Local grant programs—number and dollar value of greenway planning grants (p. 53); acres protected through Natural and Scenic Area grants (p. 52)

Community forests

Tree mortality—number of oak wilt infection centers per square mile (p. 54)

Information and technical assistance to local communities—number of communities assisted (p. 54); number of tree planting projects, forest health projects, and tree inventories conducted by local communities (p. 54)

Assistance to local communities

Information and technical assistance to local communities—number of local governments using Minnesota County Biological Survey data (p. 55); number of counties where aggregate mapping has been completed (p. 56)

Urban wildlife populations—local deer populations (p. 57); goose populations (p. 57)

Indicators used in Recreation Chapter

Providing access to recreation lands and waters

Minnesota recreation facilities—percent of facilities administered by federal, state, county, private (p. 60)

DNR-administered lands and facilities—number of acres in state parks, WMAs and AMAs, and SNAs (p. 61); number of trail miles (p. 62); number of waters accesses (p. 62); number of fishing piers and shore sites (p.62); number of boating routes (p. 62)

Use and satisfaction with DNR facilities—number of state park visits (p. 61); percent satisfaction for state parks (p. 62); number of seasonal user hours for state trails (p. 62); percent satisfaction with state trails (p. 61); percent satisfaction with waters access (p. 61)

Meeting dynamic demand—use of facilities by distinct groups (e.g., number of Southeast Asian field trips) (p. 63); facilities developed through partnerships (e.g., number of new safe harbors) (p.63)

Sustaining healthy recreation lands and waters

Resource management—number of management projects completed (p. 64)

Law enforcement—number of warnings and summons (p. 65); number of arrests through Turn In Poachers (TIP) (p. 65)

Managing fish and wildlife for recreation

Fish populations—walleye; muskie; brown trout; steelhead (pp. 66-67)

Angler satisfaction—percent satisfaction with fishing in Minnesota (p. 66)

Game populations—deer; wild turkey; ruffed grouse; waterfowl (pp. 68-69)

Hunter satisfaction—percent satisfaction with hunting in Minnesota (p. 68)

Wildlife viewing—eagle (described in Forest Resources chapter p. 33); loon (described in Water Resources chapter p. 6)

Wildlife tourism—number of wildlife tourism workshops (p. 70)

Providing information and education

Information delivery—number of phone and e-mail inquiries; number of DNR webpage requests (p. 71)

Education delivery—number of people participating in education programs (p. 71)

Promoting safety

Safety training—number of volunteer instructors and people participating in safety training (firearms, recreation vehicles) (p. 72)

Accident trends—hunting-related accidents (p. 72)