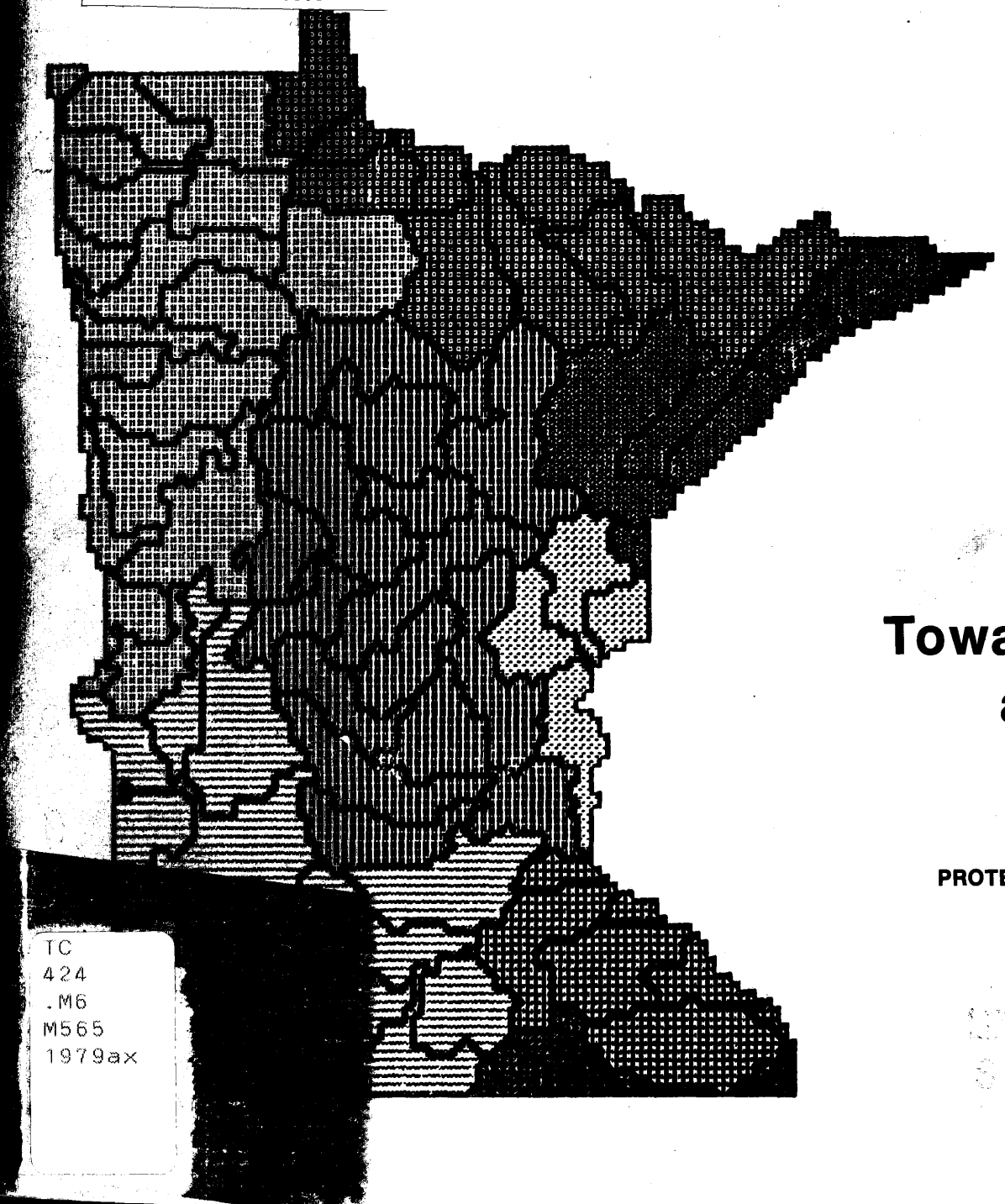

A REPORT OF THE MINNESOTA
WATER PLANNING BOARD
TO
THE LEGISLATIVE COMMISSION
ON MINNESOTA RESOURCES
AND
GOVERNOR ALBERT H. QUIE

Toward Efficient Allocation and Management:

A STRATEGY TO PRESERVE AND
PROTECT WATER AND RELATED LAND RESOURCES

JUNE 1979

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Department of Agriculture
Mark Seetin, Commissioner
Rollin Dennistoun, Alternate

Energy Agency
Al Johnson, Director
Ron Visness, Alternate

Department of Health
Dr. George Pettersen, Commissioner
Gary Englund, Alternate

Department of Natural Resources
Joseph Alexander, Commissioner
Steve Thorne, Alternate

Pollution Control Agency
Terry Hoffman, Executive Director
C.A. Johannes, Alternate

Soil and Water Conservation Board
Leonard Pikal, Chairman
Vernon Reinert, Alternate

Thomas Kalitowski, Chairman

The members of the Technical Committee of the Water Planning Board are:

Steve Levy, DOA
Norm Fox, DED
Edwin Ross, MDH
Ron Visness, MEA
Rob Arnold, DNR
Matt Walton, MGS
C.A. Johannes, PCA
Steve Pedersen, SWCB
Joe Sizer, SPA
Tom Jorgens, MARC

Jack Ditmore, WPB, Chairman

The members of the Work Groups serving the Board (excluding Technical Committee members) include:

Bonnie Skelton, DOA
Linda Bruemmer, MDH
Susanne Maeder, MEA
Dennis Devereaux, MEA
Bob Tyler, MEA
Ernie Venegas, MEA
Gene Hollenstein, DNR
Dennis Woodward, DNR
Eric Madsen, DNR
Bruce Olsen, MGS
Roman Kanivetsky, MGS
Dick Holtzman, MGS
Gary Oberts, Met Council
John Velin, LCMR
Joe Gibson, DNR
George Orning, DNR
Denny Quan, DNR
Brandt Richardson, DNR
John Wells, DNR
Larry Seymour, DNR
Paul Davis, PCA
Amos Roos, PCA
Bob Pope, PCA
Mary Louise Dudding, SPA
Les Maki, SPA
Jim Ramstrom, SPA
Marilyn Lundberg, SMRBB
Mel Sinn, WRB

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EXECUTIVE SUMMARY

Toward Efficient Allocation and Management: A Strategy to Preserve and Protect Water and Related Land Resources

To prudently employ, protect, and preserve our water and related land resources, the state, its political subdivisions, and its people must work together to promote efficient allocation and effective management. This emphasis on a cooperative effort in these areas is at the heart of the "TEAM" plan prepared by the Minnesota Water Planning Board.

The thesis of the Board is that without intensified, coordinated dedication to careful allocation and management of the state's water and related land resources, pressures from an expanding society will lead to the depletion and degradation of the state's water supply to the detriment of the health and welfare of its citizens. The multitude of water and related land resource problems faced by the state are complex. Thus, any effort to provide solutions to these problems is necessarily a first step. No easy answer to the many and varied problems exists. However, it is the intent of the Water Planning Board that the information presented — much of it available for the first time — contribute to the decision-making process which ultimately will lead to successful resolution of the critical water management problems facing Minnesota.

1. THE FRAMEWORK PLAN PROCESS

Influenced by the 1976 drought and aware of the concern of the Legislative Commission on Minnesota Resources that natural resources decision-making be promoted within the framework of an explicit strategy, the Legislature created the Water Planning Board in 1977. Among other things, the Board was charged with directing the preparation of a Framework Water and Related Land Resources Plan for Minnesota and assuring public participation in the planning process. The planning effort was supported by funds provided by the Legislative Commission on Minnesota Resources.

On the basis of 19 major staff papers and public review of these papers, a first draft of a "Framework for a Water and Related Land Resources Strategy for Minnesota" was prepared in April 1979. The draft was distributed for public review and comment, including 14 public meetings held in cities throughout Minnesota. Public comments and criticism were used to revise and refine the draft of the Framework Plan, which was subsequently approved by the Water Planning Board on June 19, 1979. This draft — containing over 90 specific recommendations — is submitted to the Governor, the Legislature, and the citizens of Minnesota for action.

2. THE NEED FOR ACTION

Minnesota is not now in a state of water crisis. We should not mistake the 1976 drought for our normal situation. But the lessons of the drought must not be forgotten. The 1976 drought demonstrated that severe water supply problems can appear even in a "water-rich" state. The problems highlighted by the drought, along with continuing conflicting demands and pressures for enhancing the environment and for improving economic well-being, will produce growing concern for the state's water and related land resources.

The responses to several major problems are likely to significantly affect the future of the state. Adequate management of our water and related land resources, includng the development and use of critical information, is a long-standing problem. Pollution of streams, lakes, and ground water is likely to remain a concern for years to come. The provision of recreational opportunities in the face of an expanding population and a deteriorating energy picture is an ongoing need. Rural flooding in the Red River Basin and urban flooding in southeastern Minnesota create problems which are still unresolved. The wetlands-drainage controversy shows no signs of disappearing. The current method of allocating water resources in Minnesota may not be efficient in periods of crisis. Agricultural soil erosion. erosion and sedimetation from construction sites, irrigation growth, shoreland development, and rural water system construction raise land use questions. In addition, the lack of public awareness of water-related issues may be at the heart of many problems.

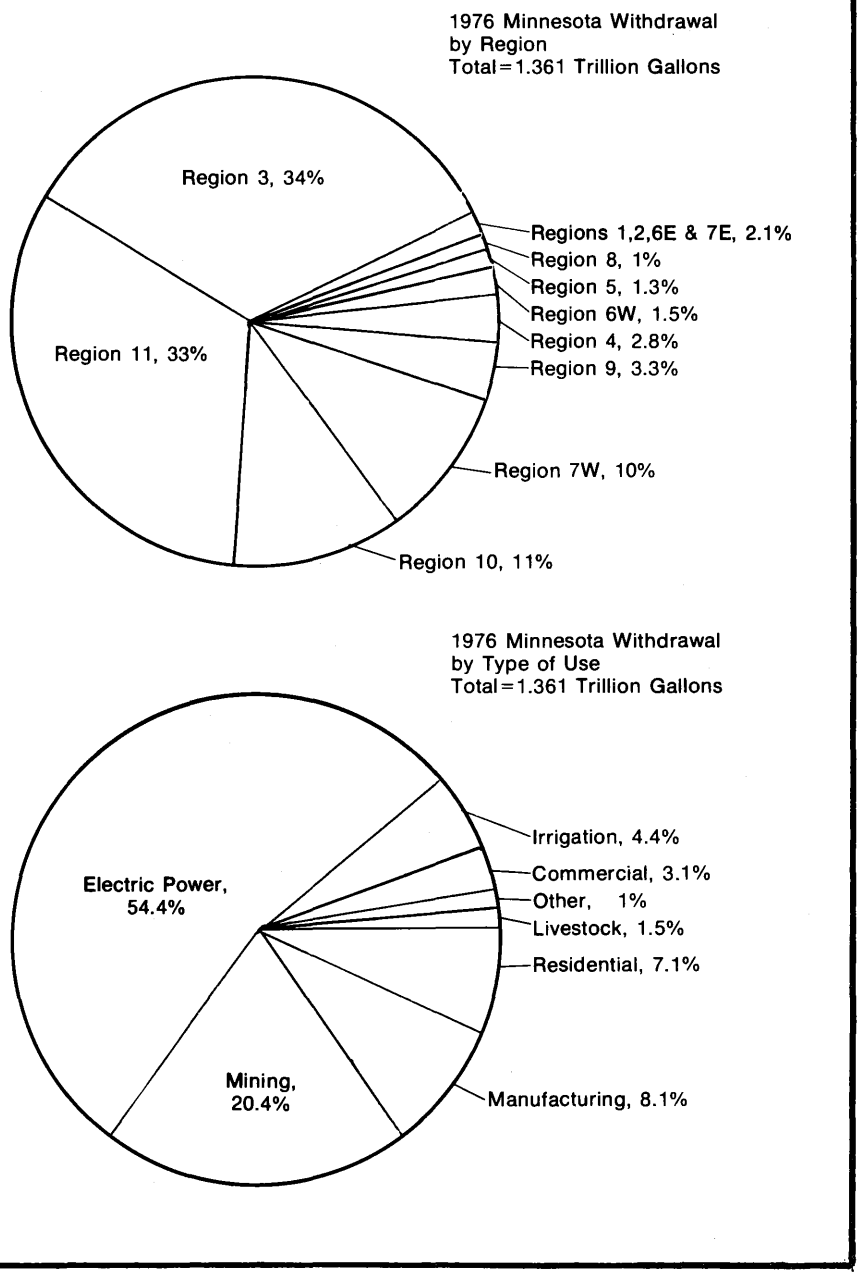
Minnesota is fortunate not to have to respond to these problems in an atmosphere of crisis. The future holds great potential for the state. On a regional basis, there do not appear to be severe ground-water shortages at this time or in the immediate future. While low streamflow is a problem in the western area of the state, surface waters are generally adequate in the populous areas which rely on them. However, the absence of an immediate crisis is not a reason to postpone action. Minnesota must act now to develop a strategy to set change in motion and, by so doing, avoid having to make hasty, perhaps reckless, changes in the future.

3. THE STATE OF WATER AND RELATED LAND RESOURCES

In 1976, water withdrawals in Minnesota (excluding hydropower) approached 1.4 trillion gallons per year — or roughly enough 32-gallon barrels of water to reach from the earth to the moon and back 52 times. The amount of water used in Minnesota in 1976 would also have been sufficient to cover the Twin Cities metropolitan area to a depth of 2.5 feet. Water was withdrawn for domestic consumption, municipal needs, industrial production, food processing, irrigation, livestock use, and electric power generation.

The electric utility industry was by far the largest water withdrawer in Minnesota, accounting for over 54 percent of total withdrawals. The bulk of this water was employed for power plant cooling. The mining industry accounted for about 20 percent of total withdrawals in 1976, with nearly all of these withdrawals concentrated in northeastern Minnesota. No other sector of the economy accounted for more that 10 percent of total withdrawals. (See Figures 1a. and 1b.)

FIGURE 1a



Consumption — that part of the water withdrawn that is no longer available for other uses because it has been evaporated, incorporated into products and crops, consumed by man or livestock, or otherwise made unavailable — was estimated to be only about 13 percent of total withdrawals in 1976, or about 179 billion gallons. Agriculture and mining were the most substantial consumers of water, accounting for about 38 percent and 34 percent, respectively, of estimated state consumption. Agriculture leaps from a relatively minor withdrawer to a major consumptive use, largely because all water withdrawn for livestock use and 80 percent of the water withdrawn for irrigation are estimated to be consumed. Electric power production accounts for only about 12 percent of the water consumed in Minnesota. (See Figures 2a. and 2b.)

Under "baseline" assumptions (i.e., an extrapolation of current trends), it is estimated that by 1990 total withdrawals could increase by over 15 percent and consumption by nearly 92 percent. If a "conservation scenario" is employed for 1990, withdrawals might be held to about a five percent increase over 1976 levels, although consumption is estimated to increase by about 85 percent. Two sectors — irrigation and electric power production — are principally responsible for the large increase in consumption relative to withdrawals. Irrigation, which is highly consumptive, is expected to be the most rapidly increasing sector in terms of water use. Electric power production withdrawals are expected to decline due to changes in cooling technology, while related consumptive use will increase markedly. The decline in withdrawals for electric power generation masks increases in withdrawals occurring in other sectors.

In addition to the uses of water that are partially or totally consumptive of the resource, there are many significant nonconsumptive uses of water. These include hydroelectric power generation, navigation, recreation, fish and wildlife habitat, and waste assimilation.

Fortunately, to support its substantial withdrawals, Minnesota has abundant supplies of surface and ground water. It is estimated that in an average year over 11.3 trillion gallons of water are available in the state from surface supplies. This includes an estimated 3.1 trillion gallons in the Rainy River basin; 2.6 trillion gallons in the Lower Mississippi River basin; and 2.0 trillion gallons in the Upper Mississippi River basin (see Table 1). Using conservative assumptions which incorporate only surficial and bedrock aquifers discharging water into streams, it is estimated that ground-water availability equals some 1.1 to 2.0 trillion gallons in Minnesota. These estimates include 500 to 800 billion gallons of available ground water in the Upper Mississippi River basin; 175 to 300 billion gallons in the Lower Mississippi River basin; and 130 to 280 billion gallons in the Minnesota River basin (see Table 1).

Despite this generally positive picture of demand and supply, there are very significant cautions. Water resources are not evenly distributed across the state. As a result, localized shortages occur or have the potential to occur where users are concentrated, where withdrawers are too near the headwaters of a subbasin, or where a potential user is simply not located near a readily obtainable ground- or surface-water supply. In some cases, water supplies may be unable to sustain flows or pumping at desired rates. Finally, major natural occurrences — such as the drought of 1976 — cannot be accurately predicted and have demonstrated the capacity to create tremendous problems even in a generally "water-rich" state.

While the preceding discussion of the state of water resources has focused on water supply and demand, the only concerns of the state do not rest with water quantity issues. Water quality is of critical importance. Flooding will continue to occur. Land use decisions will affect both water supplies and quality.

Because clean water resources are an important tourist attraction, provide a principal recreational resource for citizens of Minnesota, and serve as the essential source of supply for domestic and industrial use, considerable concern must be focused on water quality issues. These issues are being addressed in detail by the Minnesota Pollution Control Agency and the Metropolitan Council. When complete, the results of their studies will become the water quality elements of the state water resources strategy.

The economic losses due to flooding in Minnesota are conservatively estimated at $54 million (1978 dollars) annually. About 35 percent of the losses are estimated to occur in the Minnesota River basin and about 30 percent in the Red River basin. Flood damage reduction programs have traditionally fallen within the purview of the federal government, but require additional state emphasis.

Finally, land use decisions affect water supply, demand, and quality and must be viewed within such a framework. Irrigation, flood plain management, designation of wild and scenic rivers and critical areas, shoreland development, mining, industrial development, and the introduction of rural water supply systems are among the major land use decisions in which water is a factor. The use of the land and the protection provided to it affect water quality and supply.

4. FOUR REQUIREMENTS FOR THE FUTURE

While Minnesota faces a wide array of water and related land resources problems, it also has great potential. The Water Planning Board believes four requirements must be met if Minnesota is to achieve its potential. The requirements are:

** A stronger focus on effective management — a cornerstone of Minnesota policy in the past, but even more important in the future.

** Greater emphasis on the efficient allocation and use of water resources and rejection of the concept of water as a limitless, free good.

** Improved collection and dissemination of information for use in making critical water and related land resources decisions.

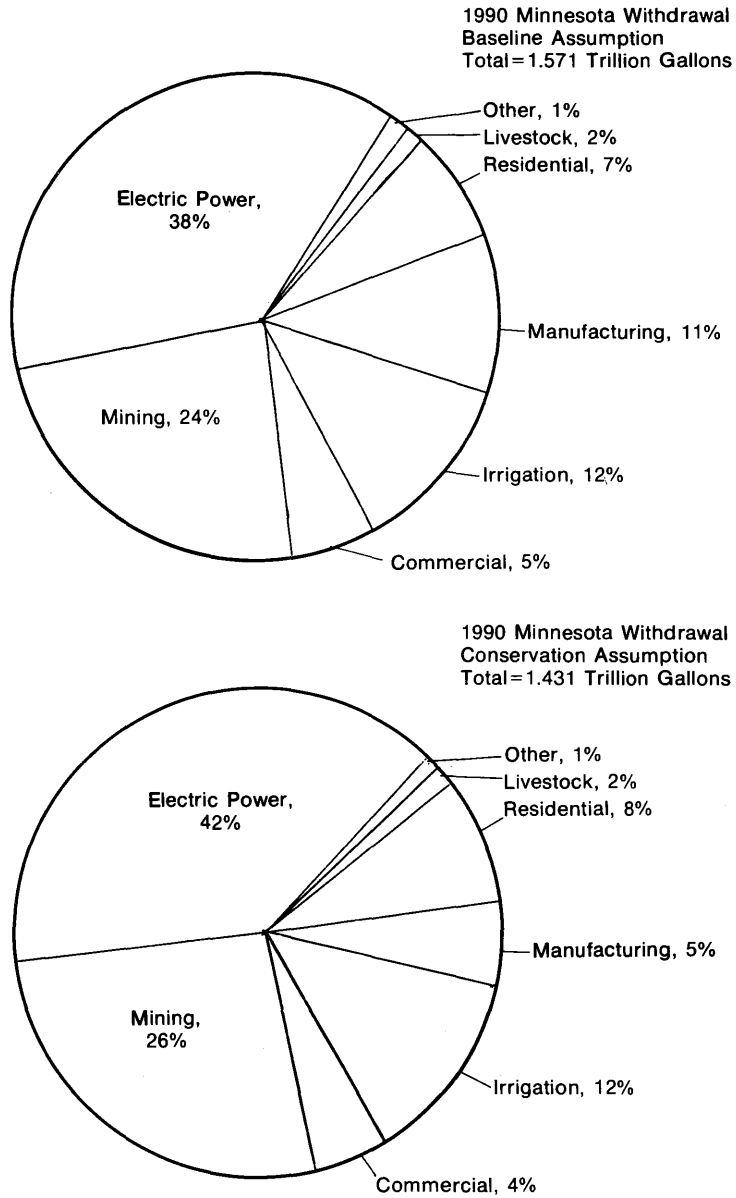
** Planning, research, and decision-making that deals with the interdependence of issues and places increased emphasis on the state as a unit.

The four central requirements for securing the state's resources future must be met if Minnesota is to move toward efficient allocation and management of its water and related land resources.

5. STRONG FOCUS ON EFFECTIVE MANAGEMENT

Five levels of government — the federal, interstate, state, regional, and local — are currently involved in decision-making affecting water and land related resources in Minnesota. The existing institutions have not always worked together effectively or functioned efficiently internally. A fragmented, often disorganized approach to water management has evolved which fails to recognize or deal effectively with the interdependence of water problems and management solutions.

FIGURE 1b



At the state level, the Water Planning Board has identified 16 state agencies and boards which administer more than 80 water-related programs. The execution of these programs requires the coordination and exchange of vast amounts of information among various decision-makers in order to achieve program goals.

The Departments of Natural Resources and Health and the Pollution Control Agency are the major water management agencies in the state. Of the 63 programs reported on by the Board, these three agencies were responsible for 46, or nearly 75 percent. In contrast, the Minnesota Historical Society and the Iron Range Resources and Rehabilitation Board have only tangential program responsibility. (Table 2 lists the 11 other agencies and boards.)

Federal responsibilities in water and related land resources management, planning, and development in Minnesota are divided among eight executive departments, five independent agencies, several units in the Executive Office of the President, and a number of other boards, committees, councils, and commissions. There are at least seven interstate bodies directly involved with water resources in Minnesota; five intrastate and regional entities; and 14 local units of government (See Table 2.)

Minnesota's major water management programs can be grouped into five topical areas: (1) water resources planning and environmental review; (2) water quality management; (3) water quantity management; (4) related land resources management; and (5) wildlife and recreation management. Analysis of state programs in these five areas revealed 152 specific problems encountered in the operation of programs which prohibit the effective realization of program goals. Some of these problems are very real; some could arise in theory, but have not been a hindrance to date; and some are admittedly of less significance. Of the 152 problem areas, 34 were judged to be highly relevant for further analysis, 64 were judged to be of medium relevance, and 54 were determined to be low of importance from an institutional perspective.

To deal with the deficiencies in the existing system, the Water Planning Board proposes a strategy that will strengthen the ability of Minnesotans to determine how they choose to manage their water and related land resources. The Board proposes that:

** The state serve as the steward of Minnesota's water and related land resources, providing policy guidance and incentives for local and regional action;

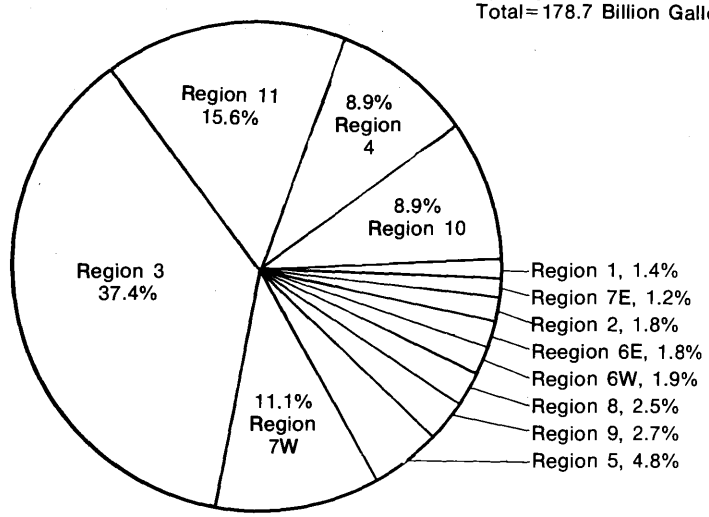
** Regional entities focus on integrating local interests with a comprehensive view, providing coordination among levels of government, and affording assistance to local bodies; and

** Local governments initiate local management plans and implement solutions to identified problems, consistent with state policy guidelines.

This hierarchy requires continuous three-way interaction between the state, regional bodies, and local units of government; efforts to refine and improve authorities and to clarify relationships at each level; and better mechanisms to achieve communication among all parties.

FIGURE 2a

1976 Minnesota Consumption
by Region
Total=178.7 Billion Gallons



1976 Minnesota Consumption
by Type of Use
Total=178.7 Billion Gallons

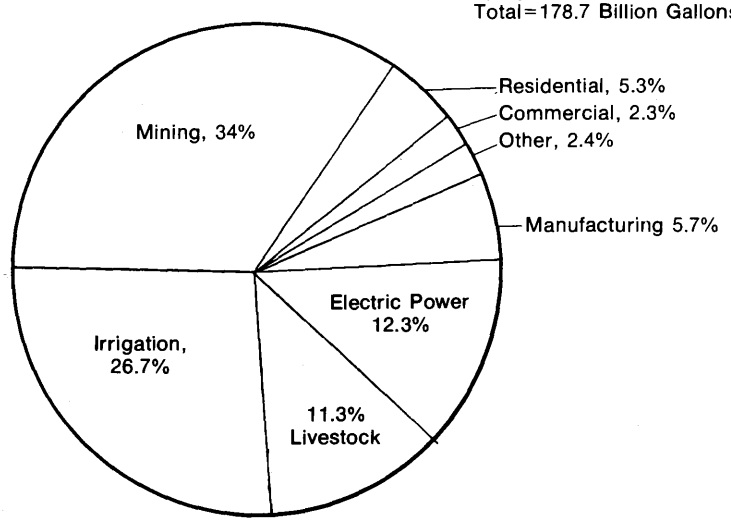
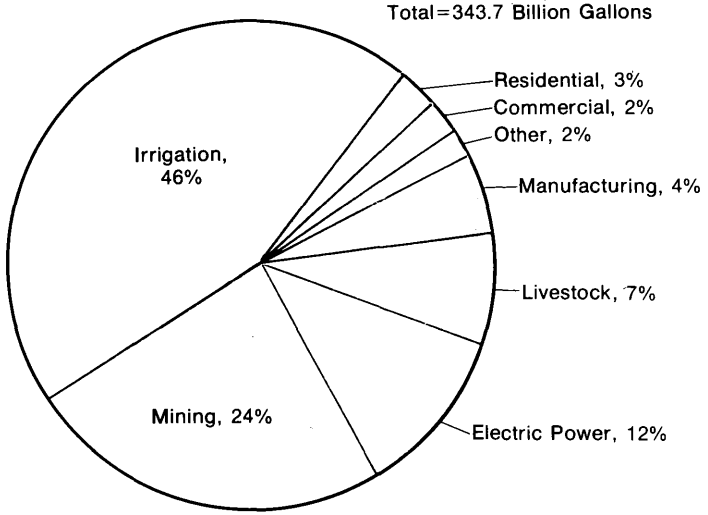
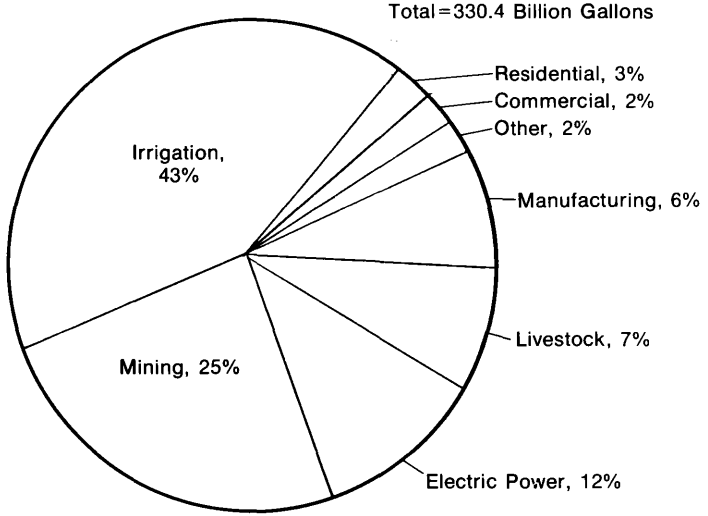


FIGURE 2b

1990 Minnesota Consumption
Baseline Assumption
Total=343.7 Billion Gallons



1990 Minnesota Consumption
Conservation Assumption
Total=330.4 Billion Gallons



The fundamental requirement of the Board's strategy is an ongoing process for making water policy and water management decisions in Minnesota. In order to function fully, the process must be centered on one organization at each level of government. This organization must be capable of identifying and coordinating often competing and conflicting views. It must be capable of expressing and addressing the needs for effective water management at its particular level of government. In the Board's opinion:

** A water resources coordinating body is necessary to provide a focal point for the process at the state level;

** The regional development commissions should be utilized to provide the important link in the process between state policy and local plans (with assistance in the regional role from **ad hoc** river basin boards or joint powers arrangements in special situations); and

** Watershed districts, where they exist, and general purpose governments (e.g., counties and municipalities), where watershed districts do not exist, should be the focal point for the development of local water management plans.

In the development of local management plans, soil and water conservation districts must play a major role and become responsible for the soil and water conservation elements of such plans.

To implement this management strategy, the Water Planning Board recommends:

1. **Establishment of a water resources coordinating body with adequate authority to carry out coordinating functions.** This body is essential to insure comprehensive policy development which includes the views of state, local, regional, and public interests; to deal with the range of activities which cut across agency interests, levels of government, and political boundaries; to resolve interagency conflicts; to integrate plans of local and regional agencies with state strategies; to initiate and coordinate comprehensive water resources planning; to advise the Legislature on the compatibility of agency budgetary requests with the state's overall policy and strategy; to facilitate the receipt and effective utilization of federal funds; and to insure citizen involvement in water resources policymaking. The Legislature should select the type of organization it desires to carry out the coordinating functions from among major options such as the Department of Natural Resources, the Environmental Quality Board, a board modeled after the Water Planning Board (perhaps with alterations in its make-up), and a citizens board.

2. **Initiation of program planning and evaluation functions within each water management agency.** These functions would provide the essential link between agency strategy, the state water resources strategy, and the budgetary process. The full implementation of this recommendation would lead to the development of programs which are understandable in their operation and effects, which have the effects intended, and which are subject to policy and fiscal control.

3. **Implementation of a binding process for interagency conflict resolution carried out by the state coordinating body.** The coordinating body would be authorized to resolve water policy conflicts involving two or more state agencies where these agencies are unable to reach a mutually acceptable course of action in a timely fashion. This function could be clearly distinguished from the environmental conflict resolution process of the Environmental Quality Board and would replace similar functions now held by the Water Resources Board. Resolution of private-state conflicts would continue to be handled through the Office of Hearing Examiners and the courts.

The Water Planning Board believes that the three preceding recommendations, working in concert, negate the need for a major reorganization of state water management agencies into either a Department of Waters or a natural resources "super" agency. By redirecting and refining existing structures, the Board believes the state can avoid the costs (capital, administrative, and human) of a major reorganization and still effectively manage its resources. The water resources coordinating body need not constitute a major investment, probably requiring about one precent of the state's water and related land use program budget annually. However, it is recommended that within five years of the initiation of the preceding recommendations, the state coordinating body reevaluate the Board's decision.

4. **Increased emphasis on the initiation of water management plans and projects at the local level, consistent with state policy guidelines.** Development of water management plans is an effective way for local government to (1) address water management problems systematically and comprehensively, (2) provide a focus for citizen involvement and participation in the solution of water resources problems, (3) speed state approval of permits that might be required in implementing the plan by having prior acceptance of local directions at the state and regional level, and (4) facilitate the administration of state permit programs at the local level, when feasible.

5. **Adoption of a natural resources management fund targeted at assisting local water management authorities in implementing state-mandated programs.** Administered through the State Planning Agency, this fund would provide money for implementation of state-mandated programs at the local level. Local water management authorities would be required to develop program plans for review by a committee made up of natural resources management agencies in order to demonstrate need and feasibility of approaches.

6. **Detailed examination of the feasibility of consolidating functions of the Soil and Water Conservation Board, the Water Resources Board, and the oversight of lake improvement district formation by the Department of Natural Resources.** The staff of the Water Planning Board, in consultation with the SWCB, the WRB, and the DNR, will conduct this examination. Staff findings are to be presented to the Board by March 1, 1980. The staff analysis will include specific proposals for legislative action if consolidation is found to be feasible and desirable. The Water Planning Board will evaluate study results and make any appropriate recommendations to the Governor and the Legislature. The staff study should be carried out with recognition of the need for clarifying functions and changing authorities at the local level of water management.

7. **Development of a statewide flood damage reduction grant-in-aid program administered through the Department of Natural Resources and the Soil and Water Conservation Board.** The purpose of the grant-in-aid program would be to provide incentives to local units of government to implement flood damage reduction measures, both structural and non-structural. The Department of Natural Resources would be charged with determining initial eligibility of proposals through review and approval of comprehensive flood plain management plans. The DNR and the Soil and Water Conservation Board would establish by formal agreement procedures for coordinating administration of grants for structural measures (by the SWCB) and grants for non-structural measures (by the DNR).

8. **Execution of three water management functions at the regional level — provision of a forum for citizen participation, regional coordination with comprehensive planning efforts, and implementation of regionwide projects where necessitated by hydrologic conditions.** Regional development commissions would be charged with providing the forum for citizen participation and with the responsibility for coordination. River basin boards, similar to the present Southern Minnesota Rivers Basin Board, should be formed on an **ad hoc** basis as major river basin studies are developed.

6. GREATER EMPHASIS ON EFFICIENT ALLOCATION AND USE

Traditionally, water planning for the future has been concerned chiefly with the problem of acquiring and developing additional supplies. Assuring efficient use of available supplies has only recently come to the fore.

While Minnesota is a "water-rich" state, it experiences many of the same water-related problems occurring nationwide. These problems appear in localized shortages. Three factors contribute to localized water shortages. First, expanding population pressure increases the demand for water from municipal and domestic supplies. High density population also increases water use and demand for goods requiring water for manufacturing and processing. Second, advancing technology and a rising standard of living increase water demand and encourage new uses in agriculture, industry, municipalities, and homes. Finally, natural precipitation remains unpredictable.

The State of Minnesota has attempted to promote efficient and beneficial use of its water resources by applying precedent and enacting legislation. The basic Common Law Riparian Doctrine has been modified to what is known as the American Reasonable Use Doctrine of Riparian Rights. Under this doctrine, each riparian land holder has a privilege to make reasonable beneficial use of available water. Minnesota law establishes a priority system for granting water appropriation permits.

The Department of Natural Resources has been charged since 1947 with the responsibility to "develop a general water resources conservation program for the state." As recently as 1977, the Legislature enacted legislation to provide for more efficient use of water through water conservation approaches.

The intent of state law has been to preserve water supplies for the future; to protect the quality of existing supplies; and to postpone development of untapped supplies. The efficient use of water resources can reduce the need to construct new sewage treatment facilities and reduce the costs associated with

TABLE 1
ESTIMATED GROUND AND SURFACE WATER AVAILABLE
(in billions of gallons)

MAJOR WATERSHED	GROUND WATER AVAILABLE	SURFACE WATER AVAILABLE		
		Average for Period of Record	1976 Drought	Inflow to Basin
Upper Mississippi River	500-800	2,035	1,285	0
Lower Mississippi River	175-300	2,607[1]	2,392[1]	3,816
St. Croix River	85-175	1,330[1]	1,146[1]	0
Minnesota River	130-280	627	269	0
Lake Superior	55-110	698[2]	474[3]	0
Red River	77-165	768	673	0
Rainy River	35-85	3,137[4]	2,153[4]	0
Cedar River	25-50	44	23	0
Des Moines River	10-25	64	20	0
Missouri River	5-10	N.A.	N.A.	0
Total	1,097-2,000	11,310[5]	8,435[5]	3,816

1 Includes water from Wisconsin portion of watershed unit.
2 Estimates are low because of the number of ungaged tributaries flowing into Lake Superior
3 Lake Superior provides a massive source of water for users located near the lake
4 Includes water from the Canadian portion of the basin
5 Assumes Missouri River Basin is zero

energy demand. To further this intent and to improve on Minnesota's past efforts, the Water Planning Board recommends:

1. **Repeal of the existing priority system, replacing it with a more flexible system capable of meeting area needs in critical situations.** While the present priorities system has positive aspects, important problems exist. The present system does not necessarily promote efficient allocation; may in some cases be infeasible; and is not necessarily equitable. In place of the present system, a system consisting of three main priority classes should be established: (1) basic necessity uses, (2) environmental protection requirements, and (3) economic production. To fully define and refine the "basic necessity uses" and "environmental protection" classes, the coordinating body, in consultation with appropriate agencies, will quantify these classes prior to submission of legislation to repeal the existing system. Subject to these requirements and pending the development of local management plans, regional development commissions may develop regional "economic" class priorities, which will be advisory to the DNR. Where an RDC elects not to establish regional priorities, the Commissioner of Natural Resources may establish priorities for the region.

2. **Adoption of explicit guidelines for settling well interference disputes.** Rules and guidelines for the settlement of well interference disputes should be based on three explicit responsibilities: (1) All appropriators of water shall be responsible for making a reasonable effort to obtain water in sufficient quantity and quality for their needs; (2) all appropriators shall be responsible for meeting the well code requirements of the Minnesota Department of Health; and (3) if further development of the aquifer causes interference with existing appropriators who are meeting their responsibilities, the new appropriator (or appropriators) shall be responsible for the costs of corrective measures, including any needed treatment facilities. The Department of Natural Resources will, by rule, define the concept of "a reasonable effort to obtain" an adequate supply of water.

TABLE 2.
LEVELS OF GOVERNMENT IN WATER MANAGEMENT

THE FEDERAL LEVEL

A. Executive Agencies

1. Department of Agriculture
2. Department of Commerce
3. Department of Defense
4. Department of Energy
5. Department of HEW
6. Department of HUD
7. Department of Interior
8. Department of Transportation

B. Independent Agencies

1. Environmental Protection Agency
2. Water Resources Council
3. Interstate Commerce Commission
4. National Science Foundation

C. Executive Office of the President

D. Other Boards, Committees, Councils, etc.

THE INTERSTATE LEVEL

1. Upper Mississippi River Basin Commission
2. Missouri River Basin Commission
3. Great Lakes Basin Commission
4. Souris-Red-Rainy Regional Committee
5. Great Lakes Commission
6. Minnesota-Wisconsin Boundary Area Comm.
7. South Dakota-Minnesota Boundary Waters Comm.

THE REGIONAL (INTRASTATE) LEVEL

1. Regional Development Commissions
2. Metropolitan Council
3. Southern Minnesota Rivers Basin Board
4. Lower Red River Watershed Management Board
5. Resource Conservation and Development Areas

THE STATE LEVEL

1. Department of Agriculture
2. Department of Economic Development
3. Department of Health
4. Department of Natural Resources
5. Department of Transportation
6. Division of Emergency Services (Department of Public Safety)
7. Energy Agency
8. Environmental Quality Board
9. Iron Range Resources and Rehabilitation Board
10. Minnesota Historical Society
11. Pollution Control Agency
12. Soil and Water Conservation Board
13. State Planning Agency
14. University of Minnesota
15. Water Planning Board
16. Water Resources Board

THE LOCAL LEVEL

1. Counties
2. Municipalities
3. Townships
4. Watershed districts
5. Soil and water conservation districts
6. Drainage and conservancy districts
7. FmHA county committees
8. Lake conservation districts
9. Lake improvement districts
10. Water authorities
11. Sanitary districts
12. Sewer authorities
13. Public drainage authorities
14. ASCS county committees

3. **Development of a comprehensive water surface management program.** There is a need to recognize lakes and streams as management units in order to assure a comprehensive approach to decision-making regarding them. Recognition of this need necessitates that goals, objectives, and policies for water surface management on a statewide basis be developed. These should be developed through an interagency task force, led by the Department of Natural Resources. In addition, accelerated acquisition of public access to surface waters should be undertaken, focusing on the metropolitan area and areas of rapid lakeshore development.

4. **Determination of wetland values and accelerated implementation of the Public Waters and the Water Bank Programs.** Among other things, the Department of Natural Resources should (1) identify state goals for wetland management; (2) determine specific characteristics of wetlands providing flood control, nutrient and sediment retention, ground-water recharge, and other public benefits (with financial assistance from the Corps of Engineers); and (3) undertake a statewide inventory of wetlands which reflect the characteristics and values of wetlands providing public benefit. When these activities have been completed, priorities for compensation and acquisition programs can be established, with adequate compensation to encourage wetland preservation.

5. **Initiation of a water conservation technical assistance program.** Water conservation programs are a potentially effective means of promoting efficient water withdrawal and consumption in Minnesota. Employing federal funds expected to become available as a result of federal water policy initiatives, the state should take the lead in obtaining, evaluating, and disseminating information on conservation techniques through an education and technical assistance program closely tied to existing structures (e.g., the Agricultural Extension Service, the Department of Education, and the Minnesota Environmental Education Board). The state coordinating body should be designated as the clearinghouse for these activities. Emphasis should be on voluntary adoption of techniques, with programs arising from the local level employing state technical assistance.

6. **Establishment of a pilot project to evaluate marginal cost pricing for municipal water supplies through actual application by a local utility.** Marginal cost pricing for municipal water supplies may bring about more efficient allocation of water, prevent excessive demand for water at the source, and eliminate uneconomic capacity expansions. However, neither the costs of implementing such an approach nor the actual effects on water use are known. Thus, the pilot project approach is justified.

7. **Implementation of related land use measures which preserve and protect the state's water supply and maintain its availability for its best use.** Measures which should be adopted include (1) expansion of funding for the existing state soil and water conservation cost-sharing program; (2) mandatory statewide adoption of construction site erosion controls through county and municipal ordinances; (3) mandated considerations in irrigation permit issuance (e.g., soil types, topography, economic impacts, and potential for ground-water contamination), in conjunction with a longer-term interagency study of where irrigation development might be permitted and where it may be infeasible or impractical; (4) an evaluation of the Shoreland Zoning Act; and (5) consolidation of the existing rural water supply system law into a single statute. It should be recognized that several of these recommendations may be affected by decisions in the concurrent "208" water quality planning effort in Minnesota.

7. IMPROVED DATA COLLECTION AND DISSEMINATION

Gathering and utilizing timely and accurate data concerning the state's water resources is one of the keys to effective management. Development and maintenance of state water resources goals and measureable objectives requires sufficient and correct information. To be useful, such information must be readily retrievable.

In 1978, nearly 60 programs or projects were cataloged in Minnesota which deal with primary water resources data collection. A major problem was identified in the ability to share and disseminate this information for use in planning and management decision-making. To assist in remedying this problem, the Water Planning Board recommends:

1. **The State of Minnesota continue to support and develop a comprehensive water resoures information system including the collection, interpretation, and extensive dissemination of data.** This system should develop as a mechanism to tie together existing and future individual agency information systems in order to coordinate and simplify user access. This system, presently called SWIM (Systems for Water Information Management), should be further developed within the State Planning Agency Land Management Information Center, in coordination with the interests of the state agencies (as expressed by a User's Committee). Funding should be administered and coordination assured through the state coordinating body.

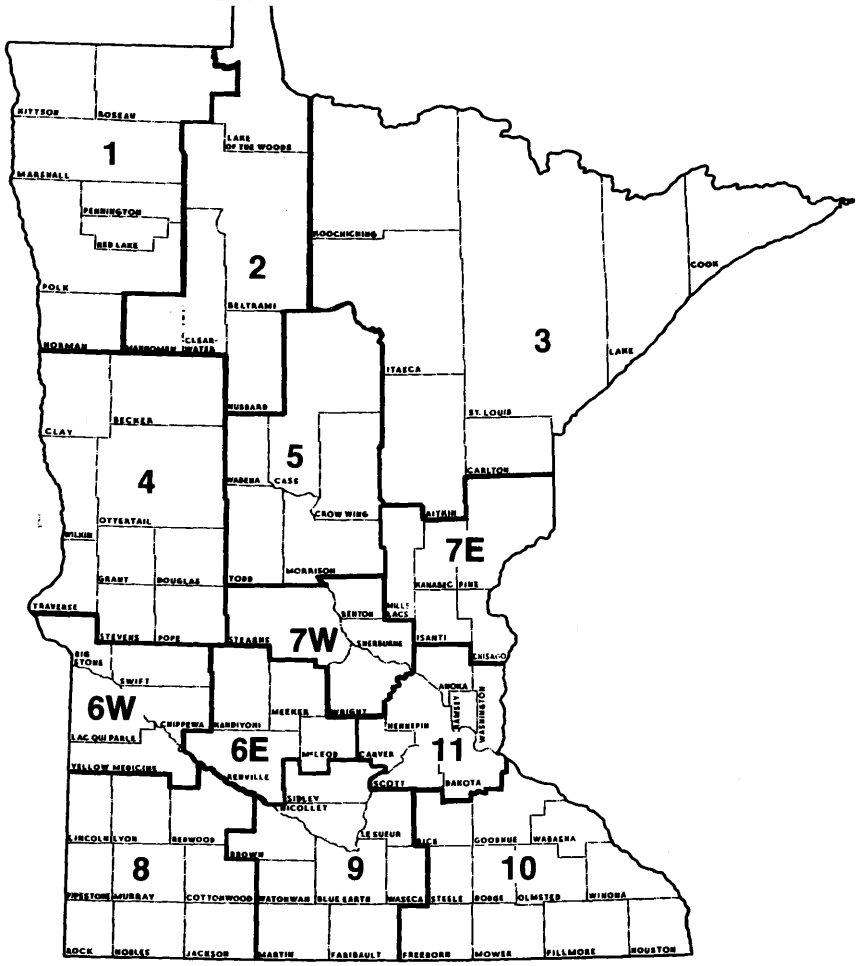
2. **The high-priority elements of SWIM involve policy and service functions, provision of limited technical assistance to agencies, and assessment of priorities for information systems development.** River mile indexing, data quality, geo-reference, and parametric data standards should be established to provide uniformity to SWIM output.

3. **An increased emphasis on buried aquifers in the U.S. Geological Survey Cooperative Ground-Water Study Program.** Studies conducted under this program have dealt primarily with surficial, sand-plain aquifers. Although substantially increased expenses will be involved, the emphasis should be changed to studies of buried aquifers, particularly in areas where surficial aquifers are not widespread and where water use appears to be increasing.

4. **A continued expansion throughout Minnesota of the ground-water observation well network.** Wherever feasible, observation wells should be used to monitor quality and quantity and to update the ground-water information system data base. In part to supplement and expand this information, (1) the Department of Natural Resources should continue to require well logs for test holes, source information on aquifers, and pumping tests for ground-water permit applications in areas where this information is not available from other sources, and (2) the hydrogeologic research functions and well log data acquisition programs of the Minnesota Geological Survey and the Department of Health should be continued until an adequate hydrogeologic data base is established for the state.

FIGURE 3

ECONOMIC DEVELOPMENT REGIONS



8. COMPREHENSIVE FRAMEWORK FOR NATURAL RESOURCES DECISIONS

The state has three major roles in water resources decision-making: protector, developer, and allocator of water resources. Each of these roles might benefit from the support and guidance which can be provided through planning, evaluation, and research.

By definition, planning involves taking present actions to prevent future problems. Planning functions which could benefit the State of Minnesota include (1) anticipation of short- and long-term demands for the state's water resources; (2) development and maintenance of explicit, comprehensive water-related goals to reflect overall state needs and citizen desires; (3) coordination and integration of the policies of state agencies involved in water management; and (4) development and maintenance of a forum for citizen participation in water resources decision-making.

In simplistic terms, the purpose of research is to aid in the understanding of the environment. This understanding should be reflected in policy decisions which lead to the ultimate goal of providing the greatest good for the greatest number of people. Specifically, in the area of water resources, it is crucial that researchers uncover new facts and discover interrelationships which can be used in planning to conserve and utilize the water resources of Minnesota in the best interests of the people of the state.

To facilitate the functioning of the state in its roles as protector, developer, and allocator of water resources, the Water Planning Board recommends that:

1. **Water planning be supported on the state level at two organizational points.** The state coordinating body should be charged with directing state involvement in activities relating to the federal Water Resources Planning Act (P.L. 89-80), comprehensive interagency planning efforts, and evaluation and recommendation of improvements in water resources management and regulation. The coordinating body should build on the Water Planning Board's framework plan efforts by initiating and coordinating more detailed studies needed to address water resources problems cutting across agency interests, levels of government, and political boundaries.

Water planning by water management agencies should be directed toward support of agency programs and objectives. Such functions should include program planning and evaluation (discussed above), as well as program-related resource planning functions.

2. **Citizen participation in water resources decision-making be carried forward by both state agencies and the state coordinating body.** State agencies involved in water management should develop ongoing programs of citizen participation, staffed by full-time coordinators not directly involved with the affected programs. The state coordinating body should continue a citzen's forum like the Water Planning Board's current Water Interests Advisory Committee. Further, the coordinating body and state agencies should develop and maintain links to the regional citizen participation forums.

3. **The State of Minnesota continue to place primary reliance on its Universities for water resources research.** However, (1) efforts should be made to more closely link University research to state needs through regular and extensive communication among researchers, planners and decision-makers and (2) the state should be prepared to provide increased research funding if federal funding decreases. The state should continue to utilize relevant federal and private research findings to supplement University research efforts.

9. OTHER RECOMMENDATIONS

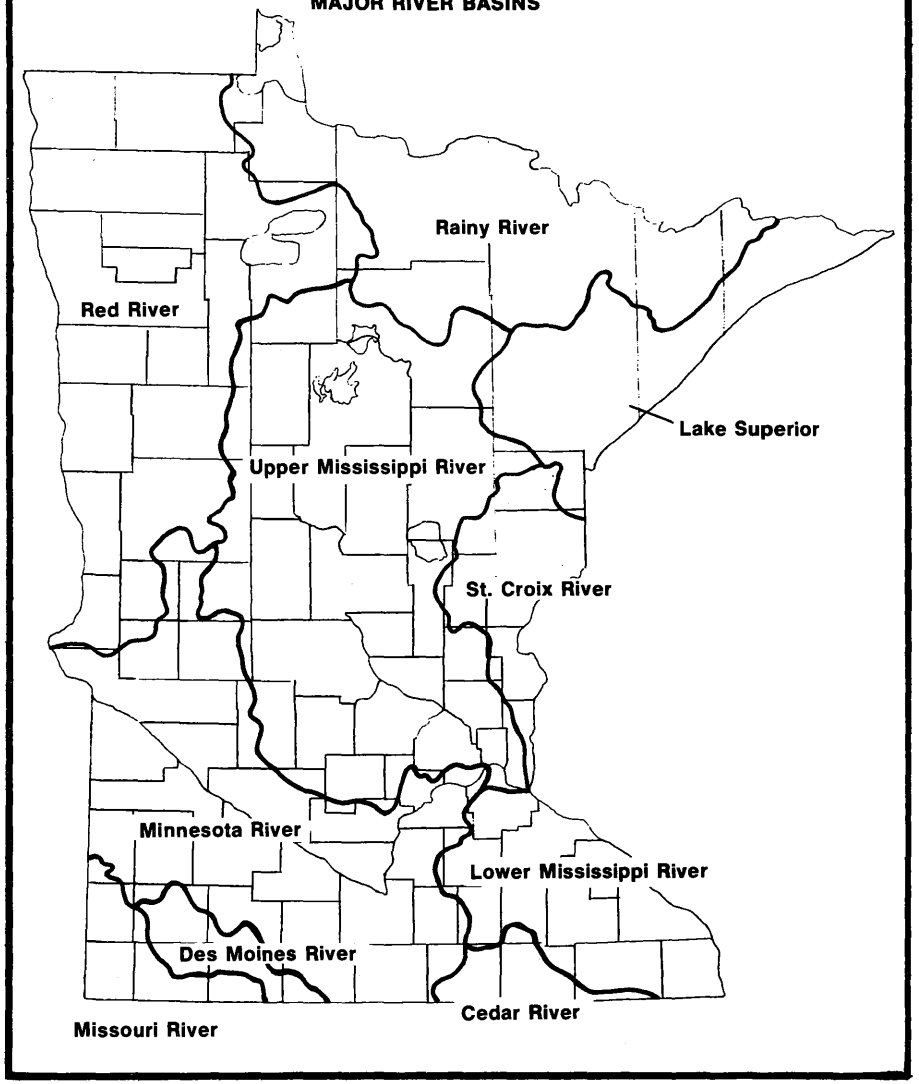
The preceding discussion was intended to serve as a summary and therefore does not cover each of the recommendations of the Board. For example, major recommedations in the areas of federal-state relations, water quality, and flooding and flood damage reduction have not been described. The fact that certain recommendations are not summarized here should not diminish their significance. These recommendations should also receive careful consideration by the public and the decision-maker.

10. CONCLUSION

The Water Planning Board does not prescribe a future for Minnesota, but does make recommendations which would influence the future. A water and related land resources strategy for Minnesota can never be a fixed product. It must involve an ongoing process, including evaluating state goals and policies to guide change in an orderly way and supporting consistency with state objectives. To be effective, this process must involve a team effort which utilizes Minnesota's state, regional, and local level resources.

FIGURE 4

MAJOR RIVER BASINS



TOWARD EFFICIENT ALLOCATION AND MANAGEMENT:

A STRATEGY TO PRESERVE AND PROTECT WATER AND RELATED LAND RESOURCES

OVERVIEW

The future of Minnesota's water and related land resources will be influenced greatly by the legacy of the past, by the pressures of the present, and by regional and national forces. However, much can be done to shape this future through a clarification of state goals and development of state policies which are designed to guide change in an equitable and orderly way. Decisions which are made in the present will influence the economic well-being, environment, and lifestyles of Minnesotans for years to come.

While serious water and related land resources problems must be faced, the future holds great potential for Minnesota. On a gross basis, the state's water resources appear to be capable of exceeding projected needs through at least the year 2000. Meeting this potential, however, will require:

** A stronger focus on effective management—an important cornerstone of Minnesota policy in the past, but even more important in the future;

** Greater emphasis on the efficient use of water resources and rejection of the concept of water as a limitless, free good;

** Improved collection and dissemination of information for use in making critical water and related land resources decisions; and

** Planning, research, and decision-making that deals with the interdependence of issues and places increased emphasis on the state as a unit.

There are both near- and long-term needs that require attention. Pollution of streams, lakes, and ground water is likely to remain a problem for years to come. The wetlands management controversy shows no signs of disappearing. The impact of large-scale development of ground water for irrigation is an issue receiving considerable public attention. Adequate management of environmental resources is a long-standing problem. Rural flooding in the Red River basin and urban flooding in southeastern Minnesota are problems which have not been solved. Loss of fish and wildlife habitat and provision of recreational opportunities are standing concerns. The drought of 1976 has reminded us that the threat of water supply problems cannot be forgotten. Problems relating to navigation on the Upper Mississippi River persist.

Impending water resources problems are associated with potential mining of peat and copper-nickel, regulation of Lake Superior levels, lake level fluctuations, potential diversion of northern Minnesota waters out-of-state, potential impoundments of water in Minnesota for use downstream, and impacts of future energy development. Conflicts will likely intensify between the desires of individuals and the needs of society (such as in the ownership and use of wetlands).

While it is apparent that water and related land resources are interdependent, management of these resources remains fragmented and approaches issues from narrowly defined perspectives. Mechanisms must be developed to provide greater coordination and flexibility to adapt to changing situations. It will be increasingly important for the public and private sectors to work toward greater cooperation.

To assist the State of Minnesota in meeting its potential and to deal with the near- and long-term needs of the state, the Water Planning Board makes over 90 recommendations for action by the Governor, the Legislature, and state, regional, and local units of government. Among the major recommendations are:

** Development of an ongoing water resources coordinating body to initiate, direct, and coordinate a wide range of activities which cut across agency interests, levels of government, and political boundaries;

** Establishment of a natural resources management fund targeted at assisting local water management authorities in implementing state-mandated programs;

** Initiation of program planning and evaluation functions within each water management agency as an alternative to major reorganization;

** Development of a statewide flood damage reduction grant-in-aid program;

** Replacement of the existing priority system for water appropriation with a more flexible system capable of meeting area needs in critical situations;

** Initiation of a water conservation technical assistance program;

** Implementation of related land use measures which will preserve the state's water supply; and

** Continued support for the development of a comprehensive water resources information system, including the collection, interpretation, and extensive dissemination of data.

Numerous other recommendations address federal-state relations, water quality, recreation, wetlands management, and research and education.

The Minnesota Water Planning Board does not, in this report, prescribe a future for Minnesota. The report does include recommendations which would influence this future. The Board believes a that water and related land resources strategy for Minnesota can never be a fixed product, but rather must be an ongoing process involving evaluation of state goals and policies to guide change in an orderly way and support consistency in state objectives.

INTRODUCTION

The Act of the Legislature in 1977 which created the Minnesota Water Planning Board required that the Board "direct the preparation of a Framework Water and Related Land Resources Plan." Among other things, the Act also required that the Board "assure the participation of the public and of all units of government in the preparation of the Framework Plan." The Board was to carry out these duties by June 30, 1979, at which time the Act specified the Board would expire.

The Act became effective on July 1, 1977. The Board's Chairman was appointed in August 1977. An extensive public participation program was implemented in November 1977. Staff persons in 13 state, university, and federal-state organizations assisted in producing 12 Technical Papers, three Work Group reports, and several Working Papers en route to the Framework Water and Related Land Resources Plan.

While considerable interest has existed in the preparation of a Framework Water and Related Land Resources Plan for the last decade, the concept of a Framework Plan had not been adequately defined and the necessary funds had not been made available. The Water Planning Board defined a framework plan to be a "planning effort conducted by a state coordinating organization providing indications of economic activity; translation of available information into demands for water and related land resources uses; projections of water availability, both as to quantity and quality; examination of options for managing water resources; and projections of related land resources availability so as to outline the characteristics of projected water and related land resources problems and the general approaches that appear appropriate for their solution."

The Legislative Commission on Minnesota Resources provided the primary funding for the planning project, with additional assistance provided by U.S. Water Resources Council Title III Water Resources Planning Grants.

The Board has attempted to reach its conclusions and make its recommendations based on an overall, or holistic, view of water and related land resources in the state. A holistic perspective requires a thorough understanding of the parts which make up the total picture, but considers the whole as more important than any of the individual parts. The need to consider the whole is based upon the growing realization that the basic elements of the resource picture are highly interdependent, including all human activities and the physical environment upon which all life depends.

The state of water and related land resources is described from the perspective of traditional perceptions of water, the physical system in which water resources exist, and the manner in which the resources are used. Water quantity and quality, present and future land use, and existing and projected water use are described in this section, Based on an assessment of current and suggested future conditions, potential conflicts are identified. The attempt of the section is to establish a background against which the question of a state strategy for future resource management can be considered.

Based on public meetings, advisory committee recommendations, and agency interests and resources, the Board selected 11 special issue areas for emphasis in the Framework Plan.

** **Water resources coordination.** The questions addressed in this issue area are the **need** for a continued water resources coordinating body and the options available in selecting a coordinating body.

** **Federal-state relations.** This section addresses needs for better relations with federal agencies, basin commissions and other non-state entities.

** **Water quality.** Tempered by the concurrent "208" water quality planning efforts, the water quality issue area focuses on several concerns raised by citizens and the Water Interests Advisory Committee.

** **Water-based recreation.** The focus of this issue area is water surface management and the provision of water-based recreational opportunities.

** **Water resources information and data.** Discussion in this area is targeted on the development of systems for water information management.

** **Flooding and flood damage reduction.** This segment of the document addresses issues raised by increasing flood damages and proposes changes in state flood damage reduction programs.

** **Wetlands management.** Major issues of the wetlands-drainage controversy are examined.

** **Conservation of water resources.** This issue area addresses the provision of water conservation technical assistance in Minnesota.

** **Water supply and allocation.** Questions ranging from data availability and analytic techniques to water allocation priorities are raised in this issue area.

** **Related land use.** Agricultural and construction site erosion, irrigation policy, shoreland development, and rural water supply systems are addressed in this area.

** **Research and education.** The focus of water resources research and education efforts is discussed.

A major emphasis is placed on an examination of issues related to water resources management, including present water resources management in Minnesota and critical water management problem areas.

Time and resource limitations have not always allowed the Board to move as far as it would like in resolving issues. The same factors have limited exploration of other issue areas.

Goals, objectives, and general policies are suggested as guidelines for state decision-making. They must be continually evaluated because they may be greatly influenced by changing conditions.

Importantly, a comprehensive design for the future cannot be found in this report. The framework plan study is an effort to describe and suggest processes that may be developed and utilized in a water and related land resources decision-making system capable of anticipating and responding to the possibilities and problems that are ahead.


The State of Water & Related Land Resources

The complexities of the physical system governing water supply, the unknowns involved in estimating water demand, and the intricacies of water resources policy-making have made it particularly difficult to focus on a strategy to relieve public anxiety—implied or expressed—that present policies, institutional arrangements, and approaches may not be sufficient to deal with the state's water resources in the future.

The Traditional Perception of Water

The way in which water is perceived is a key to understanding the nature of water resources policies. Water is generally perceived as an unlimited birthright. In many sectors, water is considered limitless and not amenable to the operations of the marketplace.

A perception of water without limit has led users to think of their interests as discrete and separable. Water as a resource has been considered infinitely divisible into particular and specific uses. Its benefits are generally seen as being capable of distribution to everyone.

To be sure, drought conditions bring about an awareness of the possibility of limited supplies and potential conflicts between users. Yet responses to drought conditions and the duration of altered perspectives is instructive. As municipal supplies were threatened by the 1976 drought, a number of Minnesota cities (including St. Paul), planned to drill new wells to insure water supplies. Lawn sprinkling and car washing curtailments and the occasional absence of water glasses from restaurant tables were the only apparent major efforts to change use patterns, however.

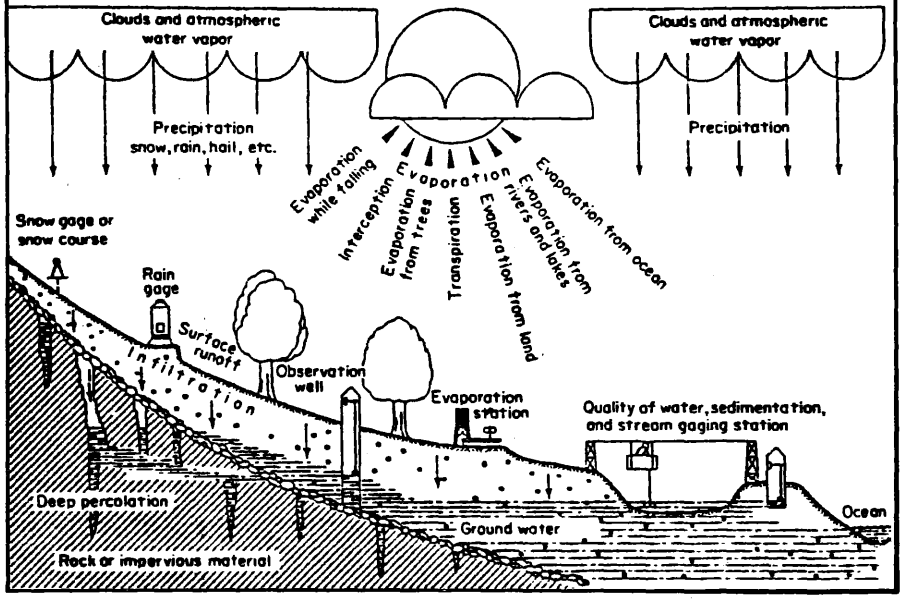
Water resources strategies based on "distributive" policies are subject to criticism because they do not recognize competing uses and their value. The greatest possibilities for altering the traditional perception of water as a limitless birthright lie in promoting an understanding of the physical characteristics of the resource and how it is used. The fundamental base of the present fragmented strategy for dealing with water resources is the body of perceptions which are held about the resource.

The Hydrologic Cycle

In Minnesota, lakes (excluding Lake Superior) cover about 4.8 percent of the state's area. Minnesota has more lakes than any state except Alaska. There are approximately 25,000 miles of streams in the state, draining three major drainage basins and a very small part of a fourth. Water from Minnesota flows into 22 states and three Canadian provinces. Nearly all of the rural population and one-half of the municipal population of the state depend on Minnesota's ground-water supply.

Most importantly, these water supplies which fuel the state are not static. Water is constantly on the move. It falls to earth as precipitation (generally, rain or snow). It is carried back into the atmosphere through the process of evapotranspiration. Some rainfall and snowmelt infiltrate the soil and percolate downward into temporary storage. Stored water may be drawn on by plants or man, or it may move under the surface to lakes or streams. Surface runoff also supplies lakes and streams. Streams carry water toward oceans, constantly subject to evaporation which feeds moisture to the atmosphere to produce precipitation.

FIGURE 1. The Hydrologic Cycle



It is important to think of water resources within this system. This system is described as the "hydrologic cycle." Understanding the hydrologic cycle and related water balance is central to understanding the total quantity of water which might be available and policies which might be adopted.

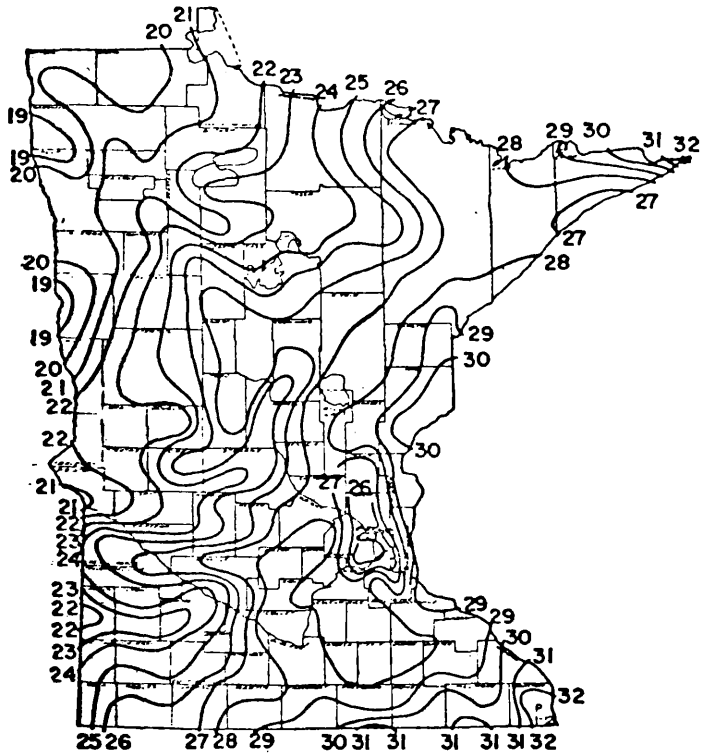
Simply stated, the "hydrologic cycle" suggests that all water which falls as precipitation must be lost to evapotranspiration or runoff or be utilized for the recharge of ground water.

Figure 1 demonstrates the functioning of this system. Man intervenes in this system through pollution of the air; weather modification; land use and management; waterwells; technology; economics, law, and custom; diversions; and impoundments and drainage.

1. Precipitation

Because Minnesota is at the head of three of the North American continent's major watersheds, the source of nearly all water in Minnesota is precipitation. Precipitation includes all forms of moisture falling from the atmosphere, but its principal forms are rain and snow. For Minnesota, the major precipitation sources are the Pacific Ocean and the Gulf of Mexico (especially the latter); the major deliverers are the winds from the Dakotas; and the land is the major user.

FIGURE 2



Annual normal precipitation in inches.

The average annual precipitation in Minnesota ranges from a minimum of 19 inches in the northwest to a maximum of 32 inches in the extreme southeast (Figure 2). A likely maximum range of precipitation (i.e., one year out of 50 years) stretches from 29 inches in the extreme northwest to 42 inches in the southeast; a likely minimum range, from nine inches along the western border to 19 inches along the southeastern border (Figures 3 and 4).

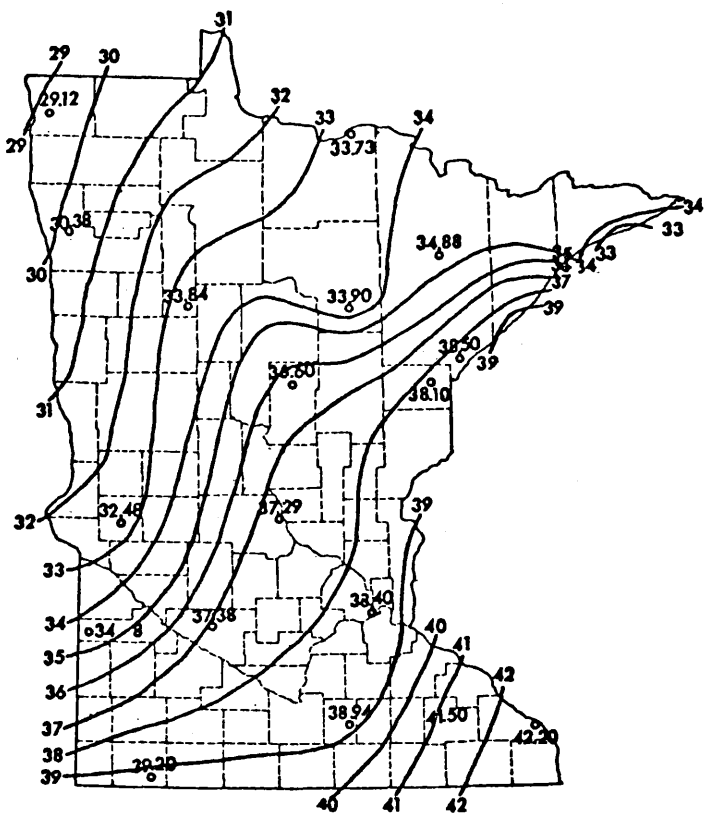
The amount of snow which can be expected in the state during a normal winter season varies from 30 inches along the western border to over 70 inches in a small section of northeastern Minnesota. Most areas of the state receive 40 inches of snow or more annually. However, to provide a good measure of the depth of water which would result from melting snow, the density of the snow-pack must be known.

In terms of water yield, small amounts of precipitation occur in the winter season. Precipitation amounts increase steadily during the spring months of March, April, and May. The summer period of June, July and August accounts for 40 to 50 percent of the state's annual precipitation. Precipitation amounts then decrease during the fall months of September, October, and November. In all, about two-thirds of annual precipitation in the state occurs from May through September, the primary crop-growing period for Minnesota.

2. **Evapotranspiration**

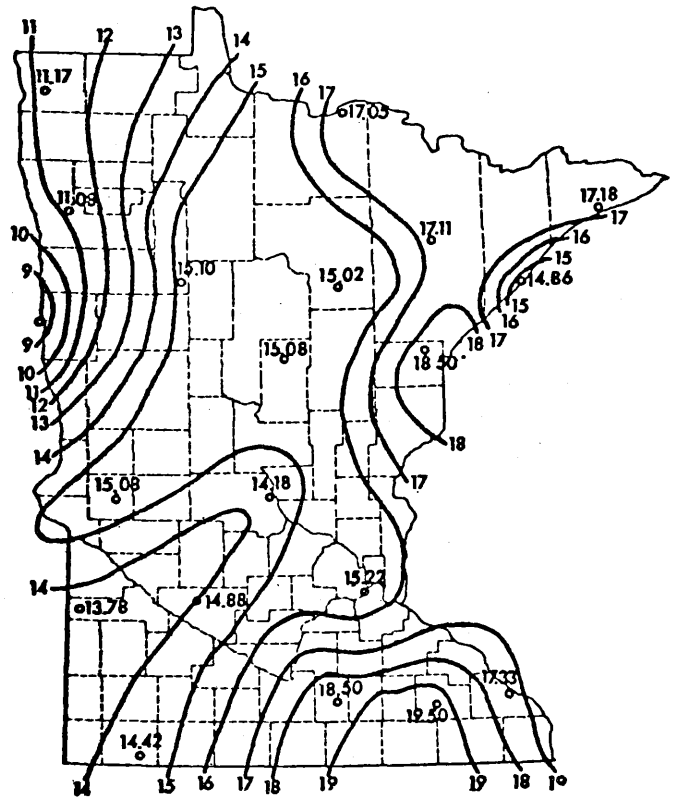
Evaporation is the change of state of water from a liquid to a gas. It occurs from both open water and land surfaces. Transpiration is the water used by plants, grasses, and trees and then released to the atmosphere. The combination of evaporation and transpiration is called evapotranspiration. For the North American continent as a whole, about 75 percent of the total annual precipitation is returned to the atmosphere by evaporation or transpiration.

FIGURE 3



Maximum annual precipitation expected in 2 percent of years, in inches.

FIGURE 4



Minimum annual precipitation expected in 2 percent of years, in inches.

Evaporation from land surfaces will vary greatly depending on land use, vegetation type, rainfall, and temperature. In southwestern Minnesota, average annual evaporation from open water exceeds average precipitation falling on the open water surface by as much as 11 inches.

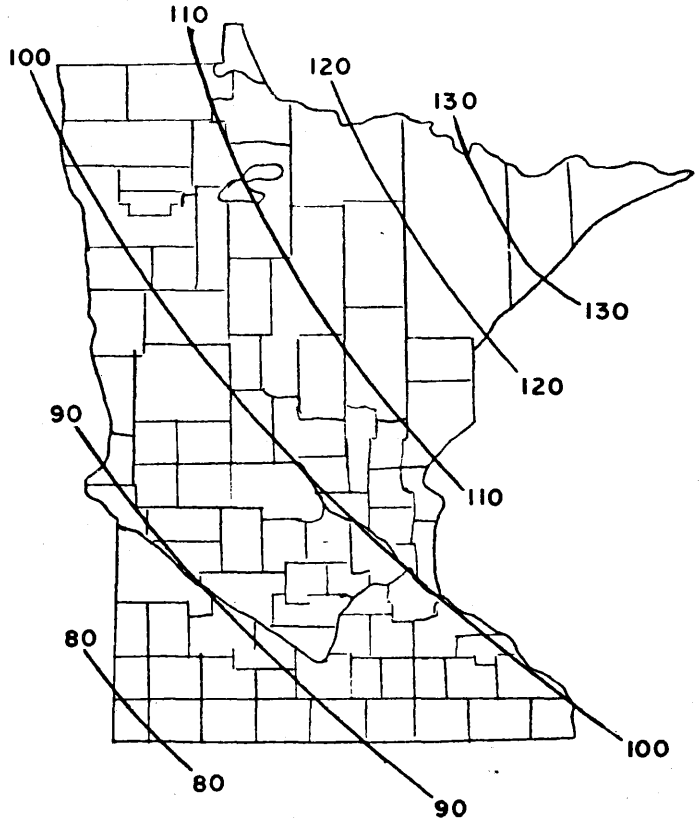
The amount of transpiration which is released to the atmosphere depends on the type of vegetation cover. Normal seasonal transpiration might vary from eight to twelve inches for grains, grasses, agricultural crops, and deciduous trees. (These quantities represent the depth of water lost by the area covered by the vegetation.)

From about 65 percent to nearly 100 percent of annual precipitation in Minnesota is released to the atmosphere by evapotranspiration. The fraction of the annual precipitation consumed by evapotranspiration averages about 82 percent for the state. Northeastern Minnesota receives considerably more precipitation than it can evaporate in a normal year (about 1.3 times more). The ratio of annual values of precipitation to potential evaporation in southwestern Minnesota is 0.8 (Figure 5).

3. Runoff

Runoff is that water which leaves a region as streamflow. Streamflow consists of surface runoff, ground-water discharge, and channel precipitation. Channel precipitation is precipitation that falls directly on the water surface of lakes and streams. Surface runoff occurs when the intensity of rainfall (or snowmelt) is greater than the rate of infiltration of the soil. It reaches streams rapidly and is generally discharged from basins within a few days. Ground water percolates slowly toward streams. In many basins, a few (three to five) days after precipitation ceases, there is no surface runoff and streamflow is derived from ground-water runoff.

FIGURE 5



Ratio of annual values of precipitation and potential evaporation in percent.

The amount of runoff depends on five factors: (1) the amount and intensity of precipitation; (2) the slope of the land; (3) the vegetation present on the soil; (4) the type of soil and how wet it already is; and (5) temperature. In Minnesota, there is a general trend toward increasing runoff as one proceeds from west to east. Variations in this pattern stem from changes in precipitation patterns, as well as differing slopes and soil conditions.

The total average annual runoff in Minnesota varies from less than one inch in the vicinity of Big Stone Lake on the western border; to about eight inches in the southeastern corner; to more than 10 inches in the northeastern part of the state (Figure 6).

4. Recharge of Ground Water

The process of recharging ground-water supplies involves infiltration and percolation (i.e., the vertical downward movement) of precipitation and surface water into the surface layer of the soil and the subsurface. Water enters the soil surface due to the combined influence of gravity and capillary forces. Both forces act in a vertical direction to cause percolation downward. As the process continues, the capillary pore spaces in the soil and rock become filled. With percolation to greater depths, there is increased resistance to downward movement due to a reduction in the extent or nature of the channels through which the water is moving, an increase in the length of the channels, or the presence of an impermeable barrier such as bedrock or clay.

In general, the actual rate of infiltration and percolation depends on a number of factors. These include (1) precipitation density and type; (2) the condition of the soil surface; (3) the density and type of vegetation; (4) the chemical composition of the water; and (5) the physical properties of the soil, such as grain and pore size, porosity, and moisture content.

The amount of infiltration and percolation to glacial drift and bedrock aquifers in Minnesota varies, but generally ranges from three to five inches of precipitation annually. Estimates as high as seven inches have been made in areas of sandy soil.

5. Storage

Importantly, in the midst of the hydrologic cycle in Minnesota, a large amount of precipitation is in temporary storage—either as surface or as ground water. Storage is a temporary state because water is always moving. Rivers are constantly flowing to the sea. These same rivers may contribute to or take water from lakes. Ground water is moving from high areas to lower areas and, along the way, may be discharged into streams or pumped through a well.

It is upon this "stored" supply that Minnesotans rely.

Surface Water—Supply and Quality

The surface water resources of a region depend on climate, topography, and the nature of the soils present. Minnesota's position in the far northern part of the United States, with its cool climate and after-effects of glaciers—as well as its moderate average annual rainfall—have combined to produce the state's numerous lakes. The position of the state at the head of three major drainage basins (and on a tip of a fourth) affects over 25,000 miles of streams.

1. Surface Water Supply

There are 15,291 lake basins larger than 10 acres in Minnesota. Excluding the state's portion of Lake Superior, lakes cover 4,059 square miles of the state, or about 4.8 percent of the state's total area. Of the total number of lake basins, however, 3,257 are classified as partly or completely dry. About 90 percent of the dry lake basins have been affected by the construction of artificial drainage ditches or the deepening of natural channels.

Lakes located entirely within the state range in size from Red Lake near Bemidji, which covers 288,000 acres and is 25 miles across, to lakes only a few acres in size located in the pine forests along the northern shore of Lake Superior. (Although not located entirely within Minnesota, Lake of the Woods is even larger than Red Lake, covering 308,000 acres.) There are 62 lakes in the state which are 5,000 acres or larger.

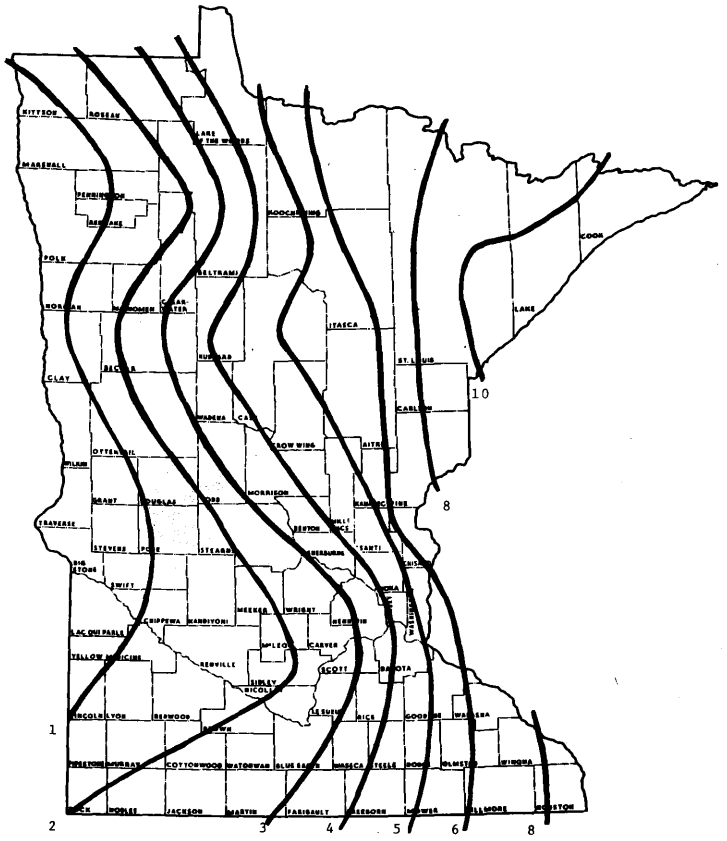


FIGURE 6. Average Annual Runoff (inches)

A majority of the lakes in the state are less than 100 feet deep. Excluding Lake Superior, the deepest lake known in Minnesota is Saganaga on the Canadian border (240 feet deep). Four other lakes are known to be at least 200 feet deep. In southern Minnesota, many lakes are very shallow. Such lakes are highly productive but may "freeze out" during the winter, causing fish to suffocate. These lakes provide important benefits through retarding runoff and assisting in replenishment of ground-water supplies.

Lakes are not evenly distributed throughout the state. They are most numerous in the northeast and the central parts of Minnesota. The northwestern, extreme western, and southern part of the state have only a sparse distribution of lakes.

Like its lakes, Minnesota's rivers and streams exhibit considerable diversity. North Shore streams plunge rapidly toward Lake Superior, forming many rapids and falls (e.g., Gooseberry, Baptism, and Caribou). To the west and south of the Arrowhead Region, streams become unpredictable, changing quickly from placid flows to heavy rapids (e.g., the St. Louis, Cloquet, Big and Little Fork, and Crow Wing Rivers). Particularly in the northwestern and southwestern parts of the state where few lakes exist and where those which exist are shallow, streams provide a major recreation resource. In the southeast, spring-fed streams (e.g., the Root, Cannon, and Zumbro Rivers) tumble through steeply wooded bluffs, providing another major recreational resource.

A high degree of variance from average streamflow levels exists across the state, with streams in the southern and western parts of Minnesota showing the greatest variation (primarily due to the effects of snowmelt). About two-thirds of the state's watersheds have recorded low flows of zero.

By far the largest part of the state's streamflow occurs in the Mississippi River basin and leaves the state via the Mississippi River. In terms of average flow, the Rainy River at the far northern boundary of the state is second only to the Mississippi River below Hastings.

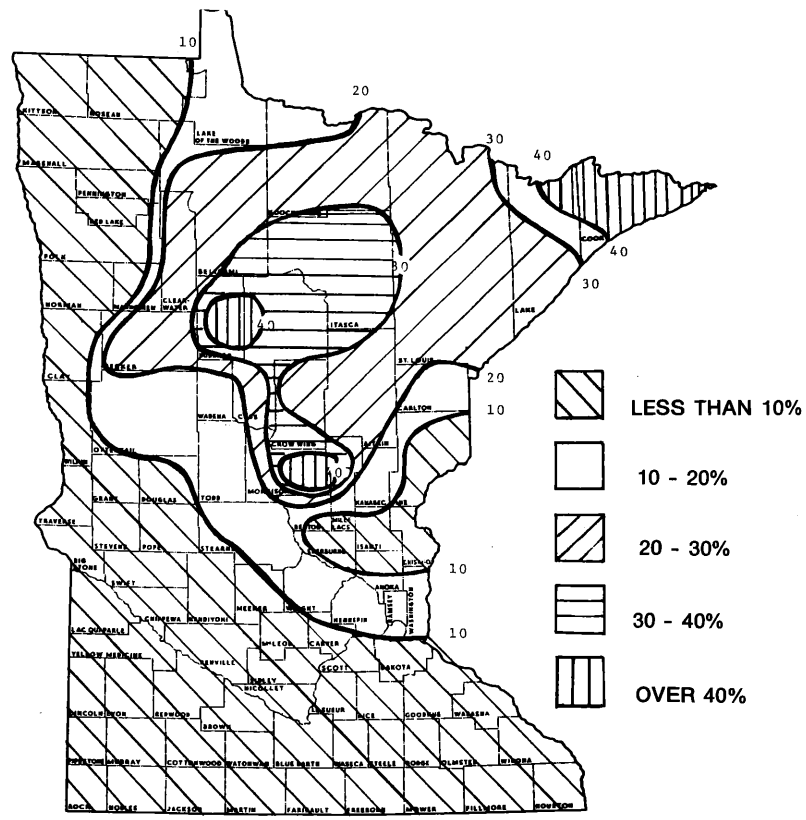
In all, it is estimated that in an average year over 11.3 trillion gallons of water are available in the state from surface supplies. This includes an estimated 3.1 trillion gallons in the Rainy River basin; 2.6 trillion gallons in the Lower Mississippi River basin; and 2.0 trillion gallons in the Upper Mississippi River basin (Table 1). Still, surface-water availability and use conflicts are problems in many parts of the state. The predominant problem is periods of low streamflow, particularly in the sub-basins in the western part of the state. Other problems occur or could occur where users are concentrated or are too near the headwaters of a sub-basin to maintain adequate water supplies (particularly if substantial increases in surface-water use occur in the basin).

2. Surface-Water Quality

Because surface-water resources are an important tourist attraction, are among the state's principal recreational resources, and are a critical source of water supply for domestic and industrial use, considerable concern must be focused on water quality.

Due to man's influence and to natural causes, many of Minnesota's lakes are impacted to some degree by the effects of eutrophication. "Eutrophication" is defined as a process of lake and stream enrichment. During eutrophication, lakes experience a series of ecologic successions characterized by increased productivity and sedimentation, sometimes detrimental to the lake and its users.

FIGURE 7.



PERCENTAGE OF FISH LAKES WITH WATER CLARITY
(SECCHI DISC) MORE THAN 12 FEET

There is a natural trend of decreasing lake clarity from northeastern Minnesota to the southwestern part of the state, which has been accelerated by man's activities. Over 40 percent of the fish lakes in the extreme northeast and in areas of central and north central Minnesota have water clarity of more than 12 feet. In contrast, southern Minnesota and the northwestern part of the state have less than 10 percent of fish lakes with clarity in excess of 12 feet (Figure 7).

In recent years, surface-water quality problems have emerged with respect to Lake Superior and the Mississippi River in the vicinity of Lake Pepin. While the overall water quality of Lake Superior is considered to be excellent, a major health concern has resulted from the discharge of taconite tailings to the lake. The movement of tailings disposal to land is designed to prevent this situation from deteriorating.

Lake Pepin has been the site of considerable concern and study concerning possible health problems posed by polychlorinated biphenyls (PCB's) found in the indigenous fish. In May 1975, the United States Food and Drug Administration (FDA) halted the interstate shipment of fish taken from Lake Pepin because the fish flesh exceeded FDA limits for PCB's. In addition,mercury problems have been identified in some northern lakes. While PCB's are known to be of human origin, the source of the mercury in northern lakes is unknown.

Using chemical and physical data from 75 monitoring stations, the Pollution Control Agency assessed the water quality conditions of 26 rivers plus Lake Superior in water year 1976. This assessment indicated that the majority of rivers in Minnesota are currently in conformance with the "fishable" and "swimmable" goals of the federal Water Pollution Control Act. However, large areas of particular rivers and a substantial number of localized areas appear to be in noncompliance with applicable water quality regulations and the national goal.

A total of 23 percent of the 75 water quality monitoring stations assessed were considered to be in noncompliance with the "fishable" and/or the "swimmable" aspect of the national goal. Rivers or reaches of rivers placed in this category are the Mississippi River below Minneapolis-St. Paul; the Zumbro River below Rochester; the Cedar River below Austin; Buffalo Creek below Glencoe; Center Creek below Fairmont; and the headwater tributaries of the Missouri and Des Moines Rivers.

In the long run, the reliability of surface-water supplies will be dependent on the long-term flow and quality characteristics of a basin. Factors such as average flow, annual and seasonal flow variations, water uses within a basin, and the extent of reservoir development will affect the dependable yield (i.e., the maximum continuous demand which can be provided by the surface source without interruption) that can be expected from a watershed.

In addition, use of surface water outside the basin cannot be excluded from consideration. Users outside the state may seek to draw on Minnesota's relative abundance of water resources.

Ground Water—Supply and Quality

Ground water exists wherever water penetrates beneath the surface, the rocks below the surface are permeable enough to transmit this water, and the rate of infiltration is sufficient to saturate rocks to an appreciable thickness. These conditions are met and ground water exists—at least intermittently—throughout most of Minnesota.

Ground water actually occurs in openings of subsurface soil and rock formations. These openings are of three general classes: (1) openings between individual particles, as in sand and gravel; (2) crevices, joints, or fractures in the hard rock (bedrock) which have resulted from the breaking of the rock; and (3) solution cavities and caverns in limestone. A ground-water aquifer is created where the rock formation, group of formations, or parts of a formation containing the openings which receive the water will yield sufficient quantities of water to be considered an adequate source of supply. The major ground-water aquifers in

TABLE 1
ESTIMATED GROUND AND SURFACE WATER AVAILABLE
(in billions of gallons)

MAJOR WATERSHED	GROUND WATER AVAILABLE	SURFACE WATER AVAILABLE		
		Average for Period of Record	1976 Drought	Inflow to Basin
Upper Mississippi River	500-800	2,035	1,285	0
Lower Mississippi River	175-300	2,607[1]	2,392[1]	3,816
St. Croix River	85-175	1,330[1]	1,146[1]	0
Minnesota River	130-280	627	269	0
Lake Superior	55-110	698[2]	474[3]	0
Red River	77-165	768	673	0
Rainy River	35-85	3,137[4]	2,153[4]	0
Cedar River	25-50	44	23	0
Des Moines River	10-25	64	20	0
Missouri River	5-10	N.A.	N.A.	0
Total	1,097-2,000	11,310[5]	8,435[5]	3,816

1 Includes water from Wisconsin portion of watershed unit.
2 Estimates are low because of the number of ungaged tributaries flowing into Lake Superior
3 Lake Superior provides a massive source of water for users located near the lake
4 Includes water from the Canadian portion of the basin
5 Assumes Missouri River Basin is zero

Minnesota occur in two broad geologic categories: (1) unconsolidated glacial deposits and (2) bedrock (consolidated rocks). The bedrock category may be further divided into a domain of well-stratified sandstone, limestone, and dolomite and a domain of crystalline rocks which underlie these sedimetary deposits.

1. Ground-Water Supply

Except in the Arrowhead Region, in the "Driftless Area" of the southeast, in a strip along the Minnesota River, and in a portion of east central Minnesota, the state is covered by a layer of unconsolidated glacial deposits ("glacial drift") more than 100 feet thick. In the western part of the state, glacial drift up to 600 feet thick has been found.

Large useable ground-water supplies in glacial drift areas occur mainly where sand and gravel deposits have been left by the glaciers. Larqe quantities of water are available from the sand and gravel deposits in the central part of the state. However, some glacial drift deposits have a high clay content and poor permeability and porosity, making them less useful as water supply sources. For example, in the Red River Valley (once the location of post-glacial Lake Agassiz) the subsurface is typically rather silty and impervious, although there are numerous beach sands and gravels in old channels and bars of the lake that yield significant quantities of water.

The major bedrock aquifers in Minnesota are sandstone and limestone sedimentary rock formations that were laid down long before the glacial period. The largest ground-water quantities of the state are in the stratified sedimentary rocks underlying the southeastern quarter of the state, roughly an area extending from the vicinity of Blue Earth County into Wisconsin and northward at least 50 miles beyond the Twin Cities.

Outside the area in which the sedimentary rocks form a major ground water domain, the remainder of the state is underlain by a crystalline rock complex which is thoroughly cemented. Available ground water in the bedrock is mainly limited to fracture zones and joints.

Widely varying yields may be obtained from the glacial drift and bedrock aquifers of Minnesota. Some surficial and buried deposits of sand and gravel are capable of providing dependable yields of up to 1,000 gallons per minute. Areas in north central Minnesota; the Bonanza Valley; large parts of Sherburne, Anoka, Isanti, and Chisago counties; and areas along the Minnesota and Mississippi Rivers have been found to yield 100 to 500 gallons per minute or more. In some cases, along the stretch of the Minnesota River from Mankato to the metro area and along the Mississippi around and below the Minneapolis-St. Paul area, yields of over 500 gallons per minute occur.

Only in the southeastern part of Minnesota are bedrock aquifers capable of consistently providing water yields in excess of 500 gallons per minute. The iron mining area (Animikie Iron Formation) and the Sioux Quartzite bedrock aquifers are capable of providing for needs of local areas. Very localized fault zones exist in the bedrock in certain areas and are capable of providing water. Only generalized statements can be made about aquifer yields. Yields can vary greatly within a local area, and even within a given aquifer. For example, a study of the Anoka Sand-Plain Aquifer revealed that about 20 percent of the sand-plain underlain by surficial outwash is capable of yielding more than 500 gallons per minute while about 45 percent of the area is capable of yielding less than 100 gallons per minute.

Using a set of conservative assumptions, ground-water availability has been estimated for Minnesota. The estimates include only surficial and bedrock aquifers that discharge water to streams. They do not include water available from deeply buried aquifers, although in some parts of the state buried aquifers may be a substantial source of ground water. Still, using average annual data, it was determined that ground-water availability equals some 1.1 to 2.0 trillion gallons in Minnesota. These estimates include 500 to 800 billion gallons of available ground water in the Upper Mississippi River basin; 175 to 300 billion gallons in the Minnesota River basin (Table 1).

Analysis of the limited available data indicates that on a regional basis there are few severe ground-water shortages apparent at this time. Ground-water problems can be expected to be localized and due primarily to concentrated use of the resource or an inadequate supply at a given site. Localized shortages may be severe where these situations exist. This situation appears to hold through at least 2000.

2. Ground-Water Quality

Information on surface-water quality in Minnesota is limited. Unfortunately, even less information is available on ground-water quality. This results because the quantity of ground water available to the state has not been fully determined; its flow is very slow; the direction of ground-water flow is difficult to determine; and because a lower priority has been given ground-water quality monitoring.

Using the best available information, a rough picture of ground-water quality may be generated. In reporting on municipal supply systems in Minnesota (over 90 percent of which rely on ground water), the Department of Health has noted: (1) a clustering of high sulfate sources in southwestern Minnesota; (2) high nitrate levels in southwestern Minnesota, although only 19 supplies were actually found to have levels in excess of the standard; and (3) relatively lower values for iron, manganese, and suspended solids in the Arrowhead Region, with increasing values toward the southwest corner of the state.

Laboratory records of the Department of Health for about 4,000 rural domestic supplies evaluated between July and September of 1975 and 1976 indicated (1) coliform counts suggesting bacterial contamination in 20 to 25 percent of the wells and (2) nitrates in excess of safe standards in about 10 percent of the well samples. The majority of the samples found to be in excess of accepted standards came from the southwestern part of the state.

Preliminary Pollution Control Agency ground-water quality evidence suggests (1) iron and manganese content of ground water in excess of accepted limits in many areas of the state; (2) phenols in excess of limits in various locations around the Twin Cities, most notably in St. Louis Park; (3) chlorides in excess of accepted limits in the Rochester—Winona—Red Wing area; and (4)cases of nitrates in excess of established limits in shallow wells located near feedlots and fertilizer storage areas.

Because contamination problems relating to nitrates and bacteria have been encountered by farms and municipalities in the southeastern corner of Minnesota and special geologic conditions are known to exist in the area, special studies have been undertaken. To date, underground tracing of water flow has revealed the potential for widespread distribution of pollutants among aquifers.

The University of Minnesota Agricultural Extension Service has pointed out problems in water quality for irrigation along the western border of Minnesota and in the southwestern portion of the state.

Water Use in Minnesota

Water is used in Minnesota in vast amounts for many purposes. In 1976, water withdrawals in the state approached 1.4 trillion gallons per year—or enough water to cover the Twin Cities metropolitan area to a depth of over 2.5 feet. Water was withdrawn, among other things, for domestic consumption, municipal needs, industrial production, food processing, irrigation, livestock use, and electric power generation. In addition, many "non-withdrawal" uses were made of the water supply, including navigation, recreation, fish and wildlife habitat, and waste assimilation. Water was withdrawn from surface- and ground-water sources, and was used in-lake and in-stream. It was supplied by public distributors and by wells belonging to individuals.

Consumption (i.e., that part of the water withdrawn that is no longer available for other uses because it has either been evaporated, incorporated into products and crops, consumed by man or livestock, or otherwise removed from the water environment) was estimated to be only about 13 percent of total withdrawals in 1976, or about 179 billion gallons. By 1990, it is estimated that withdrawals could increase by over 15 percent and consumption by nearly 92 percent. Still, consumption would only reach 343 billion gallons for the year under this estimate. Under a "conservation scenario" for 1990, withdrawals might be held to about a five percent increase over 1976 levels, although consumption is estimated to increase by about 85 percent (or to about 330 billion gallons).

The large increase in consumption relative to withdrawals results principally from changes in two sectors. First, irrigation—which is highly consumptive—is expected to be the most rapidly increasing sector in terms of water use. Second, electric power production withdrawals are expected to decline due to changes in cooling technology, while related consumptive use will increase markedly. Because of the magnitude of electric power withdrawals, the decline in these withdrawals masks increases in withdrawals occurring in other sectors.

1. Water Use by Sector and Area

The electrical utility industry is by far the largest withdrawer of water supplies in Minnesota, accounting for over 54 percent of total withdrawals in 1976. The large bulk of this water is employed for power plant cooling. The mining industry accounted for over 20 percent of total withdrawals in 1976, with nearly all of these withdrawals concentrated in northeastern Minnesota. Other major withdrawers from the state's water supply in 1976 were manufacturing (eight percent), residential users (seven percent), agriculture (six percent), commercial and institutional users (three percent), and other miscellaneous users (one percent).

When water use is viewed in terms of the amount of water consumed, the picture is very different. Agriculture and mining are the most substantial consumers of water, accounting for 38 percent and 34 percent, respectively, of estimated state consumption during 1976. Agriculture leaps from a relatively minor withdrawer to a major water consumer, largely because all of the water withdrawn for livestock use and 80 percent of all water withdrawn for irrigation are estimated to be consumed. Electric power production is estimated to be the third largest consumer of water in Minnesota, with about 12 percent of all consumptive use. Other consumptive uses are manufacturing (six percent), residential (five percent), commercial and institutional (two percent), and miscellaneous uses (two percent).

The most significant concentrations of water withdrawals are in the mining areas of northern Minnesota and in the Twin Cities metropolitan area. The Arrowhead Region (including the major mining areas of St. Louis, Lake, and Itasca Counties) withdrew over 465 billion gallons of water in 1976, or about 34 percent of the state total. The metropolitan region accounted for nearly 33 percent of all withdrawals, or 444 billion gallons. The concentration of iron mining activity combined with electric power generation results in the high level of withdrawals in the Arrowhead Region. (It must be noted that estimates of water use in mining and taconite processing are preliminary. A large variance in available estimates exists.) Electric power generation, combined with a concentration of residential, commercial, and manufacturing activities, results in large scale withdrawals in the metropolitan area.

Due to substantial electric power generation withdrawals, central and southeastern Minnesota also experience large-scale water use (about 10 and 11 percent of state totals, respectively).

The areas of the state which dominate the withdrawal picture also dominate the state's consumptive use distribution. The Arrowhead Region accounts for nearly 38 percent of all water estimated to be consumed in the state. This is largely because of the concentration of mining in the region and mining's relatively high consumption coefficient. The metropolitan area consumes 15 percent, while central Minnesota, the southern portion of the Red River Valley, and the southeastern part of the state each consume about 10 percent of the state's total water consumption.

The volumes of withdrawal and consumption are frequently dominated by a few large appropriators. From a management perspective, it is also important to understand the concentration of appropriators. Concentrations of appropriators exist in the metropolitan area (about one-fourth of the state total) and in the heavily irrigated west central region of the state.

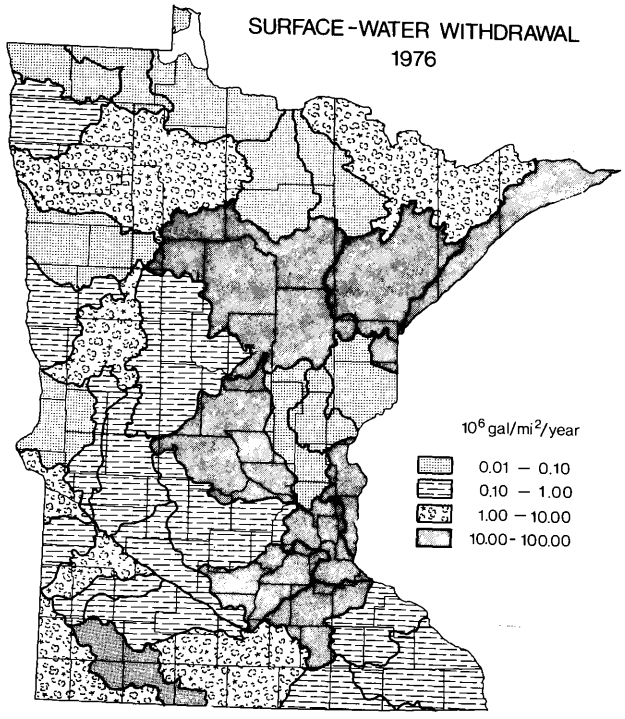
The largest volume of water appropriated in Minnesota is withdrawn from lakes. Lakes (including impoundments and river pools) are an important source of water for mining and other processing activities and for power plant cooling. Streamflow provides about 40 percent of the water for withdrawals, primarily because large volumes are withdrawn from streams for cooling and power generation.

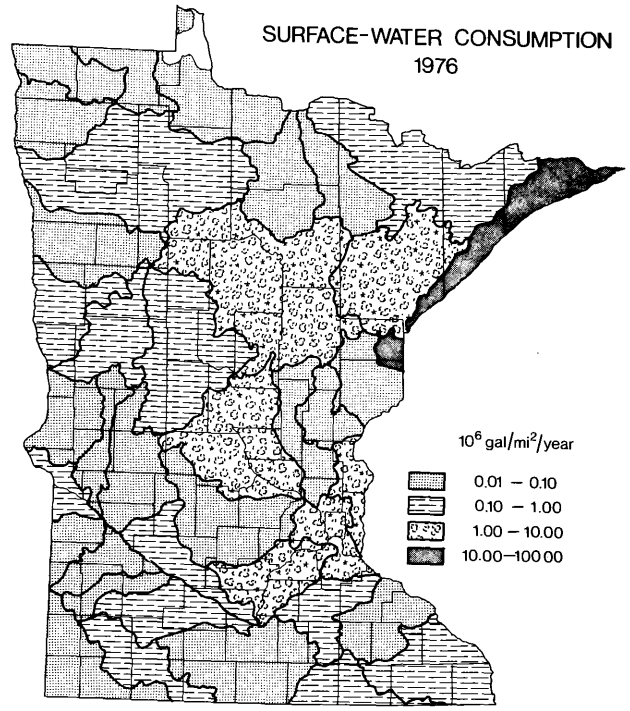
When individual sources are examined, ground-water appropriations emerge as more significant. For example, 63 percent of the water appropriated by waterworks in 1976 came from wells, with the remaining 37 percent evenly distributed between streams and lakes. Nearly 91 percent of the water appropriated for agricultural irrigation came from ground-water sources.

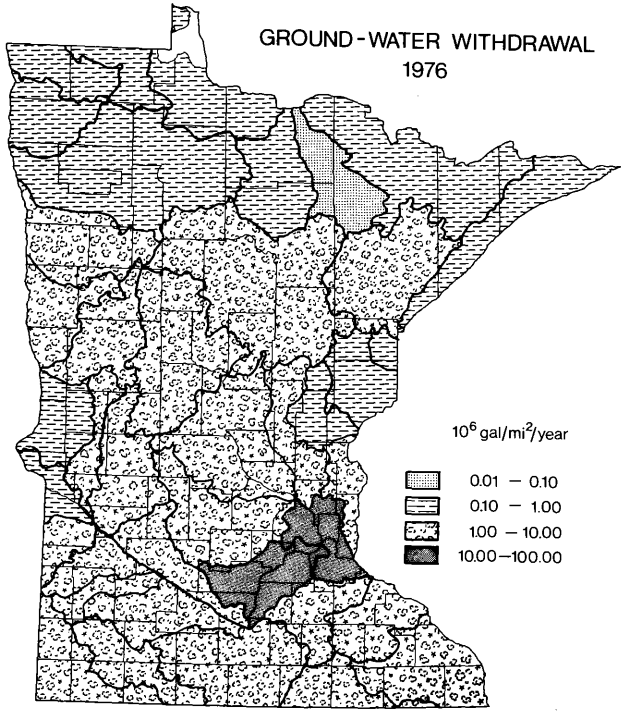
Irrigation has been expanding significantly in water withdrawal and consumption in Minnesota in recent years. In 1976, water withdrawals for irrigation were estimated at 59.7 billion gallons, with consumption equalling 47.7 billion gallons. By 1990, irrigation will represent the largest consumptive use of water in Minnesota.

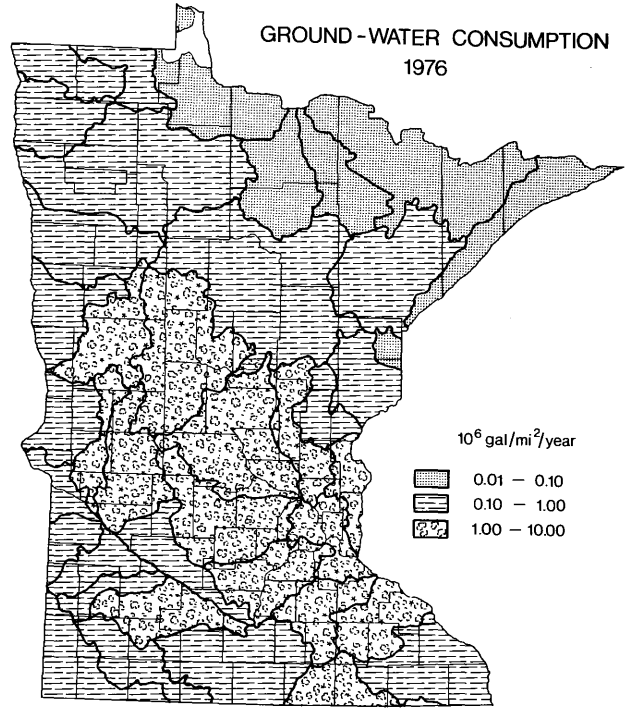
Baseline projections suggest that by 1990, irrigation water withdrawals could increase by 230 percent. (Under a "conservation scenario," irrigation withdrawals would increase by 197 percent.) The concentration of this withdrawal and consumption in limited areas of the state is expected to hold into the future.

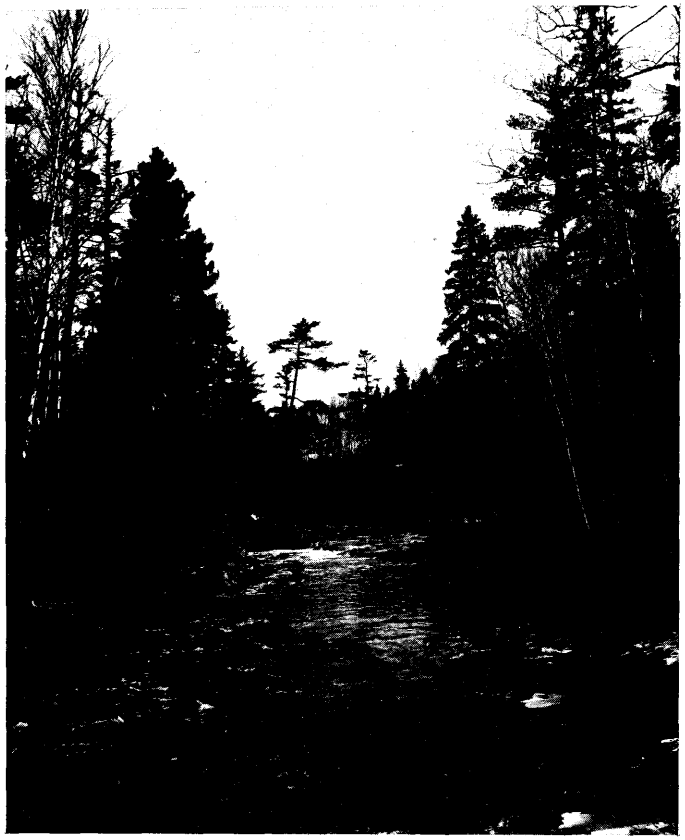
FIGURE 8


SURFACE-WATER WITHDRAWAL
1976
10^6 gal/mi^2/year
0.01 – 0.10
0.10 – 1.00
1.00 – 10.00
10.00 - 100.00


SURFACE-WATER CONSUMPTION
1976
10^6 gal/mi^2/year
0.01 – 0.10
0.10 – 1.00
1.00 – 10.00
10.00–100.00


GROUND-WATER WITHDRAWAL
1976
10^6 gal/mi^2/year
0.01 – 0.10
0.10 – 1.00
1.00 – 10.00
10.00–100.00


GROUND-WATER CONSUMPTION
1976
10^6 gal/mi^2/year
0.01 – 0.10
0.10 – 1.00
1.00 – 10.00



Through 1990, electric power generation is expected to remain the largest withdrawer of water from state supplies, although its percentage of the total withdrawals would fall sharply (from 54 to 38 percent). The mining industry is expected to continue as the second largest withdrawer, with a slight (three percentage point) increase in its share of the total. Agricultural withdrawals are expected to increase the most as a percentage of total withdrawals between 1976 and 1990 (an eight percentage point increase). Basin water withdrawals as a percent of state totals are expected to remain relatively constant between 1976 ad 1990, except in the Red River basin. Consumption is estimated to decrease significantly (as a percent of state totals) in the Lake Superior basin, but to increase in the Red River basin and in the Upper Mississippi River basin.

The "conservation scenario" developed for the state does suggest that the implementation of conservation options could dampen the growth in water withdrawals and consumption in the state. The"conservation scenario" suggests the withdrawal of 140.2 billion (nine percent) fewer gallons of water in 1990 than under the "baseline scenario" and the consumption 13.3 billion (four percent) fewer gallons.

Electric power production and mining accounted for 75 percent of all water withdrawn in Minnesota in 1976, and for an estimated 46 percent of consumption. Because of the magnitude of these uses, further study and analysis is required before the impact of their potential future use can be understood.

Current mining consumptive use estimates are still subject to verification. Production in this sector is subject to national and world markets; historically, production has fluctuated markedly from year to year; this makes accurate projection very difficult. In addition, the water use impacts of future copper-nickel mining need to be studied.

Electric power water use estimates are based upon utility siting and sizing projections as of April 1,1979, subject to state projections of future energy demand. Utility construction plans over the last several years have been characterized by delays, postponements, site changes, and withdrawals from state permitting processes. Given the magnitude of power plant water use, any change in the projected size, location, or in-service date of plants (or, for instance, a trend toward more smaller plants, located near load centers and possibly tied in with district heating systems) would drastically alter the distribution of power plant water use. Therefore, estimates of water use for electric power production, especially on a regional basis, are subject to considerable fluctuation over time. Regional water use projections would change accordingly.

2. The Economics of Water Use in Withdrawal Sectors

The availability of adequate supplies of water of acceptable quality is essential to the economy of Minnesota. Water shortage problems can affect the costs of firms, thereby affecting their output, profits, employment, and earnings. Each firm and its employees have impacts upon other firms and individuals in the economy through both market and non-market relationships. Ultimately, decreased output, employment, and earnings may affect government revenues and services, thereby bringing the impacts of a water shortage to all citizens of the state.

The economy of Minnesota is fed by a number of sectors. The 1976 gross state product (an aggregation of the market value of all goods and services produced for final demand in the economy in a given year) approached $31.2 billion. Nearly 6,400 manufacturing establishments combined for gross sales of over $10.5 billion in 1976. The value of all Minnesota ore mined and shipped in 1976 was $1.1 billion. The total value of forest products harvested in the state exceeded $486.6 million. Cash receipts from farm marketings were approximately $3.9 billion in 1976 (over $4.3 billion in 1977) and food processing generated another $1.9 billion.

Agriculture is at the heart of the Minnesota economy. It directly or indirectly accounts for 40 percent of Minnesota's employment. Agriculture is vitally dependent upon reliable supplies of good quality water at all production, processing, and distribution levels. Due to the economic complexities within the agricultural sector and the numerous interrelationships between agriculture and the rest of the economy, it is extremely difficult to isolate the extent of any water-related economic loss due to inadequate supplies. (In 1976, the Minnesota Department of Agriculture estimated drought-related losses at $1.5 billion.) In the most

general terms, water shortages adversely affect crop yields, farm income, and regional economic stability. Insufficient water supplies can lead to the bankruptcy of both farms and processing firms, food shortages, and increased prices of agricultural commodities.

Although the food processing sector is characterized by the existence of large, multi-plant, multi-product firms, there is still sufficient competition among these and hundreds of small and medium size firms to make this a highly competitive sector. Therefore, the opportunity for passing on any increases in costs related to water is limited. Unaffected firms would have the ability to undercut the price increases of the affected firms.

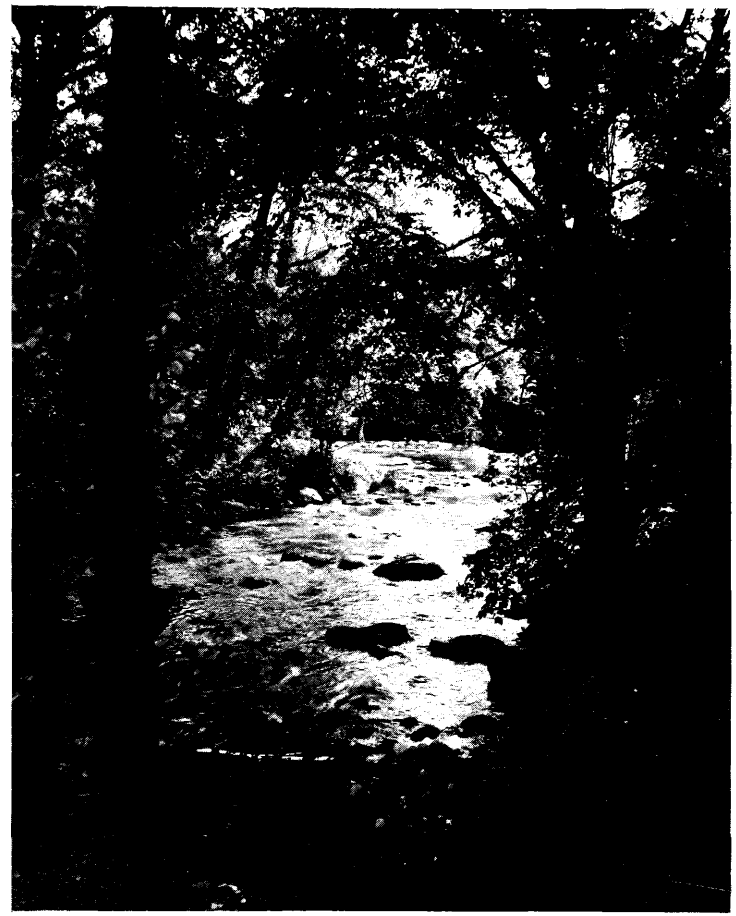
If a rise in water-related costs makes a firm unable to cover its variable costs, the firm will be forced to close down temporarily—perhaps permanently. This, in turn, would have a detrimental effect upon supplying firms. As agricultural processors employ an annual average of 47,500 workers, or 15 percent of all manufacturing employment in the state, the effects of short supplies of required water could move rapidly through the state's economy.

The forest products industry is another major sector of the Minnesota economy (about 40,000 employees) which could be significantly affected by water shortage. Much more information concerning the technical and financial aspects of Minnesota pulp and paper plants would be required to make definitive statements about the response of such firms to increased costs of water. It does appear that the ability of firms in this sector to deflect increases in the costs of using water (by decreasing their water intake or consumption) is diminishing as dependence upon water recycling increases in achieving compliance with pollution control regulations. Furthermore, there is little leeway for pulp and paper manufacturers to recoup water cost increases by raising product prices. It appears that even very small increases in costs of intake water can wipe out the profits of a firm because of the large amounts of water required to generate one dollar of profit.

The iron mining industry in Minnesota is dominated by large steel firms. In the event that water shortage problems would materialize in the mining area, the parent steel firms are in a position to pass a large portion of any water-related cost increases on to consumers. Therefore, there does not appear to be any significant threat to the economy of the Iron Range area due to increased costs of water use in taconite mining operations.

Because of their high water withdrawal requirements and their low priority as water users under current law, electric power plants could face water supply problems in years of low surface-water flow. In short-term shortage conditions under which a plant might be required to curtail production, several responses might be available to the firm. These include (1) increasing generation at other baseload or intermediate plants (if possible); (2) bringing on line peaking plants, which require little water but are expensive to operate; or (3) buying power from other utilities. The second and third reponse would result in higher operating costs and higher costs of electricity to the consumer. If excess power from other sources were not available, there would be economic ramifications in all sectors of the economy which draw on electrical supplies.

In summary, even a broad, non-quantitative assessment of the economics of water use in the withdrawal sector suggests significant implications of short supplies for the economy of Minnesota.



3. Non-Withdrawal Uses of Water in Minnesota

The analysis of water use generally has focused on those uses which are partically or totally consumptive of the resource. In Minnesota, there are a number of important non-withdrawal, nonconsumptive uses of water. These include hydroelectric power generation, navigation, recreation, fish and wildlife habitat maintenance, and waste assimilation.

Hydroelectric power production has been on the decline in Minnesota for a number of years. It currently only supplies a small percentage of state power needs, although this trend could be reversed as the costs of alternative energy sources rise. In 1974, there were 23 hydroelectric power plants operating in the state. The two hydropower plants which reported appropriations of water in 1976 took 956.9 billion gallons of water to operate.

Minnesota is fortunate to have four major waterway systems. Navigation on the Mississippi River, on stretches of the Minnesota and St. Croix Rivers, and on

Lake Superior are of great importance to Minnesota. In 1975, over 11.0 million tons were shipped down the Mississippi River (including 2.4 million tons from the Minnesota River) by barge and over 9.5 million tons were received at various terminals on the Mississippi and Minnesota Rivers. A study by the Upper Mississippi Waterway Association concluded that the river system handled 56 percent of the area's grain exports, 41 percent of the area's fertilizer, and 28 percent of the refined petroleum products. In addition, about one of every three persons residing in the Upper Mississippi River basin is served by electricity obtained from barged coal.

The volume of commodities barged to and from the Twin Cities area terminals has increased some 2.3 and 10.3 percent per year, respectively, in the last 15 years. Agricultural and energy-related products account for nearly all the barge shipments made from the Twin Cities area. The agricultural products— primarily corn, soybeans, wheat and other small grains—travel long distances, generally terminating in the New Orleans-Baton Rouge area of the lower Mississippi River.

Ports in the Twin Cities area serve as major rail to barge transshipping points for western coal. Such shipments are largely intradistrict shipments to other points within the St. Paul District of the Corps of Engineers. Of the 2.4 million tons of coal shipped from Twin City ports in 1975, over 1.8 million tons went to other terminals in the St. Paul District.

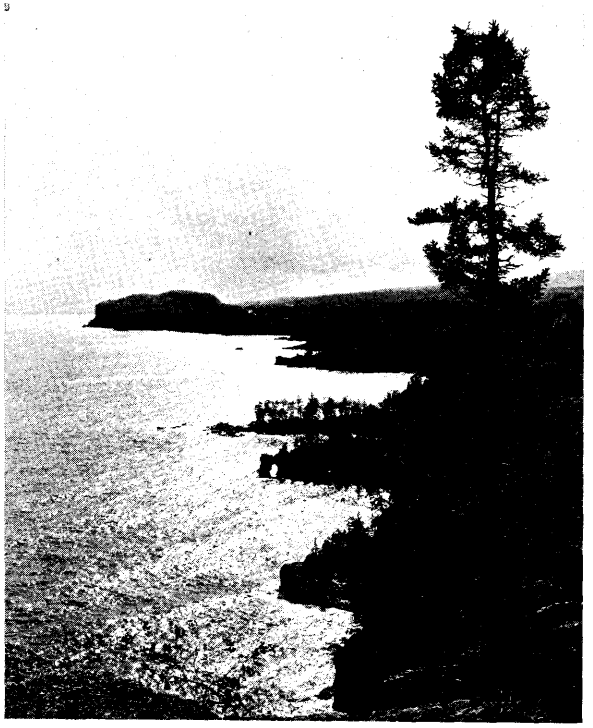
There are also major intradistrict shipments of refined petroleum products, sand, gravel, and rock. In the Twin Cities area, barge shipments of sand, gravel, and rock are second only to coal in volume and generally involve only very short movements. Nearly all shipments of refined petroleum products are from refineries on Pool 2 of the Mississippi River, with about 75 percent of the shipments to St. Paul terminals.

Baseline projections suggest that farm products will continue to be the most important category of barge shipments in 1985. The baseline forecast of the University of Minnesota's Department of Agricultural and Applied Economics for farm products is 10.8 million tons, of which corn will account for about one-half and wheat for about one-third. While more difficult to forecast, total western coal barge shipments are projected to be about three million tons, two-thirds of which will go to users in the St. Paul District. Shipments of other commodities are projected to increase by 22 percent (or 3.8 million tons) between 1975 and 1985.

The Port of Duluth-Superior ranks as one of the 10 busiest ports in the United States. An average of more than 40 million tons of domestic and international cargoes is shipped each navigation season. In 1976, a total of 32.6 million tons was shipped, with about 28.8 million tons involving interlake shipments. In 1973, total shipments approached 46.9 million tons.

Bulk grain is the principal export commodity of the Duluth-Superior port. More than three million tons of grain are exported each year. In recent years, the port has made steady growth in import/export movements of the general cargo and exports of bulk liquids, coal, scrap iron, and refrigerated commodities. The location of the port, recent legislation, and the fact that six railroad systems and more than 20 over-the-road common carriers link the port with the Upper Midwest suggest further development of the port as a major international and interlake facility.

The tourist-travel industry is highly important to the economy of the state with some 7.7 million travelers spending over $1.3 billion in Minnesota in 1976. It is



estimated that 30 percent of Minnesota's visitors come primarily for water-related activities, demonstrating clearly the recreational value of Minnesota's water resources. The recreational industry directly or indirectly provides employment for an estimated 90,000 Minnesotans.

A 1972 inventory identified over 1,600 swimming beaches in the state. Sixty-six percent of the state's population is estimated to go swimming at some time during the year. Counting all lakes 50 acres or larger, more than 2.6 million acres of water are available for boating. More than 540,000 boats were registered in Minnesota in 1978, a 130 percent increase since 1967. Over 50 percent of the state's population is estimated to go boating at least once a year. Some 3,550 miles of river and lake routes offer potential for canoeing. Over 213 million acres of the state's total water area can be considered as having primary value as fishing water.

Minnesota ranks high in waterfowl hunting and has extensive fish production programs. By 1974, more than 380,000 acres of wetlands had been acquired by the state under the "Save Minnesota's Wetlands" program, and more than 100,000 acres of wetlands had been acquired or secured by easements by the U.S. Fish and Wildlife Service. Public accesses have been provided on more than 1,600 lakes, facilitating waterfowl hunting as well as fishing and other recreational activities. The wetlands and lake areas provide living space for many wildlife species, including mallards, teal, shovelers, wood ducks, pintails, Canada geese, snow geese, blue geese, and many species of songbirds. Mam-

mals commonly associated with the aquatic environment include beaver, muskrat, otter, mink, and raccoon. Deer and moose also frequent such areas.

Several hundred million fish are produced and distributed in Minnesota each year. Walleye lakes (i.e., deeper lake types) occur most commonly in the northern part of the state. Lake trout lakes occur most commonly in the northeast. Panfish lakes are most frequently found in central and north central Minnesota. It is estimated that there are 0.66 acres of permanent fish water per person in the state; 0.12 acres per person in the south and 2.90 acres per person in the north.

Finally, both lakes and rivers are used to assimilate wastes. In streams in particular, streamflow is critical to how wastes are assimilated. During periods of low flow, many rivers have little capacity to assimilate wastewater effluents. In 1976, Minnesota's hot, dry summer reduced the flow of the Mississippi River to its lowest point in more than 40 years and aggravated pollution problems. Immediately downstream from where the discharge of the Metropolitan Waste Control Commission's Pig's Eye treatment plant enters the river, one-third of the river's total flow was treated sewage in late August 1976. A year earlier, the sewage would have been less than five percent of the flow. Below Pig's Eye, the dissolved oxygen level reached its lowest point since the period from 1931 to 1940, when levels also reached zero.

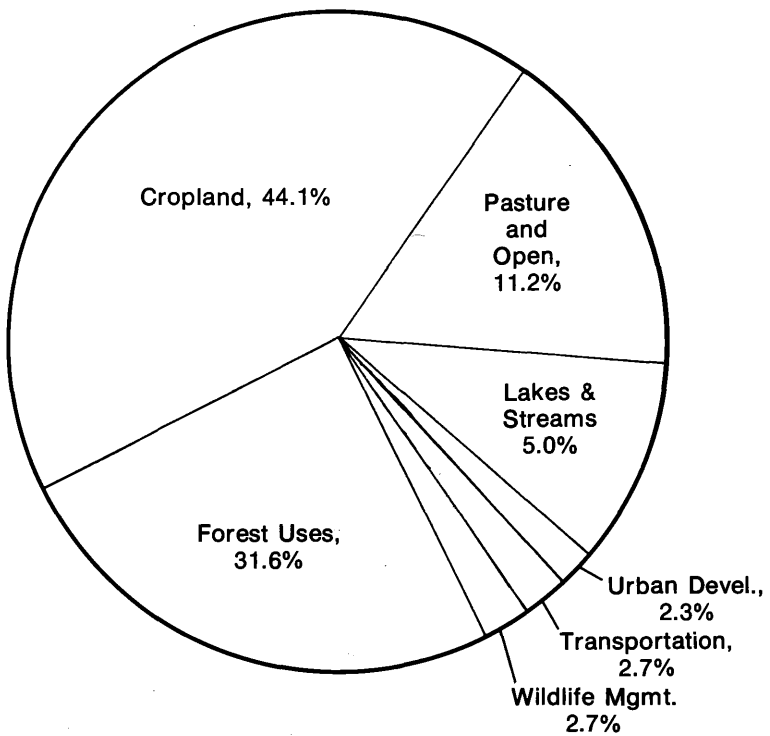


FIGURE 9. Estimates of Minnesota Land Use.

Land Use in the State of Minnesota

Since Minnesota's land and water resources are finite, there is competition among potential users for the same resources. The water resources adjacent to a parcel of land may be critical to an investment decision. Water allocation policies may directly affect land use. State policies relating to the landowner's responsibility for stewardship over the land are becoming increasingly important in the conservation of Minnesota's water resources. Therefore, it is necessary to consider Minnesota's land resources and uses in conjunction with the water resources of the state.

An estimated 3,965,000 million persons (1976) reside on Minnesota's 51.0 million acres of land area. Nearly one-half of this population is in the Twin Cities metropolitan area, although the seven-county metropolitan area encompasses only about four percent of land area of the state. About two-thirds of the population of the state resides in urban areas and about one-third in rural areas. However, between 1970 and 1976, the non-metropolitan population grew at a slightly greater rate (5.1 percent) than the metropolitan population.

Total population is expected to increase by about 12 percent between 1976 and 1990, or about 456,000 persons. The metropolitan area population is expected to exceed 50 percent of the total state population by 1990. Zero growth or a reduction in population is expected in many counties between 1976 and 2000 in the principal agricultural areas of the state; the largest growth is anticipated in the "transitional" area of the state; and a mixed growth pattern is suggested in the forested region of Minnesota.

Employment patterns have shown a shift from jobs in agriculture and mining to jobs in service industries, government, and manufacturing. Throughout this shift, total personal income has continued to climb, exceeding $24.5 billion in 1976. In the same year, the civilian work force in the state reached 1,943,500 persons.

While Minnesota's population and employment have shifted away from agriculture, cropland still made up 44 percent of the land use in the state in 1975. Pasture and open land accounted for 11 percent of the land use; forest uses, 32 percent; wildlife management, three percent; transportation, three percent; urban development, two percent; and extractive uses (0.2 percent) and energy facilities only a very small percentage of the total land area. About 2.8 million of Minnesota's 53.8 million total acres are water.

In general, the state can be divided into three major land use zones. These include an area of intensive agruculture, a transitional zone, and the forested zone. The agricultural zone comprises south central and southwestern Minnesota and a narrow band of land along the Red River Valley. This zone contains 15.7 million acres, or 28 percent of the state, and is characterized by extensive prairie lands with the most intensively cultivated and productive cropland in Minnesota. Agriculture dominates this zone, with nearly 90 percent of the land being cultivated and an additional seven percent used as pasture or open space. Remaining land uses account for less than four percent of the total area.

The transitional zone cuts across the state diagonally from the northwest to the southeast. This zone of mixed land uses contains 16.9 million acres, or 32 percent of the state's land area. The area northwest of the Twin Cities is glacial moraine pocketed with numerous lakes, while the area to the southeast is largely stream-dissected land with steep slopes. The zone is characterized by interspersed areas of cultivated farmland, rolling hills, woodlands, and poor

drainage. There are areas of high quality farmland, but also substantial acreage with limited potential for cultivation. Nearly half of the transitional zone is cultivated, with 20 percent in open space and pasture and 16 percent forested. A dominant feature of the zone is the concentration of urban development. Approximately 70 percent of the state's urban development is located in this transitional area.

The forested zone dominates the northeastern one-third of the state. A heavy forest canopy covers 72 percent of the zone, interrupted only by numerous lakes and isolated areas of open land. The landscape is diverse, typified by extensive areas of moraine, a considerable amount of ice-scoured land in the Arrowhead, and a large bog in the northwest. The zone is a prime area for many forest uses including timber production, seasonal homes, recreation, wildlife management, and open space preservation.

This zone contains nearly all of the state's large-scale mining activity and about 60 percent of the state's inland surface-water resources. The forested zone has the lowest percentage of agricultural land (about five percent) among the three zones. This limited agricultural potential is due to a short growing season and poor soils, although some speciality crops are grown.

Full consideration of land use characteristics of the state would require a more thorough examination of the three zones. For example, in the above discussion, no consideration is given to the distinction between cultivated land, pasture and other less intensive uses of land for agricultural purposes, and open lands. Cultivation is a major variable in land use change. In the past decade, there has been a major expansion in the number of acres cultivated in both the agricultural and transitional zones. This change is not reflected in the general discussion even though the additional cultivated acreage has been derived from practices which have a profound effect on water resources.

By 1990, about 1.3 million acres of land use change is projected to take place in nine activities. Over 65 percent of the change will be the result of fee title acquisition for wildlife management areas. Urban land development represents the second largest change, 16 percent of the total. Overall, little change is foreseen among land uses in the agricultural zone, with the most noticeable feature being continued agricultural intensification. Projections suggest that approximately 80 percent (or 165,000 acres) of the state's urban land needs will occur in the transitional area. While forest cover will remain dominant in the forest zone, competing uses are likely to steadily reduce the amount of commercial forest land.

This information is broad-ranging and may need some clarification. No agricultural expansion is indicated. United States Department of Agriculture projections of total land in farms in 1990 suggest there will be less total land in farms than at present. However, harvested cropland is expected to increase over the same period.

The indication that wildlife habitat acquisition will account for the most significant change in land use over the period, also requires explanation. When the state or the federal government acquires a tract of wetland, the use of the land does not necessarily change. Thus, some of what is reflected in the above estimates is a change in ownership, rather than an actual change in physical use. A change in use occurs when land or water resources are physically reallocated to a different purpose than was previously the case.

While the allocation of land resources will largely continue to be made by the private market system, it is necessary to relate anticipated changes to their potential effects on water resources and uses.


GOALS, OBJECTIVES, AND GENERAL PRIN

GOALS, OBJECTIVES, AND GENERAL PRINCIPLES

A strategy for managing Minnesota's water and related resources must have a sense of direction. It must be oriented toward the goals of the public. This statement defines the goals, objectives, and several principles which should guide the Water Planning Board and decision-makers in the adoption of a framework water and related land resources plan for Minnesota.

Purpose and Definition

The goals and objectives outlined below are drawn from an evaluation of issues and needs, expressions of public opinion, and discussions with a wide range of interest groups. They are intended to help guide decisions in the future that may require different perspectives and different approaches from situations in the past. The overlaps, interrelationships, and conflicts between basic objectives cannot be avoided. They suggest the trade-offs which must be considered in future policy choices.

None of the basic objectives is overriding; none is subordinate. These objectives should be taken into account as guidelines in evaluating the potential effectiveness of any water and related land resources policy.

In brief, a **goal** represents an end to which a strategy is directed. It provides a specific direction in which to proceed in order to approach the ideal condition (although it may not be attainable). Goals are the aspirations the citizens of the state have for their social, economic, and environmental well-being.

Objectives are achievable and measurable steps toward goals. They are described in a general way without specific formulae for achievement. They are interdependent and cannot be treated separately. Priorities are not established among the objectives below. In decision-making, they must be dealt with pragmatically, concurrently, and holistically.

The **general principles** represent guidelines or assumptions which should be adopted by the decision-maker in selecting programs responsive to identified objectives.

Following the adoption of state water and related land resources goals and objectives comes the assessment of needs, setting of priorities, designation of responsibility, reorganization of systems, the flow of useful information, and the evaluation of existing and prospective policies.

Goal and Objectives for Minnesota

The recommended goal of the framework water and related land resources strategy for the State of Minnesota is:

> To efficiently employ the water resources of the state to assure maintenance of a supply and quality, from surface- and/or ground-water sources, which is adequate to meet seasonal long-range requirements for domestic, municipal, industrial, agricultural, power, recreation, navigation, wildlife, and aquatic ecosystem needs.

This goal has policy implications in numerous areas related to water resources management, including energy use and development, health, economic development, fish and wildlife preservation, agricultural production, land use, and environmental protection.

Importantly, "efficient" employment of water resources does not imply only "economic efficiency." Also included are the concepts of "administrative efficiency" and "target efficiency." That is, efficiency implies (1) the desirability of explicitly considering the trade-off between economic impacts and other objectives being pursued in order to avoid needless sacrifices of economic development; (2) the attainment of objectives at a minimum cost and in a straightforward manner; and (3) the focusing of policies on means of achieving ends which are consistent with the social values held by the citizens of the state (i.e., the promotion of equity in the allocation of water resources).

To approach such a goal, the following objectives must be pursued:

** Development of procedures designed to provide sufficient water quantity and quality to meet essential domestic needs and health requirements of Minnesota's population at all times;

** Direction of the growth of water intensive industries to areas where water quantity and quality are sufficient to meet the needs of the industries;

** Development of feasible energy resource projects in a framework which explicitly addresses trade-offs between water consumption and water quality and does not allow reduction in stream flow, lake levels, or ground-water storage below an acceptable level;

** Identification of areas in the state where irrigation development may be beneficially pursued and where development may not be feasible;

** Continued development of water-borne commerce on navigable rivers and Lake Superior, while striving to protect other uses of such waterways and to preserve their natural beauty, habitat, and air and water quality;

** Reduction of urban and rural flood damage through the use of "nonstructural approaches" (e.g., flood plain zoning and flood proofing) whenever social and economic conditions permit, but with full recogition that structural approaches may be required in certain situations;

** Development of systems for water information management based on separate but coordinated systems housed in individual agencies and linked through a central clearinghouse, consistent standards and identifiers, and interagency communication;

** Identification of the full costs and benefits of draining or preserving wetland areas, considering the multiple natural resource values of wetlands (in both urban and rural settings) and the benefits associated with additional agricultural production;

** Maintenance of an environment in the state that offers a diversity of cultural experiences and recreational activities in keeping with resources available, while preserving aesthetic values to the extent possible;

** Protection of waters of the state against pollution in order to assure a safe source of water for domestic consumption and to meet established water quality goals;

** Promotion of land use practices that effectively control sedimentation and erosion which occur in excess of natural conditions;

** Management of Minnesota's lakes and shorelends to resolve problems of water quality, incompatible surface uses, and improper development;

** Maintenance of hunting, fishing, and related opportunities (e.g., canoeing and sightseeing) for Minnesota's sportspersons and nature lovers through management of water resources; and

** Presentation to the citizens of the state of accurate, understandable information on the state's water resources in order to allow full participation of an informed public in the decision-making process.

This goal and series of objectives are directed toward the betterment of the citizens of Minnesota and toward improvement of the body of government responsible for preserving the environment of the state. Some of the specific objectives are now being carried out in various degrees by state agencies. Others are not clearly the responsibliity of any agency. All are important.

General Principles

In striving to attain the stated objectives, a number of guidelines and assumptions should be employed. They include:

** Consideration of all potential actions in light of their possible impact on regional and local programs, functions, and contributions;

** Emphasis on multiple use concepts for water and related land program development where compatible with the preservation of the resource;

** Recognition of the desirability of retaining and emphasizing those physical, cultural, and aesthetic characteristics associated with regions of the state;

** Recognition that where there are quantifiable benefits to society as a whole derived from public actions, the costs should be shared by all, but where there are quantifiable benefits to individuals, the costs should be borne by those individuals as possible;

** Recognition that the use of water resources should be considered in a framework of long-term costs and benefits to society and not in a framework of short-term demands and crises;

** Fostering of economic development consistent with resource availability and in harmony with environmental constraints;

** Allowance of the flexibility to permit programs to adjust as quickly as possible to changes in water availability, water use, environmental conditions, or the economy with as little government intervention as possible;

** Development of programs which are understandable in their operation and effects, which have the effects intended, and which are subject to policy and fiscal control;

** Strengthening of regional and local participation in the decision-making processes of the state;

** Responsiveness and adaptability of organizations developed to deal with water resources concerns; and

** Employment of a holistic perspective in water resources decisions.


SELECTED ISSUE AREAS

WATER RESOURCES COORDINATION

The State of Minnesota is currently involved in numerous statewide, intrastate, and interstate water planning and management programs. The state has recognized the need to identify and maintain an ongoing comprehensive water policy. These programs and the policy development process have many complex—and sometimes conflicting—goals, objectives, and procedures which require integration and coordination if they are to work effectively and not be at cross-purposes. In addition, the creation of state level policy development mechanisms can be used to provide means to incorporate state, local, regional, and public views in policy development.

Situation

Federal actions (most importantly, the passage of the Water Resources Planning Act) and the heightened environmental consciousness of the mid and late 1960's served to focus Minnesota's attention on development of a comprehensive statewide water resource strategy. In 1970 and 1971, the State Planning Agency—through the Water Resource Coordinating Committee—used federal funds to produce a first assessment of Minnesota's water resources and a report discussing alternate programs and policies through the year 2000. The Water Resources Coordinating Committee was suspended following the completion of the documents and the Department of Natural Resources was given authority to receive federal water planning funds in November 1972.

In 1973, Governor Wendell Anderson created through Executive Order No.71 the Water Resources Council because "coordination of. . .programs and activities is necessary for proper water and related land resources planning and elimination of duplication of efforts."

In 1974, the responsibility for preparing a "Framework Water and Related Land Resources Plan" was vested in the Department of Natural Resources. The Water Resources Council was to "coordinate the preparation of (the Framework Plan) for the state, in harmony with (other similar efforts)." However, neither the Department of Natural Resources nor the Water Resources Council was provided adequate funding or staff for this effort.

In 1976, the Legislative Commission on Minnesota Resources approved emergency funding for water planning based on a request from the Water Resources Council. Funds were provided directly to the Department of Natural Resources, which contracted with four other agencies for products. A "Phase I" report was completed under this funding and coordinative mechanism.

The 1977 Legislature elected to create the Minnesota Water Planning Board to supercede the Water Resources Council. The Board—a separate state agency within the Executive Branch of state government—was charged, among other things, with directing the preparation of a framework water and related land resources plan; assuring participation of the public and governmental units in the development of the framework plan; and coordinating public water resources management and regulation among the state agencies.

A major provision of Minnesota Statutes, Section 105.401 (the codification of Laws 1977, Ch. 446) is that the Water Planning Board "ceases to exist June 30, 1979." Interim funding was requested and approved to extend the life of the Board only through June 30, 1980 for the purposes of (1) communicating framework plan elements to the public and the Legislature and (2) maintaining, on an interim basis, certain functions assigned in Minnesota Statutes, Section 105.401 (e.g., representation of the Governor on federal-state basin commissions).

Implications and Considerations

At the close of F.Y. 1980, the State of Minnesota will be without a designated mechanism to coordinate water-related activities which cut across agency interests, levels of government, and political boundaries. Since 1970, this has been viewed as a legitimate function of state government, although various mechanisms to achieve coordination have been tried. However, by attaching a "sunset" provision to the most recent coordinating mechanism, the Legislature may have indicated its intent that the state have its house sufficiently in order by the expiration date to eliminate the need for a coordinating mechanism.

An examination of nine states—the five surrounding Minnesota, plus Nebraska, Idaho, Texas, and California— indicates that seven use some form of representative board or commission to maintain and update state water policy. California and Texas do not maintain such coordinative bodies because almost all policy is set through statute under western water law. After a recent evaluation of state water management, the State of North Dakota elected to request funds to staff an Office of Water Policy Development in order to assure the development and coordination of a more comprehensive state water policy.

Specific to Minnesota, 16 agencies and boards administering more than 80 water related programs have been identified at the state level. The execution of these programs requires the coordination and exchange of vast amounts of information and the integration of numerous program objectives in order to achieve state goals. Using interactions between water quantity and water quality programs as an example, the need for identifying and formalizing relationships between programs in Minnesota has been demonstrated.

Specifically, the Water Planning Board has found:

** There are currently no formalized agreements governing how the Department of Natural Resources and the Department of Health will interact during critical periods of water supply. The DNR is charged with developing regulations governing mandatory adoption of ordinances by public water authorities for use during critical supply periods. The MDH is charged with developing emergency plans to protect the public when declining quantities create health risks.

** The fragmentation of lake management authorities has spawned several independent data-gathering activities. A survey of data collection programs evidenced the need of program managers to access related lake data housed in other agencies and to be kept informed of proposed data collection programs.

** The creosote contamination of ground-water supplies in St. Louis Park is a good example of a management problem which calls for coordination among agencies. Both the Department of Health and the Pollution Control Agency are involved in this issue through their water quality programs. In addition, the solution to the problem could very well involve restriction of appropriation permits, a Department of Natural Resources responsibility.

** Few state water resources programs provide a clear and precise statement of purpose. As a result programs tend to operate as individual units and often fail to provide benefits which might be achieved if they operated in concert. For example, the whole might be greater than the sum of its parts if state and matched federal assistance to lake management authorities could be tied to other programs, such as compliance with shoreland management or achievement of soil and water conservation planning in rural areas.

The need for a means to facilitate interaction of programs is also demonstrated in discussion of conflict resolution processes, water planning, supply and allocation of water resources, and information system development.

There are several precedents which demonstrate the effectiveness of coordinated action in the State of Minnesota. These include:

** **Comprehensive water planning.** During the periods in which coordinating mechanisms with sufficient authority and funding have existed (e.g., 1970-71 and 1976-79), comprehensive planning has moved forward. During other periods, comprehensive planning has stalled.

** **Information system development.** In 1972, a subcommittee of the Environmental Quality Council's Citizens Advisory Committee found that ". . .experiences with groundwater contamination. . .have pointed to the need for a groundwater information system for Minnesota." The coordination of a ground-water data base within a broader water information system has been carried out through a multi-agency work group of the Water Planning Board. The development and coordination of a water appropriations data base for Minnesota has been accomplished in a similar manner.

** **Receipt of federal funds.** To receive funds under the federal Water Resources Planning Act, the state must have a mechanism to coordinate planning and other activities. (This source of funds is expected to increase dramatically in the future under federal water policy initiatives.) Coordinated through the Water Planning Board, funding has been obtained through the Corps of Engineers for several projects. A coordinating mechanism also will likely be a requirement for receipt of federal funds to carry out the proposed water conservation technical assistance program.

** **Interstate relations.** Coordinated state agency positions must be developed for effective state participation in federal-state basin commissions. Coordinated activities of state agencies have led to development of a state policy toward basin commissions and are leading toward full participation in the Upper Mississippi River "Master Plan" development process.

In addition, there is a new focus on the need for coordinating mechanisms at several levels. Proposed federal water policy places a greater responsibility on the states to carry out planning and evaluation activities in order to receive federal project funds. The state will require a central mechanism to bring these responsibilities together. The National Governors' Association has proposed as a central principle that "water management must be approached in a more comprehensive and coordinated manner at federal, state, local, and interstate levels."

Finally, an unquantifiable but important result of coordinating activities is the effect on interagency staff interactions. Familiarity with actions of related agencies breeds an openness in relations. Interaction promotes awareness of the impacts of one agency's decision on another agency. The current water planning effort has seen many such benefits.

Issues

There are two central issues which must be addressed by decision-makers in relation to water resources coordination in Minnesota:

(1) Is there a need for a continuing coordinating body in the State of Minnesota? and

(2) If there is to be such a body, what are the major options available to the state for continuing a coordinating body?

These issues are also addressed in various forms in the "Management" section of this document. The "Management" section specifically addresses the responsibilities and authorities appropriate for a coordinating body.

Options

The issue of the need for a water resources coordinating body to deal with the wide range of activities which cut across agency interests, levels of government, and political boundaries must be answered with a "yes" or "no." While such a body might be viewed as another level of government and a contributor to the multiplicity of agencies involved in water resources activities of the state, the failure to maintain such a body may result in (1) the loss of a check against agencies working at cross purposes, (2) the absence of a viable mechanism to resolve interagency disputes, (3) the absence of a viable mechanism for initiating and coordinating interagency water planning and for integrating plans of local and regional agencies into state strategies, (4) a reduced ability to pursue federal funds and products, and (5) the absence of a unit clearly charged with and capable of interfacing with federal and federal-state basin commission programs which involve the interests of more than one state agency.

There are a number of options which might be employed to carry out the coordination function, not all of which involve creation of a new agency of government. These options include:

** **The Department of Natural Resources.** The DNR was charged with coordinating state water planning activities and the use of federal funds in these areas from 1972 to 1977. There was dissatisfaction at several levels with the DNR in this role. In addition, the DNR lacks a meaningful forum for bringing major state water management agencies together on equal footing.

** **The Environmental Quality Board.** This existing body currently administers some functions relating to water resources, provides a forum for representing most major water resources agencies (neither the Soil and Water Conservation nor the Water Resources Board is included) and is charged with interagency environmental policy development. The EQB does not currently have the technical staff capability to carry out water resources coordination. In addition, the EQB has focused on firefighting activities, and is concerned with a wider range of environmental issues which may obscure water-related issues.

** **A Citizens Board.** Several examples of citizens boards currently exist in Minnesota, including the Pollution Control Agency Board, the Water Resources Board, the Southern Minnesota Rivers Basin Board, and the Metropolitan Council. The experience with these boards could be drawn upon to design a board capable of providing coordination of water management programs and policies at the state level. The advantage of a properly constituted and staffed citizens board would be a conflict resolution forum removed from narrow agency interests, but combined with comprehensive planning and policy development activities. Such a board would be especially capable of providing independent review of agency budgetary requests and agency program evaluations for compatibility with the overall state water strategy. The disadvantage of the citizens board would lie in its separation from state agencies and the resulting lack of a positive forum for agency-agency coordination; the possibility that it would be perceived as a new layer of government; the possible difficulty in getting state agencies to participate in board functions and to comply with board determinations; and the possibility that a larger staff would be required for the board to actively pursue resolution of conflicts, since agencies seem less inclined to bring disputes to non-agency boards.

** **A Water Planning Board-model.** The major drawback of this option is that it would create a new state agency along the lines of a body which was created for a limited time to serve a specific purpose. However, this type of body has been successful in coordinating water-related concerns; it would have a specific focus on water issues; it might draw on existing staff capability; and it would provide a forum for representing public interests and major water resources organizations (although the Water Resources Board and the State Planning Agency are not represented on the current Board). In addition, this type of structure has been able to administer federal and federal-state basin commission funds which require interagency coordination.

The discussion of the Water Planning Board-model throughout this document generally implies a body of agency heads and is described as a "new state agency" above. However, the Water Planning Board-model need not be limited to present agency members, and it need not rule out a combination citizen-agency board. The actual structure of a coordinating body based on the Water Planning Board-model is an open question.

There would be little difference in the number of staff positions required for the Environmental Quality Board or the Water Planning Board-model to operate as a coordinating body. The Department of Natural Resources might better draw on existing staff, although the historical difficulties with such an approach must be considered. The citizens board could require additional staff to actively pursue resolution of conflicts among agencies for the reasons noted above, but would not require more staff than the interagency board options to carry out comprehensive planning, budgetary review, and program evaluation functions.

Criteria

There are two decisions which must be made. The first is related to the **need** for a coordinating body; the second to the **organization or organizational model** to house such a body.

In considering the need for a continuing coordination body, decision-makers might consider whether such an entity is likely to improve (1) the manner in which state water policy is developed, (2) integration of local and regional initiatives and policies into an overall state strategy, (3) implementation of methods to achieve state water resources goals and objectives, (4) political feasibility, and (5) potential costs.

In selecting among the organizational options for carrying out coordination, decision-makers might consider the degree to which the option would provide (1) an effective forum for representing all major state water management interests, (2) the capability and authority to carry out coordination activities, (3) the forum and authority to determine which issues are interagency in nature and to resolve these issues, (4) an effective organization for integrating local and regional plans with a state strategy, and (5) the ability to administer and the authority to receive funds for which interagency coordination is a grant requirement. In addition, potential differences in the cost of implementation must be considered.

Recommendations

The Minnesota Water Planning Board recommends that:

(1) **The State of Minnesota explicitly designate or establish a water resource coordinating function.** The coordinating function is essential to deal with the range of activities which cut across agency interests, levels of government, and political boundaries; to insure comprehensive policy development which includes the views of state, regional, local, and public interests; to facilitate the receipt and effective utilization of federal funds; to resolve interagency conflicts; to initiate and coordinate comprehensive water resources planning; to review budgetary requests of agencies for consistency with state policy; to integrate plans of local and regional agencies with state strategies; and to assure citizen involvement in water resources policy-making.

(2) **The Legislature — with input from the public — select among the major organizational options for meeting the need for a state coordinating body.** The entity designated or established to fulfill the coordinating function must be provided with sufficient authority to carry out the above coordination functions. The necessary authorities are fully described in the "Management" section of this report.

Supportive Documents: Technical Paper No. 5, "State Water Resources Program Inventory and Problem Identification"; Technical Paper No. 14, "Management Problems and Alternate Solutions"; and "Final Report of the Management Work Group."

FEDERAL AND INTERSTATE RELATIONS

Federal agencies and interstate basin commissions significantly affect the water resources activities of the State of Minnesota. For example, the Corps of Engineers and the Soil Conservation Service undertake flood control measures. The Upper Mississippi River Basin Commission submits priorities for state and regional programs and projects to Congress in an attempt to influence federal funding. The Minnesota-Wisconsin Boundary Area Commission coordinates activities between the two states. Because of their capability for affecting water resources activities in the state, Minnesota must be increasingly concerned with federal and interstate relations.

Situation

Federal responsibility in the field of water resources is divided among more than 25 separate agencies in eight Cabinet departments and various independent organizations. Water-related planning, construction, maintenance, and grant and loan activities of these agencies are supported by more than $10 billion per year in federal funds. The Environmental Protection Agency's municipal wastewater treatment program is funded by $5 billion of these funds. Construction and related activities of the Corps of Engineers, the Soil Conservation Service, the Bureau of Reclamation, and the Tennesee Valley Authority represent about 75 percent of the remaining $5 billion.

The Soil Conservation Service has 43 active watershed projects in Minnesota, 12 of which had construction completed by January 1978. Through 1977, the Corps of Engineers had completed 17 flood control projects in the state, with 11 more under construction. Both the Corps of Engineers and the Soil Conservation Service are engaged in river basin studies in Minnesota, including a joint study covering an area of approximately 2.7 million acres in southwestern Minnesota. The Corps of Engineers is engaged in recreational navigation, commercial navigation, and beach erosion control projects in the state. In addition, there are numerous other federal activities ongoing in Minnesota, including flood insurance programs, wetlands acquisition, permitting programs, and many others.

There are more than 55 federally assisted water and related land resources programs addressing planning; flood damage abatement; land stabilization; natural, historical, and recreational sites; navigation; water quality; and water supply. While far from an inclusive listing of federal funds coming into the state, in F.Y. 1978 Minnesota received nearly $60,000 in water planning assistance from the U.S. Water Resources Council; $124,000 for dam safety inspections; and an equivalent of some $70,000 for studies conducted through the Corps of Engineers Section 22 (P.L. 93-251) program. Much larger amounts were received through soil conservation programs and Environmental Protection Agency municipal wastewater treatment facility grants. In F.Y. 1978, the state also received nearly $47,000 through the Upper Mississippi River Basin Commission and $4,000 through the Missouri River Basin Commission. However, it is important to note that federal and basin commission funding varies from year to year.

The receipt of federal assistance in the area of water resources planning obligates the State of Minnesota to participate in various planning processes required by the federal government. Specifically, the Water Resources Planning Act (P.L. 89-80) offers federal assistance contingent on state participation in various river basin commissions and other water-related federal grant programs. The Water Resources Development Act (P.L. 93-251) also provides planning assistance to states from the Secretary of the Army (U.S.C.E.) based on coordinated and comprehensive work programs developed by the grantee. All of these grant programs require continual state participation through initial planning efforts, operations monitoring, and evaluation.

In 1976, federal-state basin commissions were authorized to (1) serve as the principal agencies for the coordination of federal, state, interstate, local, and non-governmental plans for the development of water and related resources; (2) prepare and update comprehensive plans for the development of water and related resources; (3) recommend long-range schedules of priorities for the collection and analysis of data and for investigation, planning, and construction of projects; and (4) carry out special studies. In F.Y. 1978-79, Minnesota was a member of the Upper Mississippi River, the Missouri River, and the Great Lakes Basin Commissions. A total of $83,400 in state funds was appropriated in F.Y. 1978-79 for participation. With the exception of the statutory designation of the Chairman of the Water Planning Board as the Governor's representative on the Basin Commissions, no state funds for staff are currently allocated to basin commission efforts.

Two other interstate organizations and one intrastate board are prominent in the water resources picture for the state. The interstate organizations are the Minnesota-Wisconsin Boundary Area Commission and the Great Lakes Commission. (The Great Lakes Commission is oriented primarily toward economic development; the Great Lakes Basin Commission toward basinwide planning.) The intrastate board is the Southern Minnesota Rivers Basin Board.

Implications and Considerations

1. **Federal Relations.** The State of Minnesota presently lacks both a policy toward federal water resources efforts and an effective mechanism for developing comprehensive policies regarding federal initiatives. While individual agencies monitor federal activities in their respective areas of interest, there is no assurance interagency concerns will be recognized and resolved. At best, coordination of agency interests occurs through personal contacts. Examples of problems in coordinating agency interests to form state policies include Locks and Dam 26 legislation and Corps of Engineers' dredging activities. Examples of future needs for coordination include the Upper Mississippi River Master Plan, the designation of the responsible agency for the Rural Clean Waters program, and development of approaches to water conservation in response to federal initiatives.

2. **Basin Commissions.** Minnesota Statutes, Section 105.401 specifically require the Water Planning Board to "Evaluate state participation in the federal-state basin commissions and make recommendations to the governor and the legislature concerning continued state involvement."

Through this evaluation, the Water Planning Board determined:

1. Because of improved communications, the coordination of water planning and management within a basin is improved. As a result, decisions made affecting water and related land resources within the basin are enhanced.
2. Ongoing planning and priorities activities established by the basin commissions have created dynamic and orderly processes which are receptive to state input. These activities provide a base for concurrent development of state priorities and policies.

3. Basin commission activities have had little impact on intrastate coordination with federal agencies at the program or project level. In addition, the basin commission has not been an effective mechanism for addressing difficult problems, with decision by consensus leading toward the "lowest common denominator."
4. While Minnesota has been a member of three basin commissions, it has placed very little emphasis on basin commission activities. The state has not **actively** participated in all activities and programs of the commissions. State agency review of basin commission output has been a low priority.

The Board concludes from the evaluation that basin commissions must be viewed as coordinators and facilitators. Minnesota's interest in participating in basin commissions lies in enhancing its intrastate planning and management capacity, with cognizance of surrounding states' interests and of the potential impacts of their planned actions on Minnesota. The potential which basin commissions offer for enhancing the state's water planning and management capacity must be weighted against the policy, manpower, and funds required.

While the Board was not directly charged by the Legislature with examining the Minnesota-Wisconsin Boundary Area Commission, The Great Lakes Commission, and the Southern Minnesota Rivers Basin Board, consideration of these entities was desirable in obtaining a full picture of federal and interstate relations.

Issues

There are three major issues to be addressed in developing a state water and related resources plan with regard to federal-state relations and interstate commissions:

1. What process should the state employ to coordinate policy development with regard to federal initiatives, including the establishment of priorities for the use of federal funds?
2. Should the state continue involvement with the Upper Mississippi River, Missouri River, and Great Lakes Basin Commissions?
3. Should the state continue its funding of the Minnesota-Wisconsin Boundary Area Commission, the Great Lakes Commission, and the Southern Minnesota Rivers Basin Board?

Options

The options available to the state in the development of a process to coordinate policy development with respect to federal initiatives include:

1. **Strengthened role of the Governor's staff.** This option would require additional Governor's staff devoted directly to this area. The cost and visibility of additional staff may make this option unattractive.

2. **Voluntary communication with increased emphasis on coordination.** This is essentially a no change option, relying on individual contacts to assure that interagency concerns are addressed. However, the Governor through a directive to all agency heads would be requested to highlight the need and establish procedures for interagency communication and coordination. Agencies may perceive the need for additional staff to carry out this option.

3. **Establishment of a coordinating body.** The precedent for such a mechanism lies in the Water Planning Board's coordination of the development of a position paper on President Carter's federal water policy initiatives. The establishment of a coordinating body would provide a formal mechanism for addressing multiple agency concerns.

In resolving the issue of continued basin commission participation, three distinct options are available;

1. **Discontinue participation.** Under this option, the State of Minnesota would drop all formal association with a basin commission(s) and realize a savings in dollar contributions to the commission(s) and staff time.

2. **Reduce state status to that of observer.** This option would entitle Minnesota to information from the commission(s) without membership costs, but would remove the state's right to vote on commission matters.

3. **Continued participation.** Minnesota would continue to have full access to commission activities and voting privileges, but would continue to sustain membership costs.

If the state is to continue its participation, the issue of staff must be considered. That is, the Board has concluded that Minnesota has not **actively** participated in commissions. Staff may be required to remedy this situation.

The options relating to the interstate commissions and the intrastate board are essentially the "discontinuance" and "continuance" options identified for the basin commissions.

Criteria

In deciding among the federal relations options, four criteria are suggested. They are the degree to which the option is likely to (1) limit fragmented, incremental responses to federal initiatives; (2) establish responsibility for assuring that all appropriate agency views are considered; (3) aid in the development of explicit state goals and objectives; and (4) provide a means of accountability for decisions.

In choosing among both the basin commission and the interstate commission and intrastate board options, the criteria which might be employed include (1) the degree to which Minnesota's interests are adequately represented in Commission decisions; (2) duplication of efforts of other organizations; (3) support or opposition among citizens, interest groups, and legislators to continue participation; and (4) effectiveness of commission operations.

Recommendations

The following are the recommendations of the Water Planning Board with respect to federal and interstate relations. Importantly, these recommendations are based on an assumption that the State of Minnesota will maintain and incorporate a water resources planning capability. The findings of state-level planning must substantiate positions taken on federal and interstate initiatives.

(1) **Interagency Priorities Committee.** The State of Minnesota should establish an interagency Priorities Committee under the authority of the state coordinating body which will facilitate the development of state policy for federal water resources initiatives which affect the programs or concerns of more than one state agency. **At the minimum,** this body should include representatives of the Departments of Agriculture,

Economic Development, Health, Natural Resources, and Transportation; the Energy, Pollution Control, and State Planning Agencies; and the Soil and Water Conservation and Water Resources Boards. Subcommittees should be formed where decisions of the Priorities Committee are limited to fewer agencies than those participating on the full Committee. Additional intrastate input should be obtained on appropriate matters through regional development commissions. The state should maintain its current mechanism for obtaining decentralized input through the review and comment procedures of all regional development commissions and associated committees.

The Governor's Office should require the heads of agencies to give priority to water resources coordinating activities, including designation of responsible staff persons.

In order to advise the coordinating body, the Priorities Committee shall fulfill the following tasks:

A. Recommendation of basin commission priorities;

B. Initiation or review of new federal program proposals for areas with identified water-related problems;

C. Ranking of new planning, analysis, and research proposals for which federal funding has been requested, with rankings based on criteria which address types of programs eligible for funding, available cost-sharing mechanisms, economic and environmental considerations and an evaluation of alternative solutions;

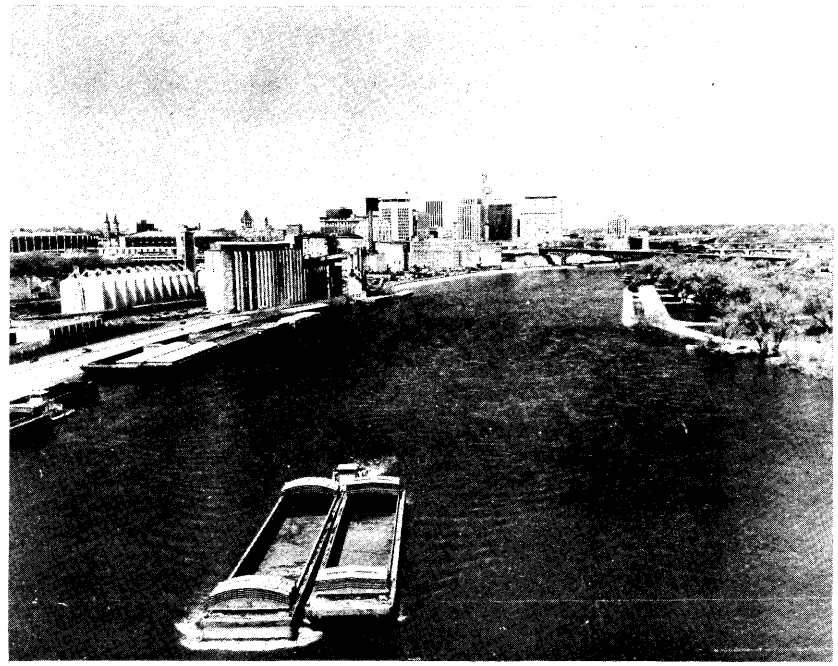
D. Provision of input to the Legislature (through the coordinating body) with regard to federal program proposals for Minnesota; and

E. Coordination and direction concerning state activities in federal programs which require interagency or interstate input.

(2) **Basin Commission participation.** The State of Minnesota should continue participation on the Upper Mississippi River and the Great Lakes Basin Commissions, with increased state and agency priority on commission activities. The state should reduce its status to that of an "observer" on the Missouri River Basin Commission, since this basin commission offers the state the potential for only limited or intangible benefits.

(3) **Souris-Red-Rainy Regional Committee.** The State of Minnesota should continue to support an autonomous regional committee structure for the Souris-Red-Rainy River basins under the Upper Mississippi River Basin Commission, but oppose reestablishment of a separate basin commission. Minnesota should continue to supplement international cooperation through active participation in the International Joint Commission.

(4) **Other commissions and boards.** The State of Minnesota should continue participation on the Minnesota-Wisconsin Boundary Area Commission and the Great Lakes Commission. The state should continue to fund the Southern Minnesota Rivers Basin Board. The responsibility for coordinating these activities should be delegated to the coordinating body selected by the Legislature.
Participation in the Southern Minnesota Rivers Basin Board in its current form should be continued only through the F.Y. 1980-81 biennium, if the concept of a coordinating body is adopted. Beyond F.Y. 1981, the SMRBB should be continued as an **ad hoc** advisory body to the coordinating body. (Also see "Management" section recommendations.)



(5) **State staffing.** The state should fund a full-time staff to assist the Governor's representative in the planning activities required by P.L. 89-80. The staff should be responsible for the coordination and execution of the annual planning activities required by each basin commission or committee (e.g., Comprehensive Coordinated Joint Plans, Priorities Reports, Program Reports, etc.) and the special water planning activities sponsored by the various basin commissions (e.g., Upper Mississippi River Master Plan, National Assessment, Level B's, Special Sub-basin Studies, etc.). Agency commitment to river basin planning should be affirmed by identifying a river basin commission liaison within each state agency participating in the required river basin planning activities. A corresponding item should be added to the job description of each agency's liaison in order to assure accountability for such participation.

(6) **Revision of P.L. 89-80.** Through its Congressional delegation, the state should actively support revisions of P.L. 89-80 (the Water Resources Planning Act of 1965) which would further strengthen the state's position in water management and planning. In addition, the State of Minnesota should more actively seek funds from federally assisted water and related land resources planning and management programs to allow expansion of state efforts in these areas.

In this regard, in F.Y. 1980, the Water Planning Board should assume an advocate role in the exploration and coordination of federal grant programs and requiring interagency input (e.g., Titles II and III, P.L. 89-80, and Section 22, P.L. 93-251).

Supportive Documents: Working Paper No. 4, "An Evaluation of Minnesota's Continued Participation in Federal-State Basin Commissions."

WATER QUALITY

The quality of surface- and ground-water resources depends in a large part on natural conditions. Water picks up materials from the air, the ground over which it flows, and the soil through which it infiltrates. Variations in the chemistry of soils and underlying rocks have a strong impact on the quality of the waters that pass through them. As water flows in lakes and streams, it is affected by the life forms in the waters (just as the life forms are affected in the quality of the water). Thus, even in the absence of man's activities, there would be "natural" variations in water quality.

However, man's activities have significantly affected the "natural" state. Air pollution has changed the material picked up in the air. Agricultural and industrial chemicals and urban land use add contaminants to runoff. Disposal of hazardous waste may alter water as it infiltrates into the ground.

Because Minnesota is a headwaters state, control of man-induced water quality problems is a special responsibility. Minnesota has not only its own interests in preserving water quality, but also an ethical obligation to protect the quality of water which reaches downstream users.

Relationship to Water Quality Planning Programs

The Minnesota Pollution Control Agency and the Metropolitan Council, working under provisions of Section 208 of the federal Clean Water Act, are addressing major water quality issues.

These activities are being carried on concurrently and in coordination with the framework water and related land resources plan. Through its water quality planning program, the MPCA is beginning to address water pollution by non-point sources and potential abatement measures. The Metropolitan Council is preparing a plan for achieving federal water quality goals in the metropolitan area through adoption of a sewer system plan and a program for managing and regulating water quality-related facilities. When complete, these efforts will become the water quality elements of the state water resources strategy.

In the interim, the role of the Water Planning Board is to address the present quality of the state's waters; to explore relationships among the state's waters; to explore relationships among state water quality programs; and to examine limited, specific issues which might otherwise "fall between the cracks" of the planning efforts. Because the major water quality elements of the state strategy will await completion of the MPCA and the Metropolitan Council efforts, the water quality section of this report discusses only the present situation in Minnesota and the conclusions and recommendations of the Board in limited areas suggested by the public and the Board's Water Interests Advisory Committee.

Situation

The quality of Minnesota waters is generally good, but continued and improved careful management is essential if this quality is to be preserved.

Surface waters are subject to comparatively rapid changes in quality because they are easily reached by natural and artificial contaminants. As a result, many of Minnesota's lakes are now affected to some degree by the effects of eutrophication. Naturally eutrophic lakes are found within the prairie-grassland regions of southwestern, western, and northwestern Minnesota. Man-induced eutrophication results from industrial, municipal, or commercial waste system discharges and from erosion or drainage of cultivated farmland, urban runoff, and septic tank systems. In general terms, lake clarity decreases moving from the northeast to the southwest.

Studies of the Minnesota Pollution Control Agency in 1976 indicated that the majority of the rivers in the state are currently in conformance with national goals for "fishable" and "swimmable" waters. However, large areas of particular rivers and a substantial number of localized areas appeared to be in noncompliance with applicable goals. Twenty-three percent of the 75 water quality monitoring stations assessed in the report were considered to be in noncompliance with one or both of the national goals. Rivers or reaches of rivers in this category were the Mississippi River below Minneapolis-St. Paul; the Zumbro River below Rochester; the Cedar River below Austin; Buffalo Creek below Glencoe; Center Creek below Fairmont; and the headwaters tributaries of the Missouri and Des Moines rivers.

Studies of water quality in Minnesota based upon chemical data collected for municipal water supplies have shown marked deviations depending upon whether the water was supplied from a surface- or a ground-water source. These studies indicate that ground water supplying communities in southwestern Minnesota deviated most from currently accepted quality criteria. In addition, the Karst area of southeastern Minnesota faces special problems in relation to ground-water contamination. (In general, however, ground water is considered to be a more consistent source and is the source of supply for over 90 percent of the municipal suppliers in the state.)

Three state agencies are principally involved in the resolution of water quality problems: the Pollution Control Agency, the Department of Health, and the State Soil and Water Conservation Board. In addition, the Minnesota Departments of Agriculture, Natural Resources, and Transportation and the state Water Resources Board and watershed districts are involved to a lesser degree.

Water quality activities in Minnesota involve some 30 separate permitting authorities, nonpermitting regulatory activities, and monitoring and study programs targeted to control pollution of the state's waters. There are overlapping jurisdictions in a number of these programs, although this is not necessarily undesirable or damaging. The number of programs and the overlapping jurisdictions highlight the necessity of coordinated, goal-oriented management of programs if water quality objectives are to be met at least cost to the public.

The costs of pollution control are high in any case. In a June 1977 report to Congress, the MPCA estimated total needs for municipal treatment systems in Minnesota at $1.6 billion (including sewer systems and infiltration inflow corrections). Soil Conservation Service estimates of agricultural non-point source pollution control for Minnesota are in the neighborhood of $1.2 billion, with lakeshore and streambank erosion controls possibly adding another $700 million to this figure. However, the benefits of high quality water to Minnesota are also substantial. Beyond the essential health and safety factors, high quality water is central to the tourist industry of the state (which generated expenditures of $1.3 billion in 1976 and produced an estimated 90,000 jobs), to many industries, to commercial fishing, and to the overall quality of life enjoyed by citizens of the state.

Conclusions

The review and analysis undertaken by the Board led to 11 major conclusions relative to the quality of the state's water and the efforts to maintain water quality.

** The quality of Minnesota's waters is generally good. However, conditions and problems vary among geographic areas of the state. Large areas of particular rivers and a substantial number of localized areas appear to be in noncompliance with water quality goals. Many Minnesota lakes are now impacted to some degree by eutrophication, due both to natural and man-induced conditions. The Karst area of southeastern Minnesota faces special quality problems, while southwestern Minnesota ground-water supplies have been found to deviate most from currently accepted quality criteria.

** Continued and improved careful management is essential if the quality of Minnesota waters is to be preserved. Such management must take cognizance of the variation in conditions and problems among geographic areas. Where water quality is impaired in excess of natural conditions, it must be improved to insure the health and welfare of the citizens of the state.

** With the completion of the "208 Plan," the state will have the opportunity to adopt effective programs to address most water quality problems. The "208 Plan" will identify approaches to deal with diffuse, or non-point, sources of pollution. This will complement existing efforts to control pollution from point sources. However, there will be an urgent need to coordinate water quality program goals with other water resources interests of the state.

** While the Minnesota Pollution Control Agency and several other agencies regularly collect information on the quality of a variety of Minnesota waters, there is no coordinated system for collecting it or disseminating it to potential users. As a result, the State of Minnesota is obtaining far less benefit from available information than could be achieved. At the same time, there is insufficient data to answer many of the specific questions raised by planners, organizations, and individuals.

** To a limited extent, industries which practice water conservation in order to reduce their water costs might also benefit through reduced waste treatment and disposal costs. However, in the future new power plants will consume more water in order to protect waters from thermal pollution.

** There is a need to ensure proper construction and maintenance of on-site waste disposal systems in many areas where no regulation currently exists. (On-site systems include subsurface soil treatment and disposal, as well as alternatives such as composting toilets.)

** The runoff of stormwaters from urban areas creates significant levels of water pollution in some areas. Solutions to such problems are likely to be costly and must be tailored to each locality.

** There is a need for continued close attention to the problem of ground-water quality in the Karst (sinkhole) region of southeastern Minnesota. The Department of Health is coordinating a study "to define the nature, extent, and projected problems and solutions" relating to the contamination of ground water in this region. While major efforts may prove necessary to protect ground-water resources in the region, the Water Planning Board should not preempt the ongoing efforts to arrive at these solutions.

** Because dredging operations have the potential for disturbing the bottom habitat in a harmful manner and for resuspending harmful materials (most notably heavy metals, PCB's, and pesticides), maintenance of navigation on the Mississippi, Minnesota, and St. Croix Rivers and in the Duluth-Superior harbor will continue to pose a water quality concern.

** A few Minnesota cities have historically discharged their treated wastewaters just upstream of lakes. Due to the high costs of reducing the amount of phosphorous in the wastewater — a measure necessary to the protection of lake water quality — in a few specific situations these cities have found it more economical to remove their discharges from those lakes, sometimes even into another drainage area. Similar situations are expected to arise in the future. Appropriate agencies (e.g., the Department of Natural Resources, the Pollution Control Agency, and local governments) may find it necessary to examine more closely the effects of wastewater discharges on water availability.

** There is a substantial body of Minnesota law enabling Minnesotans who live outside of incorporated cities to establish waste disposal systems for their communities. Some of this law is not being utilized. A number of districts are created by special legislation, when other authority exists. Revisions in the existing body of law are warranted. In making these revisions, care must be taken not to overlook linkages to rural water systems or the land use implications of rural sewage. Further, coordination of various state and federal requirements for funding rural sewer systems should be improved.

Recommendations

Within the limited issue areas suggested during public meetings and by the Water Interests Advisory Committee, the Water Planning Board makes the following recommendations:

(1) **Program management.** Because of the number of water quality programs and their overlapping jurisdictions with other programs designed to protect both the quantity and quality of state waters, it is recommended that these programs be managed in a coordinated and efficient manner, including consideration of geographic variations, in order to achieve state quality-quantity objectives. The Water Planning Board structure should be used to resolve quality-quantity issues emerging from Framework Plan and "208 Plan" development.

(2) **Coordination of water quality monitoring.** It is recommended that information being collected for management studies and to revise and update a water data sources catalog be aggregated and used to address the issue of the coordination of water quality monitoring in Minnesota. In addressing this issue, the fact that water quality data is gathered for different purposes by different bodies must be considered. Key options which require examination are (a) centralization of monitoring control, (b) development of a coordinating mechanism between agencies monitoring water quality, and (c) continuation of the present approaches, but under memoranda of agreement between agencies. The study of these options should be initiated by the coordinating body and carried forward by the involved agencies. Increased non-point monitoring must be an element in any case.

(3) **Trade-offs between effluent standards and conservation measures.** Targeting on areas where water conservation measures have a potential impact on water quality, it is recommended that efforts be made to address the trade-offs (economic, technological, etc.) between effluent standards and water conservation measures. The MPCA and the DNR must actively coordinate activities in this area.

In a related area, it is recommended that water quantity concerns continue to be given high priority in power plant siting, specifically including considerations of greater consumptive requirements due to closed system cooling.

(4) **Strategy for on-site waste disposal.** In order to realize the full potential of recent on-site waste disposal rules (sometimes cited as the septic tank rules) adopted by the state protecting public health as well as water quality, it is recommended that a statewide strategy for on-site waste disposal be developed. Such a strategy should address: (a) certification of installers and inspectors of on-site systems; (b) proper maintenance of existing systems; (c) adoption of regulations for on-site disposal by all localities in which a need is established; and (d) control of adverse land use impacts resulting from non-uniformity among localities in the adoption of regulations. The strategy should be developed under the joint leadership of the Pollution Control Agency and the Department of Natural Resources, coordinated by the state coordinating body, and include the Department of Health and local and regional entity participation.

The Metropolitan Council has adopted on-site waste disposal policies as a part of its water quality ("208") planning effort. These policies essentially reflect the four-part strategy outlined in this recommendation.

(5) **Reduction in runoff.** Stormwater runoff — including its effects in areas undergoing construction activities and on overflow from combined sewers — has been identified as a significant contributor to water quality problems in the metropolitan area and in developing areas across the state. It is anticipated that the Metropolitan Council and the MPCA will make recommendations for actions by other entities (e.g., counties, soil and water conservation districts, watershed districts, and municipalities) in their "208" plans. These responsibilities are expected to include developing plans and programs for the abatement of pollution through runoff controls and adoption and enforcement of erosion and sedimentation controls. It is recommended that the MPCA and the Metropolitan Council place additional emphasis on measures to reduce runoff and to increase infiltration of non-polluted water, on erosion and sediment control measures, and on measures to deal with pollutants other than sediment. Further, it is recommended that proposals resulting from the "208" plans be carefully reviewed and adopted by the state, as appropriate.

(6) **Dredging and channel maintenance.** With regard to dredging and channel maintenance, it is recommended (a) that the Corps of Engineers — in coordination with the state — fully examine the environmental consequences of its dredging and disposal at each site prior to dredging and use mitigating measures as necessary to comply with state requirements; (b) that the findings of GREAT I (an investigation and development of a management plan for the Mississippi River, with particular emphasis on a

balanced plan for maintaining the 9-foot navigation channel) be carefully reviewed and adopted as appropriate; and (c) that, where GREAT I leaves unanswered questions, the authorized "Master Plan" for the Upper Mississippi River carry out additional priority studies, including economic and energy-related studies.

(7) **Management strategy for rural sewerage.** It is recommended that a statewide management strategy for rural sewerage be developed in coordination with the rural water systems recommendations of this report. (See the "Related Land Use" section.) This management strategy must take into account potential land use impacts of expanded sewer systems; the potential effect on agriculture; environmental benefits; and other social considerations, including impacts on area growth strategies.

Further, it is recommended that (1) existing waste disposal system laws be examined to determine what revisions might be made to reduce special local enabling acts (while retaining sufficient flexibility at the local level) and (2) coordination of various state and federal requirements for funding rural sewer systems be improved.

(8) **Development of minimum protected flows.** The Water Planning Board recommends that the Department of Natural Resources and the Pollution Control Agency, in consultation with other interested bodies (e.g., the Environmental Planning staff of the SPA), coordinate actions to develop minimum protected flow guidelines, reflecting both quantity and quality concerns, for high-priority rivers and streams in Minnesota. The process of developing such guidelines must take into account the purposes for which protection is being provided, recognizing that the same protected flows may not be appropriate for all purposes. (This recommendation is also important to the "Supply and Allocation" section which appears later in the text.)

(9) **Funding.** The Water Planning Board recommends that full attention be given to balancing point source and non-point source pollution control abatement efforts. (Also see the "Related Land Use" section.) While funds have been available for dealing with control of point sources, a significantly lesser amount has been available for non-point source abatement.

As indicated above, the Water Planning Board recommends that the water quality planning program recommendations of the Pollution Control Agency and the Metropolitan Council be fully reconciled with the framework plan strategy and become the principal water quality elements of the state water resources strategy. Similarly, the findings of the Soil and Water Conservation Board resulting from efforts related to carrying out the Resource Conservation Act in Minnesota should be integrated into the framework plan strategy, as appropriate.

Supportive Documents: Technical Paper No. 11, "Minnesota Water Quality: Management and Issues"; Working Paper No. 2, "An Analysis of Instream Flow Needs in Minnesota (Interim Report)"; and "Final Report of the Supply, Allocation, and Use Work Group."

WATER-BASED RECREATION

The abundance and quality of Minnesota's lakes and streams encourage extensive levels of water-related recreation, with important effects on both the livelihood and leisure of Minnesotans. Over half of the state's population actively engages in boating, fishing, and swimming, and much land-based recreation depends on water for its attraction. The lure of Minnesota waters is the foundation of the state's tourism industry, which provides employment for 90,000 Minnesotans and generates more than a billion dollars of expenditures annually. Maintenance of attractive recreational opportunities is essential for maximizing the benefits from Minnesota's lakes, streams, and wetlands.

Situation

Although the federal government contributes substantial funds from the Land and Water Conservation Act (LAWCON) to the acquisition and development of recreational facilities, the management of water-based recreation is principally the role of state and local government. State responsibilities are delegated to the Department of Natural Resources, except for the protection of water quality and public health. The DNR has eight programs of direct relevance to water-related recreation, in addition to its management of state parks and public lands.

Foremost among DNR programs is the Comprehensive Recreation Planning program charged with developing the State Comprehensive Outdoor Recreation Plan (SCORP) and maintaining a statewide inventory of recreational facilities. The program evaluates all DNR plans for consistency with recreational needs and provides information for recreational planning to all units of government. The SCORP plan serves as a baseline by which all LAWCON-funded projects are reviewed.

Recreational waters are "developed" by four DNR programs — Public Access, Wild and Scenic Rivers, Canoe and Boat Route Planning, and an Acquisition Program for Rivers. The Public Access program purchases access on lakes larger than 150 acres and without existing free public access. The Boat Route program performs a similar function on rivers selected as canoe or boat routes by the legislature, by identifying and evaluating accesses and campsites for purchase by the Acquisition Program. Rivers which exhibit "outstanding scenic, recreational, natural, historic, scientific and similar values" are eligible for designation as Wild and Scenic Rivers by the Commissioner of the DNR. After a river management plan is prepared and local input is received, units of government along designated rivers are required to enact land use regulations. Selected tracts and scenic easements may be purchased by the Acquisition Program. (The Wild and Scenic Rivers program is discussed further in the "Related Land Use" section.)

Other DNR programs directly regulate recreational activities, such as boat safety, enforcement of conservation rules and regulations, and management of fish and wildlife populations.

Local units of government provide water accesses and parks to residents, aided in some cases by state or federal funds. Additionally, water surface use regulation is a function of local government, although regulations promulgated by local governments must be approved by the DNR before they can be enforced. Shoreland zoning ordinances regulate lakeshore development, thereby affecting the number of riparians with direct lake access.

Implications and Considerations

The growth of water-based recreation in Minnesota has increased conflicts among users and between users and riparians. Lakes have long been the focus of recreational activity, but the use and awareness of Minnesota's rivers as recreational resources is expanding. This interest, reflected by legislative programs for watercraft routes and river preservation, has been opposed by local governmental units objecting to state-mandated programs and required zoning. Even some lake-related programs have lagged; the acquisition of public access on lakes has been based on availability rather than need, and state guidelines for water surface use regulation have not been promulgated. Rising energy and land costs necessitate the provision of public access and recreational opportunities in proximity to metropolitan areas.

Coordination of recreation and related programs is needed at both the state and local level. Although SCORP planning has provided state and regional policy guidance, many programs suffer from a lack of specific long-term objectives and planning (e.g., fish management and public access). Implementation of state-level policies is facilitated by review of LAWCON-funded projects and other grants, but initiatives must be undertaken at the local level.

Actions taken on a specific lake or stream must consider the capacity of the resource, its relationship to other waters or recreational units, and the need for its use. Case-by-case decisions (e.g., surface-use population on a single lake) may unintentionally lead to "multiple use" rather than "best use" management of a region's resources. Foresighted decision-making is constrained by the lack of standards for determining the recreational capacity of a water body and data on recreational demand for an individual resource.

Issues

The principal issues requiring resolution with regard to water-based recreation include:

(1) How should the state assure a comprehensive approach to decisions regarding a specific lake or stream?

(2) How can the objectives of the SCORP plan be fulfilled, including (a) translating statewide "needs" into local action and (b) influencing specific objectives of state recreation-related programs?

(3) Should the state accelerate its acquisition of public access sites? If so, how should this be accomplished?

(4) Should priority be given to the development of water-related recreation facilities in metropolitan areas or in rural areas where acquisition costs are lower?

In addition, it is important to consider the impacts of water quality on water-based recreation in Minnesota.

Options

The central issue with regard to water-based recreation focuses on assurance of a comprehensive approach to decision-making. A comprehensive approach requires the establishment of goals for a water recreation system in Minnesota based on regional characteristics. Development of goals and comprehensive policies treating each lake and stream as a part of a regional water recreation system is necessary since changes in the management or use of individual lakes or streams can affect how others in an area are used. The three principal options for identifying goals and comprehensive policy are:

** **Internal program monitoring.** Under this approach, each program with water-based recreation components would be expected to evaluate its recreational impacts. Agencies would establish maximization of recreational opportunities as a priority, and require programs to explicitly consider this priority.

** **Development of management plans and goals.** This option would move toward the establishment of an explicit "water surface management program" for Minnesota. Existing planning, management, and water quality programs would be analyzed for goals and objectives. These goals and objectives would be refined and specific policies developed linking each program to a broader comprehensive water recreation system.

** **Memoranda of agreement.** Increased coordination between units of government structured around memoranda of agreement (e.g.,those existing between the DNR and DOT for major highway projects) could permit early identification of potential water-based recreation impacts of program decisions which might be unknown to the initiating agency.

With regard to fulfilling the objectives of the Statewide Comprehensive Outdoor Recreation Plan (SCORP), several options exist. Importantly, SCORP facilitates both the flow of information among levels of government and the development of policy and priorities based on data and information. Translating statewide "needs" into local action and influencing specific objectives of state water-related programs might be carried out by:

** **Involving regional development commissions in the SCORP planning process.** This is a major effort of the present planning process. Data on use and user preference is being collected by region and augmented by a regional map series on recreation resources and facilities. However, regions might be more fully involved in the development of objectives for a Minnesota recreation system using SCORP data and processes.

** **Reguiring local units to use the SCORP data (or other objective information) in support of state grant applications.** The Department of Natural Resources is in the process of finalizing a new grant application procedure with the State Planning Agency which would require this.

** **Establishing priorities for local or regional funding requests in accordance with SCORP objectives.** In conjunction with the State Planning Agency, local or regional applications for funds could be ranked according to SCORP objectives.

** **Evaluating state, regional, and local programs and conformity to SCORP objectives.** Evaluation of programs for achievement of and compatibility with SCORP objectives might be used to translate statewide needs into local action and to influence state program objectives.

The question of whether the State of Minnesota should accelerate its acquisition of public access sites can be answered with a "yes" or a "no." If decision-makers respond in the affirmative, it becomes important to examine options related to how the program should be accelerated and where state priorities should be placed. Options relating to how the program should be expanded include:

** Use of the existing Department of Natural Resources public access program with adequate funding;

** Initiation of joint agreements with the Department of Transportation to evaluate DOT-owned lakeshore and rank parcels based on need;

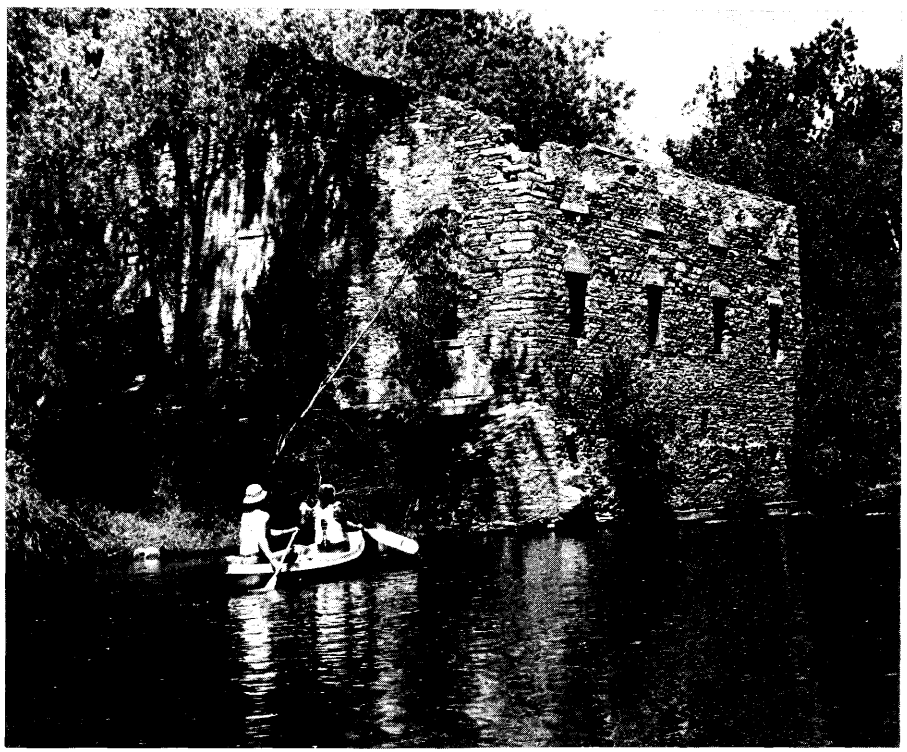
** Stimulating action by local units of government through data and information sharing activities.

Accelerated access development can be undertaken by several levels of government. However, the DNR should centrally monitor such access development.

The options for where public access programs might be accelerated, in broad terms, include the metropolitan area, the north central lake region, and rural areas. (It should be noted that the Legislative Commission on Minnesota Resources has increased funding of metropolitan area accesses.)

Options for developing water-related recreational facilities are similar to those for accelerating public access acquisition. Important considerations in examining the options are the relative use expected for recreational facilities, the future energy picture, and the priorities of related programs currently in operation.

Finally, it is important to note that the options relating to controlling urban and agricultural runoff; preserving wetlands; the Wild and Scenic Rivers program; and monitoring irrigation and other water appropriations are closely related to water-based recreation issues. Options available in these areas are discussed in detail in other sections of this report.



Criteria

In selecting among the options for resolving each major issue, criteria employed by decision-makers might include (1) facilitation of coordination among recreation-related programs; (2) fulfillment of recreational demand; (3) the impacts of future energy resource limitations; (4) the minimization of state expenditures while achieving desired ends; and (5) the preservation of natural resources.

Recommendations

The Minnesota Water Planning Board recommends:

(1) **Development of a comprehensive water surface management program.** There is a need to recognize lakes and streams as management units in order to assure a comprehensive approach to decision-making regarding them. Recognition of this need necessitates that goals, objectives, and policies for water surface management on a statewide basis be developed. Goals, objectives, and policies should be developed through an interagency task force, led by the Department of Natural Resources and coordinated through the state coordinating body. Goals to be examined by the interagency task force should include:

** Protection of the lake or river environment.

** Attainment of the highest possible total satisfaction among users. Among the possible methods which should be examined pursuant to attaining this goal are (1) use of management techniques compatible with individual lake resource characteristics and which maximize public benefits; (2) encouragement of public use of recreationally valuable water bodies through public access purchase, based on accessibility to users; and (3) development of private lakeshore compatible with the resources.

** Attainment of the highest possible individual satisfaction among users. To approach this goal, methods such as (1) actively encouraging certain activities on some lakes (or streams) and restricting or prohibiting activities on others and (2) completion of the development of water surface use guidelines for local regulation should be explored.

Three activities which will facilitate the development of a comprehensive program are (1) the creation of a lake data base, relying on existing data sources presently stored independently, (2) an examination of the relationship among lake classification schemes used independently by state agencies, and (3) consideration of interrelating management programs to achieve mutual objectives. These activities should be undertaken and coordinated by the interagency task force.

(2) **Involvement of the regional development commissions in the SCORP planning process.** This is a major effort of the present SCORP planning process and should be continued. Options relating to use of SCORP data in grant applications and funding of local or regional objectives consistent with state needs are viable options, but basically follow from full regional involvement in the planning process.

(3) **Accelerated acquisition of public access sites, focusing on the metropolitan area and areas of rapid lakeshore development.** Acceleration of acquisition can be accomplished by all units of government, but should be centrally monitored by the Department of Natural Resources Public Access program. Increased emphasis should be given to evaluation of lakeshore owned by the Department of Transportation for public access sites, and to the provision of indiscriminate public access except where restrictions are in accord with promulgated guidelines for surface-use regulation.

(4) **The State of Minnesota sponsor a major conference relating to the problems, concerns, and issues relating to water surface use and management.** As Minnesota's lakes are central to a $1.3 billion tourist industry, to appropriators who rely on surface water as a source of supply, to recreationists, and to those interested in maintaining the state's environment, such a conference can be a centerpiece in the development of a comprehensive water surface management program. The conference should be coordinated by the Water Planning Board and held during F.Y. 1980.

Supportive Document: "Final Report of the Supply, Allocation, and Use Work Group."

WATER RESOURCES INFORMATION AND DATA

Gathering and utilizing timely and reliable data concerning the conditions and trends with regard to the state's water resources is one of the keys to effective water resources management. Development and maintenance of state water resources goals and measurable objectives require sufficient and accurate information. To be useful, such information must be readily retrievable. Because of the central importance of data gathering and information system development to water resources management, the State of Minnesota must be increasingly concerned with the support and development of a comprehensive water resources information system including the collection, interpretation, and extensive dissemination of data.

Situation

In 1978, nearly 60 programs or projects were identified which deal with primary water resources data collection. A major problem was identified in the ability to share and disseminate this information for use in planning and management decision-making.

The principal state agencies involved in the collection and processing of data are the Departments of Natural Resources and Health, the Pollution Control Agency and (to a lesser degree) the Department of Transportation. In addition, the State Planning Agency uses water resources data gathered by other entities in the Minnesota Land Management Information System and the Minnesota Energy Agency has been responsible in F.Y. 1978-79 for water resources information system development for the Water Planning Board. The Minnesota Geological Survey of the University of Minnesota is also a major participant in the collection, processing, and dissemination system. The United States Geological Survey, frequently working in cooperation with the Department of Natural Resources, is a major federal participant.

Until recently, the water information systems of the Department of Natural Resources have been almost entirely manual (one exception being the operations of the State Climatologist). The Minnesota Pollution Control Agency systems are computer-based, but in various stages of evolution. The Department of Health maintains a system to store water sampling information, but only very recently has begun to computerize well log data. The Department of Transportation collects water data while taking borings at construction sites, but does not computer-store this information.

The Minnesota Geological Survey maintains a program to inspect waterwell driller logs throughout the state, collect logs containing useful geological and hydrological information, code the geology and hydrology in a computer format, and create a flexible computerized data management system for basic groundwater resources data. The MGS has developed a set of computer programs to analyze well log data.

Importantly, the Department of Health, the DNR, and the MGS all share an important data source—the waterwell drillers' logs. These logs have been submitted to the Department of Health since 1975 and paper copies have been distributed to the MGS and the DNR. The information taken from the logs is used for different purposes by each agency. Since 1975, each agency has drawn what it needs from the paper copy and required storage for its copy. In F.Y. 1978-79, the Water Planning Board—through the Minnesota Energy Agency with Legislative Commission on Minnesota Resources funds—has worked with other units of state government to begin development of prototypes for a statewide water resources information system. The resulting effort has created the System for Water Information Management (SWIM). Although future expansion is expected as a response to user data needs, SWIM will begin operation with six coordinated data bases:

(1) **The ground-water information system data base.** The ground-water information system brings together in one common data base structure information from the Minnesota Departments of Health and Natural Resources and from the Minnesota Geological Survey. The source of this information is water well records submitted by well drillers. The Department of Health employs this information in monitoring well construction and water quality; the Department of Natural Resources for hydrologic data and permit decisions; and the Minnesota Geological Survey for hydrologic raw data.

(2) **The appropriations data base.** This data base provides resource management and planning activities with reports on water withdrawn according to Department of Natural Resources permits; supplemental estimates for non-permitted withdrawers; and estimated consumption. Information is available by location and type of withdrawal.

(3) **The water data source catalog.** To update portions of the 1975 "Water Information Systems Catalog," state agencies were surveyed to determine present information systems. Responses have been computerized so all state water programs are listed in a single data base. This data is accessible to state agencies and others with access to a University Computer Center computer terminal.

(4) **The DNR surface-water data base.** This data base will be the analog to the ground-water data base.

(5) **The PCA effluent dischargers data base.** The effluent dischargers data base contains detailed information about companies and municipalities with discharge permits. Importantly, this data base can be closely linked to both the appropriations data base and the surface-water data base.

(6) **The DNR watershed mapping data base.** This data base was developed as the official reference standard for watersheds in Minnesota. Watersheds have been delineated on the United States Geological Survey topographic maps and have been incorporated into the Minnesota Land Management Information System (MLMIS).

While considerable strides have been made in the development of SWIM, (1) only prototypes have been established, with much actual data loading remaining; (2) only a limited number of units of government have been tapped; and (3) evaluation of data needs and quality is incomplete.

In addition to establishing SWIM, a demonstration of its capabilities as a fully populated set of coordinated data bases has been carried out for irrigation issues, using Region 6E as an example.

Implications and Considerations

While individual agencies will continue to collect and store information under any future scenario, standardization of this information and compilation of the information in a way that it can be made readily accessible to potential users remain problems. There is no assurance of standardization and accessibility under individual agency system development plans. Further, as data quality needs vary among users, uniform quality may not be achieved. Data privacy may become an issue either under individual agency systems development or standardized, coordinated development.

The development of SWIM should serve to address the needs of (1) individual state agencies, (2) local governments, (3) citizens, and (4) other public or private groups doing water-related research. For individual state agencies, SWIM can provide information for regulatory activities, management, and planning and research. Local governments might draw information for use in shoreland management or water quality monitoring. Individual citizens require readily accessible water resources information for solving their own personal needs (e.g, obtaining water quality information for individual supplies) and for becoming involved in environmental issues. Private groups such as environmental organizations and industries become involved in water-related research and planning from time-to-time and seek ready access to water resources information.

Development of information systems to meet government and citizens' needs is costly. For example, in the F.Y. 1978-79 biennium, the Minnesota Energy Agency received nearly $100,000 for work in development of prototype elements of a water management information system and the Minnesota Geological Survey received $270,000 toward development of a subsurface geology data base. The Minnesota Land Management Information System has cost over $1.8 million in its first ten years.

However, considerable benefits are available in meeting the needs of state and local governments, citizens, and other groups. In addition, SWIM will provide the Legislature with a better view of available water-related information, its quality, its necessity, and of future data collection needs. Such systems are directly in line with the stated legislative policy to "establish and maintain statewide environmental information systems sufficient to gauge environmental conditions."

Issues

There are several major issues to be addressed relative to further development of a state water resources information system. The central issue, of course, is: Should the state continue its efforts to develop systems for water information management? If the answer is affirmative, further issues are:

(1) Should the system attempt to centralize water resources information in a single data base or serve as a mechanism to tie together existing and future agency systems?

(2) What organizational structure should be used to insure necessary coordination in the type of system to be developed?

(3) What should be the high-priority elements in further system development?

Options

The State of Minnesota can either elect to continue or discontinue a coordinated approach to water information system development. In F.Y.1978-79, six coordinated data bases have been developed, providing both a management and an analytic tool to state agencies. Less quantifiable, but perhaps more important, has been increased communication between state agencies. Absence of a system would result in resource decisions based on information that develops only from case-by-case questions. However, information system development may be costly (four data base development projects suggested for F.Y. 1980-81 approached $450,000); raise privacy issues; and require further assessments of data quality.

If the state elects to continue water resources information systems work, it may choose:

** **Creation of a centralized water resources information system in a single data base.** The principal arguments for a centralized system are (1) to maintain control and (2) to reduce complex lines of communication. Initial discussions of a water information system for Minnesota were carried out along these lines. However, (1) many past system failures in other areas and in other states can be directly attributed to attempts to centralize; (2) control is not enhanced by a centralized system, but rather when an information supplier maintains its own files and makes them widely accessible; and (3) lines of productive communication may be reduced under a centralized system.

** **Development of a coordinated approach to collecting and using water resources information.** This approach would employ computer technology to allow transfer of information among programs and would systematically computerize important state data sources. The approach would (1) ensure that information gathered for one program might be of value to other programs in the future; (2) avoid redundancy by providing common methods to diverse users; (3) keep resources programs better informed of each other's operations; and (4) retain control of information files in individual agencies, while making them widely accessible to other agencies. However, to accomplish this, all subsystems must be consistent and compatible and all appropriate entities must be committed to maintaining the system with high quality data.

Organizationally, a number of options must be considered. The options are not necessarily mutually exclusive. They include:

** **Creation within a state coordinating body structure.** While this option may maximize coordination among agencies, serious problems exist with access to technical staff and computer facilities.

** **Development within the State Planning Agency Land Management Information Center.** The Minnesota Land Management Information System is operated through the Center. The activities of the Center in development of water resources information systems might be coordinated through a state coordinating body.

- **Development within the Information Systems Division (ISD) of the Department of Administration.** ISD is the principal computer operation arm of state government. However, ISD was found inappropriate for either the Regional Energy Information System or the Minnesota Land Management Information System, two systems with which the water information system has close kinship.
- **Continuation within the Minnesota Energy Agency.** While the Energy Agency has employed the staff most responsible for systems work to date, it does not see itself as a permanent home for system development. It will continue in the role if necessary.

In addition to any one of the options, a "User's Committee" should be created to assure coordination in the design of SWIM. The "User's Committee" could serve to set policy and provide technical advice to the staff of the coordinating body.

The priorities of the future systems development might focus on one or more of the following:

- **Development of policy elements.** These elements of the systems for water information could focus on provision of a forum for formal interaction among suppliers and users of water information, organization of a service bureau for centralized user-oriented access to data bases, establishment of official reference standards, and identification of overlap and duplication of data collection.
- **Development of service functions.** Service function elements would affect actual data access and use, including review and cataloging of water resources data; provision of technical reports on access and utilization of systems; educational training, including systems documentation; and coordination of water data-related funding requests.
- **Provision of technical assistance to agencies.** This function would focus on the provision of technical assistance in the development of software and provision of "trouble-shooting" assistance. Such functions would necessarily be limited to the needs and uses of SWIM.
- **Assessment of priorities for information system development.** A first priority might involve assessing automated data bases and determination of software and staff assistance needs. A second priority might be the identification of non-automated data bases and a determination of their potential for computer operation.

In addition, because some of the multiple data bases which would comprise SWIM would be managed by System 2000 at the University of Minnesota, a function of the coordinator of state systems development might include participation on the University's Long Range Planning Committee for the University Computer Center.

Criteria

The major criteria suggested in determining future system development and priority elements are (1) need and (2) cost. The Water Planning Board believes the ability to develop systems has been proven and that the technology exists.

In choosing between a centralized data base and a coordinated approach to collecting and using water resources information, primary considerations should include: (1) maintenance of control over the quality and accessibility of data; (2) coordination between data suppliers and users; (3) avoidance of overlap and duplication in data collection and computerization; and (4) assurance of widespread usability of data.

In selecting among the institutional options, it is suggested that decision-makers consider: (1) the capability of the institution to maximize the usefulness of available information; (2) the capability to provide for coordination among various user agencies; (3) demonstrated ability to handle large-scale system development in a timely and cost effective manner; (4) the capability to guide agencies in movement toward computerized information systems; and (5) access to computer facilities.

Recommendations

The Minnesota Water Planning Board recommends that:

(1) **The Governor and the Legislature continue to support development of the System for Water Information Management (SWIM).** The benefits of SWIM as a management tool and as an analytic tool are significant. These, in turn, benefit local government, citizens, interest groups, and industries.

(2) **SWIM develop as a mechanism to tie together existing and future information systems in order to coordinate and simplify user access.** This approach has been found preferable to centralized data base development.

(3) **SWIM be developed within the State Planning Agency Land Management Information Center, in coordination with the interests of state agencies and the state coordinating body.** SWIM funding should be administered through the coordinating body. Further, the Board recommends establishment of a permanent "User's Committee" which would be coordinated by a state coordinating body and which would set systems policy and provide technical advice to the coordinating body and SWIM staff.

(4) **The operational framework for SWIM consist of a small core SWIM staff operating as a service bureau, the "User's Committee," individual agency data bases operated by agency personnel, and a link to the coordinating body through the SWIM coordinator.**

(5) **The important elements of SWIM involve policy and service functions, provision of limited technical assistance to agencies, and assessment of priorities for information systems development.** More specifically, it is recommended that the work program and priorities developed in the final report of the Data Work Group be followed.

(6) **Because of the close relationship with University Computer Center (UCC), it is recommended that the SWIM coordinator request to serve on the University's Long Range Planning Committee for the UCC.**

(7) **River mile indexing, data quality, georeference, and parametric standards be established to provide uniformity to SWIM output.** Further, it is recommended that the Governor and the Legislature adopt the data base developed in the water planning effort delineating watershed boundaries for official state use.

Supportive Document: "Final Report of the Data Work Group."

FLOODING AND FLOOD DAMAGE REDUCTION

Flooding is a recurring problem along many rivers and streams in Minnesota. Major flooding has occurred in every basin in the state, causing tremendous social and economic costs. Despite the efforts of federal, state, and local governments, damages appear to be increasing. Lives continue to be lost and families residing in flood plain areas are uprooted. The economic losses due to flooding are conservatively estimated at $54 million annually (1978 dollars).

The State of Minnesota has made significant progress toward reducing flood damages. Since 1969, the state has operated a comprehensive flood plain management program which has been cited as one of the better programs in the United States. Still, there appear to be opportunities to strengthen the flood plain management program and to reduce both the social and economic costs of flooding.

Situation

The major type of flooding in the state is spring flooding caused by rapid snowmelt. In some cases, snowmelt is augmented by spring rains. The accumulation of ice which occurs on most rivers during the winter may also contribute to flooding. Intensive summer thundershower activity may create locally severe flooding, especially in the Cannon, Root, and Zumbro River basins and in those watersheds drained by streams flowing into Lake Superior.

Estimated average annual flood damages in Minnesota are approximately evenly divided between agricultural and non-agricultural losses. In the Red River Valley, flooding may cover vast agricultural areas; over 605,000 acres are in the 100-year flood plain, and over 30 percent of total state damages occur in this basin. The greatest damages, over 35 percent of the total, are experienced in the Minnesota River basin.

Until the late 1960's, various types of structural measures were the primary means of reducing flood damages. Reservoirs, levees, dikes, and small impoundments were constructed in many parts of the state to modify the frequency or the magnitude of floods or to protect property from flood damages. In spite of these measures, flood damages increased because of the continuing development in flood plains.

Since the late 1960's, the primary emphasis in flood damage reduction has been changed from structural to non-structural measures at both the state and the federal levels. Non-structural measures such as flood plain zoning, flood insurance, flood-proofing, disaster planning, flood-warning systems, land use controls, and stormwater management have become common. However, both structural and non-structural measures are recognized as essential components of a comprehensive flood plain management program.

The state flood plain management program is administered by the Department of Natural Resources in cooperation with local governmental units. The program places primary emphasis on non-structural measures, while recognizing structural measures, as essential components of a flood plain management program in some areas. The major thrusts of the program have been to identify flood hazard areas, to enroll individuals and businesses on flood-prone lands in the National Flood Insurance Program, and to implement local zoning ordinances regulating further development in the flood plains. Other areas of emphasis include the establishment of flood-proofing requirements in the state building code, public education, and emergency assistance.

In 1975, the Legislature established a grant-in-aid pilot program for building floodwater retarding and retention structures in the Minnesota River basin. The pilot program is administered by the State Soil and Water Conservation Board and provides funding for up to 75 percent of total project costs. A second program was approved by the 1979 Legislature. This program will provide up to 50-percent funding for the construction of floodwater retention projects by the Lower Red River Watershed Management Board. The program will be administered by the Department of Natural Resources.

In addition to these programs, there are numerous federal agencies, local governmental units, and private organizations involved in flood damage reduction programs. The principal federal agencies are the Corps of Engineers, the Soil Conservation Service, and the Federal Emergency Mitigation Administration. Local units of government cooperate in the state flood plain management program. The Minn-Dak Farmers Flood Control Association is an active private organization. Although the Water Planning Board has concentrated on the state role in flood plain management, the role of federal agencies, local governments, and private organizations is important.

Implications and Considerations

The floods in Rochester during 1978 illustrated that the current flood plain management program can be effective. Structures built in the flood plain in accordance with standards adopted by the local governments were generally protected from major damage. However, over the last decade, several shortcomings of the existing state program have been identified. These include (1) the failure to provide supplemental funding for both non-structural and structural flood damage reduction measures and (2) the failure to expand the flood plain program into areas authorized in the Flood Plain Management Act due to low priority and staffing and funding constraints.

Land use changes outside of the immediate flood plain area are not considered by the Flood Plain Management Act. Some of these changes—such as wetland drainage and increasing urbanization—may have detrimental effects on flood-prone areas because they increase flood stages above established protected elevations. A closely related concern is the undefined responsibility of a landowner or developer to manage the water which falls on or flows over his property in order to prevent damage to others.

Finally, federal policy changes may have significant impacts on Minnesota's flood plain management strategy. President Carter has proposed more stringent requirements for funding federal flood control projects, including mandatory front-end cost-sharing for such projects. Several of the President's policies which do not require legislation are already being implemented under Executive Order No. 11988. This Executive Order encourages the restoration and preservation of the natural and beneficial values served by flood plains and requires the consideration of alternatives to avoid adverse effects and incompatible development in the flood plain. This Order may have far-reaching effects on state policy through its impact on federally-funded programs vital to Minnesota.

Issues

Four issues require consideration:

(1) Should the current flood plain management program of the State of Minnesota be expanded?

(2) If the state elects to expand its program, what types of additional or expanded activities should it adopt?

(3) What criteria should be employed to evaluate flood damage reduction measures?

(4) How should the State of Minnesota establish priorities for flood damage reduction measures?

Options

In determining whether the state's current flood plain management program should be expanded, several considerations of the issue must be recognized. First, in 1978 alone, spring and summer flooding in the Red River Valley, southern and southeastern Minnesota, and the Twin Cities area accounted for well over $100 million in damages. Second, there are a number of aspects of the Flood Plain Management Act which have not been implemented. Third, federal actions proceed slowly, prompting organizations such as the Minn-Dak Flood Control Association to conclude there is "the need for a drastic shift to more state involvement." The Legislature has taken preliminary steps in the direction of increased state involvement. Federal initiatives also promote greater state activity. However, an increased state role in flood plain management could be expensive. In 1972, the Souris-Red-Rainy River Basins Commission estimated reservoir flood control storage costs at $20.0 million (1967 dollars) for the Red River basin in Minnesota. In 1970, the Upper Mississippi River Basin Commission estimated floodwater storage project costs through the year 2020 at $159.8 million in the Mississippi Headwaters basin; at $38.3 million in the Cannon, Zumbro, and Root River basin; and at $266.7 million in the Minnesota River basin. While the bulk of these costs might be met with federal funds, they indicate the magnitude of the problem. These costs must be considered in relation to the average annual damages occurring in the state.

If the state elects to expand its program, a number of non-structural, structural, and evaluation and coordination options are available. Non-structural options include:

** Amend Chapter 104 to authorize the mandatory disclosure of flood hazard information prior to property transactions.

** Investigate the types of flash-flood warning devices currently in use and provide this information to communities subject to flash flooding. These devices can signal rising flood stages and provide time to evacuate flood plain areas.

** Establish a technical assistance program within the Flood Plain Management Unit to assist local units of government in making application for state and federal assistance for flood damage reduction, including flood plain acquisition, redevelopment and disaster assistance.

** Establish a technical assistance program to provide information on flood-proofing residences and commercial and industrial structures. Loans or grants could also be made available for flood-proofing and relocation.

** Establish a program for increased public information and education on the risks of flooding and the techniques available for flood damage reduction.

** Establish a program of state cost-sharing for the acquisition of flood plain property, particularly in urban areas subject to frequent flooding.

** Identify the effects of wetland drainage in basins with severe flooding in cooperation with federal agencies. The cumulative effects of wetland drainage on flooding should be considered.

** Amend Chapter 104 to include provisions requiring stormwater management in urbanizing areas. Natural water basins, small impoundments, and maintenance of the natural drainage system can be utilized to retard runoff from developing areas during flood periods.

Structural options include:

** Discontinue the current grant-in-aid pilot programs upon completion of the funded projects and provide no additional state funding for structural flood damage reduction measures. Rely on the federal government to continue to fund and construct necessary and feasible structural measures.

** Establish a statewide program for structural flood damage reduction measures. The amount of state cost-sharing could be fixed or be allowed to vary according to the type of measure.

** Establish a statewide loan program to finance structural flood damage reduction measures. If a loan program were adequately funded for 10 years, it is possible it could become self-sustaining as the principal and interest are repaid.

** Establish a centralized state program for completely funding the planning and construction of structural flood damage reduction measures.

** Permit mill rate increases over the current levy limit or the issuance of local bonds to allow local units to fund flood damage reduction measures.

Evaluation and coordination options include:

** Increased state lobbying efforts in Congress and through the basin commissions to get economically and environmentally accepted flood damage reduction programs submitted and funded.

** Establishment of project and program priorities for state assistance, based on criteria established for project and program evaluation. If major interagency conflicts exist after proposals are ranked according to the criteria, the state coordinating body should resolve these issues.

** Continuation of a direct role for the Legislature in determining where and what types of flood damage reduction measures should be funded.

** Development of a consistent set of criteria based on economic efficiency, environmental quality, community and regional development, and social welfare by representatives of local, state, and federal agencies for use by the state in evaluating specific flood damage reduction projects. In addition, programs and criteria would be developed for monitoring the effectiveness of flood damage reduction measures following their implementation.

Criteria

In selecting among the options presented above, decision-makers might include the following considerations:

** **Goal attainment.** The degree to which the option would accomplish the goals of the Legislature for comprehensive flood plain management should be considered.

** **Increased coordination.** Options selected should promote increased coordination among local, state, and federal agencies.

** **Preventive approaches.** The degree to which the options would employ preventive—as opposed to corrective—approaches to flood damage reduction should be considered.

** **Relationship to other programs.** Options adopted should be related to other planning, management, and regulatory programs at the local, state, and federal level.

** **Costs.** The relative amount of money which the state wishes to spend in this area should be considered.

Recommendations

The Minnesota Water Planning Board has adopted the following recommendations:

(1) **Expanded state program.** Because of the magnitude of the current urban and agricultural damages occurring in Minnesota and the numerous opportunities for action, it is recommended that the flood damage reduction program of the state be expanded and improved.

(2) **Program emphasis.** The primary emphasis of the State of Minnesota should continue to be on non-structural means of flood plain management, while fully recognizing that structural controls are suitable to some situations. Local flood plain zoning, flood-proofing, and selected land use controls continue to be the most effective means of long-term flood damage reduction because they reduce the amount of development subject to flooding. However, there are agricultural areas and developed urban areas where structural measures are needed and can be effectively implemented as part of a comprehensive flood plain management program. These structural measures shall receive full consideration where they are found to be economically and environmentally feasible.

(3) **Statewide grant-in-aid program for flood damage reduction.** Minnesota Statutes, Chapter 104 should be amended to provide for a statewide program of cost-sharing to implement both structural and non-structural components of approved comprehensive flood plain management plans. This program is intended to replace other specific flood damage reduction cost-sharing programs that are currently authorized and funded. The program should be jointly administered by the Department of Natural Resources and the Soil and Water Conservation Board based on a formal agreement between the two agencies. The purpose of the program is to provide incentives to local units to implement flood plain management measures. The amount of the local share should be proportional to benefits which accrue to the local area; the amount of the state cost-share should be proportional to the benefits received by society as a whole from the flood damage reduction project (e.g., benefits which are too widespread to permit identification of direct beneficiaries).

(4) **Establishment of criteria for evaluating and ranking programs.** The Department of Natural Resources and the Soil and Water Conservation Board in cooperation with other state and local agencies should develop joint criteria for evaluating and ranking the structural and non-structural components of approved comprehensive flood plain management plans. The criteria to be drafted should include but not be limited to: (1) types of programs and projects eligible for funding; (2) percentages or amounts of cost-sharing; (3) environmental and economic considerations; and (4) requirements for evaluation of alternatives.

(5) **Mandatory disclosure of flood hazard information.** Minnesota Statutes, Chapter 104 should be amended to require mandatory disclosure of flood hazard information prior to any property transaction. Persons purchasing land or homes in flood plain areas have not always been able to obtain adequate information about flood hazards. For areas in which studies have been completed, flood hazard information is available through county or municipal zoning administrators and should be provided to the prospective buyer by the realtor or seller before contracts or purchase agreements are signed.

(6) **Technical and educational assistance.** Technical assistance for flood-proofing, for assistance with applications for state and federal aid, and for information dissemination and education programs is currently authorized by Minnesota Statutes, Chapter 104, but has not received sufficient funding. Training is also needed for local officials responsible for adopting and implementing local flood plain management ordinances. Additional funding should be provided to expand these components of the flood plain management program.

Many individuals do not fully appreciate the risks of locating in flood hazard areas and do not fully understand the benefits to be gained by purchasing flood insurance or by flood-proofing their residences. A similar situation exists with some small communities, which may be unaware of the types of state and federal acquisition and redevelopment funds or disaster assistance that are available. The economic value of information related to flooding and the steps which can be taken to reduce flood losses is potentially great. The cost of providing ths information is low when compared to the reduction in flood losses that can be achieved with increased access to proper information.

(7) **Evaluation of the effects of drainage on flooding.** The State of Minnesota, in cooperation with the appropriate federal agencies, should immediately begin to define the effects of wetland drainage and filling in basins subject to severe flooding. All actions affecting wetlands should be considered in the context of the cumulative effects of wetland drainage and filling on flooding in order to evaluate the true costs and benefits of wetland drainage activities.

(8) **Flood-warning devices.** Information on flash flood warning devices should be collected and be made available to areas subject to flash flooding and to areas located downstream from dams with possible safety hazards. These devices allow timely evacuation of flood plain areas and help to prevent loss of life. Relatively inexpensive and simple devices are in use in some areas and their use in Minnesota should be encouraged.

(9) **Mandatory urban stormwater management plans.** Minnesota Statutes, Chapter 104 should be amended to include provisions for mandatory urban stormwater management plans meeting minimum statewide standards in urbanizing areas. One function of flood hazard studies is to identify an elevation above which structures will be protected except for the most severe flood events. Increases in urbanization upstream from flood plains may cause flood stages to rise higher than the protected elevation, causing increased damages to otherwise protected structures. By retaining the water or delaying it until after peak flood periods, this problem can be alleviated. Maintenance of natural storage areas, provision of on-site or on-line storage areas, and minimizing the amount of impervious surface are all means of reducing flood stages downstream and may also improve water quality. It is easier and less expensive to plan for these features before development occurs than to establish an effective stormwater management program after an area has been extensively developed. (This recommendation also involves water quality benefits.)

Supportive Documents: Technical Paper No, 7, "Flooding and Flood Damage Reduction" and "Final Report of the Supply, Allocation, and Use Work Group."

WETLAND MANAGEMENT

The modification of wetlands through agricultural drainage and urban development is perhaps the most emotional and pervasive issue in Minnesota's management of water resources. The controversy crosses many units of government, where decision-making often has been based largely on political considerations rather than on applied research and resource inventories. The issue is significant not only because it addresses the bounds between public and private rights, but because wetland resources influence agricultural production, flooding, water quality, wildlife, and water supply throughout the state.

Situation

In the last century the ownership, management, and public perception of wetlands have changed dramatically. In the late nineteenth century wetlands were viewed as a menace and a hindrance to land development, stimulating both state and federal action to encourage land reclamation. Farmers organized drainage districts, the state funded construction and supervision of state ditches, and the federal government cost-shared drainage works and subsidized research on improving drainage techniques. By 1920, the Agricultural Census showed that nearly one-fourth of Minnesota had been drained. In urban areas, the filling of wetlands was a convenient source of land for development.

Today, wetlands are viewed by many in a different perspective which reflects environmental awareness, loss of wildlife habitat and open space, increased competition among land uses, and recent wetland research. In Minnesota, the drainage code has been amended to reflect environmental concerns, legislation designating and protecting public waters has been passed, and federal aid is no longer available for drainage of most wetlands. Scientific research is documenting the public benefits of wetland preservation. However, wetland drainage for agricultural production continues to occur, and the expansion of urban centers results in additional encroachment.

Wetlands have long been recognized for their importance to the nesting, rearing, and feeding of migratory waterfowl and to the success of many other game and non-game species of wildlife, but attention has been given recently to other beneficial functions of wetlands which may be even more important. Hydrologic studies in Wisconsin and Minnesota indicate that existence of a critical amount of wetlands and lakes in a watershed is extremely significant in reducing peak flows. Modeling studies have shown that drainage increases runoff and peak discharges which may contribute to downstream flooding. Wetlands also provide water quality benefits, by serving as highly efficient sediment traps and retaining moderate amounts of nutrients, and have also been used to provide treatment of stormwater and sewage plant effluent. Although the relationship with ground water varies among wetlands, some are known to provide recharge of groundwater supplies. A few studies indicate that wetlands exert a moderating influence on climate, but such research is not definitive.

A major role of wetlands is the provision of refuges and "islands" of genetic and aesthetic diversity in landscapes otherwise dominated by uniform land use, such as row crops or urban development.

Most of these beneficial aspects of wetlands have gone unrecognized for two reasons: (1) they are rarely expressed in dollars and cents, and (2) they are often cumulative. Destruction of an individual wetland may appear inconsequential unless considered along with other similar actions.

Modifications of the state's wetlands are in response to a directly recognizable economic benefit, usually accruing directly to an individual. This is true both for agricultural drainage and the filling of wetlands in urban areas, where fill is cheaper than adjacent land. Agriculture is fundamental to Minnesota's economy, and many soils have excessive moisture which inhibits production. Not all moist soils are considered to be wetlands, but the distinction is often vague. There is little doubt that some drainage was and will be in the best interest of individual farmers and the people of the state. However, much future drainage of wetlands will require forfeiting nearly all of the public benefits they provide in a natural state.

Discussion of the wetland drainage issue has been complicated by a lack of information and imprecision in terms. Drainage can be accomplished by several methods, involving surface or subsurface flow, and it is difficult to determine precisely how much land is affected. Wetlands range from seasonally waterlogged depressions to lake basins, and the values of each type are different. This range in terms accounts for some of the wide range in estimates of "drained wetlands" in Minnesota. A recent study by the Legislative Auditor suggests that about 200,000 acres of water basins (lakes and deep marshes) have been drained, and that another 100,000 acres are likely to be drained. At the other extreme, the Soil Conservation Service has estimated that over five million acres now have excessive soil moisture which would benefit from drainage. Data on the conversion of wetlands in urban areas is also lacking. No mechanism has been established to regularly monitor the filling of wetlands for urban development.

The institutional framework which addresses drainage and wetland protection reflects the ambivalence of the legislature. State legislation has been characterized by vague terms and the absence of clear guidelines for decision-making, and sections of the statutes are specifically designed to represent the divergent interests. Although this may be intended to achieve the required balancing of interests, resolution of problems through administrative and judicial processes has been time-consuming, ineffective, costly to taxpayers, and has heightened the controversy.

Public drainage projects may be initiated through watershed districts but are more frequently undertaken under the drainage code, set forth in Minnesota Statutes, Chapter 106. The procedure is initiated by the filing of a petition with the county board by local landowners. The proposed project is surveyed and submitted to the Department of Natural Resources for comment and review, which is strictly advisory. The county board holds a public hearing and determines if the project will be of public benefit and will promote the public health as set forth in the statutes. This process has given landowners access to the power of the state, including eminent domain, to aid drainage projects. Unless the project substantially affects public waters, no state approval is required. The local character of Chapter 106 decision-making probably has a strong pro-drainage bias, and there is little representation of conservation or statewide interests.

The principal regulatory programs are the DNR's Public Waters Inventory program and the permit requirements for works in designated public waters. The Corps of Engineers 404 permit requirments for filling of wetlands have generallly not been extended to drainage activities. Wetland preservation programs cover about 80,000 acres of wetlands and adjacent uplands in Minnesota, funded largely by the State Acquisition Program, U.S. Fish and Wildlife Acquisition and Easement Programs, and under compensation provided by the federal Water Bank. The state Water Bank has not yet disbursed funds.

Implications and Considerations

The wetland drainage issue is extremely complex, as it straddles the boundaries between land and water, public and private interests, conservation and development, and tangible and intangible benefits. Progress toward its resolution requires consideration of many related concerns.

The cumulative effects of wetland drainage must be dealt with by government, since individual decisions are based largely on personal economic return. There is no consideration in the marketplace of the "external" public benefits provided by wetlands for flood damage reduction, sedimentation, and other public benefits described previously. Only government can adequately consider benefits foregone and damages incurred by wetland modification throughout a watershed.

Concern with property rights and financial effects are implicit in either wetland preservation or drainage. The policy of the Legislature and the state seems to favor wetland preservation and just compensation of landowners where private rights must be sacrificed, but the adequacy of the compensation must be examined. The Public Waters program appears to be well designed to compensate owners even though the program has performed poorly. Acquisition programs have raised concerns regarding loss of tax base, but studies of wildlife areas by the Upper Minnesota Valley RDC suggest that federal and state payments in lieu of taxes provide more revenue than if the lands were included on local tax rolls.

The conflict between wetland preservation and agricultural production is often mentioned, but cannot be precisely evaluated. The need for Minnesota's agricultural production must be viewed in the context of national agricultural economics, but decisions are made by individual farmers maximizing the return on their investments. However, the large "set-aside" acreage taken out of production in Minnesota questions the need for continued drainage.

An essential consideration is the rapidity of resolving this issue. The Legislative Auditor has suggested that those remaining wetlands which can be feasibly drained probably will be drained within twenty years, and that awaiting the development of case law to clarify statutory language will likely provide a solution by default. Restoration of wetlands has been attempted and is an evolving technology, but restored wetlands are likely to be primitive ecosystems lacking most of the values of the original.

A final implication is that public understanding and rational discussion are essential to successful decision-making. The DNR must make the rationale, and the overriding public interest, apparent when wetlands are preserved. An authoritarian image hinders cooperation and is often ineffective; the DNR has experienced serious enforcement problems in the restoration of illegally-drained public waters. Conversely, decisions made in the public interest and based on careful analysis should not be sacrificed for politically powerful special interests.

Issues

Several major issues form the basis of the wetland drainage controversy:

(1) How can Minnesota determine which wetlands are of sufficient public benefit to require protection, and which wetlands could be drained in the best interest of the state?

(2) How should public benefits from owned wetlands be protected? Should programs focus on acquisition, tax incentives, easements, or the "water bank" concept? Are levels of compensation adequate?

(3) What are the rights of landowners, and are they safeguarded?

(4) Are modifications to the drainage code necessary to protect public benefits and assessed property owners?

(5) What should be done to protect local units of government against losses of tax revenue due to aquisition or incentive programs?

(6) Are existing wetland protection programs sufficient for the protection of wetlands in urban areas?

Options

Resolution of wetland management issues requires the acquisition of information needed (1) to precisely define the conflict and (2) to determine whether specific wetlands should be converted to agricultural production, used in urban development or should be protected. Available options include:

** Establish state goals and objectives for wetland management and protection in various regions of the state.

** Identify the specific characteristics of wetlands which determine their suitability for protection or conversion, and develop evaluation procedures which incorporate these criteria.

** Inventory state wetlands and their values for agricultural production and the other public benefits (flood control, water quality protection, etc.).

** Evaluate data on the extent and rate of drainage and, if it is insufficient, initiate studies in critical watersheds.

** Stimulate public education and review of findings.

After identification of wetland values, a variety of wetland protection methods are available to preserve public benefits. Many options can be considered, including the options to:

** Accelerate the designation of public waters by the DNR.

** Increase funding for wetland acquisition and the securing of easements.

** Tax wetland drainage to compensate for public benefits foregone.

** Accelerate the state Water Bank program and support improvement in the federal Water Bank.

** Provide property tax incentives for wetland preservation.

** Require petitioners for drainage projects and improvements to demonstrate that public benefits of wetlands will not be adversely affected, with such demonstration subject to state approval.

Two options are available to protect assessed landowners and assure the consideration of environmental effects in the drainage code:

** Improve the impartiality of local decision-making under Chapter 106 drainage projects (upgrade qualifications for viewers, redefine "public health," reduce possibility of gerrymandering, and base drainage petitions on **area** drained rather than population affected).

** Require DNR review and approval of drainage system improvements.

Local units of government can be protected from loss of tax revenue due to wetland acquisition or property tax incentives in several ways:

** Evaluate the adequacy of payments to counties in lieu of taxes and increase to equality if necessary (from both the state and federal government).

** Impose conditions on the redistribution of tax payments to ensure equitable allocation among local units of government.

** Maintain lands on local tax rolls through emphasis on Water Bank compensation rather than acquisition.

The protection of urban wetlands is a unique situation complicated by the inapplicability of existing compensation programs, high property taxes, and the unknown effect of "model ordinances" set forth by the Metropolitan Council. Federal and state acquisition programs have been of limited value in preserving urban wetlands. Further study is warranted to suggest alternatives and to consider creation or reorientation of compensation programs for urban areas.

Criteria

Selection among the proposed options should be based on:

** **Immediacy.** The conversion of wetlands, legally or illegally, continues at an unknown rate. Prompt action will ensure that alternatives are not foreclosed.

** **Avoidance of irreversible commitments.** Flexibility should be retained until sound decisions can be made.

** **Preservation of public benefits.** Society should not bear the cost of public benefits lost from drainage of private lands simply because they are not easily quantified.

** **Equity, and the safeguarding of individual rights.** Private property owners should not individually bear the burden of providing public benefits at the expense of private benefits without adequate compensation. Administrative procedures must consider opposing points of view.

** **Cost.** Aquisition and compensation programs are expensive. Both preservation and alteration of wetlands incur significant costs.

** **Need.** Can some wetlands be sacrificed without loss of public benefit? Is greater agricultural production warranted when farmers are being compensated for "setting-aside" cropland?

Recommendations

The Minnesota Water Planning Board recommends:

(1) **Determination of wetland values.** Several related actions should be undertaken:

- ** The Department of Natural Resources should identify state goals for wetland management.
- ** With financial assistance provided by Section 22 funds from the Corps of Engineers, the Department of Natural Resources should determine specific characteristics of wetlands providing flood control, nutrient and sediment retention, groundwater recharge, and other public benefits.
- ** The DNR, in consultation with other concerned agencies, should undertake a statewide inventory of wetlands which reflects the characteristics and values of wetlands providing public benefit. The inventory should include mapping of high-priority wetlands for flood control, water quality, recharge, and agricultural suitability as has been performed for wildlife values.
- ** Information on drainage activity should be evaluated for validity by the DNR and reliable data should be used to assess the extent of the drainage-preservation conflict.
- ** An aggressive education program should be undertaken to inform the public of the determined values and to receive public comment.

(2) **Accelerated implementation of DNR's Public Waters and Water Bank programs, and support of improved funding for the federal Water Bank program.** When Recommendation (1) has been completed, priorities for compensation and acquisition programs can be established. Water Bank programs should provide adequate compensation to encourage wetland preservation.

(3) **Further study of modifications to the drainage code to protect assessed landowners and environmental concerns.** Although there is evidence that strictly local control of drainage improvements may not lead to impartial decision-making, further investigation is necessary before specific recommendations can be made.

(4) **Evaluation of the adequacy of wetland incentive and acquisition programs, including consideration of:**

- ** **In-lieu-of-tax payments for state and federally-owned wetlands, and the distribution of payments among local units of government;**
- ** **Financial incentives for wetland preservation, including tax credits and Water Bank compensation; and**
- ** **Wetland acquisition programs, and the relationship between purchase and regulatory control of valuable wetlands.**

(5) **Development of a program for the protection of urban wetlands.** The first step should be a cooperative study of urban wetland protection by the Metropolitan Council and the state coordinating body, considering the need for protection of urban wetlands excluded from existing compensation and acquisition programs.

Supportive Document: "Final Report of the Supply, Allocation, and Use Work Group."

CONSERVATION OF WATER RESOURCES

Over time, the term "conservation" has come to mean the protection of a resource from being used completely. More recently, conservation has taken on an efficiency connotation, referring to production of a desired effect without waste. The Water Planning Board refers to conservation of water resources in terms of an efficient use/anti-waste concept, rather than a purely conservation/anti-use design.

The adoption of such a concept is necessary because the public's perception of water has generally been that it is a free resource of unlimited availability. This perception is not accurate. Water supplies are relatively fixed. Increased population, more concentrated withdrawals, and more consumptive technologies press toward the limits of these supplies. Although Minnesota generally has abundant water supplies within its borders, areas of short supply exist, water resources are unevenly distributed in time and location, and demand conflicts arise. Community growth, facility obsolescence, capacity constraints, water quality problems, and the increasing costs of distribution and treatment will exacerbate conditions in the future.

Situation

Traditionally, water planning for the future has been concerned chiefly with the problem of acquiring and developing additional supplies. Water conservation in water supply planning has only recently come to the fore, usually as the result of an extreme shortage. In 1972, when wastewater flow reduction was included in the federal Clean Water Act (P.L. 92-500), water conservation became a formal part of water management policy. In 1978, proposed national water policy included a financial assistance program for states to incorporate water conservation into planning activities through public education, information dissemination, and technical assistance. Under this program, up to $347,000 could be made available to Minnesota annually.

Minnesota is experiencing a number of the same water-related problems which are occurring nationwide. These problems generally appear in localized shortages. Three factors contribute to localized water shortages. First, population pressure increases the demand for water from municipal and domestic supplies. High density population also increases the demand for services using water and goods requiring water for manufacturing and processing. Second, advancing technology and a rising standard of living are decreasing relative water availability by encouraging new uses in agriculture, industry, municipalities, and homes. Finally, natural precipitaton remains unpredictable.

The Department of Natural Resources has been charged with the responsibility to "develop a general water resources conservation program for the state" since 1947. While no specific conservation program has been set forth, water conservation considerations have been incorporated in the issuance of permits for water appropriation and use of the waters of the state. In 1977, the Legislature further provided for conservation measures by requiring (1) public water supply authorities to restrict "lawn sprinkling, car washing, golf course and park irrigation, and other non-essential uses" under certain conditions and (2) contingency plans describing alternatives to be used by a surface-water appropriator if further appropriation is restricted due to low streamflow or lake level. In addition, the Minnesota Department of Health has the authority to develop emergency plans to protect the public when declining water supply creates a health risk.

Despite the statutory requirements, a state posture toward water conservation as a management tool has not been identified.

Implications and Considerations

Appropriate conservation methods differ dramatically from state to state and even within state borders. Due to varied regional characteristics, plant facilities, and attitudes, there can be no sweeping, ultimate conservation solutions. Therefore, the Water Planning Board selected three areas for an examination of water conservation for Minnesota—domestic consumption, agricultural irrigation, and agricultural processing. The Board found:

** While residential water withdrawals represent only about seven percent of total state water withdrawals, domestic use can contribute to supply problems because it is highly concentrated. Many options exist for reducing domestic consumption without altering lifestyles, including installation of 3-gallon toilets (using an average of 25.6 percent less water per flush than a five to six gallon toilet) and low-flow shower heads (a savings of 40 percent in water use). Flushing and bathing account for about 70 percent of water use in an average home.

** If Minnesota irrigators utilize recommended management and conservation techniques, water savings could reach 20 percent. Recommended techniques include scheduling, use of soil moisture monitors, and the use of flow meters.

** Because Minnesota is characterized by a wide variety of agricultural processing plants and because conservation options are limited by government rules, no generalizations can be drawn. However, it is apparent that many food processing operations are adjusting their water use rate downward in order to compensate for increased costs and/or diminished supplies. One food processor estimated a savings of $22,500 per year due to reductions in water use; another was able to reduce water consumption from 600 gallons per minute to 280 gallons per minute with conservation measures introduced over a four-year period.

In addition, the Great Lakes Basin Commission has recently suggested that adoption of recommendations on education and information dissemination, implementation of water-saving devices, metering of water use, and leak monitoring and control could save over 11.5 million gallons of water per day and over $5.0 million per year.

Central to all efficient use/anti-waste approaches is a change in the attitude of consumers of water. Adusted rates of use demand new patterns of thinking, as well as implementation of new technologies. A key to success in achieving a change in attitudes may be initial concentration on water-saving devices which can be installed without major disruption in lifestyles. An effective conservation program must link technologies with new thoughts.

Price changes and metering of use are two considerations frequently advocated as a means of changing attitudes about water use. Price changes have proved effective in reducing usage of municipal supplies. The Fairfax County (Virginia) Water Authority adopted a peak pricing policy in November 1974. Initial data in-

dicates that customers have reduced usage during peak periods. An Environmental Protection Agency study has indicated that a one percent increase in the price of water reduces lawn sprinkling by 1.6 percent in humid areas and that a one percent increase in price decreases overall domestic use by 0.23 percent.

In 1973, a report sponsored by the Denver Board of Water Commissioners suggested that for areas studied during the period 1965 to 1968, metered users employed 13 to 30 percent less water than unmetered users; between 1960 and 1970, 29 percent less; and in the period 1969 to 1972, six percent less. Irrigation scheduling and rates of water applications are important determinants of irrigation efficiency. Metering of irrigation systems can reduce inaccurate estimates of how often and to what extent a farmer should irrigate. However, metering may not be a viable alternative for all communities or all irrigators.

Finally, in assessing potential future water demand for water withdrawal and consumption in Minnesota, the Water Planning Board constructed a "conservation scenario" based on (1) a doubling of the price of water in the residential sector (by 1985); (2) increased efficiency in the commercial and industrial sectors; and (3) a ten percent increase in the efficiency of water use in irrigation. Under the "conservation scenario," water withdrawals are projected to be about nine percent less than under the "business-as-usual" scenario and consumption about three percent less.

It is important to note that there may be disincentives for water conservation under the present arrangements for charges by water utilities. That is, as use decreases, charges may have to be increased to meet utility costs (unless energy savings or deferrals of construction offset reduced revenue). A survey of 108 metropolitan area water suppliers reported by the Metropolitan Council indicates none use an increasing block rate structure. Several suppliers stated that conservation will result in increased costs to the consumer because of revenue that will be lost due to reduced water use. This is not necessarily the result of conservation efforts, however.

Issues

There are three major issues to be addressed relative to the development of a water conservation program in the State of Minnesota.

(1) Is water conservation an effective long-term strategy for holding down inefficient water withdrawals and consumption in Minnesota?

(2) What should be the general guiding principles in developing effective water conservation strategies and techniques for Minnesota?

(3) What actions need to be taken now? What questions require further study?

Options

The issue, "Is water conservation an effective long-term strategy for holding down inefficient water withdrawals and consumption in Minnesota?", demands a "yes" or "no" decision. While the adoption of a conservation approach may not appear to have the immediacy in Minnesota which it has in arid states, conservation (1) frees additional supplies for other uses; (2) prevents or delays construction of costly water supply and treatment facilities; (3) decreases energy costs for pumping, treating, and heating water; and (4) reduces the required capacity of future wastewater treatment facilities. Importantly, development of a conservation program has been deemed necessary by the Legislature since 1947 (with reaffirmations in 1977) and, under virtually all estimates, has been considered to be capable of reducing water consumption and withdrawal in Minnesota.

The major negative consideration is whether a state which likely faces primarily localized water shortage problems should employ its limited resources in a conservation program.

If the state elects to develop a conservation program, a number of principles should be considered. These include:

** Selection between a mandatory conservation approach with goals to be reached within a given period or a program of education and technical assistance;

** Identification of a single state agency as a clearinghouse for conservation functions;

** Determination of whether the program should be focused at the state, the regional, or the local level;

** Development of a water conservation example in state agencies;

** Provision of demonstration programs in a limited number of local communities;

** Preparation of education and school curriculum materials on wise water management; and

** Enforcement of statutory provisions requiring that the Department of Natural Resources adopt rules (1) to implement the general conservation program called for in Minnesota Statutes, Section 105.39 and (2) to be followed by public water supply authorities in restricting lawn sprinkling, car washing, golf course and park irrigation, and other non-essential uses during periods of critical water deficiency.

The areas of domestic consumption, agricultural irrigation, and agricultural processing were examined by the Water Planning Board for their conservation potential. Options in these areas include:

** **Domestic consumption.** Increased educational and informational activities, installation of water-saving devices, increased metering, price increases, and leak monitoring and control are options.

** **Agricultural irrigation.** Among the practices which could contribute to water conservation in agricultural irrigation are the practice of water stewardship as a general ethic, rehabilitation of inefficient irrigation systems, reduced incidental losses such as those caused by leaks and over-irrigation, installation of multiple uses such as irrigating with sewage outflow, development of scheduling programs, and introduction of soil moisture monitors.

** **Agricultural processing.** Options involve recycling and reuse of water supplies, organizational support, in-plant water surveys, elimination of waste, plant cleanup operations, dry conveyance of solid waste, minimization of fresh water use, and less water-intensive transport of products.

Important options for future study are (1) conservation in other manufacturing sectors, (2) reduced water use in the mining industry, (3) relationships between conservation and water quality in electrical generation, and (4) the potential impact of the adoption of water conservation approaches on municipal water charges and appropriate state responses.

Criteria

In selecting among the various options, the Water Planning Board suggests that decision-makers focus on the following considerations:

** Preservation of water supplies for the future;

** Protection of the quality of existing supplies;

** Reduction of costs associated with energy demand;

** Postponement of development of untapped supplies; and

** Reduction in the need to construct new sewage treatment facilities.

Recommendations

The Minnesota Water Planning Board makes the following recommendations:

(1) **Technical assistance program.** Water conservation programs are a potentially effective means of promoting efficient water withdrawal and consumption in Minnesota. Employing federal funds expected to become available, the state should take the lead in obtaining, evaluating, and disseminating information on conservation techniques through an education and technical assistance program.

The state coordinating body should be designated as the clearinghouse for water conservation activities. It should assure dissemination of this information to local and regional bodies and be responsible for making educational materials available to schools through the Department of Education and the Minnesota Environmental Education Board. It should serve to direct inquiries on water conservation practices to the appropriate agencies and technical service bodies, such as the Agricultural Extension Service. In addition, it should (1) administer funds which may become available under federal water policy initiatives and (2) monitor conservation demonstration programs at the local level.

(2) **Local programs.** Conservation programs, including those required by statute, should arise at the local level. Where required by law, such programs shall be consistent with state rules.

(3) **Department of Natural Resources rules.** The Department of Natural Resources should adopt rules necessary for operation of local programs to restrict non-essential water uses during critical periods and to implement the general conservation program required by Minnesota Statutes, Section 105.39 through the permit program. The conservation program should address such areas as mining, commercial and industrial, domestic, agricultural, and municipal conservation.

(4) **Metering.** All permitted appropriators shall be required to measure their water use accurately. Flow meters shall be used, except in cases where users can demonstrate that employing meters is technically infeasible or too costly. It shall be the responsibility of the appropriator to demonstrate that a flow meter is infeasible or prohibitively costly. Where successfully demonstrated, an alternative means of accurate withdrawal measurement shall be required. (See also the "Supply and Allocation" section.)

(5) **Studies.** The Water Planning Board staff, in conjunction with affected state and local agencies, should carefully study (a) the impact of water conservation approaches on municipal water charges and state responses if conservation approaches result in increased municipal charges and (b) the ways in which the state plumbing code might be revised to promote water conservation.

(6) **State agencies.** The Governor should require state agencies to initiate water conservation measures in state facilities and require agencies to encourage water conservation techniques in programs they administer.

Supportive Documents: Technical Paper No. 12, "Water Conservation Methods for Irrigation, Agricultural Processing Industries, and Domestic Consumption" and "Final Report of the Supply, Allocation, and Use Work Group."

WATER SUPPLY AND ALLOCATION

As a whole, the State of Minnesota has abundant water resources. Four of the state's lakes are among the ten largest in the country. There are some 25,000 miles of streams in Minnesota. Water from Minnesota flows into 22 states and three Canadian provinces. Conservative estimates of available ground water are in the range of 1.1 to 2.0 trillion gallons per year.

In 1976, water withdrawals in the state were approaching 1.4 trillion gallons per year. Consumption was estimated to be about 179 billion gallons in 1976, or about 13 percent of total withdrawals. By 1990, it is estimated that withdrawals could increase by over 15 percent and consumption by nearly 92 percent. However, consumption would still only reach 343 billion gallons for the year under the estimate.

While present and estimated future water use does not appear to threaten available supplies on a statewide basis, severe localized problems are known to exist. A major regional water availability problem is low streamflow in the western one-half of the state. The drought of 1976 demonstrated that even in a "water-rich" state, temporary water shortages can occur on a statewide basis.

Situation

Over the years, Minnesota has modified the basic Common Law Riparian Doctrine into what is known as the American Reasonable Use Doctrine of Riparian Rights. Under this doctrine, each riparian land holder has a privilege to make a reasonable beneficial use of available water. The Department of Natural Resources is responsible for making decisions relating to reasonableness and interference through the Water Appropriations Permit program.

The State of Minnesota has required permits for appropriation since 1937. Under the present statutory provisions (Minnesota Statutes, Section 105.41, subd. 1), and Department of Natural Resources policy, a permit is required of any appropriation of surface or ground water, except where water is appropriated for a domestic use serving less than 25 persons, or the withdrawal is less than 10,000 gallons per day and less than one million gallons per year. The Commissioner of Natural Resources has the power to cancel or modify the terms of permits previously issued.

A priority system for granting water appropriation permits is established in Minnesota law (Minnesota Statutes, Section 105.41, subd. la). A five-tier priority system is adopted, moving from domestic water supply (excluding industrial and commercial use of municipal supplies); to any consumptive use of less than 10,000 gallons per day; to agricultural irrigation and processing; to power production; and, finally, to all other uses.

To date, the Department of Natural Resources has not adopted rules implementing the appropriations permit system, although such rules are currently being drafted. Since the drought of 1976, the laws relating to water appropriations have been modified twice. However, the overall policy of the state regarding water appropriations remains unclear. As the demand for water increases, in the absence of a clearly conceived comprehensive water policy, such incremental policy changes are likely to continue.

Implications and Considerations

Action is required to develop a guiding policy for water allocation. Input and cooperation of regional and local units are essential if action is to be taken. Management plans for specific areas of the state, subject to policies established, must be the goal of any action program.

To undertake such action, three considerations must be addressed. First, the adequacy of the existing data and analytic techniques for estimation of available supplies must be considered. The preliminary estimates of ground-water availability and surface-water supplies developed through the Water Planning Board represent one of the first efforts to quantify water supplies of the state. However, there can be no doubt that this represents only a first step.

Second, the efficiency of the present appropriations permitting system must be examined. The purpose of allocation policy should be to distribute the right to consume water in such a way as to achieve efficient use of the resource consistent with widely held social goals. There is a widely held concern that the current allocation practices do not meet this purpose, due to numerous factors.

Third, newly-developing specialty users must be recognized within any system for allocating the state's water supply. These special uses include rural water supply systems and irrigation. A rural water supply system is a type of public water supply system which provides central water treatment and delivery of potable water through water mains. Irrigation is considered as a specialized use because of its rapid growth, concentration of development, and large-scale consumption of water.

Issues

The central issue in relation to Minnesota water supply and appropriation is: What is the desirable water appropriations policy for the State of Minnesota? To fully address this issue, four more specific questions must be answered:

(1) Are adequate data and analytic techniques currently available to make required allocation decisions? If not, what data and analytic techniques are necessary?

(2) Under general conditions, is the existing water appropriations permitting program achieving the goal of the most efficient allocation of water resources of the state? If not, what modifications are necessary?

(3) When water is in short supply, does the existing priorities system provide a viable mechanism for allocating water resources? If it does not, what optional approaches are available?

(4) Municipal supply systems represent one area in which water pricing structures are in place and could be used to impact required appropriations. Are municipal pricing systems effective in meeting the goal of efficient employment of water resources?

Because of the scope and complexity of the central issue and the more specific questions, the questions and optional approaches to their resolution are discussed separately below.

Data and Analytic Techniques

The Water Planning Board developed estimates of surface-water and ground-water availability for 39 watershed units in the state. Water use for 1976 was determined for township approximations of the 39 watershed units. Projected water use in 1990 was estimated for county approximations of the 10 major river basins in the state. While this effort represents the most comprehensive effort undertaken in Minnesota to develop information on a statewide basis, it is still of limited value.

Most important, efforts to date have been insufficient to demonstrate where shortages exist or may be expected to exist in the near-term future. The principal shortcoming is the inability to take supply data and future demand estimates to more localized levels. For example, ground-water estimates could be established only within orders of magnitude because (1) there is a paucity of verified information from actual field investigations, (2) hydrologic parameters used in computations (e.g., storage coefficents and recharge rates) are approximations, and (3) only estimates for aquifers discharging ground water to streams were possible.

Other Water Planning Board supply estimates are also limited by assumptions and potential sources of error. For example:

** Specific locations and sources of appropriations within each sub-basin were not always available.

** Streamflow gaging stations which were used to derive stream water availability are not necessarily located near the mouths of sub-basins, and in some cases tributaries flowing into a river or lake are not gaged; and

** The reported water use portion of the present use estimates reflect the drought conditions of 1976, with average use possibly higher or lower than these estimates.

Such assumptions and possible sources of error must be recognized in present analysis and improved on in subsequent analysis.

To improve data and analytic techniques, the State of Minnesota must choose between (1) establishing and funding a data gathering and analysis program targeted specifically on quantifying assumptions and reducing sources of error, or (2) continuing current efforts which provide data and utilize techniques on an "as needed" basis.

The Allocation System

The purpose of water allocation policy should be to distribute the right to consume water in such a way as to achieve efficient use of the water consistent with widely held social goals. Water is efficiently allocated when, given the existing distribution of wealth, it is not possible to change the allocation of water wthout making at least one individual worse off. Conversely, water is not efficiently allocated when it is possible to improve the benefits of water use accruing to at least part of the population in an area without making the rest of the population worse off. Many efficient allocations, corresponding to different benefit distributions, are possible. The particular allocation toward which the state will move should depend on the values held by citizens of the state.

In addition, allocation policy must recognize the administrative burdens introduced by its adoption, be coherent and controllable, be operable even in the absence of complete information, and account for market imperfections in economic sectors.

Although the basic water law of the State of Minnesota and the policies of the Department of Natural Resources have served the state reasonably well, in water shortage situations (particularly ones of long duration) these laws and policies could inhibit efficient and equitable water allocation. Specifically, the American Reasonable Use Doctrine of Riparian Rights, the basic water doctrine applied in Minnesota, by itself is not necessarily conducive to efficient or equitable allocation because allocation is determined primarily on the basis of location and not on the values and costs of water in alternative uses. Further, the current priority system (Minnesota Statutes, Section 105.41, subd. la) could inhibit the efficient and equitable allocation of water because priority classifications have little relevance to the marginal values and costs of water in alternative uses and because the priorities do not reflect the values of many segments of the public.

Options available to correct for the defects suggested above are described below. Importantly, each of these options is subject to the Department of Natural Resources' responsibility to regulate the total withdrawals from any source.

(1) Priorities Systems

The practice of the Department of Natural Resources has been to issue permits based on the Reasonable Use Theory, subject to statutes setting forth controlling guidelines. The priority system established in Minnesota Statutes, Section 105.41, subd. la, is one such controlling statute. The law sets up a system under which domestic water supply (excluding industrial and commercial use of municipal water supplies) is the first priority; any consumptive use of less than 10,000 gallons per day is the second priority; agricultural irrigation and agricultural processing the third priority; power production the fourth; and all other uses the lowest priority.

The present priority system may be criticized on the basis that (1) it does not necessarily promote allocational efficiency (since the priorities do not objectively allow for the fulfillment of water consumption needs in the order of their value to individual users and the rest of society), nor does it take into account the relative costs of supplying these needs; (2) in some cases the priority system may be infeasible since water consumption in lower-priority uses may be necessary for the operation of higher-priority uses; and (3) it is not necessarily equitable since higher priority uses (e.g., domestic use) could include uses of water which are frivolous (e.g., long, hot showers) compared to uses in lower categories (e.g., energy production).

In addition to the current priority system, two options are available. They are:

** **Broad priority classifications.** This priority system would consist of three main priority classes: (1) basic necessity, (2) environmental, and (3) economic. The basic necessity category would be fulfilled before any other during a water shortage. It would consist of basic allotments for drinking and sanitation, special health needs, electric power production, and so forth. The purpose of the environmental classification is to prevent the degradation of the environment, through protection of water levels and flows. The economic class would consider the needs of firms in various sectors in the state economy, as well as residential uses beyond those allowed by the basic necessity category.

Each of the two highest categories would have to be satisfied up to a minimum level before water would be allocated to the next highest category. Thus, the categories are not open-ended as are those in the current Minnesota priority system. The exact magnitude of each ceiling could be estimated and established on a regional basis. Water use in each category beyond its ceiling would have to be justified on a case-by-case basis before additional water use within the category could be given priority over use in lower categories. When this ceiling was satisfied, additional water could be allocated to the next priority category.

** **No priority system.** With no priority system, all allocation decisions could rest on Department of Natural Resources permit decisions. If pricing or free trading of shares were adopted, water would be rationed based on willingness to pay. The public would be depended on to reduce domestic consumption and other non-permitted uses as shortages increases.

The current priorities system should not be neglected as an option. While problems have been identified with the current priority system, it does have positive aspects. First, since domestic use has the highest priority under the existing system, basic necessities are for the most part protected **vis a vis** most other uses. Second, the system is relatively inexpensive to administer. Third, alternatives could be technically difficult to implement and more expensive to administer. Finally, in most cases to date, priority classes have not been in conflict (although a case in Crookston is an exception).

(2) Options for Making More Water Available to Non-Riparian Users

The following options are designed to alleviate problems of uneven water distribution by permitting transfers between riparian and non-riparian users.

** **Lease-easement arrangements.** Under this option, a non-riparian would be allowed to obtain a lease from a riparian neighbor to a small amount of riparian land. The non-riparian would then be able to sink a well or install a surface-water intake on the riparian land. To remove the water over neighboring land, an easement could be negotiated. The lessee would be required to obtain an appropriations permit, as would any other appropriator. This option has been applied in Minnesota, but is not an explicit policy.

** **Sale of water by riparians to non-riparians.** This option would have the Department of Natural Resources grant permits to riparians for the purpose of withdrawing water for sale to non-riparians (or even to other riparians). The DNR would continue to control withdrawals by the permit holder. The riparian would continue to control the amount of water withdrawn and sold, as opposed to the lessee holding control of withdrawals under a lease-easement arrangement. The legal and constitutional implications of this option are not clear at this time and would require in-depth study.

** **Mutual water companies.** Mutual water companies could secure a water supply for their members either by buying or leasing riparian land, or by contracting to purchase water from a riparian (if allowable). The mutual water company could issue shares, with each share entitling its owner to some share of the water which the company could withdraw by virtue of its permit. These shares could be marketed among water users. While this option has been employed in California, its legal and constitutional implications for Minnesota are not clear and would require detailed study.

** **No change.** Under this option, the basic approach would be unchanged. The rules being developed by the Department of Natural Resources would be evaluated against the goal of efficient use of the water resources of the state.

A major consideration in choosing any of these options is the impact of the transfer allowed on those not involved in the sale. Third parties are potentially affected in either positive or negative ways. Thus, under any system of water transfers, avenues must be available for affected third parties to obtain compensation for damages they sustain due to others' water transfers.

(3) Allocation During Water Shortages

As noted previously, current state law and policy may not function well during periods of water shortage. The following options should be considered as approaches to allocating water in specific hydrologically-defined areas during water shortages:

** **Pro-rata rationing policies.** This approach to water shortage could be applied during a temporary shortage to protect water levels in lakes, streams, and underground. In specific areas of short supply, the estimated available water supply would be apportioned among users in relation to the maximum withdrawals specified on appropriation permits, or according to reported withdrawals averaged over some period of time.

** **Benchmark water-shortage pricing.** Benchmark water-shortage pricing involves establishing a per-unit water price for withdrawals from a water source when the level of the water (in a ground-water aquifer or lake) approaches a predetermined benchmark level, or, in the case of a river or stream, when the flow of the water approaches a benchmark flow. The benchmark levels and flows would be determined on the basis of environmental and hydrological considerations. As the benchmark level or flow is approached, the price is raised to discourage water use. If levels or flows are well above the benchmark parameters, the per-unit price would be set at zero.

   This approach would tend to produce efficient water allocation at the source because individual withdrawers would be forced to take into account the value of the resource in their withdrawal decisions.

** **Trading in joint permit shares.** One way of avoiding the inefficiencies in allocation which could occur under pro-rata rationing and the "trial and error" approach of benchmark water-shortage pricing would be to establish a system of trading in joint permit shares. This option would involve the issuance of a joint permit to all withdrawers from a source. The maximum withdrawal allotment specified on each individual permit would be converted to proportionate shares in the maximum allotment attached to the joint permit. These shares would be tradable among users. During water shortages, the maximum allotment attached to the joint permit would be reached so that each share could command a smaller absolute amount of water. Thus, during water shortages the competitively established price of shares would rise, encouraging conservation. The legal and constitutional implications of this alternative are unclear and require in-depth study.

** **No change.** Under this option, the Department of Natural Resources could retain the authority to discontinue permits and limit withdrawals during periods of short supply. This approach is less likely to promote efficient use of the resource, although it is an administrable approach.

(4) **Pricing by Water Utilities**

In general, water is allocated by water utilities through some type of pricing scheme. The rate structures selected affect the allocation of water both within the service area of the utility and at the source from which the utility draws its supplies. Thus, there are two primary reasons why the rate structures selected by utilities should be of concern if the State of Minnesota is interested in achieving the maximum benefit from water supplies of the state.

(1) The water utility acts as an "agent" for individuals and certain firms in its service area when it competes for water supplies with other potential users. The rates charged by water utilities affect the total demand for water. Therefore, the total satisfaction of all users of water at or from each source depends on how water is allocated within the utility's service area.

(2) Water provided through water utilities directly provides satisfaction of personal needs and desires. It indirectly provides satisfaction to individuals by permitting firms to provide goods and services, and jobs and income. Thus, the way in which water is allocated in a utility's service area affects the satisfaction derived from its use.

Water utilities in Minnesota charge each customer for water delivered, rather than for water consumed. (Some utilities also provide sewage treatment services and charge for these services.) At least five approaches have been employed in the state.

** **Service charges.** Service charges are charges which do not vary with the quantity of water delivered. They are imposed in addition to per-unit water charges in a water rate structure.

** **Flat charges.** The flat charge is a fixed bill which is levied independently of the amount of water used. For example, a customer might pay $10 per month for water service, regardless of the volume of water used.

** **Single block rate.** The single block, or uniform rate, is a constant rate charged per unit of water (e.g., the customer pays $2.00 for every 1,000 gallons of water used). This rate may vary according to different classes of users.

** **Declining block rates.** The declining block rate structure is usually instituted with a minimum demand charge. A declining block rate structure without a minimum demand charge is a structure in which a specified rate is charged per unit of water up to a specified amount. Water consumed beyond this specified amount is charged at a lower rate up to the next plateau, and so forth. When this structure is combined with a minimum demand charge, the customer is billed a flat charge for all water consumed up to the first specified level.

** **Increasing block rates.** This type of rate structure is the reverse of the declining block structure. In this case, the rate charged increases with successive blocks.

Because the existing rate structures employed in Minnesota are not directly based upon the short-run marginal cost conditions of supplying water to individual users and because they do not reflect differences in these conditions among uses and users, the current rate structures of municipal utilities tend toward inefficient use of water and toward unnecessary capacity expansions. One alternative to the existing structure is:

** **The marginal cost approach.** This approach is based on the marginal costs imposed upon water supply systems by identified groups of users. Marginal costs may be defined as the cost of delivering the last unit (thousand gallons, acre-foot, etc.) of water. This is to be distinguished from the average cost of water, which is the total cost of delivered water divided by the number of units of water delivered. Identified groups of users would consist of customers who impose similar costs on the system (e.g., those who use water during peak periods, live at higher elevations, etc.). The rate structure imposed on each group would consist of initial charges (to cover those increments to the costs of the system which can be attributed to each new connection); service charges (to cover the fixed costs of the water utility directly attributable to each individual connection, the ongoing marginal costs of maintaining capacity for the peak needs of identified groups, and to distribute the economic gains or losses of the water utility); and commodity charges (a rate for each unit of water delivered which reflects the "true" short-run marginal cost of supplying water to groups of consumers).

The potential gains in efficiency of such an option must be weighed against the administrative costs which it may entail.

Criteria

In selecting among the water supply and appropriation system options, a wide array of criteria might be employed by decision-makers. These include:

- ** **Allocational efficiency.** Water is efficiently allocated when given the existing distribution of wealth, it is not possible to change the allocation of water without making at least one individual worse off. Conversely, water is not efficiently allocated when it is possible to improve the benefits of water use accruing to at least part of the population in an area without making the rest of the population worse off. It is desirable to explicitly identify any trade-offs between allocational efficiency and other objectives in order to avoid needless sacrifices of efficiency.
- ** **Administrative efficiency.** The appropriations strategy should achieve its objectives at a minimum administrative cost. It should be straightforward to administer.
- ** **Equity.** Because many efficient allocations are possible, the particular allocation toward which Minnesota should move depends on the values widely held by its citizens. Equity refers to the allocation of water in conformity with these values.
- ** **Information requirements.** The appropriations system adopted should be operable even in the absence of complete information.
- ** **Coherence and control.** The selected approach should be understandable in its operations and effects, should have the effects intended, and should be subject to policy and fiscal control.
- ** **Accountability for externalities.** Considerations should be sufficiently integrated with all sectors so that positive and negative externalities are taken into account.
- ** **Responsiveness to changing priorities.** Allocative systems based on efficiency and equity considerations must be sufficiently integrated into the "political" process to allow comprehension of and responsiveness to changing public values.

Recommendations

The Water Planning Board recommendations are set forth for several areas, which in total outline a water appropriations policy for the State of Minnesota.

(1) **Data and analytic techniques.** To effectively manage water resources in the state, especially during water shortages, accurate data are necessary. Therefore, the Board recommends that:

A. All permitted appropriators be required to measure their water use accurately. Flow meters shall be used, except in cases where users can demonstrate that employing meters is technically infeasible or too costly. It shall be the responsibility of the appropriator to demonstrate that a meter cannot be used. Where successfully demonstrated, alternative means of accurate withdrawal measurement shall be required.

B. A comprehensive statewide program of streamflow measurement be established, including the review and possible modification of the existing network of streamflow gaging stations and expansion of a program for low- and high-flow measurements at selected sites.

C. The ground-water observation well network continue to be expanded throughout the state. Wherever feasible, ground-water observation wells should be used for both water quantity and water quality monitoring and to update the ground-water information system data base.

D. The emphasis of the U.S. Geological Survey Cooperative Ground-Water Study program be changed. Past studies have dealt primarily with surficial sand-plain aquifers. Although substantially increased expenses will be involved, the emphasis should be changed to studies of buried aquifers, particularly in areas where surficial aquifers are not widespread and where use appears to be increasing.

E. The water-use data base developed by the DNR Water Policy Planning Project be maintained and improved by the DNR Division of Waters. In conjunction with the state coordinating body, the DNR Division of Waters shall update estimates of withdrawals by unpermitted and non-reporting users and statewide and regional water use projections.

F. The Department of Natural Resources Division of Waters continue to utilize well logs for test holes, require information on the source formation or aquifer, and conduct pumping tests for ground-water permit applications in areas where this information is not available from other sources.

G. Efforts be continued and intensified to identify unpermitted appropriators in cases where permits are required. Additional efforts are also needed to bring permitted appropriators to report their annual pumpage (as required by law).

H. Low-flows be studied in potentially water-short sub-basins to determine how much water is available for appropriation and how much flow is needed for instream uses.

I. A program be established to assist local governmental units in problem areas in the development of water management plans to solve current availability-use conflicts and guide future development.

J. The hydrogeologic research functions and the well log data acquisition and interpretation programs of the Minnesota Geological Survey and Minnesota Department of Health be continued until an adequate hydrogeologic data base is established. These data are needed both for detailed ground-water studies and for ground-water management through the appropriation permitting program.

(2) **Priorities system.** The Water Planning Board recommends that the priorities system section of Minnesota Statutes, Section 105.41, subd. 1a be repealed. In its place, a system consisting of three main priority classes should be established. The three priority classes should be: (1)

basic necessity uses; (2) environmental protection requirements; and (3) economic production and other uses. Basic necessities and environmental protection levels should be based on local demographic, hydrologic, environmental, and regional dependencies. Economic production allocations should be based on economic, social, and hydrologic considerations relevant to the area involved. Local and/or regional water management plans should be developed—consistent with state policies and guidelines—to guide such decisions.

To fully define and refine the major priority classes for "basic necessity uses" and "environmental protection requirements," the coordinating body, in consultation with appropriate agencies, shall quantify these classes prior to the submission of any legislation to repeal the present priorities system. At a minimum, the basic necessities category shall consider basic allotments for drinking and sanitation, special health needs, and electric power production. At a minimum, the environmental protection category shall consider minimum protected streamflows and protection of lake levels. Subject to these requirements and pending development and approval of localized water and related land use plans, regional development commissions shall be authorized to develop regional "economic production" class priorities, which shall be advisory to the Commissioner of Natural Resources in permit issuance. Where an RDC elects not to establish regional priorities, the Commissioner may establish priorities for the region within the "economic production" class.

(3) **Improving distribution of water resources.** To assist in meeting problems of uneven water distribution, it is recommended that the state of Minnesota adopt as its explicit policy the use of lease-easement arrangements subject to consideration of water availability and the demands of the particular situation.

In the longer term, further consideration should be given to (a) water sales by riparians to non-riparians and (b) mutual water companies. Specifically, these considerations should focus on the legal and constitutional issues involved and how such a program would be implemented and administered.

(4) **Efficient allocation during shortages.** In order to promote efficient allocation of water at specific water sources during water shortages, it is recommended that in its long-run planning efforts, the coordinating body give further consideration to (a) pro-rata rationing, (b) benchmark water-shortage pricing, and (c) trading in joint permit shares. In carrying out necessary analyses, the expected benefits and costs of each option, the administrative procedures by which each option could be implemented, and the constitutional issues involved should be studied in depth.

(5) **Well interference disputes.** Rules and guidelines for the settlement of well interference disputes shall be based on the following responsibilities: (1) all appropriators of water shall be responsible for making a reasonable effort to obtain water sufficient in quantity and quality for their needs; (2) all appropriators shall be responsible for meeting the well code requirements of the Minnesota Department of Health; and (3) if further development of the aquifer causes interference with existing appropriators who are meeting their responsibilities, the new appropriator (or appropriators) shall be responsible for the cost of corrective measures, including any needed treatment facilities. The Department of Natural Resources shall, by rule, define the concept of "a reasonable effort to obtain" an adequate water supply.

(6) **Allocation by utilities.** The Water Planning Board makes the following recommendations for promoting the efficiency and equity of water allocation by local water utilities:

A. Local water utilities shall be encouraged to consider the adoption of rate structures based on marginal cost principles, such as the three-part rate structure discussed above, in order to bring about the more efficient allocation of water among their customers and to prevent excessive demand for water at the source and uneconomic capacity expansions. In cases where it appears that the adoption of such a rate structure by a water utility would put undue cost burdens on low-income families, the water utility should consider adopting as part of its rate structure the payment of lump-sum subsidies to such families each billing period in the form of reductions in their fixed service charges. The losses in revenue resulting from such subsidies could be made up by higher service charges to other water users. Such families would pay normal per-unit water rates (based on marginal cost pricing). To encourage the consideration of such rate structures, the state shall fund a pilot project whereby such rate setting practices can be tested through actual application by a local water utility.

B. In considering the merits of rural water systems, attention should be given to their ability to bring about more efficient allocation of water. Rural water systems transfer water from places where it is relatively plentiful and less highly valued to places where it is relatively scarce and, therefore, more highly valued. They provide a means of establishing efficient allocation among their customers.

Supportive Documents: Technical Paper No. 8, "The Economic Impacts of Water Shortage and Water Allocation Policies"; Technical Paper No. 13, "Toward Efficient and Equitable Water Allocation in Minnesota"; and "Final Report of the Supply, Allocation, and Use Work Group."

RELATED LAND USE

In northern Minnesota, mining is being proposed to exploit deposits which were either recently discovered or formerly uneconomic to develop. Exploration for uranium is underway in east central Minnesota. Peat mining is being considered. Agricultural practices are being intensified. Existing urban areas are being extended. Urban residents in their leisure hours leave cities and use the out-state landscape for water-based recreation. All of these developments influence water resources, both on the surface and below the ground.

Land use gives rise to two important considerations relative to the state's water resources. The first consideration may be characterized as how the use of land affects water availability and water quality. Modification of the vegetal cover of the land—or removal of the cover—influences the amount of precipitation which reaches the earth's surface, infiltration of precipitation into the soil, soil moisture levels, and runoff. Landscape changes affect sedimentation and may contribute contaminants to runoff. Such major changes as large-scale mining of peat may affect ground-water recharge. Urban development increases runoff. Erosion from construction sites may pose substantial problems.

The second consideration revolves around land use decisions in which water is a factor. Irrigation, flood plain management, wild and scenic river and critical area designations, shoreland development, mining, industrial development, and rural water system growth are among the major areas of land use decisions in which water is a factor.

Situation

The relationship of land use to water supply and water quality is wide-ranging and complex. A number of state studies and programs exist to deal with related issues. For example, the Minnesota Department of Natural Resources is involved in a major study of water resources of peatlands and the state is actively involved in wild and scenic rivers and critical areas designations. The Water Planning Board did not wish to duplicate such efforts. Similarly, the Board has dealt with related land use issues—such as flood plain management and urban runoff control—in other areas of this report.

In targeting its resources on major, non-duplicative land use considerations, the Board identified soil conservation, construction site erosion, irrigation, shoreland development (including considerations relating to the Wild and Scenic Rivers program), and rural water system growth as principal concerns. These concerns are briefly described below.

(1) Agricultural Soil Erosion

The potential for soil erosion due to runoff is directly related to the kind of soil, vegetative cover, management practices, intensity of rainfall, and the length and steepness of the slope of the land. Of approximately 21.0 million acres of tilled cropland in Minnesota in 1978, 11.5 million acres had less than two percent slope. Generally, soil erosion caused by water on such slopes is not serious.

In general, the acceptable soil loss rate in Minnesota from a production standpoint (although not from a water quality standpoint) is four tons per acre per year. About six million acres of tilled land in the state in 1978 had slopes of two to six percent, from which loss rates averaged three tons per acre. However, about one-third of these acres were in row crops, from which the loss rate was estimated at five tons per acre.

Approximately two million tilled acres of cropland have six to 12 percent slopes. Soil losses on these lands average about six tons per acre per year, although on 750,000 acres of row crops the estimated average loss rate reaches nine tons per acre. About 300,000 acres of cropland have slopes greater than 12 percent. Soil losses on these lands are estimated at 14 tons per acre, although on the 200,000 acres with row crops losses reach 26 tons per acre per year.

The terrain in some portions of Minnesota is such that, according to recent Soil Conservation Service reports, most eroded soil is deposited at the base of slopes and does not reach lakes and streams. (The site-specific nature of erosion and deposition must be considered to avoid a distorted view.) Areas of southeastern and southwestern Minnesota, however, are reported to have drainage areas in which eroded soil reaches lakes and streams, affecting water quality. Counties in which the impact of soil erosion from water's action on sloping land is greatest are Lincoln, Pipestone, and Rock in the southwest and Dakota, Dodge, Fillmore, Goodhue, Houston, Mower, Wabasha, and Winona in the southeast. In addition, the Metropolitan Council's "208" non-point overview showed serious erosion of Minnesota River bluffs with high delivery to the river.

Although dated, the Soil Conservation Service's 1967 Conservation Needs Inventory for Minnesota indicated that only about 25 percent of the state's cropland is adequately treated to protect the soil. Another 29 percent of the cropland base could have been protected with simple management changes (e.g., adding sod to the crop rotation or implementing annual cover plantings). Another 44 percent of the cropland would have required significant engineering, financing, or educational efforts to achieve adequate treatment. Two percent should not have been cropped.

(2) Construction Site Erosion and Sedimentation

Construction accelerates erosion by removing vegetation, exposing bare soil, and altering the topography of the land. Sediment comes from soil erosion. Soil erosion from construction sites generates sediments at the highest rate of all land uses, averaging 125 tons per acre per year during the period of construction. (Individual sites may contribute much more or much less than the average yield.) Without proper controls, much of this sediment can be transported to lakes and streams.

The State Planning Agency has projected that from 205,000 to 238,000 acres of additional land will be needed for urban development by 1990 if current trends persist. While construction will be occurring at scattered sites for various lengths of time, the highest growth rates are projected to be north and south of the Twin Cities, in the high-amenity lake regions of central Minnesota, and in ubanizing areas (e.g., Mankato, Duluth, Moorhead, Marshall, and Iron Range communities).

Further, after construction has been completed, new development continues to affect water flow and quality. Altered runoff characteristics change the peak and base flows of streams, for example. The impervious surfaces created by development increase the volume and velocity of runoff, expanding its erosive capacity. The greater the erosive force of runoff, the greater the quantity of pollutants which will be picked up and later deposited in water bodies.

In the metropolitan area, the Metropolitan Council has found urban runoff to be a significant contributor of pollutants to lakes and streams. An estimate of the metropolitan region's urban runoff potential indicates that urban runoff may contribute more total suspended solids, nitrates, lead, and zinc to surface waters

than all public waste treatment plant discharges. Similar problems are expected in other urban and urbanizing areas. (Urban runoff has been considered in the "Water Quality" section of this report.)

(3) **Irrigation**

Irrigation has emerged as a major variable in water and related land use in Minnesota. In the early 1960's, only about 20,000 acres were being irrigated in Minnesota. By 1970, this acreage had more than doubled to 44,000 acres. The number of acres nearly doubled again in the following three years; then doubled again in the next two years. From about 170,000 in 1975, irrigated acreage ballooned to 387,000 acres in 1977. In 1976, water withdrawal for irrigation was estimated at 59.7 billion gallons and consumption at 47.7 billion gallons.

Irrigation is expected to continue to grow in Minnesota. While future development of irrigation in the state will be greatly influenced by market forces and other factors, irrigated acreage could conceivably grow to over 850,000 acres by 1990. Water withdrawals for agricultural irrigation could reach 196.7 billion gallons in 1990, with consumption of 157.3 billion gallons (although water conservation options are available to reduce growth in water usage).

Irrigation can produce substantial economic benefits for the state. It also has possible environmental detriments. A study completed at the University of Minnesota suggests that the total economic impact—direct, indirect, and induced—of irrigated agricultural development in 14 counties of western Minnesota is $175.1 million (in 1978 dollars) for 1985. Studies in Nebraska and South Dakota have produced similar results.

Environmental factors limiting irrigation include water availability and quality, soil suitability, and the potential for ground-water contamination. Well interference is a known problem, but arises from a number of factors. Nitrate contamination of ground water has been suspected, but research is incomplete. Irrigation on steeply sloping land, high application rates, and poor irrigation water management can result in considerable soil erosion.

(4) **Resource Protection**

As leisure time and income have increased, shoreland development has also increased. There is a large amount of residential land use around many lakes in Minnesota, especially in the central part of the state. Otter Tail, Gull, Green, Pelican, and Mille Lacs lakes are prime examples. Crow Wing County ranks fourth among all counties in the state in number of "urban" parcels of land, largely because of development around the Brainerd lakes district. Vermillion Lake provides an unusual case of extensive development in far northern Minnesota.

In the period from 1975 to 1990, prime growth areas in the state are expected to include the high-amenity resort region of central Minnesota (i.e., Regions 2,4, and 5).

Only about two percent of all of the townships in Minnesota have no land containing water bodies (although some of these areas are totally water or peat bogs). The largest share of the townships in the state—approximately 25 percent—have water frontage on 21 to 30 percent of the land. In total, over 86 percent of the townships in Minnesota have 11 to 100 percent of their land with water frontage. These figures demonstrate that nearly every area of the state has shoreland potentially subject to development.

In a related area, the Wild and Scenic Rivers program was authorized by the Legislature in 1973 to "preserve and protect the outstanding scenic, recreational, natural, historical, and scientific values of certain Minnesota rivers and their adjacent lands." The program is intended to prevent overdevelopment and overuse of the state's outstanding rivers, because rivers have become popular sites for residential and recreational development. To date, five rivers have been included in the Wild and Scenic Rivers system: the North Fork Crow River in Meeker County, the Mississippi River from St. Cloud to Anoka, the Kettle River in Pine County, the Minnesota River from Lac Qui Parle Dam to Franklin, and the Rum River from Lake Ogetchie to the Mississippi River Critical Area.

(5) **Rural Water Systems**

A rural water supply system is a type of public water supply system which provides central water treatment and delivery of potable water through water mains. The primary difference between the traditional municipal supply system and a rural water supply system is that the latter will run hundreds of miles of plastic pipeline in order to supply widely dispersed users.

Rural water systems are appropriate only to limited areas of the state, but when developed can have significant land use impacts. System development can lead to rapid and irregular population growth. It can contribute to urban sprawl, a condition where a town or other municipality grows outward to meet a rural water system. System development can lead to land inflation and speculation. Importantly, rural water supply system development does not necessarily lead to these results and can rejuvenate an area.

In June 1978, there were two operating rural water supply systems in Minnesota, the Marshall-Polk and Kittson-Marshall systems; two were scheduled to begin construction, the North Kittson and Rock County systems; and one was in the initial organization phase, the Lincoln-Pipestone system. In addition, ground-water studies in southeastern Minnesota have discussed the potential of rural water systems to alleviate problems in achieving a good water quality supply where individual domestic wells encounter quality problems.

Implications and Considerations

The implications of land uses and practices for water resources are enormous. Some implications related to agricultural soil erosion, construction site erosion, irrigation, shoreland development, and rural water supply systems are noted in the following paragraphs.

Agricultural soil erosion. The costs of providing adequate treatment to reduce agricultural soil erosion to an acceptable level in Minnesota are estimated by the Soil Conservation Service to be in the neighborhood of $1.2 billion. (Lakeshore and streambank erosion control could require another $700 million.) Although the federal Agricultural Conservation Program and an innovative state soil and water conservation cost-sharing program are operating in Minnesota, a federal Rural Clean Water Program has received Congressional authorization (but no appropriations), and the Soil Conservation Service provides technical assistance in erosion control, at present levels of effort today's erosion problems would not be resolved for over 133 years.

Construction site erosion. Construction generates sediment and other pollutants and can affect water quantity. However, there are effective management practices to control construction-generated problems. Many are relatively inexpensive. Good land use planning, erosion prevention, good "housekeeping" during construction, and controlling the volume and velocity of runoff (during and after construction) can substantially reduce problems.

Irrigation. While irrigation is practiced on only about 1.5 percent of the cropland in Minnesota (and probably will not exceed six to seven percent in the future), rapid growth, uncertainty about ground-water supplies, and unanswered environmental questions are considered problems by many. Irrigation is the second largest consumer of water in Minnesota now and could become the largest consumer by 1990. At the same time, the growth of irrigation is expected to generate economic benefits for individuals, regions, and the state.

Resource protection. Although the State of Minnesota has adopted a program designed to regulate shoreland development, this program is several years behind schedule, local governments have been unable to support qualified staff to administer programs, and local administration and enforcement of shoreland ordinances varies considerably. Regulation of shoreland development is important to preserve the quality of surface waters and to preserve the economic and natural environmental values of shoreland.

The Wild and Scenic Rivers program often has been viewed as an infringement upon local authority and control, but a recent challenge to zoning requirements specified under program rules was denied by the Minnesota Supreme Court. The program has also received close scrutiny from the Legislature.

Rural water systems. Rural water systems affect such social and economic concerns as human health, livestock production, population growth, water consumption, and wastewater management. Therefore, the rural water system is a potentially powerful mechanism for a region and can serve as a catalyst for development. Such development may be viewed as beneficial by some, but harmful by others.

Issues

Because land use and water resources decisions are closely related in many areas, a myriad of issues might be identified. The Water Planning Board has concentrated on five high-priority issues.

(1) What approaches should the State of Minnesota pursue in order to control agricultural soil erosion and construction site runoff?

(2) What policy should the state adopt relative to the continued growth of irrigation in Minnesota?

(3) How should the state respond to shoreland development to preserve water quality and maintain access to recreational areas for all citizens?

(4) How can the state meet local concerns in the development of wild and scenic rivers?

(5) What actions are necessary to take into account beneficial and adverse impacts of rural water system development in Minnesota?

Each issue is discussed separately below in terms of the options available for its resolution.

Erosion from Agricultural Land and Construction Sites

The deposition of sediment from agricultural soil erosion in Minnesota lakes and streams damages fish and wildlife habitat, decreases the quality of the water resource, and causes maintenance problems in navigational channels. Construction site erosion contributes both sediments and chemical pollutants to lakes and streams. To ameliorate certain of these problems, the 1977 Legislature empowered the soil and water conservation districts of the state to share in the cost of installing soil and water conservation practices in both urban and rural areas. In the F.Y. 1978-79 biennium, $3 million was appropriated for cost-sharing in a voluntary program. The State Soil and Water Conservation Board provides the administrative leadership for the program and distributes funds to individual districts. The state program complements the federal Agricultural Conservation Program (which has recently provided about $6 million per fiscal year to Minnesota).

Although the state program is an innovative step, it (1) may be under-funded to deal with the magnitude of the problem and (2) may require certain mandatory measures. Further, although a state plan targeted on establishing priorities for expenditures of state funds was required by the 1977 law, a formal state plan has not been written. Therefore, the following options have been developed:

** **Maintain the present state program structure, but increase its funding.** When the state program became operational, it was quickly "oversubscribed" in many areas, indicating both the feasibility of the voluntary approach and the need for additional funding. The initial legislation proposed to the Legislature would have provided $6 million per fiscal year to the program.

** **Institute mandatory measures in either the same level or an expanded program.** For example, the State of Iowa's erosion and sediment control law declares accelerated soil erosion a nuisance, requires abatement when a complaint is filed with a conservation district, provides cost-sharing of needed measures to control erosion, and requires penalties when the landowner fails to take corrective action. Similar approaches might be adopted for Minnesota.

** **Institute mandatory controls for construction sites.** Because construction site erosion is the activity that generates sediment at the highest rates per acre and because control measures are practical and relatively inexpensive, mandatory controls might be instituted through (a) the state program, (b) county and municipal ordinances or (c) a combination of state cost-sharing for acceptable practices and county ordinances.

** **Support the expansion of federal efforts, particularly the Rural Clean Water Program.** Federal soil and water conservation programs have long contributed to erosion control in Minnesota, but have been inadequately funded, do not address urban problems, and have not been sufficiently staffed to provide technical assistance to meet state needs. The Rural Clean Water Program has received Congressional authorization—but no appropriations—and continues a history of inadequate attention to urban problems.

Several considerations are important in selecting among the above options. These include (1) the perceived need and immediacy for resolving erosion control problems, (2) the desirability of voluntary measures as opposed to mandatory provisions, (3) the degree of interest in accelerating agricultural soil and construction erosion control and (4) the appropriate roles of the state and the federal government in providing erosion control. With regard to the latter consideration, the following questions are important: Should the federal government expand its role to urban problems? Given its limited resources, should the state be involved financially in erosion control?

Irrigation Policy

Projections suggest continued development of irrigation over the next decade, although the actual rate of growth is dependent on a number of factors. While such growth will place an additional stress on the state's water resources (especially on surrounding wells in localized areas), it would also be expected to benefit the economies of regions of the state. For example, for a 14-county area in western Minnesota, a University of Minnesota study estimates that the total increase (1970-1985) due to irrigation development could be in the area of $235 million for industry gross output, $106 million for gross regional product, and 5,000 for total employment. Growth of irrigation, however, might also impose environmental damages (e.g., nitrate contamination of ground water, increased soil erosion, or reduction in stream flow).

The State of Minnesota requires that water resources be conserved and utilized in the best interests of the people of the state, and has adopted a priorities system for allocation of water resources. In practice, this has resulted in case-by-case decision-making. It has been argued that an explicit irrigation policy for Minnesota is essential.

Several options are available.

** **Continuation of the present case-by-case decision-making system.** The 1977 Legislature took a number of steps to strengthen this system, including pumping test requirements in most areas of the state and increased involvement of local bodies (e.g., soil and water conservation districts) in the decision process. However, decisions continue to focus primarily on the resource capability at a given point in time.

** **Continuation of case-by-case decisions, but within a framework of mandated considerations.** The 1977 Legislature adopted a concept of placing conditions on permit issuance which go beyond resource capability. Specifically, the Department of Natural Resources cannot (unless the requirement is waived for just cause) issue a permit for irrigation appropriation from ground water where adequate soil and water conservation measures are not in place. Such conditions might be expanded to consider soil types, withdrawal impacts on future economic development of a region, and potential for ground-water contamination.

** **Limitation of future irrigation development to areas determined to be suitable for such development.** Under this option, the state would be required to define areas in the state where irrigation development may be permitted and areas in which irrigation may not be feasible. Irrigation permits would be issued only in the former areas, based on resource capability within those areas. Information to make such determinations is not readily available.

Further, the State of Minnesota must consider the level of support it should provide to developing information for future irrigation policy-making. The Water Planning Board has found available information on present irrigation location, ground-water relationships, and environmental impacts of irrigation to be severely limited. The Board has, however, identified several future approaches (e.g., use of remote sensing data and detailed area studies) which may benefit the state.

In the immediate future, availability of information is a principal criterion in selecting among these options. In the long run, this may become a lesser consideration. In addition, (1) administrative complexity, (2) economic development impacts, and (3) individual equity should be considered in selecting among the available options.

Resource Protection

Development of lakeshore property can modify the water quality resources and the character of the recreational environment. Some of the most important related effects include: (1) development of waste disposal systems which may fail or be improperly installed; (2) clearing of vegetative cover, which may lead to increased erosion and loss of natural character; (3) increased surface use; (4) adoption of incompatible land uses; (5) stormwater runoff and pollution from urban areas; and (6) dissatisfaction of residents with natural conditions (e.g., algal blooms, aquatic plant growth, and fishery impacts).

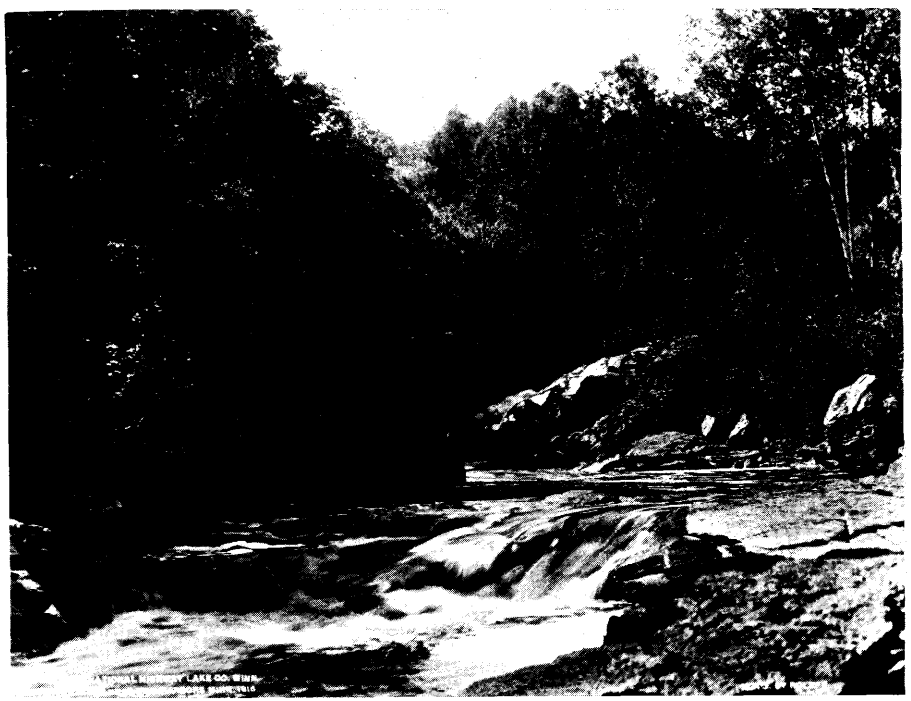
Many of these effects have been directly or indirectly affected by options discussed elsewhere in this report. The options will not be repeated here. However, several more general options relative to problems associated with shoreland development include:

** **Assessment of the impact of the state Shoreland Zoning Act.** The Shoreland Zoning Act was adopted to address a number of problems associated with shoreland development, although not all of those cited above. No evaluation of the success of the present program has been undertaken.

** **Updating lakeshore studies.** In 1970, the University of Minnesota completed a comprehensive study of Minnesota's lakeshore. Among other things, the study reported that the rate of growth of lakeshore development would decrease. New factors which will affect these study results (e.g., the Shoreland Zoning Act) have come into play over the last decade. New data are required for adjusting policy.

** **Monitoring the granting of variances by county administrators.** The granting of variances can significantly affect the shoreland program. Monitoring of county actions in granting variances for their impact on the overall program has not been carried out.

** **Amendment of the Wild and Scenic Rivers Act.** This Act could be amended to (1) make it clear that the state will not use the power of eminent domain; (2) limit the amount of private land acquired by the state; and (3) provide financial assistance for the necessary local planning and zoning. In addition, increased effective educational efforts through the Department of Natural Resources Bureau of Information and Education could result in local citizens attaining a statewide perspective on the program. Such an educational effort would be supported by survey and research on statewide attitudes concerning wild and scenic rivers.



Rural Water Systems

Rural water systems may serve as a stimulant to local economies. This stimulus may be seen in terms of benefits and adverse effects. Positive economic indicators include improvements in livestock and milk production, increases in property value and tax revenue, and expenditures on appliances, home improvements, and home construction. Many rural water districts in other states have experienced population growth and expansion in the area of service. However, system development has also coincided with the loss of prime agrucultural land, urban sprawl, duplication of urban and rural water service, and inflated land prices.

To deal with the issue of what actions are necessary to balance the beneficial and potentially adverse effects of rural water system development in Minnesota, three factors must be considered: (1) legislation, (2) administration, and (3) financing.

** **Legislation.** Rural water systems may now be formed under provisions of Minnesota Statutes, Section 116A or Laws 1978, Chapter 744. (The former is also the principal law used in the creation of rural sewer systems.) Legislative options surround (1) maintenance of the two-statute system, (2) selection of one statute over the other, or (3) adoption of a new statute combining the best aspects of both laws, along with new considerations.

Central concerns in legislation should include provisions for organization of systems, obligations and responsibilities of district courts or county boards, boundaries, powers and obligations, and planning to mitigate adverse land use effects of system development. (Revisions in Minnesota Statutes, Section 116A might also allow for a reduction in special local enabling acts for rural sewer systems, while maintaining flexibility at the local level.)

** **Administration and financing.** The overall role of the state in rural water system development has not been defined. Although there are two pieces of legislation concerning the organization, rights, and obligations of rural water systems, the legislation is passive in its position on the state's role in rural water delivery systems. While the Department of Health must authorize all system design and structure and the Department of Natural Resources is responsible for water appropriation permits, there has been little recognition by state government of the potential significance of these systems on the development of "water-poor" areas of the state.

The range of options for a state role in rural water system development includes (1) maintenance of the current posture of the state; (2) assumption by the state of planning responsibilities for rural water systems; (3) the state as "coordinator" in system development; and (4) the state as organizer and developer of rural water supply systems.

If the state maintains its current posture, the state role will continue to involve only appropriation permits and approval of facility designs. Assumption of planning responsibilities could encompass loans to proposed systems for their planning requirements or in-kind assistance in planning (e.g., aid in drafting preliminary and/or final systems plans, feasibility studies, needs assessments, engineering plans, ground-water surveys, or land use surveys). Adoption of a "coordinative" approach might include coordination of financial sources, informing projects of government requirements, and assisting projects in dealing with the judicial and regulatory structure. Finally, as an organizer and developer the state would become fully involved in the financial, engineering, and legal aspects of system implementation.

Recommendations

The Water Planning Board makes the following recommendations:

(1) **Erosion from agricultural land and construction sites.** The Water Planning Board recommends:

- ** Expansion of funding for the existing state soil and water conservation cost-sharing program;
- ** Retention of the voluntary approach to participation in the cost-sharing program, provided the "208" process does not implement mandatory measures;
- ** Mandatory statewide adoption through county and municipal ordinances of construction erosion controls, under state guidelines including model ordinances.
- ** Advocacy of Congressional approval of appropriations for the Rural Clean Water program and of increased federal emphasis on urban and urbanizing-area erosion problems.

It must be recognized that these recommendations will not be final until the State 208 (Water Quality Management) Plan is adopted and the public, regional committees, and State Task Force have made specific recommendations.

(2) **Irrigation policy.** Although the Board recognizes the need for an explicit state strategy for future irrigation development in the State of Minnesota, it acknowledges the limitations of available data to make such decisions. Therefore, the Board recommends that in the near-term Minnesota continue case-by-case decision-making, but within a framework of mandated considerations (e.g., soil types, topography, economic impacts, effects on low streamflow, and potential for ground-water contamination). For the longer term, the Board recommends an interagency study group (including the Departments of Agriculture and Natural Resources, the Soil and Water Conservation Board, the Pollution Control and State Planning Agencies, the regional commissions) be charged with the responsibilities to develop data and analyses sufficient to detail areas where irrigation development could be permitted and where such development is not feasible or practical.

(3) **Resource protection.** It is recommended that the State of Minnesota evaluate the Shoreland Zoning program to measure its success in meeting the concerns outlined above and to update the lakeshore study for examining the effects of current policies. The implementation of shoreland zoning in municipalities should be accelerated, and increased attention should be given to the inclusion of the recently revised individual sewage treatment system guidelines in existing shoreland zoning ordinances.

Further, it is recommended that the State of Minnesota continue its Wild and Scenic Rivers program, but with several specific amendments and increased education relative to the program. The Department of Natural Resources should expand its efforts to make citizens aware of the purpose of the program, including survey and research efforts targeted on an assessment of statewide attitudes concerning designation of wild and scenic rivers. The Wild and Scenic Rivers Act should be amended to make it clear that the State of Minnesota will not employ eminent domain powers; to limit the amount of private land acquired by the state; and to provide for financial assistance for the necessary local planning and zoning.

(4) **Rural water supply systems.** With respect to rural water supply system development, it is recommended that (1) Minnesota Statutes, Chapter 116A and Laws 1978, Chapter 744 be replaced by a single new piece of legislation which draws on the important parts of existing law and specifically resolves concerns relating to petitions for organization, obligations and responsibilities of district courts or county boards, boundaries, boards of directors, powers and obligations, and assessments versus user charges; and (2) the Department of Health in cooperation with other concerned agencies take on an expanded role as "coordinator" of system development.

RESEARCH AND EDUCATION

The purpose of research is to help understand the factors which influence the environment to better understand the world. Ideally, this understanding should be reflected in policy decisions which lead to achieving the goal of providing the greatest good for the greatest number of people. It is crucial that researchers uncover new facts, discover interrelationships, test hypotheses and formulate theories to provide basic information on water quantity and quality, thereby enabling decision-makers to conserve and utilize the water resources of the state in the best interests of the people.

At three of the statewide public meetings conducted by the Water Planning Board in the fall of 1977, citizens expressed strong concern that efforts be undertaken to provide better education of the public on water resources issues. At the most basic level, there is a need to educate the public concerning the mobile, cyclical nature of water, so people can understand the limits of the resource and the interrelationships and value of competing uses of water in Minnesota. This understanding should lead to a more informed public able to recognize and understand water problems and to participate more fully and intelligently in the process of problem resolution.

Situation

Water resources research in Minnesota is conducted by State Universities, federal agencies, private foundations, and private consulting and engineering firms. Specific areas where water research is needed in Minnesota include the conservation and recycling of water, treatment of wastewater, reporting of waterborne diseases, location and adequacy of ground-water supplies, groundwater contamination, urban and agricultural runoff, the relationship of energy and water, and economic and social factors related to water use and water quality. While the state funds research at its Universities and to a lesser extent through state agencies, most research in these areas is federally funded, partly under grants to the Water Resources Research Center at the University of Minnesota.

Presently, there is no state agency or program specifically designed to inform and educate the public concerning water resources. Within the Department of Natural Resources, the Minnesota Environmental Education Board (MEEB) is responsible for planning and developing general environmental education programs, projects, and activities throughout the state. MEEB operates through 13 regional environmental councils which correspond to the state's 13 regional development commissions. The Board serves as a liaison with other state and federal agencies involved in environmental education, advises the legislature about the environmental education needs of the state, and reviews environmental legislation to determine if it includes an educational aspect. In addition, the Departments of Natural Resources and Health and the Pollution Control Agency have public information offices responsible for informing the public concerning agency programs, policies, and activities. The Minnesota Water Planning Board, through its efforts to involve the public in the development of the state framework water plan, has served an educational function by presenting draft technical working papers for review and comment to citizen committees in twelve of the thirteen regional development commissions and to a 47-member Water Interests Advisory Committee.

In addition, Governor Quie has declared 1979 to the "Year of Water Awareness." The purpose of the declaration is to aid an effort involving more than 20 organizations in providing Minnesotans with information to better know and understand their water and its problems.

Implications and Considerations

Timely, high quality research is essential to the success of water resources planning and policy-making in the State of Minnesota. In addition to the general areas of research listed above, the Water Planning Board's work in preparing a state framework water plan has identified other more specific "information gaps" which limit the ability of state and local planners and decision-makers to do their jobs. State agencies often lack the commitment to research which may provide necessary data for carrying out programs. Therefore, an effective ongoing research program which communicates with and is responsive to the needs of planners and decision-makers is necessary for state programs to meet their objectives.

A recognition of the significant role water resources play in affecting the social well-being of all Minnesotans, coupled with the growing emphasis on citizen participation in government planning and decision-making, points to the necessity of providing all citizens with current, accurate information on the state's water resources. While there is a need for individual agencies to provide information concerning agency activities to interested citizens, reliance on this approach to educate citizens on water issues raises questions as to efficiency and effectiveness.

Issues

The primary issues confronting the state in the area of water resources research are:

(1) How can the state assure that high-priority water resources research is undertaken?

(2) How can this research best be integrated into the state's planning and decision-making process?

(3) What is the most effective way the state can educate the public concerning water issues?

Options

There are at least three options available to the State of Minnesota to provide for its present and future water-related research needs:

(1) Increase the research capability of the state agencies that administer water-related programs by providing substantial increases for their research staff and funding.

(2) Continue and, where necessary, accelerate the present research activities of programs at the state's universities, includng the Water Resources Research Center.

(3) Look to federal agencies for increased research support and devote more state resources to encourage federal research projects.

Options for the State of Minnesota concerning an appropriate program for public education on water resources are:

(1) Continued reliance on the Minnesota Environmental Education Board and its existing network of regional environmental councils. Included in this option is the possibility of expanding MEEB's efforts and increasing the emphasis it places on water resources.

(2) Utilization of the information offices of all state agencies with an interest in or responsibility for water resources. As with Option 1 above, included in this option is a possible acceleration of the agencies' efforts in the area of water resources.

(3) Continuation and expansion of the public education function initiated by the Water Planning Board as part of its public participation program for the state framework water plan.

Criteria

In determining the course of action the State of Minnesota should take to assure that necessary and appropriate water research is undertaken, consideration should be given to the following desirable elements for a research program:

(1) The program must have adequate funding and there must be reasonable assurances that a needed project, once begun, will receive continued funding.

(2) The program must be timely and responsive to the relevant, high priority applied and basic research projects identified by state and local planners and decision-makers.

(3) The program must have the flexibility to adjust priorities to address new research needs as they arise.

In evaluating potential approaches to educating the public concerning water resources issues the following criterial should be considered:

(1) The program should be coordinated and comprehensive. That is, it should include quantity, quality, management, conservation, health issues, recreation, economic concerns, and other related aspects of water resources in Minnesota.

(2) The program should be directed toward students, legislators, officials at all levels of government, special interest groups, and the general public.

(3) The program should provide for a dialogue and an exchange of ideas and information in addition to the mere dissemination of information.

Recommendations

The Minnesota Water Planning Board makes the following recommendations:

Research

(1) The state should continue to place primary reliance on the research programs of the State Universities, while continuing to utilize existing relevant federal and private research. An increased targeting of research toward the resolution of major state problems is strongly encouraged.

(2) The state should be prepared to provide an increased level of funding to the State Universities for the purpose of water and related land resources research (especially if they experience a decrease in federal funding) and the University research programs should be prepared to shift their priorities where circumstances require research in a specific area.

(3) The state coordinating body should institute a process for regular extensive communication and interaction among University researchers and state planners, program managers and policy-makers.

Education

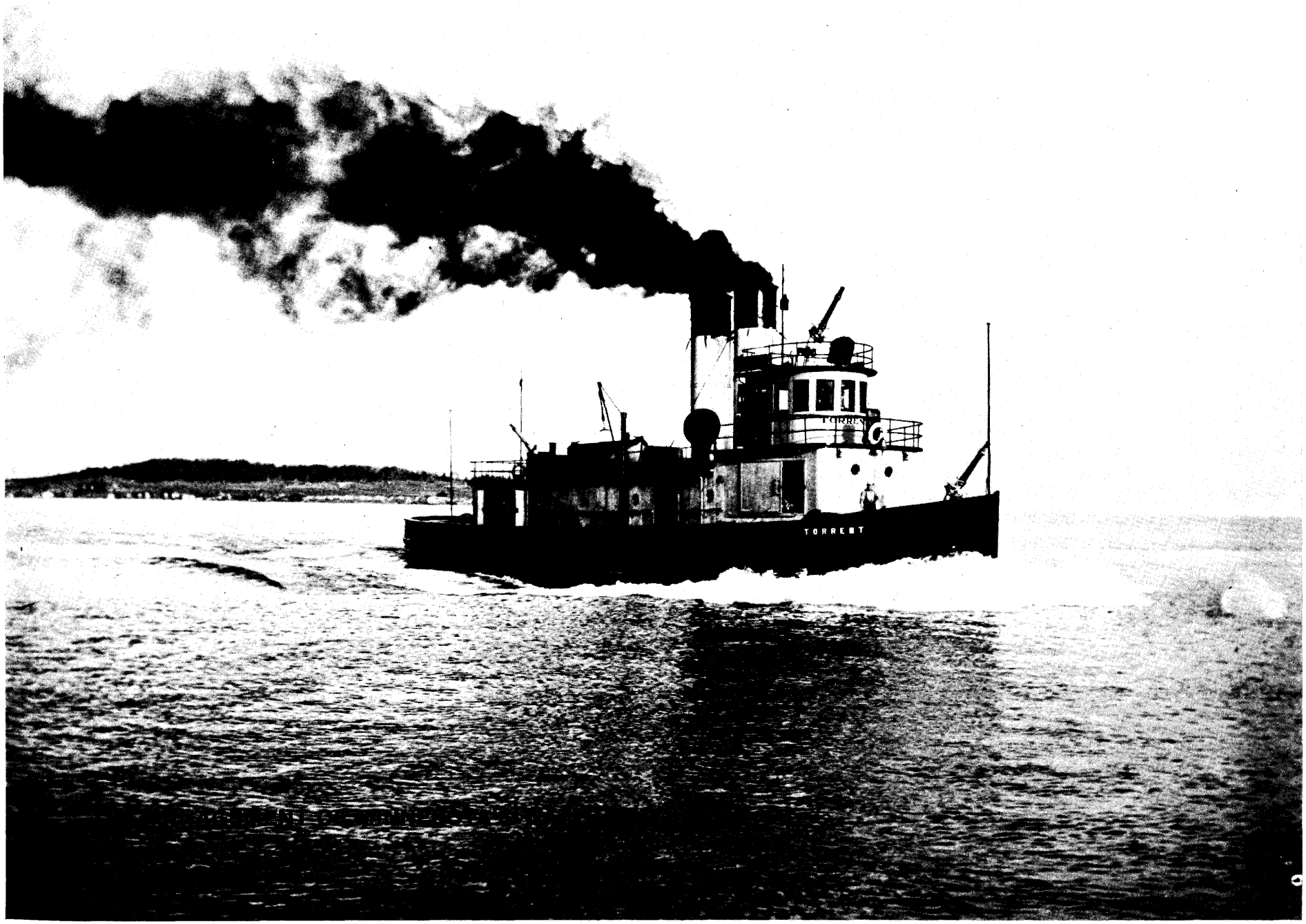
(1) In F.Y. 1980, the Water Planning Board should be given coordinating responsibility for continuing and expanding the public education efforts begun during the development of the framework water plan.

(2) The Board should utilize the existing more general educational program of the Minnesota Department of Education in cooperation with the Minnesota Environmental Education Board and the Agricultural Extension Service. The Board should coordinate the water-related efforts of MEEB and the information officers of other state agencies.

(3) The Water Planning Board should utilize locally based citizen committees, the existing citizen participation structure of regional development commissions, and a statewide advisory body to assist it in carrying out its education responsibilities.

(4) A specific effort should be made to communicate with the local decision-makers and legislators.

In the long term (beyond F.Y. 1980), the state coordinating body should carry forward these recommendations.


TORRENT

MANAGEMENT OF MINNESOTA'S WATER RESOURCES

Although localized, often severe, shortages will occur and periods of critical supply problems will result from drought conditions, Minnesota is now and is likely to remain a "water-rich" state. The future adequacy of both the quantity and quality of our water resources will depend primarily on our proper management of existing resources.

Proper water resources management implies research, education, understanding, citizen involvement, analysis, and planning—not simply institutional structures and regulation. The state has no choice but to be concerned about society's need for both economic well-being and a quality environment. Wise resource management can result in a preservation of the environment and a correction of existing environmental deterioration, as well as planned economic growth and development.

A Summary of the Management Strategy

The management of water resources involves important contributions by each level of government and by the citizens of the state. The problems which confront government and citizens are many and varied, but are also interdependent. They include the effects of flooding, drought, drainage, water pollution, recreational demand, land use, and, not the least important, improper management of our water resources. The existing institutions working in water management have not always worked together effectively. Instead, a fragmented, often disorganized approach has evolved; an approach which tends not to recognize or deal effectively with the interdependence of water problems and management solutions. Specific problems and issues in the management of water and related land resources (e.g., the problems of flooding and management solutions) are discussed elsewhere in this framework. This section describes how the policies and options presented under these specific areas should be addressed by government in a coordinated, forward-looking manner.

Five levels of government are currently involved in decision-making affecting Minnesota's water and related land resources. They are the federal government; the interstate level of government, including the federal-state basin commissions and interstate compact arrangements; the state level, through the Legislature and the executive branch; regional entities, including regional development commissions and specialized boards; and the local level of government.

The five levels of government have become involved in the management of Minnesota's water and related land resources for very good reasons. Some of these are political, going back to the formation of this country with emphasis on state's rights and interstate coordination. Others are economic, with greater economies of scale in development of technical expertise, programs, and projects possible at higher levels of government. Others recognize that the lowest levels of government are closest to the problems and the people who must live with them.

The Water Planning Board recommends a water management strategy that would strengthen the ability of Minnesotans to determine how they choose to manage their water and related land resources. The emphasis of this strategy is on the state's stewardship of natural resources and the incentives the state could provide to encourage local and regional initiative in water management. This emphasis recognizes the importance of obtaining the understanding and support of those most directly affected by water management problems and decisions. It recognizes, too, that this support can best be achieved by encouraging and developing the capability of local governments to initiate and implement solutions to water problems within the guidelines of state policy and with the help of regional, state, and federal expertise.

The fundamental requirement of the recommended strategy is an ongoing **process** for making water policy and water management decisions in Minnesota. A procedure is needed to make sure that (1) local and regional ideas and needs are addressed in and contribute to state policy, (2) the state can be responsive to local initiatives and regional views, and (3) state government can develop comprehensive and coordinated policies to guide its interaction with other states and with the federal government. An ongoing process is needed because (1)water problems continually change, (2) people need to know from one year to the next how they can influence water policy and get answers to water problems, and (3) people must have confidence that the time they spend on ideas and plans will influence state policy and actions, regardless of whether the same individuals work in the government from one year to the next.

In order to work, the process must be centered around one organization at each level of government. This organization must be capable of identifying and reconciling competing and conflicting views. It must be capable of expressing and addressing the needs for water management at its particular level of government. A water resources coordinating body is necessary to provide a focal point for the process at the state level. The coordinating function of this body must be to pull together the plans of local and regional agencies and mesh these with the resource policies and programs of state agencies. In short, this body must reconcile conflicting policies and directions of state agencies with those of local and regional governments. For the process to be successful, this body must have sufficient authority to change state policy in line with the overall state interest and the initatives and plans developed by local government.

The Water Planning Board recommends that the Legislature determine the appropriate body to be charged with carrying out this vital function. The options, each with its advantages and disadvantages, range from a single agency charged with coordination, to an interagency board, to a citizens board. Existing entities or a new organization might be employed to serve this function. The Board also recommends that part of this body's authority be obtained through its direct link to the Governor and the Legislature. The link should consist of (1) a commitment by the Governor to the water management process and coordinating function and (2) a program and policy review charge to advise the Legislature on the compatibility of agency budgetary requests with the state's overall policy and framework strategy.

Importantly, the Water Planning Board recognizes the corresponding need of state water management agencies to develop their own program planning and evaluation capability, since these agencies are the primary managers of water and implementors of water policy at the state level.

Looking to strengthen the voice that local water management districts have at the state level, the Water Planning Board, in consultation with the Water Resources Board, the Soil and Water Conservation Board, and the Department of Natural

Resources, will analyze the feasibility of and, if feasible, develop a plan for consolidating functions of the WRB, the SWCB, and DNR oversight of the formation of lake improvement districts. A consolidated board could have greater impact on state agencies, provide a strong advocate of local views in decisions of the coordinating body, encourage a coordinated state policy concerning local water management activities, and permit more effective use of staff at the state level.

At the regional level, regional development commissions should be utilized to provide the important link in the process between state policy and local plans. The commissions are currently charged with reviewing and coordinating local planning efforts within the context of regional comprehensive plans. This function is important to the success of the proposed water management process since RDC's offer a comprehensive perspective and, potentially, a good vehicle for keeping state and local agencies in touch. In line with this, regional development commissions should serve as a forum for generating and focusing citizen input to the plans and programs of state agencies and the state water resources coordinating body. In those situations where water management problems and plans must necessarily cross commission boundaries, **ad hoc** river basin boards should be formed to advise the state coordinating body. Finally, in those instances where the coordinated implementation of regionwide water management projects is needed, joint powers agreements among counties, watershed districts, and other local entities should be utilized.

At the local level, the state should encourage and facilitate initiation of water management plans and projects. Encouraging the development of water management plans is viewed as an effective way for local government to (1) address water management problems systematically and comprehensively (including water supply and quality, flooding and drainage, recreation, and other subjects), (2) provide a focus for citizen involvement and participation in the solution of water problems, (3) speed up state approval of permits that might be required in plan implementation by having prior acceptance of plans at state and regional levels, and (4) facilitate the administration of state permit programs by local authorities whenever feasible.

The Water Planning Board recommends that watershed districts, where they exist, and general purpose governments (i.e., counties and municipalities) where they do not, be the focal point for the development of local water management plans. Soil and water conservation districts must play a major role in development of such plans and be responsible for the soil and water conservation elements of such plans.

The Water Planning Board recognizes that several important issues need to be addressed to enhance the capability of local water management authorities to develop water management plans and effective programs. Important issues which need to be addressed include (1) what the relationships should be among special purpose districts, local general purpose governments, and regional planning authorities, (2) whether and when watershed or political boundaries should be followed and what the appropriate size of districts might be, (3) whether districts should be governed by elected or appointed managers, (4) what technical expertise and administrative staff are required for independent planning, management, and policy analysis capability, and (5) what the nature and extent of state oversight should be. The Water Planning Board recognizes the need for a highly visible public debate on these issues and has consequently recommended that meetings be conducted statewide to consider clarification and improvements in authorities and relationships of local water management agencies. The implementation of this recommendation would be a very important step toward strengthening the capability of local government for participating in the water management process and for influencing state water policy and actions. The final outcome of this recommendation—clarifications and improvements in authorities and relationships—may affect the roles and participants at the local level.

In short, the Water Planning Board recommends that:

** The state serve as the steward of Minnesota's water and related land resources, providing policy guidance and incentives for local and regional action;

** Regional governments focus on integrating local interests with a comprehensive view, providing coordination among levels of government, and affording assistance to local authorities; and

** Local governments initiate local management plans and implement solutions to the problems, consistent with state policy guidelines.

This process requires continuous (1) three-way interaction among the state, regional, and local units of government; (2) efforts to refine and improve authorities and clarify relationships at each level; and (3) better mechanisms and efforts to achieve communication among all parties.

Management Recommendations

The Water Planning Board makes 22 management recommendations in six major areas.

Drawing on the discussion of "Water Resources Coordination" (see Selected Issue Areas above) and the full range of analysis provided later in this section, the Board recommends that:

(1) **The State of Minnesota establish or explicitly identify a water resources coordinating body with adequate authority to carry out coordination functions.** The coordinating body should be provided with authority to (a) resolve interagency conflicts in water policy; (b) coordinate public water resources management and regulation activities with framework plan recommendations, including review and advice concerning compatibility of agency programming and budgetary requests with plan elements; (c) develop comprehensive water-related goals and policies; (d) direct state involvement in activities relating to the federal Water Resources Planning Act and other federal programs cutting across agency lines; (e) initiate and coordinate interagency water planning and integrate plans of local and regional agencies with state strategies; (f) evaluate and recommend improvements in the state laws, rules, and procedures in the area of water resources management and regulation by public authorities; and (g) carry out citizen involvement activities. The coordinating body should provide a forum for representation of all major state water management agencies and have the capability to carry out the above functions.

An interagency "Priorities Committee" should be established to assist the coordinating body in identifying state and federal program priorities. The Committee's federally-related functions are discussed in the "Federal-State Relations" section of this document. (See Selected Issue Areas.) The Committee's state functions should include recommendations to the coordinating body with regard to: (1) initiation or review of new state program proposals for areas with identified water-related problems; (2) ranking of new planning, analysis, and research proposals for which state funding has been requested; and (3) provision of input to the Legislature in regard to state program proposals. (See fourth "Accountability and Enforcement" recommendation below.)

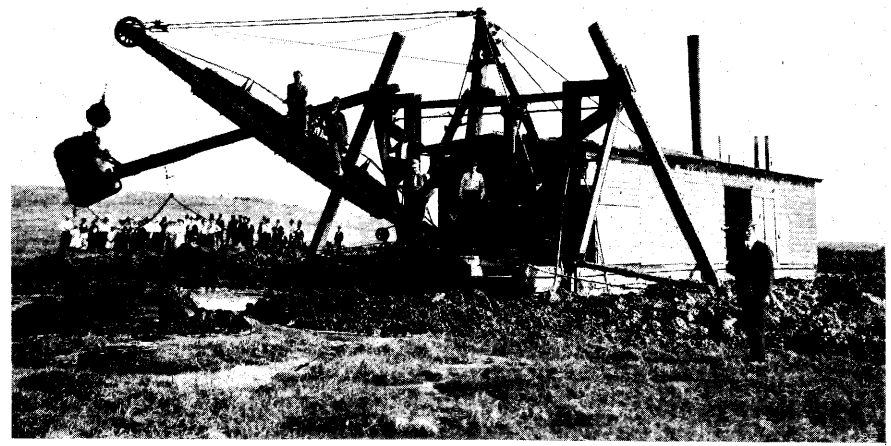
(2) **The Legislature—with input from the public—select the appropriate entity for housing the coordinating function.** The major options include the Department of Natural Resources, the Environmental Quality Board, an entity modeled after the Water Planning Board, and various types of citizens boards. In selecting among the options, the Legislature should consider the degree to which each option provides
(a) a forum for representing all major state water management activities;
(b) the authority and capability to carry out coordination activities;
(c) the authority to determine which issues are interagency in nature and to resolve these issues;
(d) the authority to receive and the ability to administer federal funds; and
(e) an effective means for integrating local and regional plans into the state strategy. In addition, the cost of implementation and political viability must be considered.

The means by which state water management agencies are held responsible for their actions and the ability of state agencies to compel compliance with state water management regulations raise important issues. These issues are discussed below under the heading of "Accountability and Enforcement." In this area, the Board recommends that:

(1) **Interagency water policy conflict resolution be carried out by the state coordinating body.** An interagency policy conflict involves two or more agencies unable to reach a mutually acceptable course of action in a timely fashion concerning a matter of water policy in which each agency has a legislative mandate. This may include matters relating to planning and regulatory decisions, or interpretations of the legislative intent of statutory language. The coordinating body should be authorized to resolve conflicts involving water policy upon its own initiative, or upon petition of involved agencies where it deems a matter of water policy is at stake and a timely resolution would not be otherwise forthcoming.

(2) **The process of water policy conflict resolution currently carried out by the Water Resources Board be discontinued by the Legislature.** Interagency policy conflict resolution presently under the authority of the Water Resources Board should be administered by the state coordinating body. Resolution of private-state conflicts should continue to be handled through the Office of Hearing Examiners and the courts.

(3) **The state initiate program planning and evaluation functions within each water management agency.** These functions should be made an integral part of the budgetary process. Program planning should include



development of work programs setting out activities and specific objectives to be achieved by program managers during the course of each fiscal year. Objectives should be clearly tied to appropriate sections of the framework water and related land resources plan. Program evaluation should include assessment of the effectiveness of water resources management and regulation activities in order to measure the degree to which legislative goals are being met and to identify means of improving program effectiveness. Agencies charged with carrying out water management programs should be required to provide biennial evaluations to the Legislature detailing findings and recommending actions. Such evaluations should be submitted in conjunction with and supportive of agency budget requests.

(4) **The state coordinating body serve in a review and advisory capacity to agencies and the Legislature concerning the compatibility of agency programming and budgetary requests with the framework water and related land resources plan.** The coordinating body should review current programming and future planning of state water management agencies to identify areas of potential conflict with the framework water and related land resources plan. The coordinating body should work with affected agencies to resolve conflicts, and to the extent practical, coordinate findings with agency budgetary requests. The coordinating body should report its findings on the compatibility of agency programming and future planning with the framework plan to the Legislature in each even-numbered year.

(5) **The Legislature initiate a natural resources management fund targeted at assisting local water management authorities in implementation of state mandated programs.** The State Planning Agency should be designated as the state agency sharged with administration of the fund.

A committee of natural resources management agencies should be formed to advise the State Planning Agency on the eligibility and priority of grant applications. Local water management authorities should be required to demonstrate need and feasibility of applications through development and submission of program plans in conjunction with applications.

A specific charge to the Water Planning Board was to examine organizational changes at the state level. Based on its analysis, the Board has rejected options to develop a Department of Waters or a natural resources "super" agency, favoring instead the coordinative approach with increased agency evaluation and budgetary analysis described above. With respect to "Organizational Changes at the State Level," the Board further recommends that:

(1) **The coordinating body reevaluate major reorganizational options for the Department of Waters and a natural resources "super" agency within five years after the initiation of agency program planning and evaluation functions.**

This recommendation is closely linked to the third recommendation above. The Board believes each agency should be given a reasonable period of time to place into effect the coordination and accountability functions of water planning and budgetary processes.

(2) **Detailed examination be made of the feasibility of consolidating functions of the Soil and Water Conservation Board, the Water Resources Board (excluding its water policy conflict resolution process), and the oversight of lake improvement district formation by the Department of Natural Resources.** The staff of the Water Planning Board shall conduct this examination in consultation with the two boards and the DNR, and shall present its findings to the Water Planning Board by March 1, 1980. The analysis shall include specific recommendations for legislative action should consolidation be considered feasible and desirable. The Water Planning Board shall evaluate study findings and make appropriate recommendations to the Governor and the Legislature.

(3) **The Department of Natural Resources be designated to administer the proposed statewide flood damage reduction program in conjunction with the Soil and Water Conservation Board.** The Department of Natural Resources would be charged with determining initial eligibility of proposals through review and approval of comprehensive flood plain management plans. The DNR and the Soil and Water Conservation Board shall establish, by formal agreement, procedures for coordinating administration of structural grants by the SWCB with non-structural grants by the Commissioner of the DNR.

A number of options for further consolidation are noted in the text. The Legislature and Governor may review this list of separated or fragmented programs and determine if further study is desirable. The Water Planning Board has not evaluated the operations of these programs sufficiently to warrant recommendations of program transfer or consolidation. The Board recognizes that certain transfers and consolidation of functions may be justified by more extensive evaluation.

The Water Planning Board makes four recommendations with regard to "The Role of the State in Water Resources Planning":

(1) **Water planning in state government be supported at two organizational levels, through a coordinating body and by water management agencies.** The coordinating body should be provided with authority to direct state involvement in activities relating to the federal Water Resources Planning Act and in comprehensive interagency planning efforts. In addition, it should have the authority to evaluate and recommend improvements in state laws, rules, and procedures in the area of water resources management and regulation.

Water planning by major water management agencies should be directed toward support of agency programs and objectives, and should include program planning and evaluation (see "Accountability and Enforcement" recommendations above) as well as program-related resources planning functions.

(2) **The coordinating body build on the efforts of the Water Planning Board in developing the framework plan by initiating and coordinating more detailed studies needed to address water resources problems cutting across agency interests, levels of government, and political boundaries.**

(3) **The coordinating body continue support of a citizen's forum similar to the Water Interests Advisory Committee of the Water Planning Board.** This forum should be charged with initiating and coordinating citizen participation in water planning and management activities of the coordinating body.

(4) **State agencies involved in water planning and management develop ongoing programs of citizen participation.** These programs should be staffed by full-time coordinators not directly involved in the day-to-day operations of affected programs.

The recommendations of the Water Planning Board with regard to "Regional Water Management" are that:

(1) **Three water management functions be carried out at the regional level.** Two of these—serving as a forum for citizen involvement in state water planning programs and providing regional coordination with comprehensive planning—should be carried out statewide on an ongoing basis. The third function—implementation of regionwide projects—should be carried out only when necessitated by hydrologic conditions.

(2) **Regional development commissions, including the Metropolitan Council, be charged with providing the forum for citizen participation in state water planning programs and with coordinating water management project proposals with comprehensive regional plans.** In addition, RDC's should be charged with recommending priorities for proposed actions to the coordinating body and appropriate state agencies.

(3) **River basin boards similar to the Southern Minnesota Rivers Basin Board be formed on an ad hoc basis as major river basin studies are developed by the coordinating body.** The Southern Minnesota Rivers Basin Board should become such a body at the conclusion of the F.Y. 1980-81 biennium. The SMRBB is presently participating in an area study, in conjunction with the Soil Conservation Service and the Corps of Engineers. This function should be maintained, but combined under the comprehensive state framework provided by the coordinating body. The position currently allocated to the SMRBB should be continued under the coordinating body to relate directly to the southern Minnesota study area.

(4) **The state not exclude any type of regional authority from implementing regionwide projects under the flood damage reduction grant-in-aid proposal,** provided the regional authority can satisfy operational requirements for administering such projects.

Local water management considerations are of great importance to Minnesota because the local level of government is closest to water resources problems and, consequently, where the problems are first perceived and where solutions must be implemented. Recognizing these facts, with respect to "Local Water Management," the Water Planning Board recommends:

(1) **The state encourage and place greater emphasis on the initiation of water management plans and projects at the local level of government, consistent with state policy guidelines.** Development of water management plans is viewed as an effective way for local government to (1) address water management problems systematically and comprehensively, (2) provide a focus for citizen involvement and participation in the solution of water resources problems, (3) speed state approval of permits that might be required in plan implementation by having prior acceptance of local directions at the state and regional levels, and (4) facilitate the administration of state permit programs at the local level, when feasible. Until the final resolution of Recommendation 2 below, the Water Planning Board recommends that watershed districts—where they exist—and general purpose governments (i.e., counties and municipalities)—where they do not—be the focal point for development of local water management plans. Soil and water conservation districts must play a major role in development of local plans and be responsible for the soil and water conservation elements of such plans.

(2) **The state coordinating body prepare analyses and presentations for statewide meetings concerning possible clarifications and improvements in the authorities and relationships of local water management agencies.** The Water Planning Board recognizes the need to clearly define the functions of local water management authorities and to assure that adequate authority and expertise exist at the local level throughout the state. It also recognizes the desirability of consolidating local water management functions, where feasible. The Water Planning Board fully recognizes the experience and expertise represented on the State Soil and Water Conservation Board and the Water Resources Board and recommends that these two boards, or their successors, work closely with the state coordinating body in the conduct and analysis of the statewide hearings on local water management authorities.

(3) **Where they exist, watershed districts be the designated authority for the assumption of local operational requirements in the proposed statewide grant-in-aid flood damage reduction program.** Where nonstructural alternatives are included, watershed districts shall coordinate activities with counties or municipalities, as appropriate. Counties, municipalities, and various joint powers agreements may assume both structural and non-structural functions on a case-by-case basis in areas not covered by watershed districts.

(4) **The Legislature repeal Minnesota Statutes, Chapter 111 and the remaining drainage and conservancy districts be required either to transfer their authority to those of Minnesota Statutes, Chapter 112 or to transfer ongoing maintenance responsibilities to the affected counties.** Repeal of Chapter 111 will update state statutes and reduce the various types of local districts involved in the management of waters.

The remainder of the section on "Management of Minnesota's Water Resources" focuses on the existing management setting and the issues and options addressed in the process of reaching the above recommendations.

Present Water Resources Management in Minnesota

Minnesota Statutes, Section 105.401 required the Minnesota Water Planning Board to "Evaluate and recommend improvements in state laws, rules, and procedures in order to reduce overlap, duplication, or conflicting jurisdictions among the many state and interstate agencies having jurisdiction in the area of public water resource management and regulation." This charge was inserted in the 1977 law in response to concerns expressed by citizens, administrators, and legislators with the number of water management programs in the state, possible overlapping program functions, and the lack of coordinated, comprehensive decision-making among the various programs.

The Water Planning Board has identified 16 state agencies and boards which administer more than 80 water-related programs in Minnesota. Achievement of the identified goals of these programs requires coordination and exchange of vast amounts of information among various decision-makers.

Although 16 state agencies and boards are involved in water management in the state their level of involvement varies greatly. Of the 63 major water-related programs reviewed in depth by the Board, the Departments of Health and Natural Resources and the Pollution Control Agency are responsible for 46, or nearly 75 percent. In contrast, the Minnesota Historical Society and the Iron Range Resources and Rehabilitation Board have only tangential relationships to water resources. Between these extremes are the Soil and Water Conservation, the Water Planning, and the Water Resources Boards; the Departments of Agriculture, Economic Development, and Transporation; the Energy and State Planning Agencies; the Environmental Quality Board; the Division of Emergency Services of the Department of Public Safety; and the University of Minnesota.

Figures 10 and 11 illustrate state surface- and ground-water and related management programs. In addition, there are fourteen local agencies, seven interstate agencies, and five regional (intrastate) agencies directly involved with water resources in Minnesota. At least 12 federal agencies directly affect water resources management in the state.

Minnesota's major water management programs can be grouped into five topical areas. These include:

** **Water resources planning and environmental review.** This area includes water resources planning programs, environmental review, and health risk assessment. Seven major state programs were reviewed in this topical area.

** **Water quality management.** Included in this area of management responsibility are water quality standards development, water quality monitoring, permit and certification programs, water treatment systems programs, runoff-related pollution control planning and management, public drinking water quality programs, and ground-water quality control. In all, nearly one-half of the 63 water-related programs reviewed by the Board fell within this area.

** **Water quantity management.** These management functions include the public waters inventory and water bank program, the water resources permit programs for works in public waters and appropriations, public drainage plan review, water quantity research and support, and industrial and agricultural water use programs. Nine programs were reviewed in this area.

(In reviewing their comparative numbers, it should be noted that programs such as the permit programs cover broad ranges of activities, while those in other areas—such as water quality—may be targeted on specific actions.

** **Related land resources management.** This category includes programs relating to flood management and flood insurance; flood control coordination; development of flood control projects; critical areas, coastal zone, wild and scenic rivers, and shoreland management; and dam safety.

** **Wildlife and recreation management.** This area of programs includes scientific and natural areas management, wildlife management, ecological services, canoe and boat route planning and acquisition, public access,and comprehensive recreation planning.

Several agencies administer programs in more than one of these topical areas. However, the Pollution Control Agency dominates the water quality management area (although the Health Department maintains a significant role in water quality management) and the Department of Natural Resources administers all of the programs in the wildlife and recreation management area and most water quantity management programs.

In total, 152 water management problem areas have been identified in programs analyzed by the Board. A "problem area" is defined as a specific problem encountered in the operation of a program which prohibits the achievement of program goals. However, not all problem areas identified are of equal concern. Some are very real problems; some could arise in theory, but have not been a hindrance to date; and some are minor. Of the 152 problem areas identified, 34 were highly relevant for further institutional analysis, 64 were of medium relevance, and 54 were of low importance from an institutional perspective.

In assessing institutional issues (rather than the validity of specific program determinations) eight categories of problem areas are discernible. "Problem area categories" are groupings of common institutional deficiencies which may be basic causes for all identified water resources management problems. The eight categories are: (1) overlap of authority, (2) gaps in authority, (3) poor coordination and communication, (4) inadequate citizen relations and participation, (5) inconsistent administration, (6) conflicts in priorities, (7) inadequate information, and (8) inadequate staff and funding. Major concerns (i.e., high relevancy problem areas) occurred most frequently in the water quantity management programs, with 11 highly relevant problem areas identified. Water quality management and related land resources management each contained eight high relevancy problem areas; water planning and environmental review, five; and wildlife and recreation resources management, two.

To further assess the identified major institutional problem areas, the Board focused on the three areas it believes to be most critical: (1) the water policy development process, (2) water quality-water quantity management interactions, and (3) the roles of state, regional, and local authorities and advisory bodies in water resources planning and management.

Figure 10

GROUND-WATER AND RELATED MANAGEMENT PROGRAMS

ENVIRONMENTAL QUALITY BOARD
STATE PLANNING AGENCY

- Environmental Impact Assessment
- Program Review and Policy Conflict Resolution
- Permit Coordination
- Environmental Policy Planning
- Critical Areas Management
- Pipeline Routing and Power Plant Siting
- Land Management Information System

SOIL AND WATER CONSERVATION BOARD

- Oversight of Soil and Water Conservation Districts

DEPARTMENT OF NATURAL RESOURCES

Division of Waters

- Water Appropriation Permits
- Information Systems Development
- Ground-Water Hydrology
- Underground Gas and Liquid Storage Permits

DEPARTMENT OF PUBLIC SAFETY

Division of Emergency Services

- Emergency Water Supply Services

DEPARTMENT OF TRANSPORTATION

- Undisturbed Boring Program
- Soil Engineering Program

UNIVERSITY OF MINNESOTA

Minnesota Geological Survey

- Hydrogeologic Mapping Statewide
- Bedrock Hydrogeochemistry Mapping
- Water Well Drillers Logs Data Base

WATER PLANNING BOARD

- Statewide Framework Water and Related Land Resources Planning
- Coordination of Public Water Resources Management

SOUTHERN MINNESOTA RIVERS BASIN BOARD

- Comprehensive Water and Related Land Resources Planning
- Coordination of Natural Resources Management

WATER RESOURCES BOARD

- Water Policy Conflict Resolution
- Watershed District Formation and Overall Plan Prescription

POLLUTION CONTROL AGENCY

Division of Water Quality

- Ground-Water Quality Monitoring
- Water Quality Management Planning
- Standards Development
- Certification Program (401,PCB)
- Municipal Sludge Disposal
- NPDES Permits Program
- State Disposal System Permits
- Liquid Storage Site Permits
- Land Application Program

Division of Solid Waste

- Feedlot Operations Permits
- Residual Waste Management
- Hazardous Waste Management

DEPARTMENT OF HEALTH

Division of Environmental Health

- Water Well Construction
- Safe Drinking Water Program
- Occupational Health*
- Environmental Field Services*
- Hotels, Resorts, and Restaurants*
- Ground-Water Quality Information System
- Analytical Services
- Health Risk Assessment
- Radiation

Division of Health Facilities*

DEPARTMENT OF AGRICULTURE

Planning Division

- Weather Modification

Dairy Division*

Agronomy Services Division

- Pesticides Control

Food, Meat, and Poultry Division*

*Includes surveillance of water supplies.

FIGURE 11

SURFACE-WATER AND RELATED MANAGEMENT PROGRAMS

ENVIRONMENTAL QUALITY BOARD
STATE PLANNING AGENCY

- Environmental Impact Assessment
- Program Review and Policy Conflict Resolution
- Permit Coordination
- Environmental Policy Planning
- Critical Areas Management
- Pipeline Routing and Power Plant Siting
- Land Use Planning Assistance
- Land Management Information System

SOIL AND WATER CONSERVATION BOARD

- Oversight of Soil and Water Conservation Districts
- Land Treatment Cost-Share
- Rural Rainfall Monitoring
- Flood Control Assistance (Area II)
- Sediment and Erosion Control Plan Development

WATER PLANNING BOARD

- Statewide Framework Water and Related Land Resources Planning
- Coordination of Public Water Resources Management

SOUTHERN MINNESOTA RIVERS BASIN BOARD

- Comprehensive Water and Related Land Resources Planning
- Coordination of Natural Resources Management

WATER RESOURCES BOARD

- Water Policy Conflict Resolution
- Watershed District Formation and Overall Plan Prescription

DEPARTMENT OF NATURAL RESOURCES

Division of Waters

- Public Waters Inventory and Permits
- Water Appropriation Permits
- Surface-Water Hydrology (including Lake Improvement)
- Climatology
- Hydrographic Services
- Information Systems Development
- Dam Safety
- Shoreland Management
- Flood Plain Management
- Public Drainage Review
- Water Bank Program

Division of Fish and Wildlife

- Habitat Improvement
- Lake Rehabilitation
- Rough Fish Control
- Wetlands Acquisition
- Water Quality Monitoring
- Lake Mapping
- Aquatic Nuisance Control Permits
- Habitat Evaluation

Division of Parks and Recreation

- Scientific and Natural Areas
- Canoe and Boat Route Management
- Public Access

Office of Planning and Research

- Wild and Scenic Rivers Planning
- Statewide Comprehensive Outdoor Recreation Planning

Division of Enforcement

DEPARTMENT OF TRANSPORTATION

- Small Stream Flood Investigation
- Ambient Water Quality Program
- Navigation Planning

DEPARTMENT OF PUBLIC SAFETY

Division of Emergency Services

- Emergency Water Supply Services
- Flood Disaster Assistance

POLLUTION CONTROL AGENCY

Division of Water Quality

- Surface-Water Quality Monitoring
- Water Quality Management Planning (208)
- Lake Studies and Restoration
- Standards Development
- Certification Program(401,PCB)
- NPDES Permits Program
- State Disposal System Permits
- Liquid Storage Site Permits
- Land Application Program
- Municipal Sludge Disposal

Division of Solid Waste

- Feedlot Operations Permits
- Residual Waste Management
- Hazardous Waste Management

DEPARTMENT OF HEALTH

Division of Environmental Health

- Safe Drinking Water Program
- Occupational Health*
- Environmental Field Services*
- Hotels, Resorts, and Restaurants*
- Analytical Services
- Health Risk Assessment
- Radiation

Division of Health Facilities*

DEPARTMENT OF AGRICULTURE

- **Planning Division**
- Weather Modification
- **Dairy Division***
- **Agronomy Services Division**
- Pesticides Control
- **Food, Meat, and Poultry Division***

*Includes surveillance of water supplies.

Issue Areas and Optional Approaches to Resolution

The goal of the Water Planning Board in its management study was to identify the best institutional structure available for improving overall management of water resources in Minnesota. The Board's objectives were to identify organizational and institutional alternatives for (1) improving the manner in which state water policy is developed, (2) better integration of water quality and water quantity management decisions, and (3) implementing options that may be selected to improve management of water resources in the state. The following discussion identifies major issues related to achievement of these objectives; provides a discussion of each; and highlights conclusions with regard to selected management issues.

In choosing among available options, there are criteria which should be considered by decision-makers. These include: (1) the effect on reduction of overlap and duplication of water management functions and programs, (2) the compatibility of program objectives with agency goals and charges, (3) the priority given to water management within an organization, (4) the capability of institutions to carry out management responsibilities and operational requirements, (5) performance of institutions in carrying out related programs or options, (6) institutional stability, (7) the adequacy of funding methods and sources in support of education, research, data collection, planning, operations, and enforcement, (8) proximity to important service or reference programs and the ability to obtain input from them, (9) the effect on reducing expense of program administration, (10) the accessibility of program planning and decision-making to the public, and (11) the separability of functions.

The major issues are discussed in terms of (1) water management at the state level, (2) the role of the state in water resources planning, (3) water management at the regional level, and (4) water management at the local level.

(1) Water management at the State Level

Based on a detailed examination of water quality-quantity management interactions, the Water Planning Board has attempted to (1) identify overlap and duplication in state water resources management, (2) determine if the present institutional structure impedes integrated decision-making relating to water quality-quantity management, and (3) assess alternative solutions relating to accountability and enforcement problems, increased local initiative, and organizational changes at the state level. In addition, the Board has addressed the issue of which state agency should administer the proposed statewide grant-in-aid flood damage reduction program.

A. Overlap and Duplication

To deal with issues related to overlap and duplication, the terms must first be defined. "Overlap" means to extend over and cover part of or to have something in common. "Duplication" means the state of existing in two corresponding or identical parts. Thus, duplication may be considered the most overt kind of overlap.

Applying these definitions to water management authorities and activities, it can be concluded that no duplication exists if the same function is carried out by two different agencies for two different purposes. However, this would constitute an overlap. An example of overlap without duplication is evident in the water quality monitoring programs of the Pollution Control Agency and the Departments of Health, Natural Resources, and Transportation. The MPCA monitors water quality to aid in its enforcement of water quality standards. The MDH monitors water quality to assure safe drinking water; the DNR to aid in its management of fisheries; and the DOT to assess impacts of highway development. While the overlap of functions is clear, duplication would not exist unless monitoring of identical parameters took place at similar times and places.

Since it is not always possible to determine when identified overlaps might become duplications, overlap and duplication are treated jointly in the discussion. More intensive analysis than was possible would be required to make such determinations.

The search for overlap and duplication of authorities and activities at the state level was carried out through surveys of and interviews with program managers, case studies, and a review of pertinent laws. Exhibit 1 identifies 11 areas of overlapping authorities. These include overlaps in: conflict resolution processes, coordination of water management, water and related land resources planning, protection of domestic supplies from degradation, storage of gases and liquids, protection of available supplies during critical periods, collection of well logs, regulation of well abandonment, the interaction of water pollution control programs with the Public Waters Inventory and Permitting programs, permitting of storm sewer systems, certification of dredge and fill operations, non-point source pollution control management, provision of guidance to multi-purpose water management districts, and implementation of a lake improvement program.

Thus, it can clearly be concluded that instances of overlap and duplication of state water management authorities exist. However, the utility or the inefficiency of these can only be judged on a case-by-case basis. In the area of both surface- and ground-water management, identified overlaps cannot be condemned outright as inefficient because they may lead to constructive advocacy and cross-check various agency activities. On the other hand, where overlaps exist, well-coordinated program management is required if inefficient and ineffective management of resources is to be avoided.

B. Impediments in the Present Structure

In the specific analysis of water quality-quantity management interactions, several impediments to integrated decision-making were identified. Exhibit 2 lists problem areas directly resulting from fragmented responsibilities in quality-quantity management at the state level and from the general absence of agency interaction in problem-solving and program development.

The items listed in Exhibit 2 indicate that the present institutional structure can be linked in a number of instances to problem areas in decision-making relating to water quality-quantity management interactions. Regardless of answers to specific questions (e.g., the administrative efficiency of having separate field-level personnel monitoring and enforcing interacting programs of the various agencies), the analysis indicates the need for acknowledging and formalizing relationships in managing quality and quantity of water resources. Means to facilitate identification, recognition, and formalization of interrelationships are needed.

EXHIBIT 1. EXAMPLES OF OVERLAPPING AUTHORITIES IN WATER RESOURCES PROGRAMS

Conflict resolution is currently provided by the Water Resources Board, the Environmental Quality Board, and the Water Planning Board.

The Environmental Quality Board is charged with coordinating environmental programs it judges to be interdepartmental in nature, while the Water Planning Board is charged with coordinating water resources management.

Both the Department of Natural Resources and the Water Planning Board are charged with preparation of a Framework Water and Related Land Resources Plan, including supply and demand assessment.

Both the PCA and the MDH may regulate the disposal of sewage and pollution of streams and other waters in protection of domestic water supplies, though the MDH generally defers to the PCA in such matters. The DNR is also charged with developing and managing water resources to assure supplies are adequate to meet long range seasonal requirements of quality and quantity. The PCA and MDH also both have special powers when emergency or critical periods are involved. In addition, the Minnesota Department of Agriculture has specific charges to contain and control pesticide spills, and to inspect and improve dairy and packing plant water supplies.

Both the DNR and the MDH are charged with requiring submission of well drillers' reports containing the logs of materials and water encountered.

The Section 404 dredge and fill permit program administered by the U.S. Army Corps of Engineers overlaps the works-in-the-bed permit program administered by the Department of Natural Resources. Section 404 permits require certification by the PCA while works-in-the-bed permits do not.

The State Soil and Water Conservation Board, the Department of Natural Resources, and the Water Resources Board each provide guidance and a degree of supervision to multi-purpose water management districts at the local level of government.

Protection of the availability of domestic supplies during critical periods is handled by both DNR and MDH. The DNR is charged with developing regulations governing mandatory adoption of ordinances by public water supply authorities. The MDH is charged with developing emergency plans to protect the public when declining quantities create health risks.

Both the DNR and the MDH have legislated responsibilities for regulating well abandonment, though the DNR's interest is in identifying potential observation wells, while the MDH's interest is in protection of ground-water quality.

The distinction between state water pollution control programs concerned with protection of "waters of the state" and public waters inventory and permit programs limited to designated waters having significant beneficial public purposes is potentially unclear to affected citizens. In addition, this overlap could lead to the PCA requiring dischargers to install expensive waste treatment facilities in order to protect an aquatic habitat from pollution, while the same habitat could be destroyed by private dredging with no public controls should it not be covered by the public waters designation.

The DNR's permitting of storm sewer systems discharging to public waters could result in overlaps with the PCA. The DNR's permitting authority originates in its charge to regulate changes in the current, course, or cross-section of public waters. Should PCA choose to regulate storm sewers or plans for quality reasons, the two efforts would require effective coordination.

C. Alternative Solutions

The state level alternatives are divided into three areas: accountability and enforcement, increased local initiatives, and organizational changes at the state level.

i. Accountability and Enforcement

Issues of accountability and enforcement concern (1) the means by which state water management agencies are held responsible for their actions and (2) the ability of state agencies to compel compliance with state water management regulations. They represent related problems which may undermine successful management of water resources by state government.

Accountability. Options for improving accountability in water management at the state level include conflict resolution procedures and identification of an effective, systematic means for assuring agency compliance with statutory requirements.

Three state water management agencies currently have authorities in conflict resolution: the Environmental Quality Board, the Water Planning Board (on an interim basis), and the Water Resources Board. The principal conflicts addressed by these agencies may be categorized as those between citizens and governmental agencies or those among agencies. This scope must be considered in assessing conflict resolution approaches and needed improvements.

The Environmental Quality Board has explicit authority to resolve conflicts of an interagency nature when programs or problems significantly affecting the environment are involved. The EQB has complementary authority to review programs and suspend agency actions. Its involvement in program review to date has been limited to consideration of pesticides policies. The EQB also has water policy conflict resolution authority relating to private and governmental actions that may significantly affect the environment. This responsibility involves review of citizen-generated petitions to determine whether or not environmental impact analyses should be required. Extensive use of this authority has been made and much of the Board's time is occupied by this process.

EXHIBIT 2. EXAMPLES OF PROBLEM AREAS IN WATER RESOURCES DECISION-MAKING LINKED TO INSTITUTIONAL STRUCTURES

Interrelation of related programs is often lacking. For example, state and matched federal financial assistance to lake management authorities (county, municipality, or lake improvement district) could be tied to compliance with shoreland management, adoption of urban runoff abatement measures, or achievement of a specified level of farm conservation planning in rural areas. Acknowledgement of and formalizing interrelationships among scattered management programs could serve to achieve mutual objectives more efficiently.

Fragmentation of lake management authorities has spawned several independent data gathering activities. A Water Planninq Board survey of data collection programs evidenced the need of program managers to access related lake data housed in other agencies, and to be kept informed of proposed data gathering activities. This need concerns not only limnological sampling, which could benefit from standardization of methodology and reporting, but also includes related hydrologic and land use information.

Several examples relating to monitoring of quality in absence of quantity consideration and monitoring of quantity in absence of quality considerations were identified. For example, MPCA requires quality monitoring of roughly 800 observation wells adjacent to sanitary landfills, but level data is not consistently obtained. Correspondingly, DNR and participating soil and water conservation districts do not collect water samples for quality analysis when monitoring well levels or in conducting pumping tests. Though complete integration of such monitoring efforts might not be desirable, this kind of consideration has received little attention with existing organizational structure.

The creosote contamination of ground-water supplies in St. Louis Park provides an example of a management problem that could require extensive coordination between agencies. Both the Department of Health and the Pollution Control Agency are involved in quality considerations, with the former being principally concerned since a major domestic water supply resource is involved and the latter because of its charge to control and abate pollution of waters of the state. However, the solution to the problem could very well involve restriction of appropriation permits, a DNR responsibility, in a zone surrounding the contaminated area. Though DNR cooperation would likely not constitute a problem, administrative efficiency would likely be hampered by the absence of a single administrative entity with final decision-making authority.

The MPCA has no written policy on diverting effluent discharges. However, diversion is encouraged whenever feasible to reduce treatment costs in protection of lake quality. This diversion of effluent discharges can potentially impact water quantity, as well as quality, by changing the distribution of stream flows. The practice of adjusting effluent standards to give dischargers credit for water conservation is employed by the MPCA only when absolutely necessarv.

Many well interference disputes result from interaction of high capacity wells with wells constructed to protect ground-water quaity, but not avaiability, under stress conditions. The Water Well Construction Code sets standards protecting quality, but does not adequately address the issue of quantity.

The conflict resolution authority of the Water Planning Board derives from its charges to direct water planning activities and coordinate public water resources management. Its involvement in conflict resolution has largely focused on definition of state water policies concerning interstate and federal planning activities. However, the WPB has little direct authority to resolve water management conflicts, other than through coordination of activities and its planning process. As a result, the WPB's efforts in conflict resolution have been directed toward the development of mechanisms to avoid and/or resolve future conflicts.

The Water Resources Board conflict resolution process involves intervention upon petition into cases where apparently conflicting statutory policies may require resolution. Disputes of this kind have tended to concern the validity of specific permit decisions by state agencies acting under statutory direction or administrative regulation. The resolution of these disputes may also be provided via hearings under the Administrative Procedures Act (Minnesota Statutes, Chapter 15). Since its creation in 1957, the WRB has become involved in 11 conflict resolution proceedings.

Of the three forums for resolution of private-agency conflicts, the environmental petition process of EQB, the intervention process of WRB, and the hearings process of the Office of Hearing Examiners, only the latter two appear to overlap significantly. The Water Resources Board process addresses the apparent conflicts between statutes, but such conflicts have manifested themselves in the agency permit proceedings which the hearing examiner process also addresses. In addition the WRB process does not provide permanent solutions to conflicting statutes, a responsibility only the Legislature can meet. This leads one to the conclusion that this process might be logically combined with water planning and policy development functions. These are currently the responsibility, on an interim basis, of the Water Planning Board and, on a broader environmental basis, of the Environmental Quality Board.

The EQB has the most explicit authority in the area of interagency conflict resolution but has used it only once, in part because of its preoccupation with more visible issues. The Water Planning Board's authority emphasizes development of policies to address and minimize conflicts, but does not enable it to direct the

resolution of conflicts. The Water Resources Board has proven ineffective in resolution of interagency conflicts, because of the reluctance of agencies to bring disputes to it. Analysis consequently indicates that consolidation of explicit interagency conflict resolution authority with the authority for water policy development and coordination would provide the best combination for addressing interagency conflicts.

The second set of options for improving accountability of water management at the state level revolves around identification of a means for assuring agency compliance with statutory requirements. The lack of an effective, systematic means for assuring agency compliance with the requirements of law is reflected in the number of legislative deadlines missed by state agencies involved in water management. Among the examples are:

** The failure of the Department of Natural Resources to develop a water conservation program (mandated in 1947), prepare a framework water and related land resources assessment (due in 1975), and to develop rules governing the water appropriation permit program (due first in 1975, but postponed to January 30, 1978);

** The failure of the DNR to promptly implement laws designed to protect or enhance the use of lakes, including the development of rules for lake improvement districts (due July 1, 1974), surface-use zoning, and appropriations from lakes;

** The failure of the Environmental Quality Board to complete and approve an inventory of power plant sites (required by 1976, and extended to January 1, 1979), although this task has been confounded by the DNR's tardiness in developing criteria for establishment of protected streamflow and lake elevation levels; and

** The failure of the Environmental Quality Board to prepare a long range plan and program for the implementation of state environmental policy in each even-numbered year as charged in Minnesota Statutes, Section 116C.07 (first due November 15, 1975).

While it is likely that many of these deadlines have been missed as a result of staff and funding shortages, conflicts in agency priorities, and unrealistic deadlines, the absence of effective program planning and evaluation linked to the budgetary process may play an important part in hampering efforts to address these problems. Therefore, a key option in improving water management is initiation or expansion of program planning and evaluation functions within each water management agency.

Enforcement. The ability of state agencies to enforce water management rules is a related issue of major significance. Enforcement problems are evident in a number of areas including:

** Regulation of water well construction. Since 1975, the rate of compliance by well drillers in submitting well records as required by law has been roughly 50 percent, with compliance in submission of water samples somewhat less. The Department of Health has been reluctant to employ its authority to revoke licenses for failure to comply with this law.

** Permit coverage reporting of withdrawals in the water appropriation permit program. Large-volume appropriators in at least one category, municipal supply, are without permits in some cases. An effective monitoring program through the Department of Natural Resources is absent.

** Abandonment of wells. The Water Well Construction Code stipulates procedures for the proper abandonment of wells, but there is no redress if procedures are not followed and no viable means of assuring compliance with the Code during abandonment.

** Administration and enforcement of shoreland zoning ordinances. Local units of government (counties and municipalities) are required to enforce minimum standards for the subdivision, use, and development of shorelands of public waters. Local administration and enforcement of shoreland ordinances vary considerably. The Department of Natural Resources appears to have no direct enforcement power, with its only recourse when violations are encountered being action in district court.

** The Pollution Control Agency construction grants program. The Legislative Audit Commission found that a significant number of projects funded under this program have had serious design or construction problems, but legal action has been pursued in only a few cases.

Analysis indicates that enforcement of state water management rules by state agencies is a major deficiency, with qualified staff and funding shortages contributing to the problem. Increased staff and funding is a major option in resolving this deficiency, although the initiation of program evaluation efforts by agencies may be equally important.

ii. Local Initiatives

Several state water management programs place great emphasis on implementation by local units of government. Examples include shoreland and flood plain management, feedlot and septic tank regulation, public waters inventory, nonpoint source management (e.g., land treatment), and wild and scenic rivers management. Local units of government are also given the option of participating in other state programs, including review of Department of Natural Resources works-in-the-bed and water appropriation permit applications, participation in pumping tests, well log verification, and Water Well Construction Code enforcement. In addition to these responsibilities, local units of government are authorized to carry out a wide variety of water management activities through soil and water conservation, watershed, and lake improvement districts, as well as other water management authorities.

Certain state-delegated or mandated tasks are accompanied by grants, such as through the Department of Health (Community Health Services Act), the Soil and Water Conservation Board, or the Department of Natural Resources. With the exception of the Community Health Services Act, analysis suggests little attention has been given to the burdens imposed on local government by the state in mandating administration of water and related land resources programs. Limitations in staff, expertise, and funding were consistently identified in the Water Planning Board's water management survey as significant problems in local implementation of state policies. In addition, state-imposed limitations on tax levies have compounded this problem by reducing local fund-raising capabilities.

Two approaches to facilitating local water management warrant consideration: (1) provision of a natural resources management fund and (2) more effective utilization of local water management institutions in state water management programs and planning. These approaches may be operated jointly.

The economic justification for a natural resources management fund lies in the benefits that would accrue to the state with more effective implementation and management of state water resources programs and policies at the local level. Identification of planning and management activities warranting state funding would be necessary. Those activities which would produce the greatest return on the state dollar in any given region would receive the highest priority. Consideration would also be given to criteria for allocating state grants among regions or local units of government. In line with the overall state "return-on-investment" criterion, such factors as the amount of shoreland requiring management, population growth, development pressure, and severity of resource problems might be considered. Extrapolating from experience with the Community Health Services program, program plans approved by the state and state program effectiveness monitoring would be required.

Administration of the natural resources management fund might be handled through the Water Resources Board, the Soil and Water Conservation Board, the proposed water resources coordinating body, the Department of Natural Resources, or the State Planning Agency. Administration of these funds would require assessment of the compatibility of locally-generated program plans with state plans and objectives, as well as determination of grants.

Both the Water Resources Board (through prescription of watershed district overall plans) and the Soil and Water Conservation Board (through plans of districts participating in its cost-sharing program) have existing means of oversight, but have less direct links to water policy and plan development. The Department of Natural Resources is directly involved with many of the water management activities that would be eligible for funding. The State Planning Agency's Office of Local and Urban Affairs administers similar funds in the form of planning grants and has demonstrated (through the Governor's Rural Development Council) the type of approach which might be employed to assure agency input to decisions. The water resources coordinating body selected by the Legislature could provide an effective forum for administering the fund, especially if the fund were expanded to cover a wide range of local initiatives envisioned by the proposed water management strategy.

By necessity, more effective utilization of local water management institutions in state water planning and management is directly linked to the adoption of a natural resources management fund.

iii. Organizational Changes at the State Level

Organizational options relating to conflict resolution, water resources planning, quality-quantity management organization, and state oversight of local management institutions have been examined by the Water Planning Board.

The Water Planning Board has identified several programs which are separate from the agency whose principal charge relates to the functions these programs provide. In many cases, this division of responsibility or fragmentation has occurred with the intent of better serving other programs within a given agency (e.g., small stream flood investigation in the Department of Transportation), or better serving an agency's constituency (e.g., pesticides control in the Department of Agriculture). The Water Planning Board has not evaluated the operations of these programs sufficiently to recommend program transfers at this time, but offers the following list for further executive and legislative review.

** The weather modification program in the Department of Agriculture is separated from the State Climatology Program housed in the Department of Natural Resources.

** The pesticides control program in the Department of Agriculture is separated from the water quality management program of the Pollution Control Agency.

** The Department of Natural Resources is charged with assessing lake improvement needs though most needs appear to be related to water quality.

** The water well construction code program located in the Department of Health has major importance as a water quality protection program but is separated from pollution control functions of the Pollution Control Agency.

** Regulation of the storage of liquids and gases underground is a program potentially affecting ground-water quality but is located in the Department of Natural Resources, since displacement of ground waters is also a concern.

** The Pollution Control Agency program providing certification of federal actions (under section 401 of the Federal Water Pollution Control Act Amendments of 1972) has consistently involved MPCA certification of federal permit actions relating to filling of wetlands, an area in which the Department of Natural Resources has primary concern.

** The U.S. Army Corps of Engineers "Section 404" permit program concerning wetlands filling overlaps with the public waters permit program for works-in-the-bed of public waters which is located in the Department of Natural Resources. This federal program could be transferred to the state for all but truly navigable waters, though federal review procedures would continue to apply on all permit applications and legislative changes to the public waters permit program might be required.

** The small stream flood investigation program of the Department of Transportation is separated from the hydrology and flood plain management programs of the Department of Natural Resources.

** The ambient water quality program of the Department of Transportation for assessing effects of highway construction and runoff on water quality is separated from the water quality management program of the Pollution Control Agency.

** Water quality monitoring programs of the Department of Natural Resources directed toward fishery management concerns are separated from water quality monitoring functions of the Pollution Control Agency.

** Water supply quality monitoring of the Department of Agriculture for dairy and packing plant operators is separated from water supply testing programs of the Department of Health.

** Power plant siting and energy needs certification programs are separated in the Environmental Quality Board and Energy Agency, respectively.

** The Minnesota Geological Survey has assumed an increasing role in the assessment of ground-water supplies in separation from quality programs of the Pollution Control Agency and quantity programs of the Department of Natural Resources.

** The State Soil and Water Conservation Board program for flood control assistance in Area II of the Minnesota River Basin is separated from the flood plain management program of the Department of Natural Resources. (Note: The proposed flood damage reduction grant-in-aid program of the Water Planning Board would be administered by the Department of Natural Resources in conjunction with the State Soil and Water Conservation Board.)

** The aquatic nuisance control program of the Department of Natural Resources permits the amount and type of chemicals used in aquatic plant control, but is separated from the water quality program of the Pollution Control Agency and the pesticides control program of the Department of Agriculture.

Conflict resolution. Two alternatives are available to the state in dealing with the problem of water policy conflict resolution. The first alternative is to maintain the specific conflict resolution function within the Water Resources Board, but with certain modifications in law to assist the WRB in carrying out this function. The second alternative is to shift the water policy conflict resolution process entirely to the body also charged with water policy planning and development. This alternative would include the options of the Environmental Quality Board, a body modeled after the Water Planning Board, and a citizens board. (The Department of Natural Resources can be dismissed as an option since it could not be expected to represent the interests of other agencies unless these were transferred to it in a major reorganization.)

The existing Water Resources Board conflict resolution process requires a petition from an involved party to start an action. Thus, the WRB's scope of responsibility pertains only to existing conflicts. The WRB cannot address policy problems which appear likely to arise in the future but which might be avoided by present action, nor is it able to substantially affect the situation after the hearing process is concluded. Although binding determinations could assure impact after the hearing process, the value of this solution should be weighed carefully against the cost in terms of administrative efficiency and agency policy-making.

If conflict resolution authority is to be retained by the WRB, the Legislature should consider a more specific definition of the Board's role in water policy conflict resolution. This might include delineation of specific categories of conflicts in which the WRB might become involved; use of a state hearing officer and specifically defined quasi-judicial procedures; and imposition of binding determinations, sanctions, or other means of insuring that decisions are carried out. Alternatively, the WRB might be charged with providing annual reports to the Legislature containing proposed statutory modifications to deal with problems uncovered in policy dispute hearings.

Shifting resolution of water policy conflicts to the body also charged with water policy planning and development would be an effective means to link identification of conflicting statutory and program policies with development of new policies. The options for housing these combined functions include the Environmental Quality Board, Water Planning Board-model, and a citizens board.

The Environmental Quality Board might assume an expanded conflict resolution process under its current program review authority. This option would vest conflict resolution authority in a board composed of agency administrators and citizens, providing access to substantial technical expertise in water management. In addition, the involvement by top agency administrators would increase the likelihood of implementing the Board's decisions within agencies.

The Water Planning Board-model option would place the water policy conflict resolution function in a multi-agency water-oriented board. Use of this type of body for water policy conflict resolution would have advantages of an ongoing direct focus on water resources planning and policy development, areas closely linked to water policy conflict resolution. In addition, it would also have access to technical expertise, staff support, and citizen input.

The citizen board option would provide a conflict resolution forum removed from narrow agency interests, but combined with comprehensive planning and policy development (in contrast to the existing Water Resources Board process). Such a board would have disadvantages in its lack of a positive forum for interagency

coordination, the possible difficulty in getting state agencies to participate in board functions and to comply with board determinations (which are problems with the current Water Resources Board process), and the possibility that a larger staff would be required for the board to actively pursue resolution of conflicts (since agencies seem less inclined to bring disputes to non-agency boards).

Water resources planning. The organizational options for housing comprehensive state water resources planning include the Department of Natural Resources, the Environmental Quality Board, an agency modeled after the Water Planning Board, and a citizens board.

The following requirements should be met by the entity carrying out policy planning and coordination functions. It should (1) provide a forum for representation of all major state water management agencies, (2) have authority and capability to develop comprehensive water-related goals and policies, (3) have authority to undertake and administer funding of water resources planning activities of an interagency nature, (4) have authority to determine which activities are of an interagency nature, (5) have authority to resolve conflicts in water policy, (6) have authority to represent the Governor on federal and interstate commissions relating to water policy planning, and (7) have authority to coordinate public water resources management activities of the state.

The Department of Natural Resources has been charged with the development of a framework water and related land resources assessment and with administration of a wide range of water management programs. However, the DNR lacks the means for providing a meaningful forum for representation of other major state water management agencies. In addition, in the past the DNR has not demonstrated the willingness to give systematic, ongoing long-range water planning sufficient priority to meet legislative mandates. For these reasons, the DNR is not an appropriate candidate for coordinating water planning, although it must play a major role in water planning.

The Environmental Quality Board (a board combining citizens and agency leaders) satisfies the criterion of providing a forum for representation of the major state water management agencies, though it does not include direct representation of either the State Soil and Water Conservation Board or the Water Resources Board. The EQB currently administers programs relating to water resources management through its environmental impact assessment process, program review authority, critical areas planning, power plant siting, environmental permit coordination, and environmental conflict resolution authority. The EQB is also charged with preparation of long-range environmental policy plans. Most EQB authority has been directed toward highly visible "firefighting" activities, such as environmental assessment and the siting of power lines and power plants. Long-range policy planning has not been effectively addressed by the EQB and there is an acknowledged tendency for this function to be given low priority in relation to its other more visible and pressing charges. The EQB does not currently have the staff technical capability to carry out the identified water resources planning and coordination functions, though it could develop this capability with the transfer of staff which has been directed by the Water Planning Board. Whether EQB's primary environmental and firefighting focuses would tend to divert this staff from water planning charges, as has happened with its current long-range policy planning effort, is uncertain.

The Water Planning Board (a body composed of agency officials) was created on an interim basis and charged with preparation of this statewide water and related land resources framework plan by June 30, 1979. Among its other charges are coordination of public water resource management and regulation; assurance of participation of the public and all units of government in state water planning activities; direction of state involvement in federal water planning activities; evaluation of state participation in the federal-state river basin commissions; and evaluation of state laws, rules, and procedures in public water resources management.

Any body which retains these functions would satisfy the criterion of providing a forum for interagency representation of the major state water management agencies. A coordinating body chaired by an independent appointee of the Governor would provide a full-time, visible advocate on behalf of water resources with direct ties to the Governor. This person could serve as the Governor's representative on interstate basin commissions, direct state response to federal policy initiatives, and direct state pursuit and utilization of special funding sources.

The primary shortcoming of a body like the WPB with regard to the identified characteristics of the authoritative water planning body would be its insufficient authority to resolve conflicts in water resources management. As noted, the Board's authority is limited to coordinating public water resources management. In addition, should a coordinating body other than the EQB be designated to carry out the identified functions in an ongoing capacity, procedures for coordinating water resources and environmental policy planning and conflict resolution would need to be developed. One possible approach would be to authorize the head of the coordinating body to make recommendations the EQB for initiating and resolving policy conflicts.

A citizens board also warrants consideration as the body charged with directing state comprehensive water resources planning and policy development. The Southern Minnesota Rivers Basin Board provides an example of a citizens board with a similar charge. This board has functioned successfully, although with nearly complete reliance on staff of federal agencies. It has maintained close contact with the Legislature and has not been burdened by the conflicting charges facing agency heads participating on interagency boards. This has enabled the Board to propose and advocate, independently of narrow agency interests, such programs as the state pilot flood damage reduction grant-in-aid and forestry assistance programs. The Board has not been successful at getting commitment of time and staff by state agencies to its planning efforts despite legislative mandates to this effect. This raises questions concerning the ability of a citizens board to coordinate water resources management activities of the state. Other experiences with citizens boards in Minnesota such as the Water Resources Board, Pollution Control Agency Board, and the Metropolitan Council, might be drawn upon to design a board minimizing weaknesses.

Water quality-quantity management organization. Based on an in-depth analysis of water quality-quantity management interactions in Minnesota, five categories of management options have been identified for dealing with problem areas: (a) miscellaneous coordination options, (b) planning and budgeting approaches, (c) establishment of an authoritative coordinating body, (d) an incremental reorganization option, and (e) major reorganization. The goal to which each group of options is directed is the assurance that water quality-quantity management efforts work in concert.

The category of **miscellaneous coordination options** includes two approaches targeted on processes for solving specific, existing institutional problems. In general, these approaches should be used as an interim step or if the more detailed organizational and planning options are not implemented.

The first approach is an interagency agreement among the Departments of Natural Resources and Health, the Pollution Control Agency, and the Minnesota Geological Survey. Such an agreement would define clearly the lines of responsibility in ground-water management. Beyond this, the agreement could provide for interaction of field personnel in enforcement of ground-water management programs, acquisition of data by one agency for another, joint training of personnel where appropriate, and integration of quality and quantity monitoring sites.

The second approach also involves an interagency agreement. Such an agreement could be used to implement joint criteria, standards, and plans for identifying and managing ground and surface water during emergency or critical periods. In addition to the DNR, the MDH, and MPCA, the Division of Emergency Services would be involved in this agreement.

The options for **planning and budgeting** include mandating preparation of program plans annually, development of long-range plans, and linkage of these plans to operations through the budgetary process. Each of the agencies involved in water resources management—with particular emphasis on the Departments of Health and Natural Resources and the Pollution Control Agency—would be charged with preparation of program plans for submission to the selected coordinating body and the Legislature. The model for these program plans would be those currently prepared by the MPCA. The coordinating body would be responsible for identifying conflicts between programs or priorities and for assuring consistency with the framework plan. Upon development of more specific comprehensive or special purpose plans (e.g., the DNR water conservation program plan), consistency with those plans would also be required. Budgetary requests would be carried forward by individual agencies through program plans.

The **authoritative coordinating body** would satisfy the need for a single entity with final decision-making authority where two or more agencies have overlapping jurisdiction. If effectively implemented in conjunction with planning and budgeting options, the authoritative coordinating body would supplant more radical reorganization options discussed below. However, certain incremental reforms would also require coordination.

The options which should be considered to fulfill this function are the same as those noted to fulfill the water resources planning function—the Department of Natural Resources, the Environmental Quality Board, a citizens board, or a body modeled after the Water Planning Board.

The DNR is charged with the administration of a wide range of water management programs. It could be assigned the duty of assuring coordination of its programs with all other state water and related land resources programs. However, the DNR does not have authority to resolve conflicts among agencies and does not have a strong record in interagency coordination. The provision to a single agency of the authority to resolve disputes between it and other agencies raises serious questions of equity.

The EQB is presently charged with coordinating state programs it determines are interdepartmental in nature, as well as resolving agency conflicts with regard to programs, rules, and permits. It has not fully utilized this authority, however, due in part to its preoccupation with more visible environmental concerns.

A citizens board could remove the resolution of conflicts among agencies from the narrow boundaries of agency interests. However, the separation of such a board from agencies may make the achievement of interagency coordination difficult and increase the difficulty of achieving agency compliance with citizen board decisions.

The Water Planning Board has been charged on an interim basis with coordinating public water resources management and regulation activities, though it has not had the EQB's authority to resolve conflicts. A body modeled after the Water Planning Board would have the advantage of a direct focus on water resources, as opposed to the EQB's more general environmental focus.

Options characterized as the **incremental reorganization approach** include (a) placement of both the Safe Drinking Water Act and the Water Well Construction Code program of the Department of Health in the Pollution Control Agency and (b) placement of only the Water Well Construction Code program in the MPCA. The first option would create a "little Environmental Protection Agency" structure, facilitating state interaction with federal Environmental Protection Agency programs. It would solve one major problem identified in the management analysis: The separation of domestic supply-quality regulation from regulation of the sources of pollution. However, a significant problem would involve separation of the program regulating public water supplies from non-public supply regulation and other health programs (e.g., food sanitation inspection).

The option of placing only the Water Well Construction Code functions in the MPCA would avoid the separation problem mentioned above. On the positive side, this option would place a program with major pollution control functions in the MPCA, while at the same time fostering in the MPCA a more balanced focus between surface- and ground-water pollution control. The reception of this option by those most affected, the water well contractors, may bear heavily on the consideration of this option.

Finally, the **major reorganization** options would bring quality, quantity, and health aspects of state water programs together under the direction of a single agency. The three major options are:

** A Department of Waters. This option would involve an independent agency combining the present Pollution Control Agency, the Department of Natural Resources-Division of Waters, and the water well construction and safe drinking water programs of the Department of Health. This combination would (a) place all major water-related programs in a single agency, (b) keep all pollution control functions together (as air and solid

waste programs of the MPCA would be included), and (c) place greater emphasis on integrated water management. A major concern with this option is the absence of other water agencies capable of checking decisions of the single agency.

** An expanded Department of Health. All major ground-water programs might be combined in the Department of Health. The MDH would operate programs in water appropriation, ground-water hydrology, underground gas and liquid storage, ground-water pollution control, and ground-water quality monitoring under this option. Further, this option would place all water supply functions in the MDH, since splitting of surface- and ground-water appropriation permitting is untenable. The MDH option would maximize health goals but would not effectively address coordination with the surface-water quality programs of the DNR and the MPCA.

** A new "super" department. This option would combine the programs of the Department of Waters option with conservation programs in the present Department of Natural Resources. This alternative would result in nearly total integration of quality, quantity, and health-related programs with other natural resources conservation programs. Other states, including Wisconsin, have adopted this option with various degrees of success. A major question is whether such a department can be effectively administered.

State oversight of local management. A somewhat specialized question related to state-level organization is that of state oversight of comprehensive local water management authorities (e.g., soil and water conservation, watershed, and lake improvement districts). Organizational options for carrying out oversight functions include (a) strengthening the existing functions carried out by the Department of Natural Resources, the Soil and Water Conservation Board, and the Water Resources Board and (b) consolidating these functions in a single unit.

The option of strengthening existing arrangements for assisting local water management authorities and for assessing compatibility of local plans and projects with state policy and objectives would mandate that memoranda of understanding be adopted and areas necessitating interagency cooperation and exchange of information be clearly defined (along with procedures for their implementation). The principal advantages of this option are the strengthening of ties between existing agencies and their respective districts; an increased service function of state agencies, resulting in an increased input for local authorities in management of water resources at the state level; and, to the extent that the memoranda of agreement are successful, facilitation of a coordinated state approach to local comprehensive water management.

The primary disadvantages of the first option lie in the expense of administration and its failure to fully address at the state level the overlapping authorities at the local level. The expense of administration is likely to be higher than that of the second option because sharing of staff between agencies would likely be precluded.

The second option would consolidate state oversight of comprehensive local water management authorities in a single body. The essential requirement of this option is that representatives of the Soil and Water Conservation and Water Resources Boards and their constituencies be included in the governing structure of the new body. Location of the new body for administrative purposes might be most appropriately within the Department of Natural Resources, given its charges in comprehensive water resources management (although this warrants further examination).

The advantages of the second option include (a) reduced expense of administration of oversight functions, including consolidation of staff; (b) increased visibility of and emphasis on local authorities and opportunities for implementing water management programs; and (c) a unified state approach to and advocacy for comprehensive local water management. In addition, this option is likely to encourage coordination among local entities.

The disadvantages of this option principally concern the perceived weakening of ties between existing state bodies and their local districts. There must also be the recognition that a "forcing together" at the state administrative level will only begin to address problems with overlapping districts at the local level. Significant problems could initially develop in getting unified action from a diversely constructed board. In addition, inclusion of the Department of Natural Resources lake improvement district function in a consolidation of oversight functions would separate this function from the state's technical expertise in lake management (although a positive aspect would be equal access of the DNR and the MPCA in formation of lake improvement districts).

Summary. Organizational options at the state level have been described which relate to water policy conflict resolution, water resources planning, water quality-quantity interactions, and state oversight of local water management authorities. In some cases, sufficient information has been gathered to warrant recommendation of an action. In other cases, the magnitude of the issues and the available information on options are such that the Board is forced to suggest more thorough examination and, most importantly, full public debate of the options.

iv. Administration of Proposed Grant-In-Aid Flood Damage Reduction Program

In the "Flood Damage Reduction" section of this report, adoption of a statewide grant-in-aid flood damage reduction program is recommended by the Board. The four state agencies which might feasibly administer the program are the Department of Natural Resources, the Soil and Water Conservation Board, the Water Resources Board, and a body modeled after the Water Planning Board.

The Department of Natural Resources is currently the lead state agency in comprehensive flood plain management. The proposed grant-in-aid program would be compatible with the charges and goals of the DNR. In addition, the Division of Waters houses technical experts in water management and the DNR option provides for early detection of projects posing environmental problems. On the other hand, conflicts with DNR programs oriented toward preservation could pose problems to those favoring flood control with greater discretion at the local level of government.

The Soil and Water Conservation Board currently administers the pilot grant-in-aid program for a portion of the Minnesota River basin. Although the SWCB has experienced certain problems in program administration, there appears to be general satisfaction at the local level. In addition, the Board is responsible for recommending priorities for small watershed projects to the Soil Conservation Service; for dealing with soil and water conservation districts; and pursuant to

Minnesota Statutes, Section 40.02, for controlling floods and preventing the impairment of dams and reservoirs. Potential problems are that the SWCB may not be able to obtain the same level of technical support from the SCS in administering a statewide program and that it may be viewed as too heavily oriented toward rural/agricultural resource considerations.

The Water Resources Board is involved in flood damage reduction less directly, through its responsibilities for establishing watershed districts and for prescribing overall plans for watershed districts. The Water Resources Board's limited staff, reduced working relationships with the DNR, and legislative charge bring into question its capability to aggressively administer the grant-in-aid program. In the latter instance, while the Board's enabling legislation deals with flood control, its existing conflict resolution charge may require that it remain an independent, impartial agency.

A final option would entail giving administration of this program to a body patterned after the Water Planning Board. The duties of the Water Planning Board have led it to deal with development of flood damage reduction programs. However, the WPB has emphasized coordination of resource management programs, not direct administration of programs. Assigning a resource management program such as the flood damage reduction grant-in-aid program to a body like the Board would represent a major departure from the Board's previous emphasis.

In the consideration of each of the options, it should be noted that the grant-in-aid program would be targeted on small flood damage reduction projects (e.g., less than $1 million total present value), with major projects funded through separate legislative action, and various independent or companion nonstructural measures. It should also be recognized that the Department of Natural Resources would continue to exercise authorities relating to public waters permits and flood plain management regulations, necessitating a close working relationship with the DNR if an option other than the DNR is selected to administer the program.

(2) The Role of the State in Water Resources Planning

The state maintains three major roles in water resources management: protector, developer, and allocator of water resources. As protector, the state has instituted major programs to manage water supply, water quality, and related land resources. As developer, the state has programs to assist in provision of flood control, wildlife and natural areas, and parks and other recreation areas. The state's role as an allocator of water resources has included programs to manage appropriation of water and access to water amenities.

Each of the state's three major roles in water management might benefit from the support and guidance which could be provided through water resources planning. Therefore, it is important to focus on four central issues: Should the State of Minnesota remain involved in water resources planning? If so, what form should the state's water planning effort take? What kind of organizations should be involved in water resources planning? and, How can the state improve citizen relations and facilitate citizen participation in development of water resources policy?

A. State Involvement in Water Resources Planning

By definition, planning involves taking present actions to prevent future problems. Planning functions which could benefit the State of Minnesota—but which are often not being provided—include:

** Anticipation of short- and long-term demands for the state's water resources;

** Development and maintenance of explicit, comprehensive water-related goals to reflect overall state needs and citizen desires;

** Coordination and integration of the policies of state agencies involved in water resources management;

** Assurance of actions compatible with framework plans and resolution of differences through evaluation of proposed actions;

** Advocacy of policies and programs;

** Development and maintenance of a forum for participation in planning and management decision-making by citizens and interest groups; and

** Establishment of a process to integrate local and regional water and comprehensive planning with state plans.

The advantages of state commitment to accomplishing these functions would be development of coordinated, prospective management of water resources by the state, and the encouragement of the same by other levels of government. Certainly, coordination with federal agencies would be improved so that federal agencies would understand what the state wants and where it wants to be in the future. Also, regional and local agencies would better understand the necessity

of state actions, be able to anticipate and influence these actions, and would know how and where to communicate problems and request assistance of state agencies.

The Legislature would, likewise, be able to anticipate the staffing needs of state agencies, and would better understand where all the various requests fit into the overall picture—if they do. Legislators would also have close at hand a good yardstick by which they could measure and assess agency performance. Such plans, when refined and made specific through program and budgetary planning, would serve implicitly to set priorities between programs of the various water-related disciplines.

The disadvantages of such a state commitment would relate to the expense of maintaining qualified technical planning staff, the effort necessary to obtain full commitment and participation by administrators and managers, and the initial costs of setting up procedures for integrating water planning with program and budgetary planning, essential to assure commitment and implementation of the state water plan.

B. The Form of the Water Planning Effort

Each of the state roles in water management requires the support and guidance of certain levels of water resources planning. These levels include (a) broad statewide framework studies; (b) detailed sub-state planning; (c) single-purpose and project planning; and (d) short-range or crisis studies.

Broad statewide framework water planning is presently being carried out by the Minnesota Water Planning Board on an interim basis. Planning at this level is concentrated on identification of resource problems, demands, and supplies on a statewide basis for use in setting state priorities, evaluating and developing water policies (and establishing procedures for implementing policies), coordinating agency efforts, involving citizens in decision-making, and communicating results of water management plans.

Detailed sub-state planning involves systematic consideration of alternative ways for meeting projected water demands and solving water-related problems associated with river basins or other regions. This level of planning should utilize the policies and procedures and follow the priorities developed through framework planning efforts, where they exist. This would assure that plans and projects identified for specific river basins will reflect overall state needs and priorities. Thus, the situation can be avoided where those basins with completed plans get the greatest share of limited state dollars, simply because they were ready first and not necessarily because they had the greatest need. The Southern Minnesota Rivers Basin Board has been responsible for guiding a comprehensive sub-state water resources planning effort in the Minnesota River basin and in the southeastern watersheds tributary to the Mississippi River. The administration and staffing of this effort has been directed by the U.S. Soil Conservation Service.

Single-purpose or project planning is directed at solving specific water management problems. Coordination of each of these with comprehensive framework and sub-state planning is necessary to assure that state policies are implemented and priorities followed. The need for this is evident in planning for a single flood control project in which the state has an interest in assuring that its resources are wisely utilized. A similar need exists in single-purpose planning for such areas as water supply management. This planning involves consideration of overall resource adequacy for absorbing proposed and projected water appropriations. The pressure in such considerations is to make decisions based on short-term resource capability with little regard for long-term cumulative needs and effects. These effects may go beyond impacts on water availablity to related impacts on water quality and land use. Coordination with comprehensive plans is designed to place such impacts and resource management decisions into perspective.

Short-range or crisis water planning studies constitute the fourth level of planning that might be conducted by the state or its subdivisions. This level of planning may be associated with flood or drought, or any major unanticipated water use. It is essential in conduct of such studies to have a well-defined body of policies and framework of reference by which to evaluate impacts and proposed actions. One example of this level of study is contingency planning required of surface-water appropriators. While the state has not conducted contingency planning of its own in the appropriation permit program, it has conducted similar studies through its environmental review process.

Each of these levels of planning is being or has been conducted by the state. However, state efforts have been incomplete, uncoordinated, and sporadic. With completion of the initial framework water and related land resources plan by the Minnesota Water Planning Board, the opportunity will exist to put into effect a coordinated, prospective planning function serving a wide range of interests.

C. State-Level Organizations for Planning

The planning functions and levels of planning needed to support the state as protector, developer, and allocator of water resources indicate a requirement for two kinds of water planning organizations: an authoritative coordinating body and individual water planning units located in the major water management agencies.

An authoritative coordinating body is required to provide planning functions which clearly cut across state agency lines, such as in (1) integrating efforts in determining short- and long-term demands on water resources in the future, (2) developing and maintaining comprehensive water-related goals and policies, (3) coordinating actions of water management agencies, including resolving conflicts between these agencies, (4) integrating water goals and policies with those of other disciplines, (5) communicating state plans to citizens and other levels of government, (6) integrating plans of local and regional governments into state plans, and (7) recommending adoption of water policies and programs by the Legislature.

Individual water planning units also need to be established in the major water management agencies. These units would concentrate on planning functions primarily directed at supporting agency water management programs. These functions would include such tasks as assessing water availability for demand-supply comparisons, translating overall state water policy and goals to program objectives, assessing effects of these policies on program operation, and monitoring effectiveness of water management programs and policies in satisfying water demands and solving water problems. Findings of program and policy shortcomings must be communicated back to the coordinating body.

D. Citizen Participation in the Development of Water Policy

A survey of water managers by the Water Planning Board found significant and sometimes major problems in the way citizen participation is pursued in state water resources management. One need only read the newspapers to learn of major problems encountered in state water management programs because of inadequate citizen relations. The thesis of this section is not that effective citizen participation can make citizens like state programs they would not otherwise like, but that such an effort can provide better understanding and appreciation of the purposes of state water management activities by citizens and a better understanding and appreciation of citizen concerns by water managers.

As might be expected, the survey identified the most significant problems in citizen relations as occurring with land-use-related water management programs. Major problems were identified in programs for siting hazardous waste disposal facilities; inventorying public waters; and critical areas, coastal zone, and wild and scenic rivers management. The last three of these programs generally experience problems with citizen perception of the program as usurping local authority. In coastal zone management, citizen relations were a major factor in stopping a program with many potentially significant local benefits.

Short of stopping state water management efforts, failures in citizen participation may have negative effects on overall agency posture, as well as on related programs. For example, adverse citizen reaction to the DNR was cited as causing initial problems in perception of the natural areas program (though these appear to have been cleared up through informational meetings). More significant is the possible effect of causing agencies to act tentatively and inconsistently in their water management activities across the state. Although several factors distinguish the programs, an interesting illustration of this might be a comparison of the DNR's public waters inventory program with the MPCA's effort to identify Class "D" quality waters.

It was considered beyond the scope of the management analysis to analyze citizen participation programs of the state in greater detail than this brief introduction represents. However, it is possible to cite several observations relating to water management program needs in citizen participation: (1) the expectations and limitations of citizen input should be defined for each program, (2) major target groups should be identified for inclusion into the citizen participation effort, (3) the type of effort(s) most suitable for each program should be selected with thought to how lines of communication can best be developed, (4) provision should be made for periodic program review and evaluation for each stage of project development. In addition, it has been observed that effective citizen participation programs generally work best when the public has a perceived ally or facilitator removed from the pressures of program management, who serves as a full-time coordinator of all such agency programs.

The Water Planning Board has utilized a citizen participation process involving a statewide Water Interests Advisory Committee, a series of citizen meetings at the start and draft final plan stages, and a regional forum of citizen committees organized by regional development commissions. The Water Interests Advisory Committee offers a good forum for focusing citizen participation efforts in comprehensive water resources planning. While this forum has not yet been fully developed, a process could be envisioned where the Committee would take the initiative in aggressively pursuing citizen input on such major projects as the Upper Mississippi River Master Plan and development of various sub-state water plans.

(3) **Water Management at the Regional Level**

Two major issues must be addressed in assessing water management at the regional level. They are: What water management functions should be carried out at the regional level? and, What organizations should be assigned the responsibility for carrying out these functions?

A. Regional Level Functions

Three functions were identified as possible regional responsibilities in water resources management: (1) serving as a forum for citizen participation in state water planning programs, (2) coordinating local water management efforts with state programs and regional needs through comprehensive regional planning, and (3) administration of regionwide water management projects.

A regional forum for citizen participation in state water planning programs is currently utilized in two major state efforts. These are the water quality management "208" planning program of the Pollution Control Agency and the framework water and related land resources planning program of the Water Planning Board. The regional organizations carrying out this function are the regional development commissions. The RDC's have organized citizen committees to review and comment on informational packages of the MPCA and on technical reports of the WPB. The regional goal of these efforts is to ensure that regional and local viewpoints are incorporated into both state plans.

The RDC's responding to the Water Planning Board's Water Management Survey indicated concern that the State Water Quality Management Plan would not adequately reflect regional considerations. Skepticism was also expressed that the citizens committees were only being utilized in the "208" effort for appearance's sake. Many commissions tend to feel that in any balancing of state versus regional interests, regional interests will inevitably lose out. No regional concerns were expressed with the WPB framework water planning effort although this could be attributed to the timing of the Board's survey.

From the state perspective, this regional function has served positively in communicating the views of both regional governmental units and citizens. This conclusion stands for both the water quality management and framework plan programs. Problems indicated by the regions may stem in part from the large volume of technical material they have been expected to review, the lack of attention given by state planners to concise presentation of this material, and the possible failure to adequately define the boundaries of the process.

The regional coordinating and comprehensive planning function concerns the needs (1) to establish regionwide priorities for proposed water management projects which may receive state or federal funding, (2) to ensure that these priorities are compatible with existing water resources plans for the area, and (3) to ensure that these plans and priorities are coordinated and compatible with comprehensive regional plans. These needs would be facilitated by an active citizen participation program at the regional level. Satisfying these needs at the regional level would assure coordination of locally-designed projects at some sub-state level, as well as set priorities at the regional level. The integration of activities targeted at solving or reducing water management problems with activities targeted at other resource areas, such as land use and transportation, would also be well served by this regional function.

With respect to the proposed statewide grant-in-aid flood damage reduction program, regional screening of projects would reduce the possibility that local units would have to commit resources to project evaluation without prior indication as to whether a project might receive state funds. Also, depending on the degree to which this regional function is considered desirable, recommended priorities could be made advisory or binding on the state or specific water management programs.

The third regional function is administration of regionwide water management projects, particularly for flood damage reduction. A regionwide project may be defined as one which has hydrologic impacts occurring geographically in more than a single local unit of government, or one that requires dealing with a flooding problem systematically in more than one administrative area. This type of project is exemplified by the Area II Region of the Minnesota River basin. Currently, regional decisions on such projects are made by the Area II Minnesota River Basin Projects Incorporated, a flood control corporation representing a ten-county joint powers board.

The Area II regional authority is responsible for the following operational requirements related to flood damage reduction projects: (1) submission of requests for grants-in-aid for specific projects, (2) demonstration that the proposed projects are consistent with plans for flood plain management, (3) conduct of comprehensive evaluations of the positive and negative environmental effects associated with the project (with the assistance of a state engineer), (4) assumption of responsibility for project operation and maintenance, (5) assumption of responsibility for the acquisition of lands and rights-of-way required for the projects, and (6) securing of the necessary financial obligations from participating counties to meet the regional/local cost-sharing requirement of the program.

The requirement of plan consistency is needed to ensure conformity with Minnesota's Flood Plain Management Act. Requirements relating to project operation and maintenance, land rights acquisition, and financing have traditionally been carried out by project sponsors of federal and state flood damage reduction programs. Assignment of these requirements to a higher level of government would represent unnecessary interference and would reduce the incentive of regional sponsors to develop economically efficient projects. Assignment of certain requirements by the regional sponsor to local units of government could also be considered (e.g., responsibility for operations and maintenance, land right acquisition, and so forth). However, determination of regional project priorities and submission of requests for state grants-in-aid would necessarily remain regional requirements. The responsibility for project evaluation rests to some extent at all three levels of government. Depending on the degree to which the regional role is necessitated by hydrologic factors, project evaluation could rest principally with state and local levels. The regional role would focus on assisting local units in meeting state requirements and on integrating local plans into a coordinated and comprehensive plan. The regional role in setting project priorities would also necessitate project evaluation at this level.

B. Responsible Regional Organizations

Four types of regional authority are considered potentially feasible for carrying out identified regional functions. A fifth type of authority, the Metropolitan Council, is considered an appropriate candidate in the seven-county metropolitan area exclusively, but is not addressed separately from RDC's. The four types of authority include regional development commissions, water management boards similar to the Lower Red River Water Management Board, boards similar to the Southern Minnesota Rivers Basin Board, and joint powers agreements between counties.

Regional development commissions were established in Minnesota under the authority of the Regional Development Act of 1969 (Minnesota Statutes, Sections 462.381-462.396). The twelve regional development commissions cover the entire state outside the jurisdiction of the Metropolitan Council. Four mandatory responsibilities given RDC's include: (1) development of a comprehensive plan for the region in cooperation with subregional planning agencies, the State Planning Agency, and local units of government, (2) review and comment on long-term comprehensive plans of local governments within the region, (3) review of plans of independent boards or commissions within the region and the authority to suspend plans which conflict with the regional plan, and (4) review and comment on applications of governmental units for loans and grants from the state or federal government.

In addition to these mandated responsibilities, the Act authorizes the RDC's to engage in other activities, including the conduct of research, development of regional information and data collection systems, provision of technical assistance and services to local units of government, coordination of civil defense and flood plain management, participation in proceedings of the Minnesota Municipal Board, and designation of its members to serve without a vote on any other multi-jurisdiction planning board or council within the region.

Regional development commissions have broad powers to raise revenues with each RDC having access to three sources of funding: (1) the commissions are authorized to levy a property tax in the region of no more than one-sixth of one mill; (2) in anticipation of collection of taxes, the commissions may borrow money on a short-term basis; and (3) the commissions may have access to various federal and state planning grant programs and to the regional and local assistance fund of the State Planning Agency (the State appropriation in support of regional development commissions was approximately $2 million in FY 78-79).

Despite the broad planning powers of the RDC's and their ability to raise funds by a variety of means, the operational requirements for administration of regionwide projects do not appear to be consistent with the objectives or capability of the RDC's. Specifically, the RDC's have little expertise in resource management; they are not currently authorized by law to undertake specific natural resource-related projects; and their boundaries do not in general coincide with any single watershed or group of watersheds in the state. Regional development commissions do have major assets that could be effectively utilized in setting regional priorities: the mandates to develop a comprehensive regionwide plan and to assure compatibility of plans of local independent boards, and the statewide coverage provided by commissions.

The institutional structure currently being utilized in Area II of the Southern Minnesota Rivers Basin in conjunction with the pilot grant-in-aid program is a ten-county joint powers agreement. The authority for joint exercise of powers is contained in Minnesota Statutes, Section 471.59. The statute authorizes cooperative exercise of any power common to the governmental units entering into an agreement. Joint powers agreements must state the purpose for which joint powers will be exercised. Since there are no other limitations on the specific objectives for which these agreements can be used, joint powers agreements represent a comparatively flexible type of institutional structure. While joint powers boards have no specific authority to tax, the law permits the parties to such an agreement to make disbursements from public funds to achieve the objectives of the agreement. Thus, the ability of a joint powers organization to raise funds is limited only by the taxation powers of the individual members.

Joint powers agreements between counties are not considered suitable for carrying out regional citizen participation and coordination functions, since these require permanent, ongoing organizations. This organizational alternative is considered feasible for administration of regionwide water management projects, however.

The advantages of joint powers agreements, flexibility of structure and ease of access to member funds, must be weighed against several disadvantages. The first is that joint powers are relatively fragile institutions whose stability depends upon the ongoing agreement of all members. In that respect, it would be difficult to work out cost allocation arrangements acceptable to member governments. The Area II corporation experienced difficulties in this, but did arrive at a formula satisfactory to all members. A second disadvantage of joint powers agreements is related to the assumption of liability required in regional cost-sharing of approved water management projects. Since there is no statutory requirement that joint powers agreements be maintained in perpetuity, the state would need to ensure that the terms of the initial agreement would require members to meet ongoing responsibilities for operation and maintenance of constructed projects. If this is not done, the state could be forced to assume this responsibility should the agreement be terminated during the operational life of a project. The Area II corporation has circumvented this difficulty by transferring the responsibility for operation and maintenance of completed projects to counties or other local governments.

Water management boards are a variation of the joint powers agreements discussed above. The major distinctions are that they are composed of watershed districts and have independent taxation power. The only such board currently in existence in Minnesota is the Lower Red River Water Management Board. Under Chapter 172 of Laws 1976, member watershed districts were empowered to levy an **ad valorem** tax of two mills or less on each dollar of assessed taxable property for the construction and maintenance of projects of common benefit to the districts. The Act also permitted the Board to institute joint projects and to enter into agreements with the State of North Dakota and the Province of Manitoba to assure integration of its projects with purposes of these governments.

The chief advantages of water management boards patterned after the Lower Red River Board are: (1) greater familarity with water resource-related problems, (2) geographical boundaries that conform closely with actual watersheds, (3) specific taxation authority of member districts for water-related projects, and (4) statutory recognition of the prototype board.

Clearly, this structure could not be employed in carrying out regional citizen participation and comprehensive plan coordinating functions, without major changes in regional government and existing regional planning charges. Water management boards are, however, considered suitable for administration of regionwide projects for the reasons listed above. A significant drawback of the water management board concept is that, unlike counties, watershed districts have not been organized for the entire state. However, it should be noted that (1) most portions of the state subject to severe flooding are already organized into watershed districts, and (2) legislation providing for the establishment, purposes, and governance of watershed districts is currently in existence under Minnesota Statutes, Chapter 112.

A fourth alternative for carrying out identified regional functions is the river basin board. The model for this concept is the Southern Minnesota Rivers Basin Board, the statutory authority for which is contained in Minnesota Statutes, Chapter 114A. The Board was established to serve as the regional organization for guiding the creation and implementation of a comprehensive environmental conservation and development plan for the Southern Minnesota Rivers Basin. Other powers and duties of the Board include: (1) adoption of planning guidelines and regulations designed to prevent the impairment or destruction of air, water, land, or other natural resources in the basin, (2) development and coordination of a system to enable units of government located in the basin to carry out those activities necessary to prepare a basin-wide plan, and (3) fostering and promoting the implementation of the plan by the various federal, state, and local units of government in the area.

The Southern Minnesota Rivers Basin Board has been generally effective in meeting its primary statutory charge. However, significant drawbacks would be associated with the use of similar boards to carry out the operational requirements for administration of regionwide projects. These include the lack of taxa-

tion powers and the lack of authority to undertake the construction of natural resource-related projects.

River basin boards provide an attractive alternative to regional development commissions for carrying out regional functions of serving as the forum for citizen participation in state water management programs and coordinating water-related activities with comprehensive plans. These boards would have advantages of alignment on a river basin basis, representation of both local and regional levels, and a focus on comprehensive water resources planning and management. The tie into planning and development of other resource areas such as energy, land use, and agriculture may be more difficult than would be the case with RDC's actually charged with comprehensive planning. Use of river basin boards may be especially appropriate for focusing state, regional, and local attention on the development of major river basin plans. As such, these boards would appropriately function to advise the state water resources coordinating body identified previously. (See conclusions concerning the role of the state in water planning.)

Regardless of the regional organization selected to carry out the functions discussed, two points must be accepted: (1) there must be two-way interaction between the regional organization and state-level organizations to assure communication and coordination among all parties and (2) further effort must be made to define how such interaction can most usefully occur and to refine current practices.

(4) Water Management at the Local Level

Most water-related problems in Minnesota have direct local impacts. Local units of government have an immediate interest in the resolution of these problems. Therefore, there is a legitimate reason for these units of government to continue to be directly involved in water resources management in Minnesota.

Numerous local units of government may be involved directly in management of water resources, including both general purpose units (counties, municipalities, and townships) and special purpose districts (watershed districts, soil and water conservation districts, lake improvement districts, lake conservation districts, water and sewer authorities, sanitary districts, drainage and conservancy districts, public drainage authorities, and county committees of the U.S. Farmers Home Administration and Agricultural Stabilization and Conservation Service).

As one might expect from this large number of authorities, several areas of overlap may be found. As a general rule, these appear to have resulted from legislative efforts to make the means of solving specific problems more readily accessible. Analysis of these overlapping authorities is focused on two general purpose units, counties and municipalities, and three special purpose districts, watershed districts, soil and water conservation districts, and lake improvement districts. In addition, discussion of drainage and conservancy districts, the forerunners of watershed districts, is also presented.

Two major issues relative to management of water resources at the local level by these entities must be addressed: Do overlapping authorities at the local level create problems in local administration of water resources management programs? Which local authorities should be eligible to participate in the proposed statewide grant-in-aid flood damage reduction program?

A. Overlap at the Local Level

Counties are authorized to pursue a wide range of health, safety, and general welfare objectives. They may construct and operate water control structures; undertake projects to change the course, current, or cross-sections of waters; and construct water and sewer systems for lake improvement. Counties have authority of eminent domain in specific circumstances for specified purposes, such as for acquisition of existing water control structures and construction of public drainage systems.

Counties may adopt ordinances, enact regulations, and issue permits relating to shoreland and flood plain management, water surface use, and works-in-the-bed of public waters, among other areas. They also have general **ad valorem** taxing authority subject to levy limits, except relating to lake improvement districts, and authority to assess property benefited by works of improvement relating to water resources.

Counties may play a special role in the formation of watershed districts, lake improvement districts, and public drainage authorities, including initiating or acting on the formation and appointing the managing boards of such districts. The specific involvement and function of counties varies in each instance, however. Counties also have major involvement in designation of public waters, shoreland management, and flood plain management, in conjunction with the DNR. Additionally, they may become involved in structural flood damage reduction, enforcement of water well regulations, and certain other health-related functions.

Municipalities perform many of the same functions with generally similar authorities as counties and, in addition, supercede the authority of counties within their boundaries. They have more specific authority than counties in certain areas, such as flood damage reduction, for which they may acquire lands by condemnation, build and maintain flood control structures, and assess taxes against benefited property owners at their own volition.

Soil and water conservation districts are generally authorized to protect soil and water resources and implement any necessary practices in the district to reduce and prevent soil erosion, sedimentation, and agriculturally-related pollution in order to preserve natural resources, insure continued soil productivity, control floods, prevent impairment to impoundments and reservoirs, preserve wildlife, and maintain navigability of streams and harbors. The SWCD's are given only limited authority to implement practices and projects, however. Except through authority shared with counties or other units of government, districts are limited to development of projects and initiation of works on a strictly voluntary basis. SWCD's are governed by elected supervisors. Districts presently blanket the state.

SWCD involvement in water management programs has traditionally focused on application of land treatment measures and development of conservation plans for management of soil and water resources. This role has been expanded recently with initiation of the State Cost-Share and Demonstration Erosion Control program for application of land treatment practices. SWCD's have played a new role in assessment of sources of non-point pollution as part of the state's Water Quality Management (208) Planning effort. Districts have also recently ac-

quired important functions in conjunction with regulatory programs of the Department of Natural Resources. They are authorized to advise the DNR on irrigation soil suitability and compatibility with SWCD long range plans, assist in the conduct of pumping tests, and advise the Department on water appropriation and public waters permits. Districts also may be involved in assisting counties in public waters identification and in serving on hearings units charged with resolving disputes in public waters designation.

Watershed districts are authorized, generally, to conserve natural resources through "land utilization, flood control, and other needs based upon sound scientific principles for the protection of public health and welfare." They may be established for such purposes as flood damage reduction, drainage and navigation improvement, reclaiming or filling wetlands, providing and conserving water supplies, providing for sanitation by regulating the use of streams for waste disposal, control of soil erosion and siltation, and regulating improvements by riparian landowners affecting the beds and shores of lakes, streams, and marshes. Their charge thus includes nearly every phase of water resources management. Watershed districts are also given a wide range of authorities in areas of regulation, permits, ordinance adoption, and initiation of works of improvement. These authorities are often qualified and in some cases made subservient to other units of government (counties and municipalities, especially in the area of ordinance adoption). Watershed districts have authority of eminent domain, taxation, and assessment, though each is qualified by certain conditions. Watershed districts are governed by appointed boards of managers. With occasional exceptions, they follow natural watershed boundaries. Watershed districts are formed upon petition to the Water Resources Board and currently cover less than one-third of the area of the state.

Watershed districts are currently involved in a variety of water management activities, reflecting the full spectrum of authorized functions. The activities of a given district vary according to its location and needs perceived by the board of managers. These activities may range from provision of flood control and management of drainage systems in both urban and rural settings, to regulation of various related land resource activities. In many cases, watershed districts assume the function of meeting operational requirements of federal water resources projects, especially those for flood damage reduction. Watershed districts have not generally provided the systematic advisory and support services for state water management programs that SWCD's have. This appears largely attributable to their lack of statewide coverage.

Watershed districts are the "modern" version of drainage and conservancy districts, the latter authorized under Minnesota Statutes, Chapter 111, a statute first enacted in 1919. The purposes and authorities of each type of district are similar, though watershed districts appear to be potentially somewhat more comprehensive and flexible, with more powers and better access to funding. Only three drainage and conservancy districts still exist in Minnesota, having chosen not to take advantage of the improved watershed authority offered by Minnesota Statutes, Chapter 112. These three districts are each involved to some degree with the operation and maintenance of federal flood control projects. It is clear that the functions of these districts can be accommodated under Minnesota Statutes, Chapter 112, the "Watershed Act", and it is concluded that these districts should be required either to transfer their authority to this chapter or to transfer ongoing maintenance responsibilities to the affected counties. Repeal of Chapter 111 is viewed not only as a step in updating state statutes, but as a move in the direction of reducing the various types of local districts involved in the management of waters.

Lake improvement districts are authorized, generally, to improve the natural character of lakes and shorelands by protecting lakes from the detrimental activities of man and from certain natural processes. While only two currently exist, they may be formed by either counties or municipalities and given several of the authorities held by these units. Lake improvement districts may construct and operate water control structures, undertake projects to change the course, current, or cross-section of public waters, improve navigation and develop comprehensive plans to carry out these and other activities. They may exercise eminent domain only through counties or municipalities.

The overlapping authorities of these special and general purpose districts are evidenced in the summaries provided above. They include broad overlaps in flood damage reduction, drainage, shoreland management, non-point source pollution control, and nearly every other phase of water management. To a large extent, these overlaps may be seen as constructive, enabling districts to take advantage of their special authority or focus to implement and advocate proper management of water resources with specific areas of emphasis.

However, four general types of problems may be at least partially attributable to the overlapping of these authorities. The problems include shortages in qualified staff and resources to support this staff, problems with public awareness and perception of the various special purpose districts, inconsistent statewide coverage of water management authorities, and limitations to the fund-raising abilities of the various districts. Each of these problems was identified by local authorities in the Water Planning Board's water management survey. Most were also described by managers at the state level. Each of the problems may tend to be aggravated by the number of general and special purpose districts existing at the local level of government. Accordingly, it may be concluded that the state should study in depth the feasibility of organizational changes in water management authorities at the local level. Important study issues might include district relationships with counties and regional planning authorities; whether watershed or political boundaries should be followed; whether districts should be governed by appointed or elected managers; technical and administrative staff requirements; appropriate size; and the nature and extent of state oversight desirable.

B. Local Authorities in the Proposed Grant-In-Aid Flood Damage Reduction Program

In order to fulfill the local operation requirements of the proposed grant-in-aid program, local units of government sponsoring flood damage reduction must have the statutory authority to: (1) acquire lands, and secure easements and rights of way for the specific purpose of flood damage reduction, (2) construct flood damage reduction projects, whether or not these projects may be part of the areawide program, (3) raise funds for the purpose of flood damage reduction, by either (a) assessing benefited property owners on a project by project basis or (b) using existing forms of taxes generally utilized for local public works projects and (4) coordinate or direct the implementation of non-structural measures in conjunction with structural project components or, where structural measures are not proposed, independently.

Of the various types of local units under consideration (counties, watershed districts, soil and water conservation districts, and municipalities), watershed districts have the clearest mandate to carry out the above operational responsibilities. These powers are specifically granted in Minnesota Statutes, Chapter 112. Two problems are associated with assigning local operational requirements to watershed districts. Much of the state is not currently represented by watershed districts. Consequently, limiting local operational requirements to this type of body would lead to the temporary exclusion of certain areas of the state from the proposed program. The second problem is related to financial obligations that must be assumed by local units of government. While watershed districts have the power to levy taxes, existing tax limitations could in some cases hamper districts from raising the necessary revenues to meet the local cost-sharing requirement.

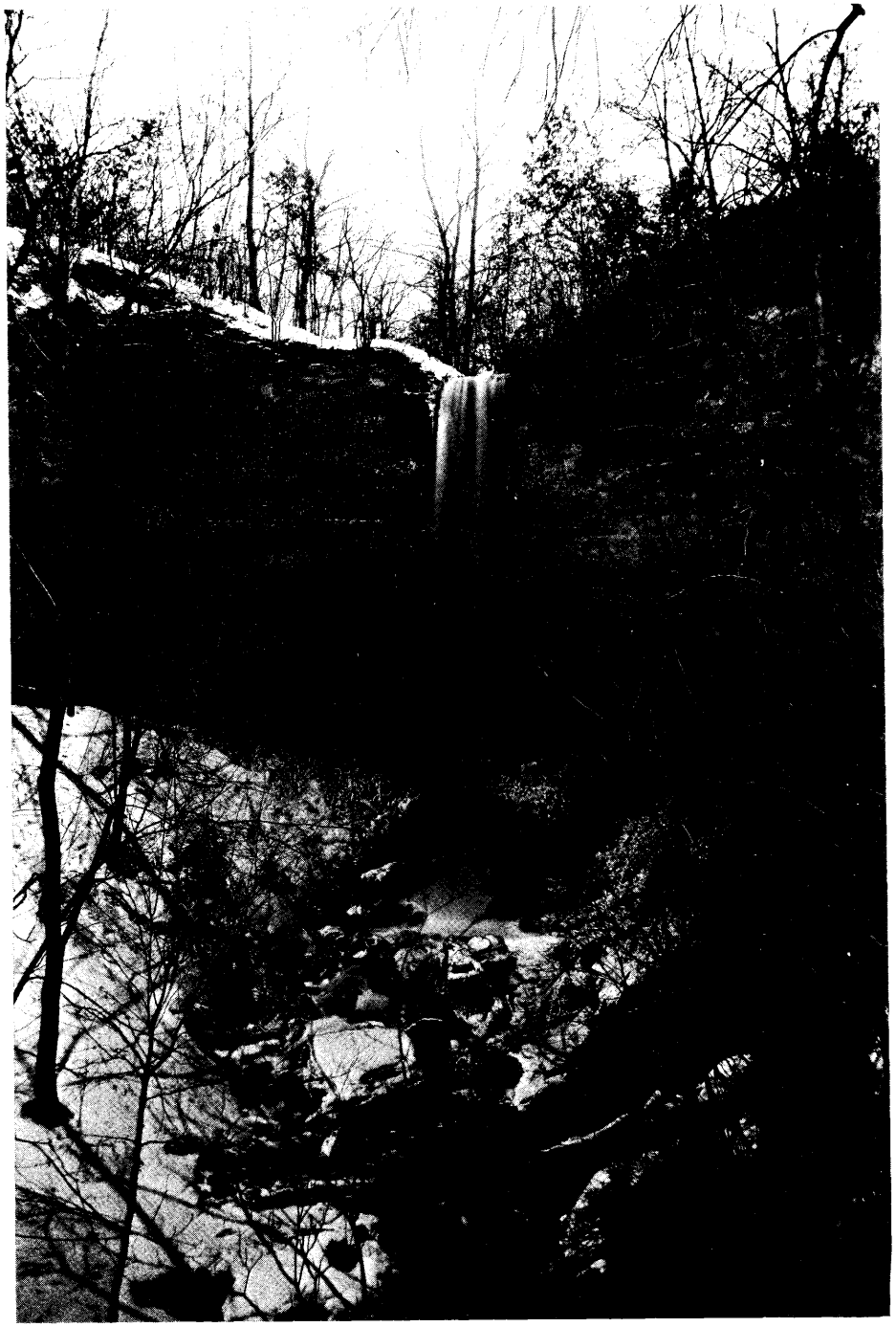
In fact, this problem does not apply to watershed districts alone, but may be viewed as a more general problem of government in carrying out local and regional operational requirements. For example, the Area II corporation has found it necessary to request that the Legislature raise the tax levy limitation in member counties in order to meet the cost-sharing requirements of the current program. The Legislature would have to confront this problem in considering any proposal to expand the current grant-in-aid program statewide.

Local operation requirements could also be carried out under joint powers agreements between soil and water conservation districts and counties. The joint powers structure would be required since neither soil and water conservation districts nor counties have all the powers needed to conduct local operation responsibilities. Under the joint powers agreement, the joint governing body would acquire from soil and water conservation districts the right to acquire land, easements, and rights of way, and to assess project costs against benefited property owners. Coupled with the more general authority of counties to levy taxes, these powers would then be sufficient to meet most local operational requirements of the program.

The shortcoming of this arrangement would be the lack of explicit statutory authority to condemn lands for the purpose of flood control, since neither counties nor soil and water conservation districts generally have this authority (counties may have such authority under Minnesota Statutes, Section 106.021 under certain circumstances). An advantage of this type of arrangement is the statewide coverage of soil and water conservation districts. However, the state would again need to ensure that the joint powers agreement contained provisions binding participants to meeting ongoing operational needs.

Municipalities would also be viable candidates for meeting local requirements in areas not covered by watershed districts. The authority of municipalities to acquire lands for the purpose of flood control, to build and maintain flood control structures, and to assess taxes against benefited property owners is contained in Minnesota Statutes, Chapter 429. One foreseeable difficulty would be that the effects of structures on flood flows often range beyond the area controlled by individual municipalities. In that event, however, a city could enter into a joint powers agreement with affected counties to obtain the needed coverage.

Supportive Documents: Technical Paper No. 5, "State Water Resources Program Inventory and Problem Idnetification"; Technical Paper No. 14, "Management Problems and Alternate Solutions"; and "Final Report of the Management Work Group."



SUPPORTIVE DOCUMENTS AVAILABLE THROUGH THE WATER PLANNING BOARD

"Public Concerns and Issues—Recommendations for Consideration in the Framework Water and Related Land Resources Plan," Technical Paper No. 1, January, 1978.

"Water: Whence It Comes and Where It Goes (A Benchmark Report on Water Resources in Minnesota)," Technical Paper No. 2, July, 1978.

"Water Forecasting System for the State of Minnesota (Final Report)," Technical Paper No. 3, June, 1979

"Rural Water Supply Systems," Technical Paper No. 4, June, 1978.

"State Water Resources Program Inventory and Problem Identification," Technical Paper No. 5, August, 1978.

"Flooding and Flood Damage Eduction," Technical Paper No. 7, November, 1978.

"The Economic Impacts of Water Shortages and Water Allocation Policies," Technical Paper No. 8, October, 1978.

"Water Availability, Water Use, and Potential Conflicts," Technical Paper No. 10, January, 1979.

"Minnesota Water Quality: Management and Issues," Technical Paper No. 11, December, 1978.

"Water Conservation Methods for Irrigation, Agricultural Processing Industries and Domestic Consumption," Technical Paper No. 12, December, 1978.

"Toward Efficient and Equitable Water Allocation in Minnesota: A Report on Water Allocation Options and Approaches," Technical Paper No. 13, January, 1979.

"Management Problems and Alternate Solutions," Technical Paper No. 14, February, 1979.

"Water Appropriations in Minnesota—1976," Working Paper No. 1, March, 1978.

"An Analysis of Instream Flow Needs in Minnesota," Working Paper No. 2, October, 1978.

"An Evaluatiion of the Natural Ordinary High Water Evaluation in Minnesota Lakes," Working Paper No. 3, November, 1978.

"An Evaluation of Minnesota's Continued Participation in Federal-State Basin Commissions," Working Paper No. 4, December, 1978.

"Final Report of the Management Work Group," March, 1979.

"Final Report of the Data Work Group," February, 1979.

"Final Report of the Supply, Allocation, and Use Work Group," February, 1979.

PHOTOGRAPHIC CREDITS

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15	Central Minnesota River Scene	Minnesota Department of Natural Resources
16	Palisade Head, Lake Superior	Minnesota Historical Society
19	Snow & ice on the North Shore	Minnesota Historical Society
23	Cove near Split Rock, Lake Superior, ca. 1920	Minnesota Historical Society
29	Barge traffic on the Mississippi, downtown St. Paul	USDA — Soil Conservation Service
31	Water pollution caused by sewage outfall, Upper Mississippi River basin	USDA — Soil Conservation Service
32	Drainage system outfall into the Cannon River	Minnesota Department of Natural Resources
35	Abandoned mill on the Cannon River; the Cannon is being considered for "Wild and Scenic rivers" designation	Charles Wechsler
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54	A 160-acre corn field near Rice, MN, irrigated by means of a center-pivot system	USDA — Soil Conservation Service
59	Extreme gully erosion caused by cropland water drainage	USDA — Soil Conservation Service
61	Beaver River, near two Harbors, MN	Minnesota Historical Society
65	Fire Tug "Torrent", 1912, Two Harbors, MN	Minnesota Historical Society
69	O.F. Doyle dredging outfit, from St. Cloud, digging a drainage ditch near Hagdenville, MN, ca. 1910	Minnesota Historical Society
70	Log jam at Taylors Falls, 1886, illustrating a single dominant use of a river	Minnesota Historical Society
80	Water pollution, filling, and misuse of wetlands, Twin Cities Metropolitan Area	Southern Minnesota Rivers Basin Board
84	Residential flooding	Southern Minnesota Rivers Basin Board
87	Snake Creek in Wabasha county, showing topography typical of southeastern Minnesota tributary streams and agricultural soil conservation practices	USDA — Soil Conservation Service
91	Fairy Falls, north of Stillwater, 1922	Minnesota Historical Society