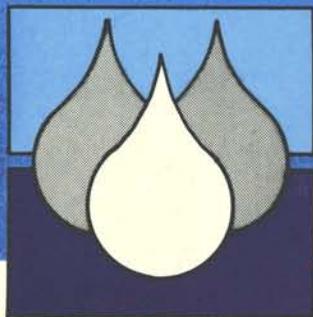


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NORTH DAKOTA STATE AGENCY

# EXECUTIVE SUMMARY



# 1983 STATE WATER PLAN



TD201 .N9 NOR

NORTH DAKOTA STATE WATER COMMISSION: APRIL, 1983

# **NORTH DAKOTA STATE WATER COMMISSION**

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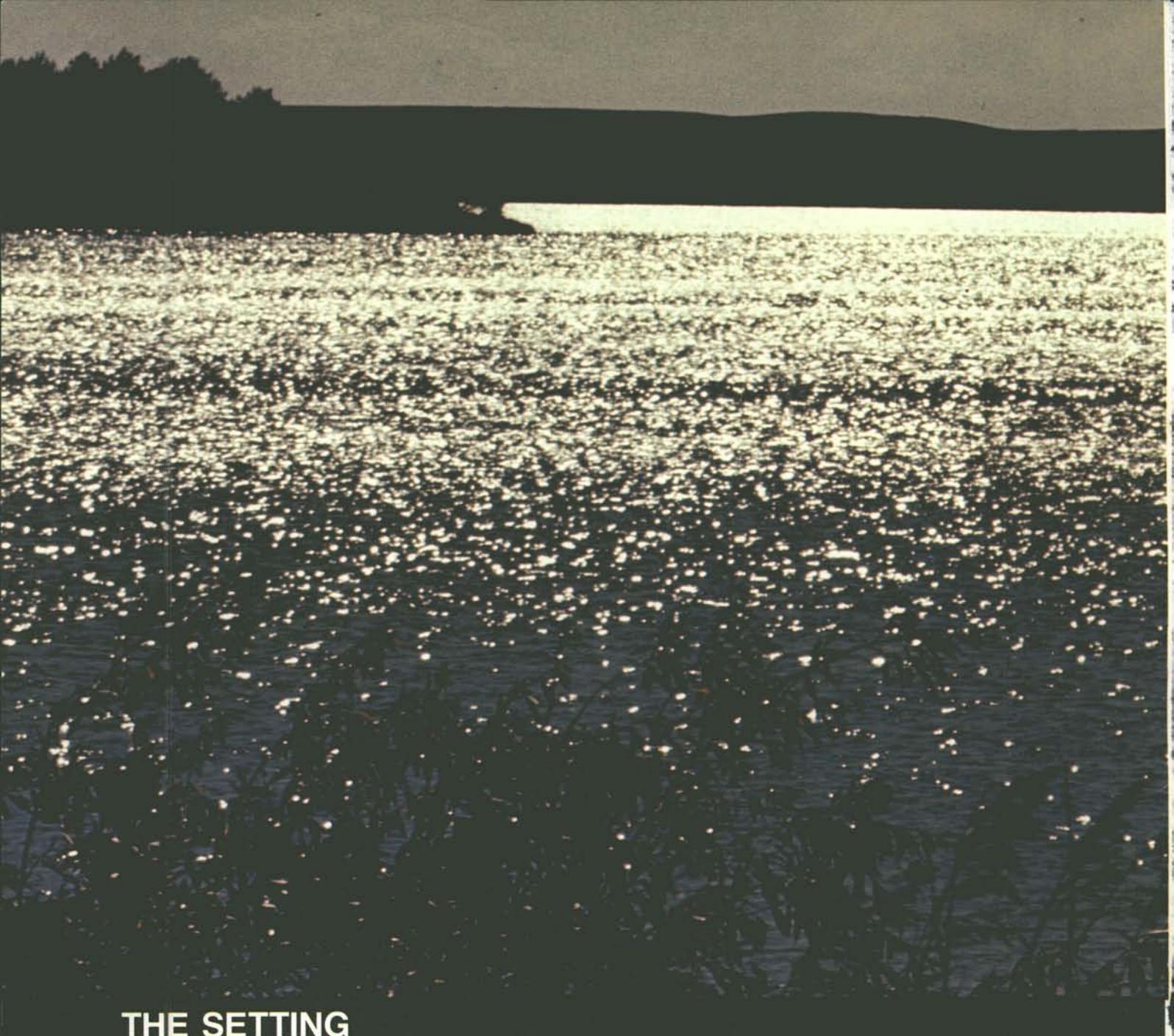
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## THE SETTING

### INTRODUCTION

North Dakota published its first long-range, comprehensive water and related land resources plan in 1968. Earlier statewide water planning efforts, such as the State Planning Board's 1937 plan and the State Water Commission's 1962 plan, dealt largely with strategies for solving problems as they existed when the plans were developed. The 1962 plan attempted to anticipate the kinds of problems and the level of water demand North Dakota might face in the 1980s.

The 1968 Plan went a step further, projecting water use and identifying areas of potential concern in the water sector through the turn of the Century. The 1968 Plan evolved during a time when pressures on the water

resource were relatively insignificant in terms of the total known water supply. The State was aware of its vast lignite reserves and a mine-mouth power production industry was developing. However, interest in utilizing the coal for gasification and/or liquefaction had not yet materialized; nor was there any serious discussion of slurry pipelines. Irrigation development was growing, but slowly. Wetland drainage to enhance agricultural production was taking place with minimum consideration being given to the value of wetlands destroyed or the impact of drainage on downstream interests. The environmental movement was in its infancy and the attitude of most of the public regarding water resources was one of indifference.



Significant changes have occurred since the 1968 plan was published and the new plan must accommodate these changes. Some of the projections and assumptions used in 1968 do not reflect what has happened in North Dakota in recent years. In some instances, the 1968 projections have been exceeded. Irrigation, for example, has increased dramatically as has the level of energy development. In other areas, such as population growth, the 1968 projections tend to be high. Moreover, factors not included in the 1968 projections now must be. In 1968, the possibility of mass diversion of Missouri

River water to states outside the Basin was largely a matter of conjecture. Today, serious attention is being given to the idea with several formal studies being conducted by governmental agencies and private interests to determine the feasibility of using Missouri River water for a variety of purposes outside the Basin. In addition, a growing barge transportation industry, functioning on both the Mississippi and Lower Missouri Rivers, is causing downstream states to closely scrutinize water development in upper reaches of the River for potential negative impacts.

## PURPOSE

The primary purpose of the study is to reassess North Dakota's long-term water requirements in a context of rapidly changing times and values and to begin a decision-making process regarding alternative courses of action. The responsibility for decisions regarding the implementation of programs and projects contained in the plan is in the political-legislative-private domain and rests ultimately with the people. Decision-makers must agree upon the timing and extent of implementation deemed appropriate; they must ascertain the State's ability and willingness to proceed; and they must weigh the relative worth of investing the taxpayer's, stockholder's or their own dollars in the water sector as opposed to investments in other sectors.

The completion of this plan report is but one step in a continuing planning process. The report can be altered and undoubtedly will be because, while it is possible to project future water requirements on the basis of known trends, such projections do not anticipate the future influence of forces which can drastically alter those trends. Moreover, the timing of

project and program implementation may be revised as a result of changing needs and values.

The 1983 State Water Plan should be viewed as a framework within which development can occur rather than a blueprint which must be followed. It should also be viewed as one part of an overall water management program which involves: (1) a permit system, (2) project investigation and design, (3) project construction, (4) program administration, (5) operation and maintenance, (6) regulation and enforcement, (7) coordination, (8) data collection and (9) research.

## PUBLIC INVOLVEMENT

Historically, the impetus for water resources development in North Dakota has come from the people. A "bottom-up" planning process was devised utilizing a public involvement effort structured around Citizens Advisory Boards. In order to obtain the maximum level of participation through the course of the planning process, the State was divided into 17 Public Involvement Regions. The boundaries of

## GENERAL PLANNING PROCESS



these regions approximate watershed boundaries for the most part, but in some instances, they were drawn along county lines to reduce travel distances for Citizens Advisory Board members and other interested citizens. A Citizens Advisory Board was appointed for each Public Involvement Region by the Governor as Chairman of the State Water Commission. These Boards ranged in size from five to 14 members with membership consisting of one representative from each of the Water Resource Districts having jurisdiction in the Region and an approximately equal number of citizens at large.

Between July, 1981 when the Board met for the first time, and November, 1982 when the Boards held their last meeting to review a draft report of the State Water Plan, 85 meetings were held across the State. All meetings were open to the public.

## STUDY GOAL

### The Overall Goal

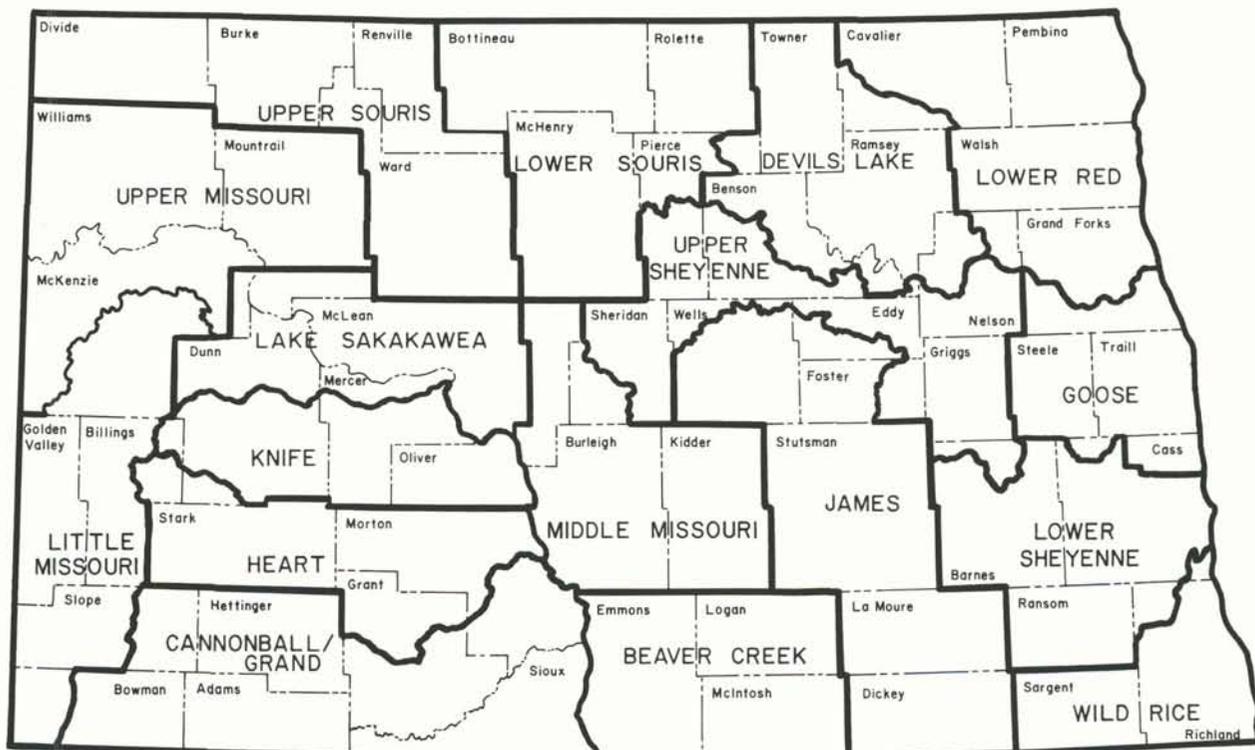
The overall goal of the 1983 State Water Plan is to provide a framework for meeting, through the conservation, development and

management of its water resources, the State's need to have a strong and viable social, cultural and economic structure. Inherent in this goal is a recognition of the need to provide for the well-being of the State's citizens at or near the national level and to protect the State's environment, particularly those elements that are unique and/or threatened.

In pursuit of this overall goal, the planning process placed special emphasis on identifying water and related land resources management measures which tended to:

- (a) broaden the economic base;
- (b) increase employment opportunities;
- (c) maintain and enhance the health, well-being and security of the people by reducing hazards from water pollution and floods;
- (d) maintain a strong agricultural economy by emphasizing watershed management, soil conservation practices, irrigation, research and education; and
- (e) improve the quality of life by preserving and enhancing the environmental and aesthetic values of lakes, parks, recreation facilities, fish and wildlife habitat and the most significant scenic

## PUBLIC INVOLVEMENT REGIONS NORTH DAKOTA STATE WATER PLANNING PROCESS



and historic sites.

Although this goal is very broad, it served to guide the planning process and provided a basis for comparing the end product with that envisioned at the outset of the study.

Still, it was recognized that a more definitive statement of goals was needed if the results of the plan were to attain the support of those affected. It was also recognized that a goal which could be applied generally on a statewide basis would likely have significantly less applicability when applied to specific sections of the State. Consequently, it was apparent that study goals and objectives should be set at the local level. The mechanism used to bring this about was the Citizens Advisory Board.

The goals and objectives adopted by the Citizens Advisory Boards are summarized in this report.

### **THREE-ACCOUNT ANALYSIS SYSTEM**

In order to develop a balanced long-term plan — one which can be embraced by the people it affects — it was necessary to build an analytical system capable of accounting for the

various kinds of impacts triggered by projects and programs being considered for inclusion in that plan. The procedure developed and used throughout the planning process is called the Three-Account Analysis System. Essentially, this involved the evaluation of every project or program which was thought to have the potential for meeting needs or solving problems from three perspectives:

- (1) its quantifiable, beneficial and adverse economic impacts;
- (2) its beneficial and adverse environmental impacts; some of which, such as land use changes, are quantifiable; others of which, such as aesthetic damage, must be handled qualitatively;
- (3) its other social effects impacts; those which are neither clearly economic nor environmental, but which nonetheless, influence life-styles, quality of life, etc; typically nonquantifiable.



## STUDY SCOPE

### Level of Investigation

The Plan recommended in this report is the result of a preliminary or reconnaissance level study intended to provide broad analyses of water and related land resource problems and development opportunities and to furnish general appraisals of the probable nature, extent and timing of measures for their resolution or implementation. In a few instances, such as in the case of the Devils Lake Basin where a substantial amount of detailed planning had already been accomplished prior to beginning this effort, the study scope is more accurately described as modified reconnaissance. Because less time is required to update the data base of such a study, it is possible to place greater emphasis on describing project/program impacts and on the clarification of public preferences.

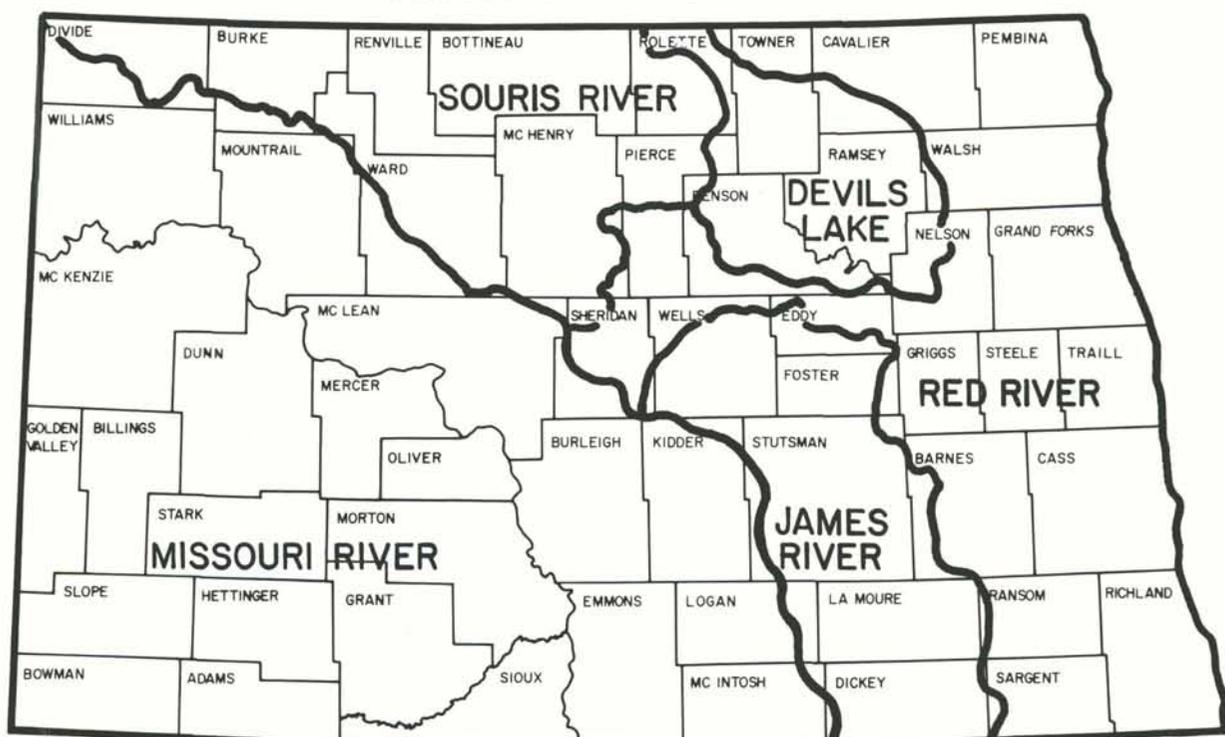
Study results should be viewed as comprehensive and long-range. All uses of water in North Dakota were considered in identifying problems, calculating need (the difference between developed supply and

demand) and formulating measures to solve a problem, satisfy a need, or take advantage of desirable growth opportunities. Moreover, each major hydrologic subdivision is treated as a system with emphasis given to reviewing a project's contribution toward solving regional problems.

### Timeframe

The study, keyed to a period of 40 years between 1980 and 2020, uses 1990, 2000 and 2020 as benchmark years for measuring water requirements and the degree to which plan features will meet those needs. The level of detail for benchmark year 1990 is far greater than for 2000 and 2020. Specific plan elements (storage reservoirs, diversion systems, etc.) for 1990 are identified by location, size and cost. Plan elements for 2000 and 2020 indicate only an estimate of water requirements to be met by surface water control, level of ground-water development, modification of existing projects and various other water management programs.

Figure I-1-1 MAJOR HYDROLOGIC SUBDIVISIONS  
NORTH DAKOTA



### Early Action Program

The timeframe ending with benchmark year 1990 deserves special mention. As indicated in the previous paragraph, it details those projects and programs with the highest priority for implementation. Throughout this report, it is referred to as the Early Action Program.

### Planning Divisions

For purposes of planning, the State is divided into five major hydrologic subdivisions or basins: Missouri, James, Red, Devils Lake, Souris (Figure I-1-1). A separate plan was developed for each major subdivision. Combined, they constitute the 1983 State Water Plan.

Most economic and demographic data are collected and compiled on the basis of political (county, township, municipal) boundaries rather than hydrologic (watershed) boundaries. In view of this, and in order to make the socioeconomic data as compatible as possible with the hydrologic data, it was necessary to divide the State into Statistical Planning Areas (Figure I-1-2) which roughly approximate the hydrologic boundaries.

## PARTICIPATING AGENCIES

### Local

Water Resources Districts

### State of North Dakota

Department of Agriculture

Department of Health

Forest Service

Industrial Commission

Parks and Recreation Department

Soil Conservation Committee

Game and Fish Department

North Dakota State University

### Department of Agriculture

Soil Conservation Service

### Department of the Army

Corps of Engineers, St. Paul District

Corps of Engineers, Omaha District

### Department of the Interior

Bureau of Reclamation

Geological Survey

Fish and Wildlife Service

### Other Organizations

N.D. Water Users Association

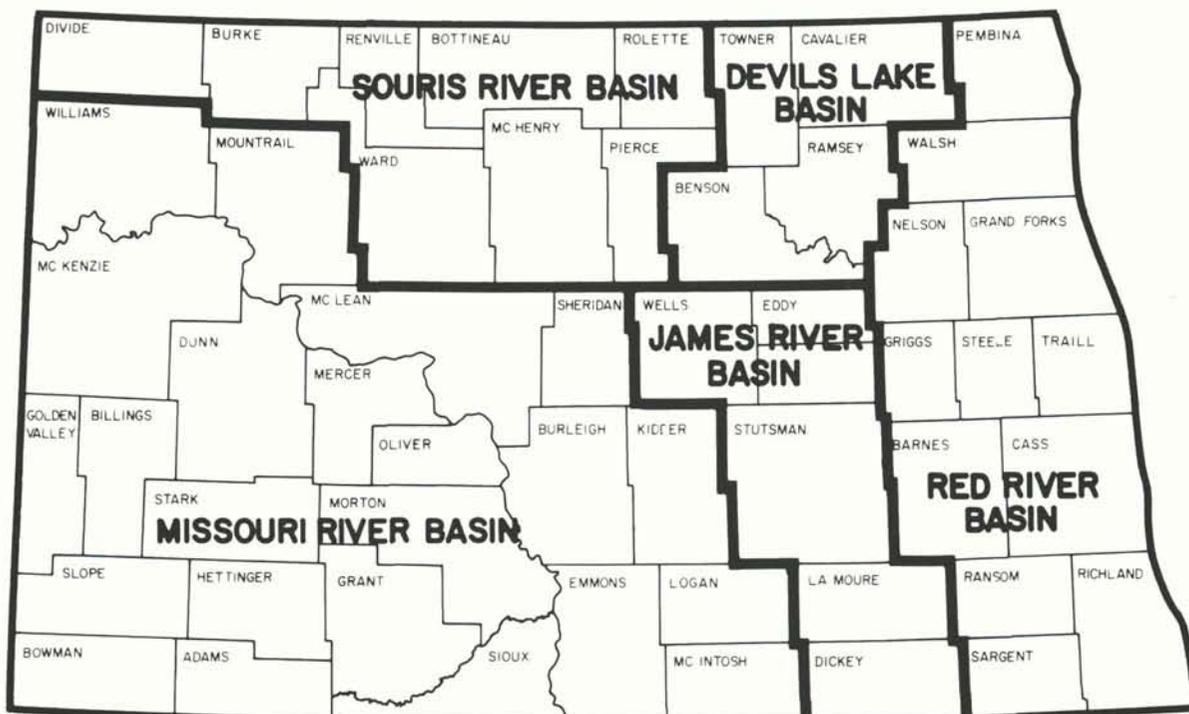
N.D. Assn. of Irrigation Districts

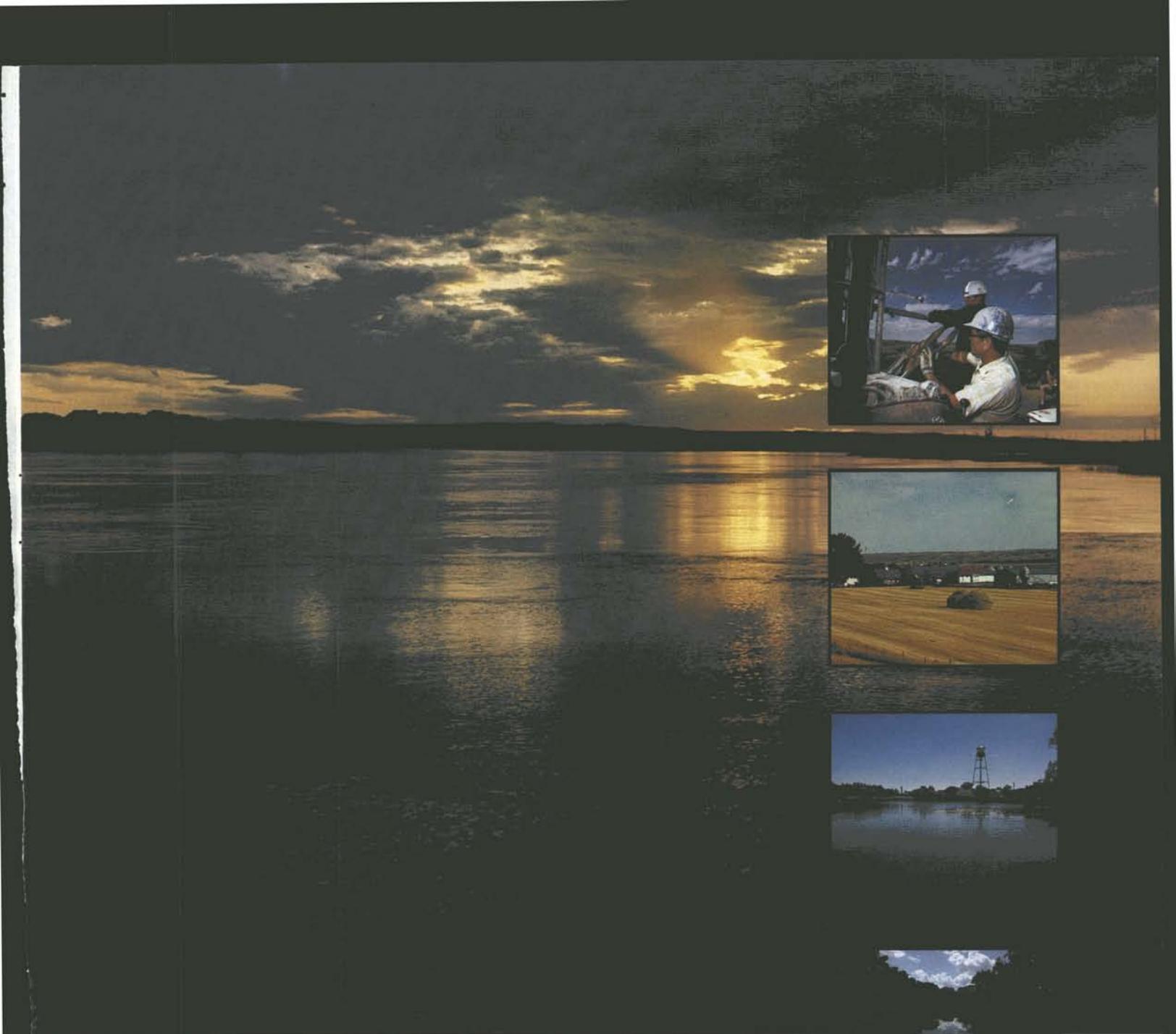
N.D. Water Resource Districts Assn.

N.D. Rural Water Association

Figure I-1-2

## STATISTICAL PLANNING AREAS NORTH DAKOTA





## STATEWIDE DESCRIPTION

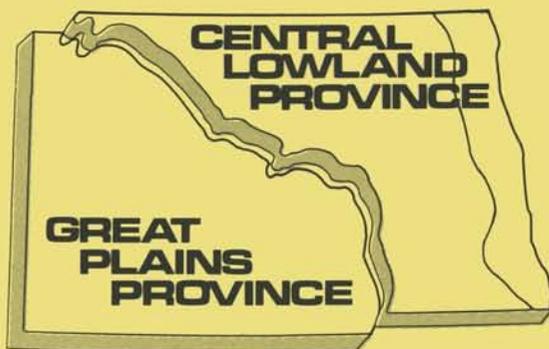
### INTRODUCTION

Describing North Dakota's physical, social, and economic characteristics is an integral part of the planning process. In this manner, the diversity of the State can be addressed in terms of its basic natural and social resources.

### GEOGRAPHY

North Dakota covers 70,665 square miles in a rectangular area around the center of the North American continent. Two major natural geographic provinces, separated along the Missouri Escarpment, divide the State about equally. The Central Lowland Province is predominantly an area of glacial landforms and lake plains; the Great Plains Province combines glaciated terrain with badlands and landforms of eroded, soft, sedimentary bedrock. Two major river systems drain North Dakota — the Missouri River system and the Hudson Bay

drainage area. The Missouri River system includes the Missouri and James Rivers; the Hudson Bay drainage area includes the Souris and Red River systems, plus the large noncontributing area of the Devils Lake basin.



## CLIMATE

North Dakota's climate is sub-humid continental, characterized by highly variable daily, seasonal and annual weather patterns. The average annual temperature ranges from 37°F to 43°F north to south across the State, but the difference between the lowest and highest annual temperature often exceeds 120°F. Set temperature patterns rarely last an extended period of time due to the regular movement of frontal systems.

Average annual precipitation varies from 13 inches to 20 inches west to east across the State, but the amount received and distribution in time and space within the State can vary considerably from year to year. Years with above and below average precipitation occur periodically, but the recurrence interval remains mostly unpredictable. The evaporation rate varies seasonally, peaking during the summer. However, average annual evaporation exceeds average annual precipitation everywhere in the State. The difference between annual evaporation and precipitation decreases during wet years. In some areas of the State, precipitation exceeds evaporation during wet years. The length of the growing season, ranges from less than 110 days to over 130 days.

## GEOLOGY

The bedrock underlying North Dakota includes Precambrian crystalline rocks older than 570 million years through Tertiary sedimentary rocks about two million years old. The thickest section of sedimentary rock occurs in the Williston Basin, the principal geologic feature of the State. Overlying the bedrock throughout much of North Dakota are unconsolidated sediments (matter deposited by wind or water) mostly glacial in origin, but also including sand, clay, etc., deposited by moving water (alluvium) and rock fragments, sand, etc., that accumulate on steep slopes or at the foot of cliffs (colluvium).

Continental glaciers moved great quantities of material into and within North Dakota. This material was deposited as outwash, lake sediments, various types of moraines (a mass of rocks, sand, gravel, clay, etc., carried and deposited directly by a glacier) and other glacial landforms. Thickness of the drift varies considerably, ranging from less than 50 feet to about 800 feet. In some areas of southwestern North Dakota, the only evidence of glaciation are glacial erratics (boulders or rock formations transported some distance from their original source). Linear and arched hills of end and recessional moraines mark stillstands in the slow fluctuation of ice fronts across the State. The hilly, dead-ice moraine of the Missouri Coteau delineates a broad band where the last ice advance stagnated. Sand and gravel units occur in the glacial drift as thin, lens-shaped beds to very thick, buried-valley deposits. These deposits of sand and gravel form the most productive aquifers in the State.

## MINERAL RESOURCES

North Dakota's mineral-resource base consists of a few major ones and many minor ones. The major resources are oil and natural gas, lignite and sand and gravel. Production of these resources comprises almost all the activity in the State's mineral industry and it is likely to remain this way as the recoverable reserves are developed. The minor mineral resources range from those that are commercially developed on a small scale, clay, potash and peat for example, to those that are at present mostly geologic curiosities such as gold and zeolites.

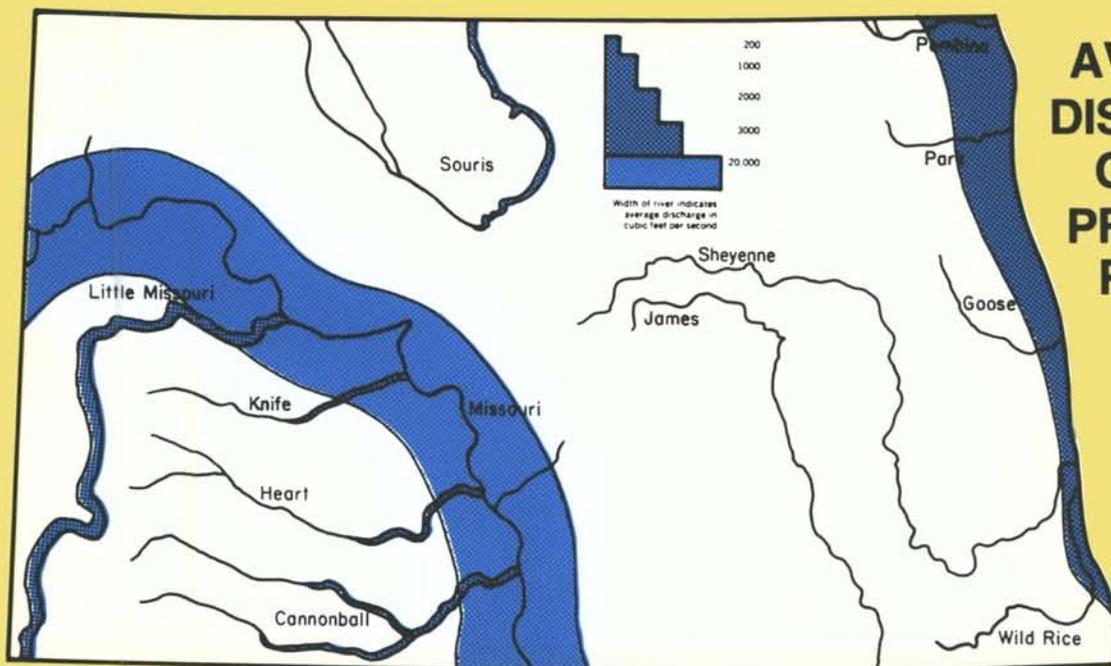
## WATER RESOURCES

Surface water is that water which occurs on the land surface, typically in lakes, rivers, streams, and the like. The three principal sources of surface water in North Dakota are streams and rivers flowing into the State, precipitation and discharge of ground water into streams or as springs. The State's major rivers are characterized by large average annual flows, but most of them can have large variations in flow during any year. Average annual runoff ranges between one-fourth inch and one inch. The difference between average annual precipitation and runoff is due mostly to evapotranspiration. The two periods of greatest runoff typically occur during late spring when snowmelt water moves through the drainage system and during summer when thunderstorms can produce heavy rainfall in localized areas over a short period of time.

Surface water contains dissolved inorganic and organic mineral matter. The type and

hydrology and climate creates the diversity of wetlands common to the glaciated region of the State. The biological functions of wetlands, particularly those related to wildlife concerns, have been established. The other functions of North Dakota's wetlands, those related to surface-water hydrology, ground-water/surface-water interaction and control of sediment and pollution, are not as well understood and require further study. The 1964 inventory of wetlands, the most recent statewide inventory available, indicated about 1.7 million acres of wetlands existed in North Dakota. Another inventory, using a classification system different from the 1964 inventory, is in progress.

Ground water occurs throughout the entire geologic section of North Dakota, from Precambrian crystalline rocks to unconsolidated deposits at land surface. Some of these materials are aquifers, that is they are sufficiently permeable to transmit water readily. Bedrock aquifers underlie the whole



## AVERAGE DISCHARGE OF THE PRINCIPAL RIVERS

concentration of this mineral matter is related to a variety of factors, including rate of stream flow, ground-water inflow, runoff, land and water management practices and climate. Surface-water quality varies greatly with quantity of flow. Better quality water is generally associated with larger stream flows.

Wetlands are land surface depressions in which sufficient water accumulates to saturate the soil or cause standing water for at least part of a year. The interaction of topography,

State, while aquifers in the glacial drift and stream-valley deposits are less widespread.

Thickness and depth of bedrock aquifers generally increase east to west toward the center of the Williston Basin. The deeper aquifers are usually carbonate formations or formations consisting of fragments of older rock. Increasing water temperatures and dissolved-solids concentrations are associated with the increasing depth. Due to these trends, deeper bedrock aquifers are typically used only

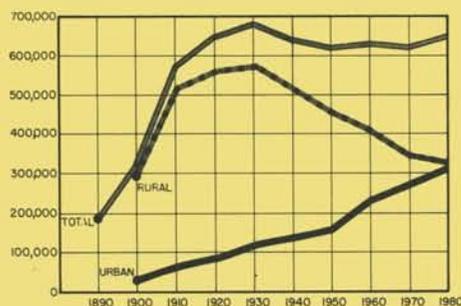
in oil field operations. However, they may be a potential source of geothermal energy. Shallower bedrock aquifers constitute a significant water resource in terms of areal extent and accessibility. These shallower bedrock aquifers are predominantly sandstone or lignite beds.

Aquifers in the unconsolidated sediments are most prevalent and productive in the glaciated portion of the State. Glacial-drift aquifers are deposits of outwash, valley fills, or deltas formed by the combined action of glaciers and rivers. The rate at which these deposits yield water depends on the thickness, extent, and permeability of the aquifer material and the amount of ground water stored in and recharged to the deposit. Well yields range from less than one hundred gallons to hundreds of gallons per minute. The water quality is typically better than that of the underlying bedrock aquifers although it varies from one area to another and with depth. In the unglaciated southwestern part of the State, aquifers occur in the alluvial sediments in stream valleys. These aquifers generally are thin, of limited extent and capable of only low well yields. Water quality is often a problem.

## SOCIOECONOMIC CHARACTERISTICS

North Dakota had a 1980 population estimate of 652,717 persons of which 43 percent was urban and 57 percent was rural in nature. This total is up 34,925 persons from the 1970 estimate of 617,792 for an increase of 5.7

### NORTH DAKOTA POPULATION, 1890-1990



percent. Housing units increased 26.6 percent in that same period. Both of these increases are largely due to the influx of people associated with the development of the State's coal and oil reserves along with increased activity in the manufacturing, service, wholesale/retail trade and financial sectors of the economy. The State has a population density of about nine persons

per square mile. The eastern part of the State is the most densely populated with approximately three times as many persons per square mile as the western part.

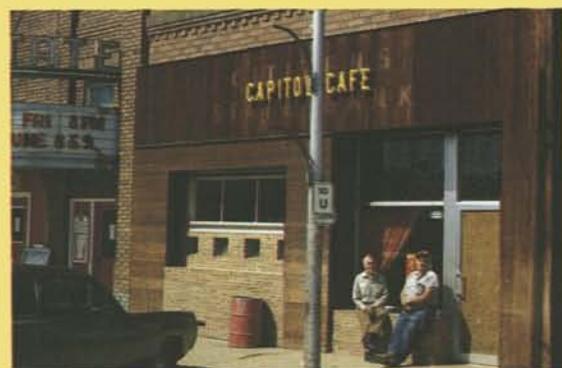
Agriculture is the major industry in North Dakota. Of the approximate 70,000 square miles of land area, about 66,000 square miles or 95 percent of the State is devoted to agricultural production. Of that total, 61 percent is cropland, 33 percent is pasture and rangeland, and one percent is forest.

North Dakota is a leader in the United States in the production of spring wheat, durum, barley, flaxseed, sunflower and honey. Production of cattle and calves is the State's major livestock enterprise. Historically, the sale of crop products has accounted for 70 to 80 percent of the total agricultural production; livestock and livestock products have been about 20 to 30 percent.

Total wage and salary income increased steadily to over \$3 billion in 1980. The services and state and local government sectors typically have the highest incomes of all sectors. Farm income varies considerably due to commodity price fluctuations.

Employment in the State totaled over 336,000 persons in 1980. The two leading sectors, retail trade, and state and local government, employed the largest percentage of the total employment. The average annual unemployment rate was 5.0 percent for 1980. This rate increased to 5.3 percent in 1982.

Exploration for energy sources, primarily oil and gas, has resulted in a substantial boost to North Dakota's economy. For example, employment in the mining sector increased 381 percent between 1970 and 1980. This growth percentage is significant in that many support industries also benefit from the additional business volume generated. During 1981 and 1982, there has been a substantial slowdown in energy source exploration resulting in a decrease in employment and business volume.





## GOALS AND OBJECTIVES

### INTRODUCTION

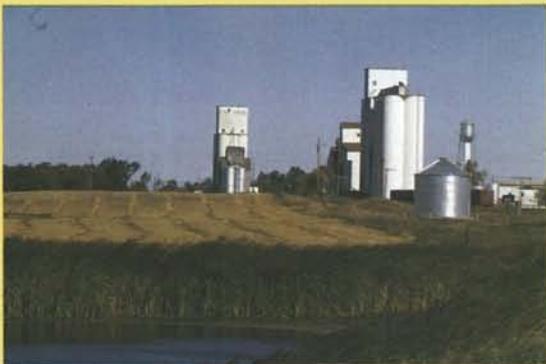
Developing a comprehensive list of goals and objectives early in a planning process is necessary in order to establish a common direction and purpose for those who participate. This increases the efficiency of the overall process by bringing the most important issues into focus.

In developing the 1983 State Water Plan, each of the 17 Citizen Advisory Boards was encouraged to develop its own goals and objectives to better represent unique physical conditions and social attitudes of their region. Accomplishing this task began with an initial statewide listing gleaned from earlier study reports. The initial draft organized these goals and objectives by function, addressing water

supply, irrigation, water quality, flooding, fish and wildlife, outdoor recreation, transportation, weather modification and energy. The draft was reviewed first by the Citizen Advisory Boards which made corrections, deletions and numerous additions. The general public responded to draft goal and objective statements during the third round of meetings. Comments obtained at these meetings aided the Citizen Advisory Boards in completing this initial step of the planning process.

The goals and objectives included in this summary are only those which attained broad support from the Public Involvement Regions. The main report includes a complete listing of the goal and objective statements.

## WATER SUPPLY GOALS AND OBJECTIVES



### GOAL:

Meet the projected water supply demands for all purposes for the years 1990, 2000, 2020 and beyond.

### OBJECTIVES:

Provide technical, administrative and financial assistance to local governments to assure a safe, reliable supply of drinking water. Research methods to deal with nuisance minerals in untreated water supplies.

Develop self-supporting, rural water systems in areas where the increasing demand exceeds available supplies and where the quality of the existing supplies is poor. Many smaller communities across the State could benefit from rural water systems. Subsidies to systems serving low-density service areas should be considered.

Develop energy resources only after exhaustive evaluation of the trade-offs and only when such developments will not significantly reduce stream flow, lake levels and/or ground-water storage.

Encourage the reclamation and reuse of water in order to minimize consumptive water losses.

Continue to evaluate the quality and quantity of surface- and ground-water resources and provide up-to-date inventories on water availability to prospective water users and to local governments.

Provide assistance in developing water supplies for new or existing industries in the State, particularly those that process North Dakota's agricultural products.

Quantify Indian and Federal non-Indian water rights to resolve the question of water availability.

Reserve sufficient quantities of water from the Missouri River system to provide a reliable supply for all foreseeable municipal, industrial, agricultural and domestic needs.

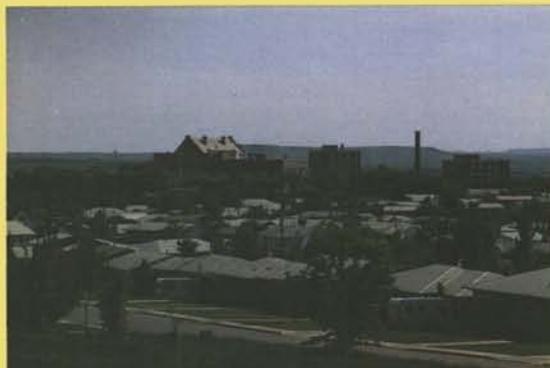
Complete the Garrison Diversion Project.

Determine the need for additional water distribution systems across the State. Southwest North Dakota urgently needs a more reliable supply of good quality, domestic water.

Develop water distribution systems in ways which are environmentally sound and which minimize disruptions to agricultural and other land uses.

Initiate a public education program designed to aid citizens in understanding water resources management, including conservation of water in homes, industry, and agriculture and the maintenance of water quality.

Develop small dams on selected North Dakota streams to retain an adequate supply of water for use in late summer and fall.



## IRRIGATION

### GOALS AND OBJECTIVES



#### GOAL:

Encourage public and private irrigation development to help stabilize and diversify the State's agricultural production.

#### OBJECTIVES:

Assist irrigators in achieving optimum efficiency of water use through rehabilitation of older systems and improvement of irrigation techniques.

Complete detailed ground-water studies to increase practical knowledge of the State's aquifer systems thereby improving the ability to manage the resource. Ground water should be managed so as to assure its availability for domestic use.

Satisfy the water supply needs for new and expanding irrigation development by implementing water supply facilities that demonstrate the potential for the greatest economic, social and environmental benefits to the public.

Analyze alternatives for distributing Missouri River water for irrigation in conjunction with other beneficial uses.

Utilize treated waste water for irrigation where the characteristics of the water and the soil are compatible.

Establish flow models of highly appropriated rivers to determine if additional irrigation withdrawals can be made. Determine the best timing for such withdrawals.

Research how, when, and at what rates water can be applied to various soils to obtain long-term, cost effective and efficient use of water. The State Water Commission and State Department of Agriculture should work together, using all available soils and water information, to assure long-term soil productivity and water quality preservation.

Soil analyses should be completed statewide to determine areas of irrigable soils; maps outlining these areas should be made available. Potential irrigators should be deterred, through the water-permitting process, from using water incompatible with the soils to be irrigated.

Improve irrigation information/education programs. Available information should include water-resource data and State Water Commission policy regarding the granting of irrigation permits.

Complete the Garrison Diversion Project. Develop irrigation along the McClusky Canal. A secondary benefit would be improvement of the water quality in Lake Audubon.



## WATER QUALITY GOALS AND OBJECTIVES



### GOAL:

Maintain and enhance the quality of all waters of the State.

### OBJECTIVES:

Increase the level of financial support to local governments for training operators of waste water treatment plants.

Increase the level of financial support to local governments for maintaining and upgrading waste water treatment plants. Aid local governments in monitoring the quality of municipal waste water discharges.

Improve land management practices to attain effective erosion control. Research should continue to find additional ways to reduce nonpoint source pollution.

Increase monitoring of water quality to aid in the detection and elimination of pollutant sources that may adversely affect water users and the natural environment.

Counties with zoning ordinances should enact water quality regulations. This should apply particularly to land-use restrictions in areas determined to be ground-water recharge areas.

Restore, where practical, natural and man-made lakes to a useful condition. The design of new reservoirs should incorporate features that help extend their useful life.

Capitalize on Federal Clean Water Act provisions for the installation of animal waste lagoons.

Maintain strict compliance with water quality regulations among holders of point source pollution permits.

Investigate the role of wetlands in affecting the quality of surface-water runoff. Additional research is needed to better understand both the negative and positive values of maintaining wetlands for this purpose.

## FLOODING GOALS AND OBJECTIVES

### GOAL:

Reduce and/or eliminate flood damages to life and property in floodplains and other flood-prone areas.

### OBJECTIVES:

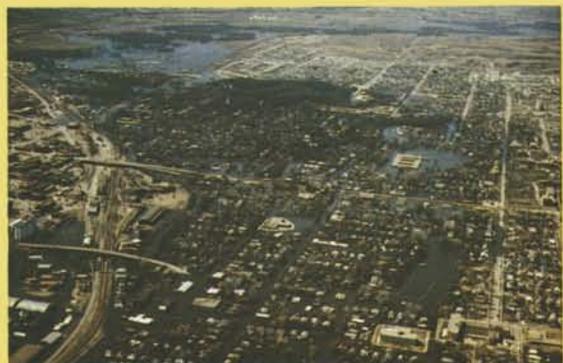
Develop structural, nonstructural and/or a combination of measures to reduce flood damages as determined on a case-by-case basis. Structural measures could include small tributary dams designed with permanent reservoirs, "dry" dams which could hold runoff for short periods and construction of levee systems. Consider use of stored flood waters for irrigation, recreation, domestic and other uses.

Implement land-treatment measures to help control heavy runoff during spring snowmelt and summer storms.

Develop and maintain a data base and management system containing information related to floodplain management such as maps of rural flood-prone areas for use by state and local officials.

Develop and maintain a public information/education program concerning floodplain management.

Actively administer North Dakota's Floodplain Management Act to guide development in floodplain areas. Achieve active participation by all flood-prone communities in the National Flood Insurance Program.



Develop a state program that would complement and resemble in function the U.S. Department of Agriculture's Watershed Protection and Flood Prevention Act of 1954 (P.L. 566). Among other things, the program would identify and treat the sources of reservoir sedimentation.

Maintain and enlarge the existing stream gauging network, particularly on smaller streams. State and local co-op stations could augment U.S. Geological Survey stations.

Improve coordination between state agencies and local governmental units, such as Water Resource District Boards, Township Boards and County Commissions, concerning modifications to natural drainage patterns and drainage improvements.

Identify wetlands as surface water features which should be protected. Discourage the practice of draining permanent wetlands where such activity could contribute to excess runoff.

Study the effect of wetlands on the downstream movement of sediment and determine the usefulness of wetlands in land-management programs.

Encourage landowners to hold water on their land for a short period of time in order to curtail downstream flooding. Financial compensation to these landowners would be an incentive.

Manage discharges from drained wetlands through the use of gated culverts, where possible, so the timing of these flows minimizes contributions to flooding. Develop acceptable, coordinated plans for the orderly passage of runoff. Prevent excess water from entering problem watersheds via legal and illegal drainage.

Productive agricultural land is a valuable resource which should be given greater recognition when determining the benefit-cost ratio for water projects.

## **FISH AND WILDLIFE GOALS AND OBJECTIVES**

### **GOAL:**

Perpetuate and enhance, where possible, fish and wildlife resources for continued recreational, aesthetic, educational and scientific use.

### **OBJECTIVES:**

Maintain and enhance habitat necessary to support wildlife populations at levels which will meet growing recreational demands.



Provide incentives through voluntary programs, like the Federal and State Water Bank Programs, to encourage private landowners and farm operators to maintain and/or improve wildlife habitat. This method of providing wildlife habitat is preferable to permanent easement and fee title purchases associated with current wetland preservation programs.

Undertake a joint federal/state effort to identify and secure "essential" habitat areas for rare and endangered species of plants, wildlife and fish.

Improve cooperation/coordination between fish and wildlife interests and landowners.

Alleviate point and nonpoint source pollution which adversely impacts aquatic and related ecosystems.

Initiate a cooperative effort between state and federal entities to define and quantify benefits derived from maintaining fish and wildlife habitat.

Develop a more equitable method of mitigating wildlife habitat affected by water development projects.

Consider development of wetlands habitat in conjunction with flood-control projects, particularly small impoundments.

Adopt intensive management of federal and state easement and fee title lands to optimize wildlife production.

Provide protection from wildlife depredation on farmlands adjacent to federal and state refuges and wildlife production areas. Blackbirds have caused particular problems with sunflowers and small-grain crops.

## **OUTDOOR RECREATION GOALS AND OBJECTIVES**

### **GOAL:**

Develop sufficient water-based, outdoor recreation facilities to meet the projected needs for 1990, 2000 and 2020.



### **OBJECTIVES:**

Identify and evaluate opportunities to develop new sites or improve upon existing recreation facilities along the State's streams and lakes. Facilities should be suitable for all age groups and should not adversely affect natural ecosystems.

Maintain water quality in streams and existing lakes at a level compatible with swimming, boating, game-fish reproduction and aesthetic appeal. Design of proposed recreation reservoirs should include measures to maintain good water quality.

Increase the level of funding for outdoor recreation facilities which can be developed either independently or as a part of a multi-purpose project.

Develop more public access areas on lakes throughout North Dakota emphasizing recreational activities such as swimming, boating and fishing. Promote the development of riverbank parks and trails.

Provide historical markers at appropriate locations, particularly along riverbanks.

## **TRANSPORTATION GOALS AND OBJECTIVES**

### **GOAL:**

Provide sufficient water to allow use of the Missouri River for barge transportation in North Dakota.

### **OBJECTIVES:**

Determine the feasibility of commercial navigation on the North Dakota portion of the Missouri River.

## **WEATHER MODIFICATION GOALS AND OBJECTIVES**

### **GOAL:**

To develop a scientifically credible and socially acceptable statewide program of precipitation management administered under existing state authority and local control.

### **OBJECTIVES:**

Increase public awareness of the existing program's ability to manage precipitation. Opportunities for public review and assessment of operational weather modification programs should be available.

Maintain an adequate rain gauge network for climate analysis. Provide a climate data base to potential users.

Improve and maintain hail occurrence records in North Dakota and border areas of surrounding states.

Recognize weather modification as a water management tool. Coordinate weather modification activities with water resource needs determined by local, state and federal agencies.

Determine the impact of precipitation management operations on the State's economy.

Weather modification and climate research activities should be coordinated. Standards for operational programs should be set and administered to protect the public health and environmental welfare.

## **ENERGY GOALS AND OBJECTIVES**

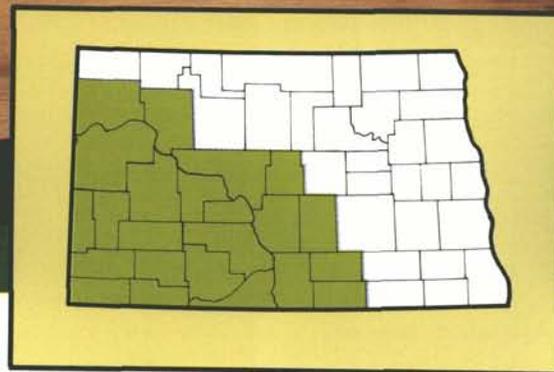
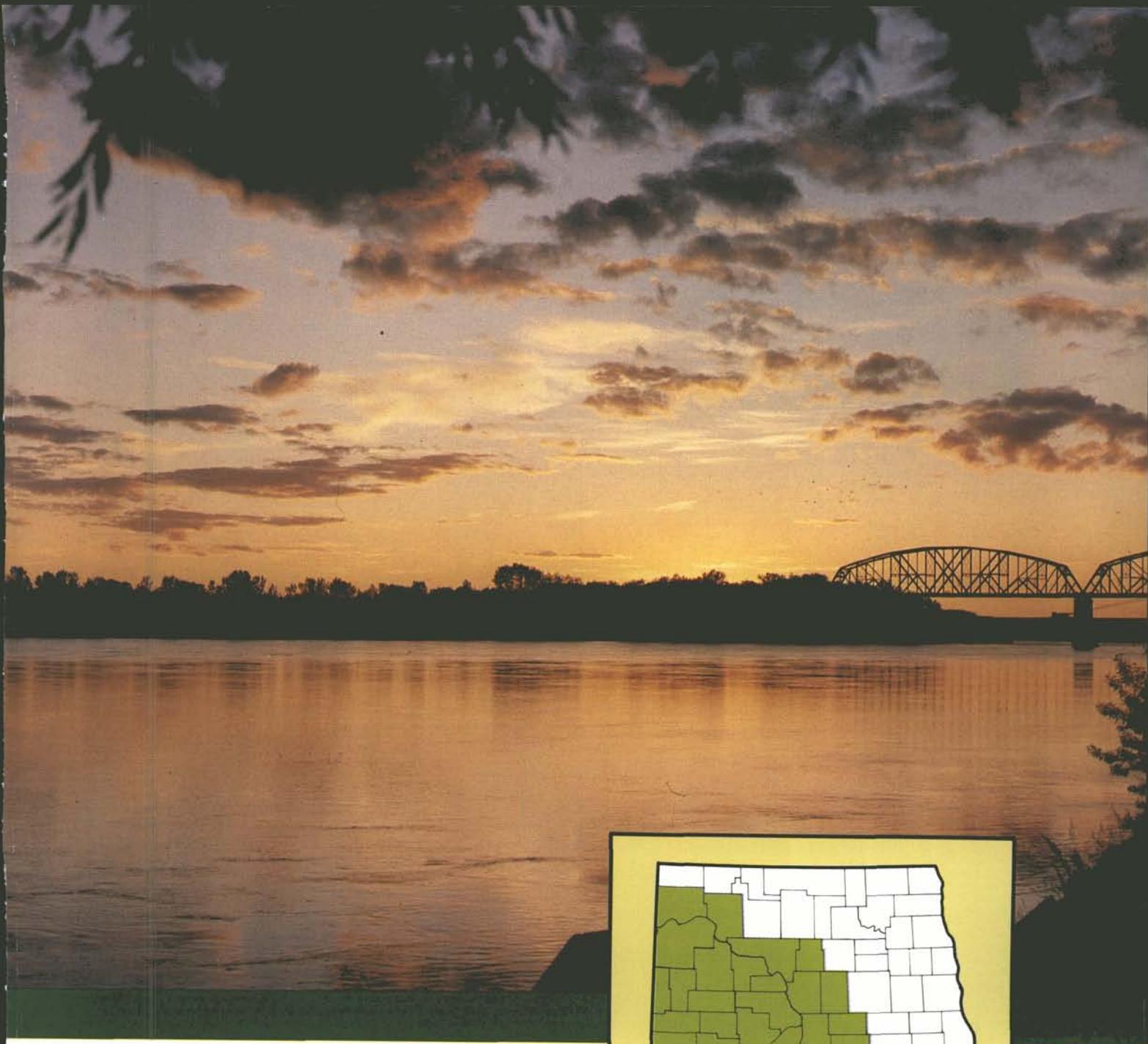
### **GOAL:**

Manage water resources for optimal use in energy production while minimizing the potential of negative impacts.

### **OBJECTIVES:**

Determine the need for, and capacity of, hydroelectric generation in North Dakota. Reserve sufficient water for future hydroelectric use.

Assess the potential for pumpback or off-stream hydropower development in North Dakota along the Missouri mainstem.



## MISSOURI RIVER BASIN





## PROBLEMS

The Missouri River Basin, largest major hydrologic subdivision of the State, drains 33,902 square miles in western and central North Dakota, or approximately 48 percent of the State's total area. Major tributaries include the Yellowstone, Little Missouri, Knife, Heart, Cannonball and Grand Rivers. A rather extensive area north and east of the River is normally noncontributing, but several small streams do drain directly into the mainstem. Two large reservoirs, Lake Oahe and Lake Sakakawea, occupy major portions of the mainstem Missouri River in North Dakota.

The major problems in the Basin relate to inadequate quantity and quality of water to meet municipal, rural-domestic, irrigation and livestock needs. Many farms and cities in southwestern North Dakota as well as localized areas in other parts of the Basin such as the Fort Berthold Indian Reservation, eastern Kidder County and Mountrail County lack a good quality — adequate quantity water supply.

Periodic flooding of agricultural land and communities such as Linton, Napoleon, Mott and Flasher results from rapid runoff of spring snowmelt and/or from heavy rainfall in the late spring or summer months.

Serious riverbank erosion is occurring along the Missouri River below Garrison Dam. Regulated flows of relatively sediment-free water discharged from the Dam cause more river bottom and riverbank degradation than is offset by accretion in unprotected reaches of the Missouri River. Riverbank erosion is also occurring along many reaches of the major tributaries such as the Heart River where many erosion sites have been identified.

Other problems include the sedimentation and eutrophication of natural lakes and man-made reservoirs. A related problem, wind and water erosion, not only strips the land of vital topsoil, but also contributes to heavy deposition of sediment into streams and lakes. As of 1980,

approximately 4.4 million acres of cropland, 542 thousand acres of pasture, 4.1 million acres of rangeland and 54 thousand acres of forest required some type of land treatment.

One concern that requires attention is the deterioration of many older dams, built mostly during the 1930s by the Works Project Administration and the Civilian Conservation Corps for various uses. A general lack of local water-oriented, outdoor recreation areas is an additional problem.

## OPPORTUNITIES

Opportunities for water development projects in the Missouri River Basin are largely those which respond to water supply problems. Multi-purpose structures could retain water for a number of uses such as municipal and rural domestic water supply, irrigation, flood control, outdoor recreation and fish and wildlife. Other opportunities which attempt to address the water supply problem in southwestern North Dakota are proposed water conveyance systems which, if constructed, would carry much needed water to municipal/industrial, agricultural and other users.

The potential exists for expanding irrigation in the Missouri River Basin using both surface and ground-water sources. Irrigation education seminars, lakeside irrigation and the collection of more specific ground water information in order to better manage the resource and expedite the irrigation water permitting process are just a few of the ways in which irrigation could be advanced.

Many opportunities exist for limiting erosion. Bank stabilization projects on streams and the installation and/or acceleration of land management practices such as windbreaks, grassed waterways and strip cropping, represent two of many solutions needed to decrease erosion and abate the movement of nutrients, fertilizers and pesticides from the land. Assistance for implementing land treatment measures is available through the Soil Conservation Service (SCS) and Agricultural Stabilization and Conservation Service (ASCS).

Development and improvement of water-based outdoor recreation facilities are also important priorities. The populations of many western North Dakota cities have grown dramatically due to recent energy exploration and development. Installation of additional outdoor recreation facilities to meet growing needs is considered essential.



- |  |   |
|--|---|
| 1. Welk Dam Repairs  | 15. Heart River Streambank Stabilization            |
| 2. Linton Flood Control                                      | 16. Otter Creek Dam                                 |
| 3. Jund Dam Repairs  | 17. Lower Antelope Creek Dam                        |
| 4. Napoleon Flood Control                                    | 18. North Dickinson Channel Critical Area Treatment |
| 5. Beaver Lake Dam Repairs                                   | 19. Schwartz Dry Dam                                |
| 6. Fort Yates Irrigation Unit                                | 20. Missouri River Streambank Stabilization         |
| 7. Square Butte Dam  | 21. McClusky Canal-side Irrigation                  |
| 8. Wolf Butte Dam  | 22. Knife River Streambank Stabilization            |
| 9. Flasher Dike  | 23. Hazen-Stanton Irrigation Unit                   |
| 10. Thirty-Mile Creek Dam                                    | 24. Beulah Dry Dams                                 |
| 11. Mott Dam   | 25. Emerson Dam                                     |
| 12. Bohlman Dam  | 26. Halliday Flood Control                          |
| 13. Little Heart Irrigation Unit                             | 27. Yellowstone River Streambank Stabilization      |
| 14. Heart River — Scenic and<br>Recreation River (106 miles) | 28. Little Missouri River Streambank Stabilization  |

### REGION-WIDE

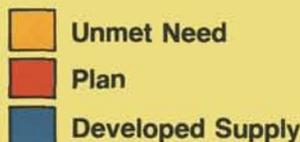
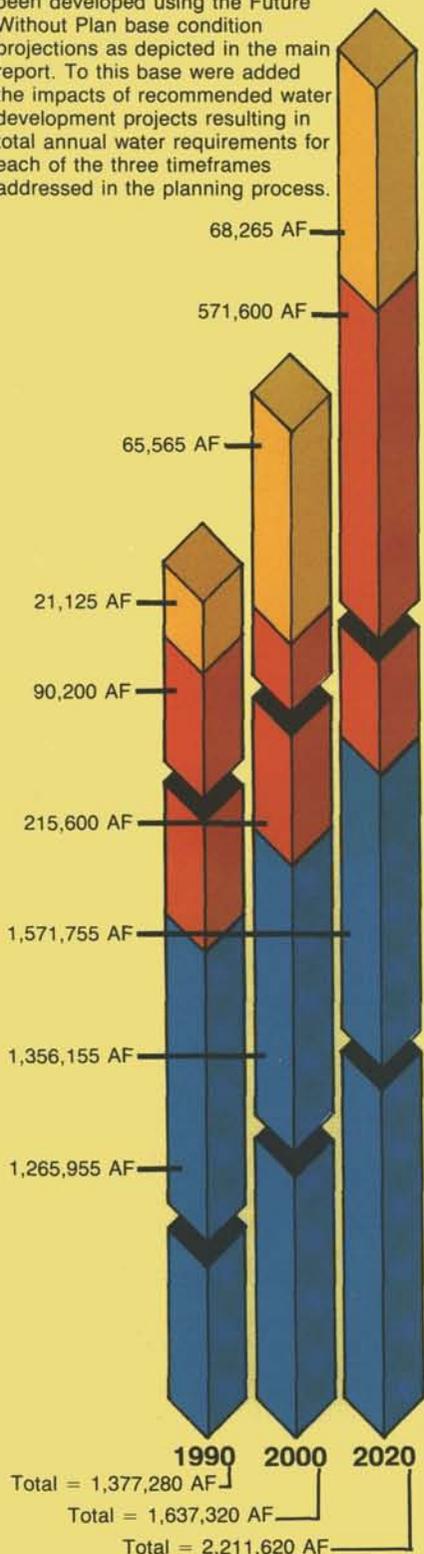
Land Treatment Measures — Measures to be applied to 2,942,000 acres of land.

Municipal Waste Treatment — Development of new and/or improvement of existing facilities in 45 communities serving 35,869 people, in addition to Fort Lincoln, Lake Sakakawea, and Lewis and Clark State Parks and the Fort Berthold Reservation.

Municipal Water Supply Treatment — Development or improvement of water supply treatment facilities in 11 communities serving 95,000 people.

# WATER REQUIREMENTS

The State Water Plan Update process emphasizes reexamination of North Dakota's future water requirements. Bar graphs have been developed using the Future Without Plan base condition projections as depicted in the main report. To this base were added the impacts of recommended water development projects resulting in total annual water requirements for each of the three timeframes addressed in the planning process.



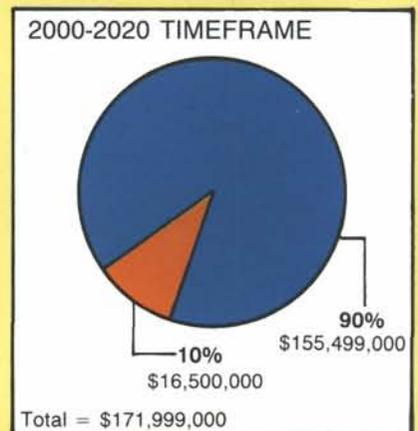
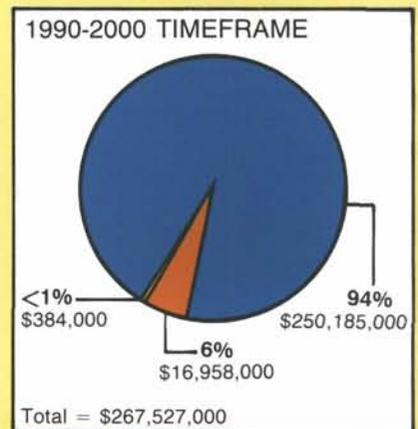
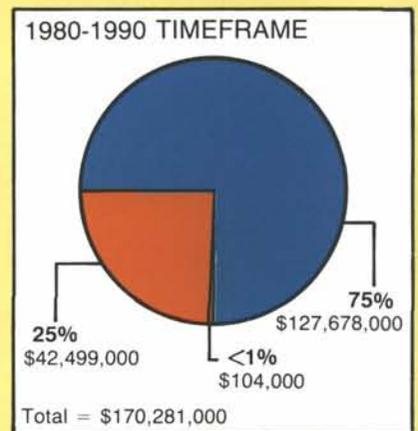
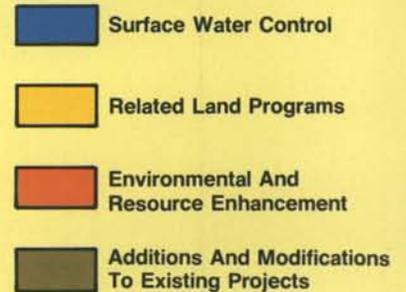
## MISSOURI RIVER BASIN RECOMMENDED PLAN — EARLY ACTION PROGRAM

Project Description and Implementation Costs for the 1980-1990 Time Frame in 1980 Dollars.

Program Feature	Description	Federal	Initial Costs State/Local	Total	
<b>SURFACE WATER CONTROL</b>					
<u>Multi-purpose Reservoirs</u>	Mott Dam — This is a 50,000 acre-foot (AF) reservoir located three miles west of Mott in Hettinger County; utilized for flood control and irrigation of 3,850 acres.	—	\$23,080,000	\$23,080,000	
	Emerson Dam — This 43,200 AF reservoir would be located three miles south and nine miles east of Manning in Dunn County; utilized for irrigating 5,500 acres and flood control.	—	\$ 9,235,000	\$ 9,235,000	
<u>Single Purpose Reservoirs</u>	Bohlman Dam — This 2,070 AF recreation reservoir would be located two miles north of New England in Hettinger County.	—	\$ 822,000	\$ 822,000	
	Square Butte Dam — This project, a 1,360 AF recreation reservoir, would be located nine miles east and ten miles north of Haynes in Adams County.	—	\$ 511,000	\$ 511,000	
	Thirty-Mile Creek Dam — This 6,000 AF reservoir would be utilized for recreation and could also have some flood control benefits. The reservoir site is located three miles north of Bentley in Hettinger County.	—	\$ 2,040,000	\$ 2,040,000	
	Lower Antelope Creek Dam — This 13,400 AF reservoir would be utilized to irrigate 1,563 acres. This site is located five miles north and two miles west of Carson in Grant County.	—	\$ 3,670,000	\$ 3,670,000	
	Otter Creek Dam — This 880 AF recreation reservoir would be located ten miles north and 13 miles east of Carson in Grant County.	—	\$ 591,000	\$ 591,000	
	Wolf Butte Dam — This 1,100 AF recreation reservoir would be located nine miles north of Bucyrus in Adams County.	—	\$ 675,000	\$ 675,000	
	Beulah Dry Dams — A total of three dry dams are to be constructed. Two dams are north and one dam is west of the City of Beulah. Total storage is 1,440 AF.	—	\$ 583,200	\$ 583,200	
	Schwartz Dry Dam — This 2,000 AF dry dam would be located three miles south and seven miles west of Wing in Burleigh County.	—	\$ 250,000	\$ 250,000	
	<u>Instream Control</u>	North Dickinson Channel Critical Area Treatment. — This project involves three concrete drop structures and riprap consisting of four acres of road and ditch and four acres of channel. The project is located southeast of Dickinson on the City's outskirts.	\$ 342,800	\$ 120,800	\$ 463,600
			<u>Channel Improvement</u>		

## RECOMMENDED PLAN SUMMARY

Implementation costs of the recommended plan are categorized by function.

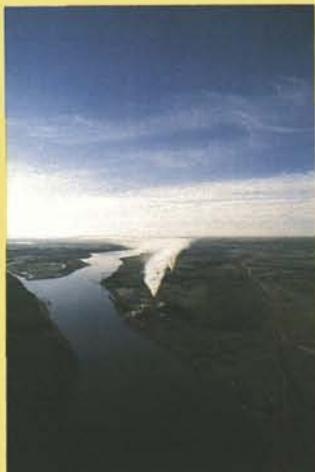


Program Feature	Description	Federal	Initial Costs State/Local	Total
Levees, Flood-wall, etc.	Napoleon Flood Control — A diversion floodway project would provide protection against the one percent (100-year) frequency flood event for the town of Napoleon in Logan County.	\$ 177,000	\$ 24,000	\$ 201,000
	Flasher Dike — This dike would provide protection against the one percent (100-year) frequency flood event for the town of Flasher in Morton County.	\$ 36,000	\$ 4,000	\$ 40,000
Streambank Stabilization	Missouri River Streambank Stabilization — Streambank stabilization is proposed for 22 sites along the River.	\$ 5,620,000	—	\$ 5,620,000
	Heart River Streambank Stabilization — Three sites in Morton County need protection.	\$ 70,000	\$ 150,000	\$ 220,000
	Knife River Streambank Stabilization — Four historical sites on the bank of the River need protection.	\$ 1,200,000	—	\$ 1,200,000
	Little Missouri River Streambank Stabilization — Two sites near Medora, in Billings County need protection.	—	\$ 70,000	\$ 70,000
	Yellowstone River Streambank Stabilization — Two sites require bank stabilization.	\$ 400,000	—	\$ 400,000
Diversion Irrigation	Fort Yates Unit — Irrigation of 4,260 acres along Lake Oahe near Fort Yates in Sioux County is proposed.	\$ 7,949,000	\$ 1,745,000	\$ 9,694,000
	Little Heart Irrigation Unit — Irrigation is proposed for 3,100 acres located along a terrace above the Missouri River beginning five miles south of Mandan in Morton County.	\$ 5,704,000	\$ 1,252,000	\$ 6,956,000
	Hazen-Stanton Irrigation Unit — Irrigation is proposed for 12,650 acres of land located at the confluence of the Knife and Missouri Rivers on the south side of the Knife River between Hazen and Stanton in Mercer County.	\$32,086,000	\$ 7,043,000	\$39,129,000
	McClusky Canal-side Irrigation — Irrigation is proposed for 14,000 acres of land along the McClusky Canal in McLean, Burleigh and Sheridan Counties.	—	\$21,000,000	\$21,000,000
Multi-feature Project	Linton Flood Control — Flood control measures would include a levee and channel improvements to provide protection against the one percent (100-year) frequency flood event for Linton in Emmons County.	—	\$ 1,124,200	\$ 1,124,200
	Halliday Flood Control — Flood control measures would include a dike and diversion channel to provide protection against the one percent (100-year) frequency flood event for Halliday in Dunn County.	\$ 94,000	\$ 10,000	\$ 104,000

## MISSOURI RIVER BASIN RECOMMENDED PLAN — EARLY ACTION PROGRAM

Project Description and Implementation Costs for the  
1980-1990 Time Frame in 1980 Dollars.

Program Feature	Description	Federal	Initial Costs State/Local	Total
<b>ENVIRONMENTAL AND RESOURCE ENHANCEMENT</b>				
<u>Protection and Management</u>	Land Treatment Measures — These measures would be applied to 2,942,000 acres of land to reduce soil erosion.	\$18,620,250	\$ 6,206,750	\$24,827,000
<u>Outdoor Recreation Stream Preservation</u>	Heart River — Scenic and Recreation River — 106 miles of the Heart River would be maintained free-flowing from the Heart Butte Dam to the Missouri River.	—	—	—
<u>Waste Water Management Municipal</u>	New and/or improved existing municipal waste treatment facilities would be developed for 45 communities serving 35,869 people, in addition to Fort Lincoln, Lake Sakakawea and Lewis and Clark State Parks, plus the Fort Berthold Reservation.	\$ 4,843,500	\$ 1,614,500	\$ 6,458,000
<u>Water Supply Treatment Municipal</u>	Additional or improved treatment facilities would be developed to meet recommended limits for domestic water supply purposes in 11 communities serving 95,000 people.	—	\$11,214,000	\$11,214,000
<b>ADDITIONS AND MODIFICATIONS TO EXISTING PROJECT</b>				
<u>Reservoir Storage</u>	Beaver Lake Dam Repairs — Repairs are needed for the existing structure in Logan County.	—	\$ 72,000	\$ 72,000
	Jund Dam Repairs — Repair is needed for the existing structure in McIntosh County.	—	\$ 26,500	\$ 26,500
	Welk Dam Repairs — Repair is needed for the existing structure in Emmons County.	—	\$ 5,000	\$ 5,000



## MISSOURI RIVER BASIN

### Additional Special Studies and Programs

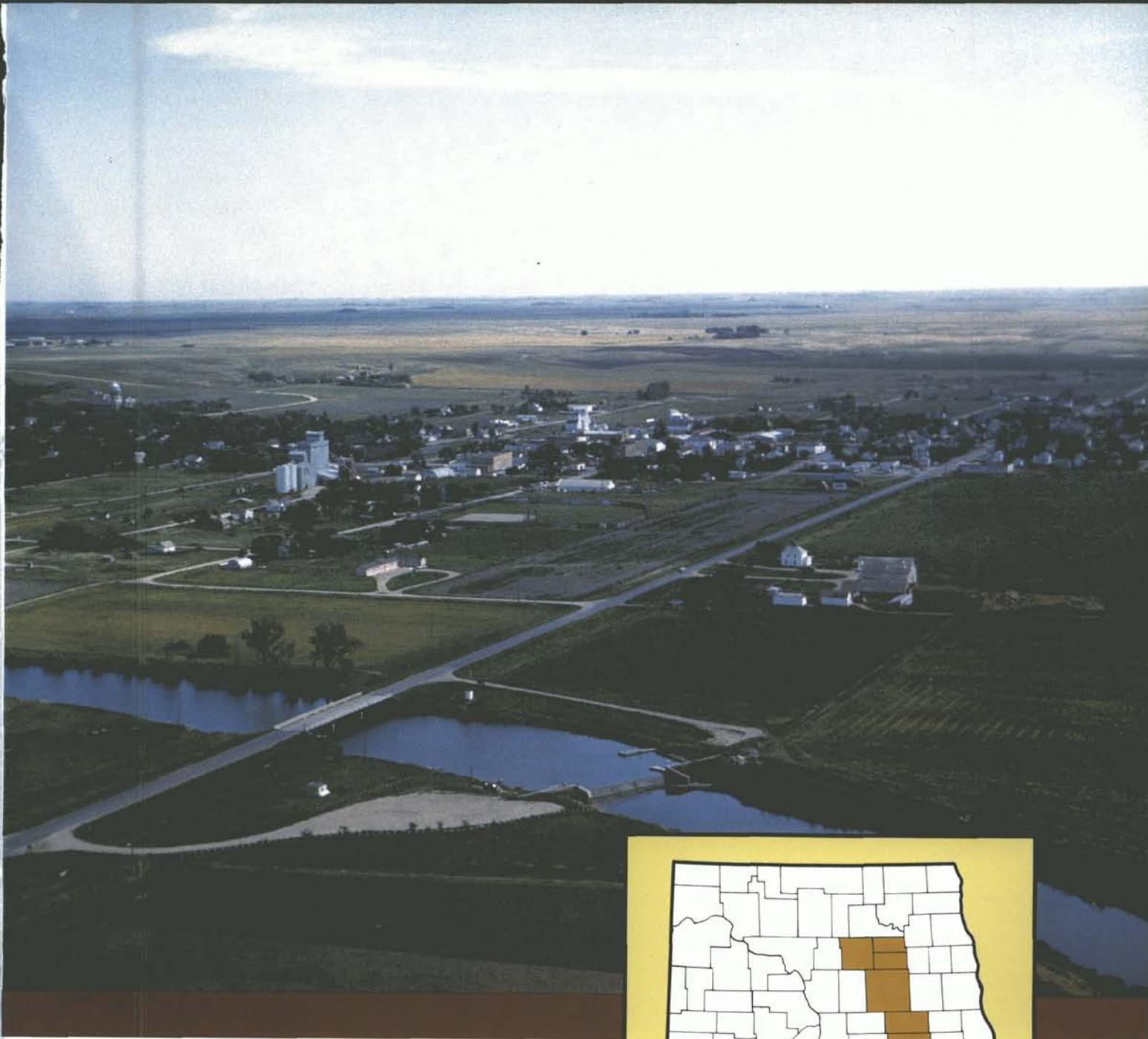
- A detailed study should be initiated to determine the economic feasibility of a water supply system from Lake Sakakawea to all the major tributaries of the Missouri River. The following multi-purpose retention structures, in addition to existing reservoirs, should be considered in the diversion system:
  - A) Philbrick Dam — a 75,000 acre-foot (AF) reservoir located 10 miles west and four miles north of New England in Slope County.
  - B) Cannonball Dam — a 60,000 AF reservoir located seven miles east and one mile south of New Leipzig in Grant County.
  - C) Mott Dam — a 50,000 AF reservoir located three miles west of Mott in Hettinger County.
  - D) Thunderhawk Dam — a 43,300 AF reservoir located four miles north and 26 miles east of Hettinger in Adams County.
  - E) Versippi Dam — a 13,400 AF reservoir located seven miles east and one mile north of Dickinson in Stark County.
  - F) Crown Butte Dam — a 34,899 AF reservoir located 12 miles north of Carson in Grant County.
  - G) Spring Lake Dam — an 18,000 AF reservoir located three miles west of Golden Valley in Mercer County.
  - H) Emerson Dam — a 43,200 AF reservoir located three miles south and nine miles east of Manning in Dunn County.
  - I) Third Creek Dam — a 46,415 AF reservoir located 19 miles south and three miles east of Medora in Billings County. This project would require an amendment to the Little Missouri State Scenic River Act.
  - J) Hettinger Dam — a 30,000 AF reservoir located 12 miles north and 2½ miles east of Hettinger in Adams County.
- Single purpose reservoirs requiring additional study include:
  - A) Wolf Butte Dam — a 1,100 AF recreation reservoir located nine miles north of Bucyrus in Adams County.
  - B) Hailstone Creek Dam — an 800 AF recreation reservoir located three miles north and one mile west of Almont in Morton County.
  - C) Upper Antelope Creek Dam — a 3,000 AF recreation reservoir located six miles south and six miles east of Dickinson in Stark County.
  - D) Buffalo Creek Dam — a 2,180 AF recreation reservoir located 15 miles south and four miles east of Richardton in Stark County.
  - E) North Coyote Creek Dam — a 4,100 AF irrigation reservoir located one mile northeast of Marshall in Dunn County.
  - F) Otter Creek Dam — a 7,500 AF irrigation reservoir located four miles east and two miles south of Beulah in Oliver County.
  - G) Beaver Creek Dam — a 55,169 AF irrigation reservoir located 16 miles north of Beach in Golden Valley County.
  - H) Marmarth Dam — a 240,000 AF irrigation reservoir located 11 miles west of Rhame in Bowman County. This project would require an amendment to the Little Missouri State Scenic River Act.
  - I) Schwartz Dry Dam — a 2,000 AF dry dam located three miles south and seven miles west of Wing in Burleigh County.
  - J) Series of dry dams for flood control purposes in Apple Creek Watershed — Implementation of the full program should be delayed until a full analysis of benefits from Neideffer and Schwartz Dams can be completed.
  - K) White Earth Tributary Dams — dry dams located near the City of White Earth in Mountrail County.

Hydropower Pumpback Reservoir — a 26,135 AF reservoir utilizing pumpback from Lake Sakakawea to produce hydroelectric power located on the Fort Berthold Indian Reservation in northern Mercer County.

- Beaver Creek Dam, a multi-purpose reservoir, requires a detailed study of the feasibility for irrigating lands in Emmons County by constructing a dam near the mouth of Beaver Creek. The project would help to irrigate an estimated 18,000 acres of land in the Horsehead Flats area and would require construction of a pumpback facility.
- The following irrigation projects utilizing water from the Missouri River or Lake Oahe should be studied in detail and implemented beginning in the 1990 timeframe:
  - A) Oliver-Sanger Unit — irrigation of 8,000 acres of land on an 11 mile strip along the west bank of the Missouri River in Oliver County opposite the City of Washburn.
  - B) Apple Creek Unit — irrigation of 20,386 acres located south and east of the City of Bismarck in Burleigh County.
  - C) McClusky Canal diversion to Kidder and Burleigh Counties — irrigation of an undetermined amount of acreage in Kidder County ranging from 50,000 acres to 120,000 acres.
  - D) Painted Woods Unit — irrigation of 610 acres of land located south of the City of Washburn in McLean County; additional study to determine the feasibility of increasing the total irrigable acres should be initiated.
- All alternatives to the use of a reregulation dam for increasing hydropower generation at Garrison Dam should be investigated in detail; this possibility is currently being studied by the Army Corps of Engineers.
- Belfield Flood Prevention (PL-566 Watershed Study) is recommended for planning authorization. This project includes a dam and floodway project for Belfield in Stark County.
- Muskrat Lake Watershed Protection (PL-566 Watershed Study) is recommended for planning authorization. This project includes land treatment measures for the Muskrat Lake Watershed located in Mountrail County.
- Alternatives for flood control in Underwood, McLean County, should be studied further to determine the best solution.
- Continued investigation into an improved water supply for the City of Garrison is recommended utilizing Lake Audubon as a water supply.
- Continued study is recommended for a drainage project in Dunn County. This project would drain a 975-acre wetland located eight miles south and four miles west of Halliday in Dunn County.
- Congressional authorization and funding are recommended for streambank stabilization sites on the Missouri and Yellowstone Rivers, including all uncompleted Section 32 sites and new erosion sites that have been identified. The annual OM&R cost of these sites should be the responsibility of the Federal Government and not the local entities as is the current policy.
- Further investigation into the Little Missouri River streambank stabilization problem at Medora is recommended.
- Continued study is recommended for Knife River Historic Site streambank stabilization; four historical sites require protection from streambank erosion.
- Consensus was not reached among the Missouri River SPA Public Involvement Regions regarding designation of the Missouri River between Garrison Dam and the upper reaches of Lake Oahe as a State Scenic River; therefore, further study should be completed in the 1980-1990 timeframe.
- It is recommended that study be continued into the restoration of Jund Dam in McIntosh County and Welk Dam in Emmons County with repairs completed in the 1980-1990 timeframe. Possible construction of new downstream reservoirs should be considered in the study.
- Consensus was not reached among the Public Involvement Regions of the Missouri River SPA to support the Weather Modification Program. The regions supporting the program include: Beaver Creek, Cannonball/Grand, Lake Sakakawea, Little Missouri, Middle Missouri and Upper Missouri.

- Implementation of rural water supply systems is recommended for south Emmons and McIntosh Counties; all possible funding alternatives should be investigated.
- A comprehensive study, to be completed in the 1980-1990 timeframe, is recommended for municipal and rural areas experiencing water supply problems (examples: Turtle Lake and Mercer in McLean County; the Pettibone area in Kidder County and McClusky and Denhoff in Sheridan County) to determine the most feasible method (including rural water) to meet the supply needs.
- An exploration of alternatives is recommended to assure a supply of good quality rural-domestic water in Mountrail County.
- Acceleration of land management practices is recommended (through coordination with the Soil Conservation Service – SCS) in order to reduce severe nutrient loading and sediment deposits in the Bowman-Haley Reservoir.
- Studies, involving a multi-agency approach with the State Health Department as the lead agency, should be undertaken to determine sources and solutions for pollution in Lake Audubon in McLean County and Lake Isabel and Cherry Lake in Kidder county, as well as several other lakes in the area.
- A feasibility study for a potential water supply from McClusky Canal to provide recreation and fish and wildlife habitat for Brush, Blue, Pelican and Peterson lakes, as well as Lake Williams in McLean County, is recommended to be completed by the 1990 timeframe. The Bureau of Reclamation is the identified lead agency for this study.
- Comprehensive water management studies with the State Water Commission as lead agency are recommended for the Painted Woods Creek Watershed. (Apple, Burnt, Hay, Buffalo and Merry's Creeks should undergo similar studies).
- A study should be undertaken to develop a mechanism to coordinate urban and rural storm water management. The study should determine the need for new or revised legislation to accomplish improved coordination particularly in the area of project cost sharing. Currently, cities may not expend funds for projects outside their boundaries.
- Studies are recommended to determine the need for, and feasibility of, lakeshore riprapping to protect recreational values of primarily public lands around these lakes. (Hoskins Lake and Green Lake – McIntosh County, and Beaver Lake – Logan County).
- Acceleration of the installation of land treatment measures is recommended to protect and preserve basic soil resources, reduce air and water pollution and to assist in the sustained production of food and fiber.
- It is suggested that the State Water Commission work closely with the Corps of Engineers in their ongoing studies to alleviate the sedimentation problems occurring in the area of Williston in Williams County.
- It is recommended that the State Water Commission's "second generation" ground-water studies be accelerated.
- Continued study on saline seeps is recommended with emphasis on implementing corrective programs and practices.
- More stringent enforcement of regulations regarding seismic activities and drilling pit disposal practices is recommended due to the threat of ground-water contamination.
- It is recommended that the State Water Bank Program be utilized to the fullest extent possible in future habitat preservation activities.
- A study is recommended to determine the potential of developing irrigation on large blocks of land adjacent to Lake Sakakawea and Lake Audubon. Studies should determine feasibility and funding sources.

- Seminars are recommended, conducted on a local level by knowledgeable representatives of the State Water Commission, the State Agricultural Department and other agencies or irrigators, to educate landowners on the advantages and current methods of irrigation.
- Studies should be conducted to determine the need for additional boat ramp facilities around Lake Sakakawea.
- The Heart River (106 miles) from Heart Butte Dam to the Missouri River should remain free flowing and be designated a State Scenic River.
- The Lake Sakakawea Board recommends that Congressional authorization and funding be made available to riprap the entire Missouri River channel from Garrison Dam to Lake Oahe.
- A study is recommended to investigate the potential for irrigation in the upper portion of Beaver Creek watershed in Emmons and Logan Counties.
- In future years, when State lands are sold, consideration should be given to allowing water management entities to enter into the bidding process when such lands have an obvious high potential for water-related outdoor recreation.
- A study is needed to accelerate research on revising and changing outdated, Federal irrigability criteria/standards.
- It is recommended that an inventory of all small dams be completed to determine necessary dam repairs or replacement. A multi-agency approach should be undertaken to investigate the feasibility of restoration and/or repair of the dams.
- There exists a need to clarify which agency or agencies have the authority to enforce existing laws regarding seismic activities and drilling disposal practices. Stricter enforcement of the existing law is also needed.
- Studies should be undertaken to identify solutions to lake shore erosion problems on Lake Sakakawea.
- An investigation is recommended to identify ground-water sources of supply for rural domestic and irrigation water on the Fort Berthold Reservation.
- A study should be initiated to delineate sources of possible ground-water contamination in the City of Stanton in Mercer County resulting from pollutants from the old Knife River channel.
- It is recommended that the State aggressively explore the possibility of early mining by the Tenneco Company on the North Dakota side of the Montana-North Dakota border. Current plans do not call for the mining of North Dakota coal for several years. Mining activities on the Montana side would, however, impact in numerous ways on Beach and the surrounding area; yet, impacts would have to be dealt with without benefit of assistance from the Impact Funds generated by North Dakota's Coal Severance Tax. In addition, in the event Tenneco should decide to mine in North Dakota, careful consideration should be given to reclaiming mined land in a manner that would permit irrigation of those lands.
- The South Heart Watershed Project (PL-566 Watershed Study) in Stark County is recommended to be authorized for planning and detailed study. The project includes the construction of three dams on tributaries of the Heart River near South Heart. The purpose of the dams is to reduce the bentonite entering the Heart River and Lake Patterson, thereby enhancing water quality and reducing the water supply treatment at Dickinson.
- Additional study is recommended to evaluate water resource problems in the Bismarck area that could be related to the operation of Lake Oahe (river aggradation upstream from Lake Oahe and ground-water level increases in response to the filling of Lake Oahe and river aggradation). A preliminary report should be released by the ground-water division of the State Water Commission in April, 1983.
- A study is recommended to identify sites along the Heart River that require streambank stabilization. To date, three sites have been identified in Morton County; however, numerous other sites have serious erosion problems.



## JAMES RIVER BASIN





## PROBLEMS

The James River rises in Wells County in central North Dakota. It follows a meandering course south and east for 260 river miles until it leaves the State in southeastern Dickey County. In North Dakota, the drainage area of the James River is approximately 6,800 square miles of which about 3,800 square miles are considered noncontributing.

Major water problems in this Basin relate to flooding of agricultural lands causing substantial cropland, hayland and pasture losses and periodic flooding of several communities. Flooding occurs when rapid spring snowmelt or heavy summer rainfall coupled with inadequate drainage of the floodwater results in overflowing sloughs and watercourses. In addition to causing problems for communities, productive farmland is taken out of use for extended periods of time. Fallen trees and other debris reduce channel capacities in portions of the James River and its tributaries, further compounding flooding problems in many areas.

Erosion is another serious problem requiring attention. Land surface and gully erosion by wind and water causes the loss of valuable topsoil and results in sediment deposition in many streams and lakes degrading the water quality. As of 1980, approximately 1.03 million acres of cropland, 235 thousand acres of pasture, 264 thousand acres of rangeland and 8 thousand acres of forest in the James River Basin were in need of some type of land treatment.

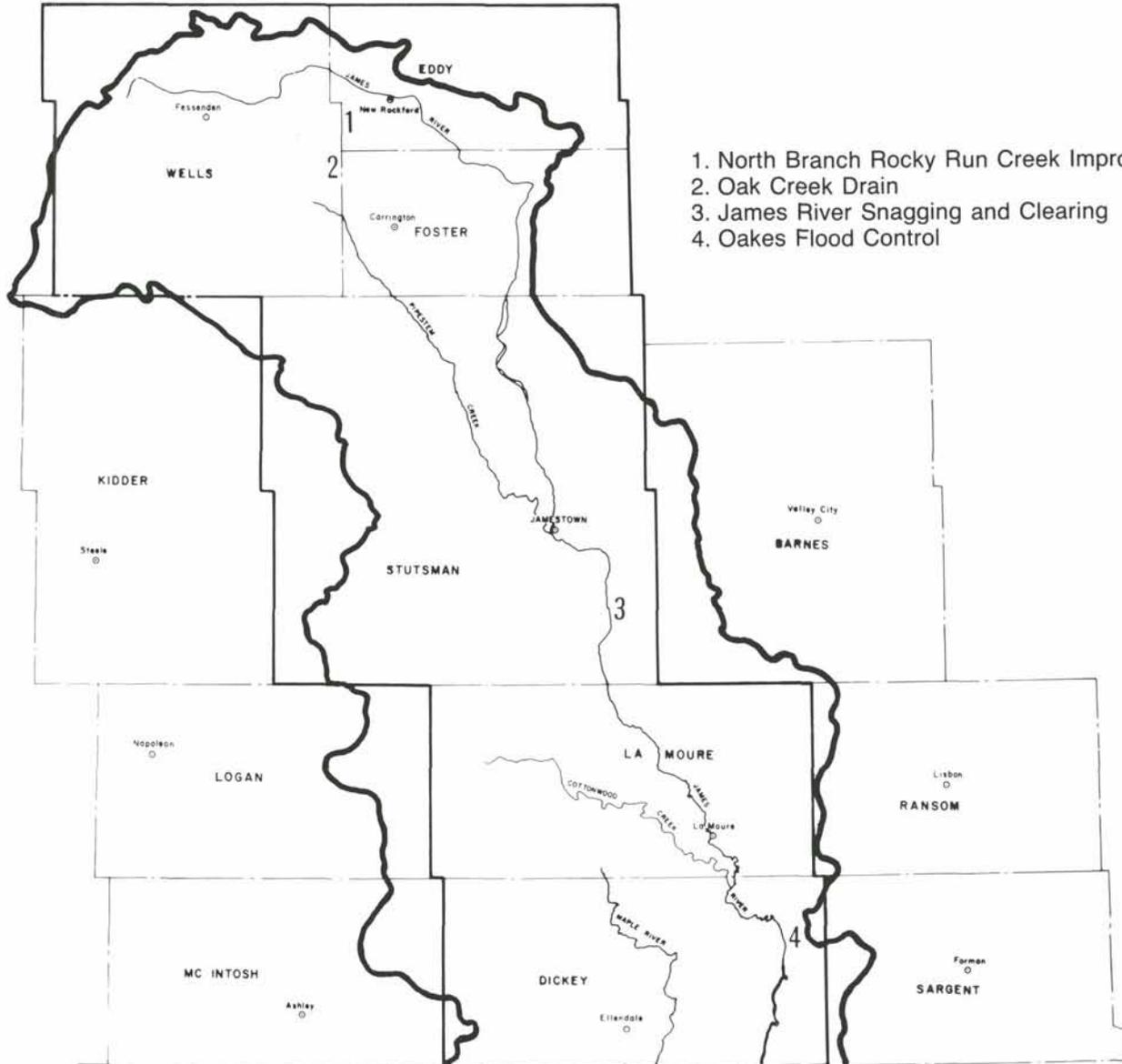
## OPPORTUNITIES

The installation and/or acceleration of land management practices in the James River Basin is considered an important opportunity for protecting and preserving the Basin's soil and water resources and for assisting in the sustained production of food and fiber. Practices such as strip cropping, grassed waterways, windbreaks and minimum or no-till farming could decrease erosion and the movement of nutrients, fertilizers and pesticides from the land. Assistance for the implementation of land treatment measures is available primarily through the Soil Conservation Service (SCS) and the Agricultural Stabilization and Conservation Service (ASCS).

Opportunities also exist for sound management of surface waters including several drainage and flood control projects. For example, the Oak Creek Drain and improvements to North Rocky Run Creek are two proposed projects which could help alleviate extensive overland flooding. Snagging and clearing of fallen trees and other debris from many reaches of the James River are required to restore channel capacity and reduce the flooding threat.

Perhaps the greatest opportunity for the area is the future importation of water by way of the Garrison Diversion Project. Garrison Diversion water could be utilized in a variety of ways in the Basin.

## JAMES RIVER BASIN LOCATION OF RECOMMENDED PLAN — EARLY ACTION PROGRAM



1. North Branch Rocky Run Creek Improvements
2. Oak Creek Drain
3. James River Snagging and Clearing
4. Oakes Flood Control

### REGION-WIDE

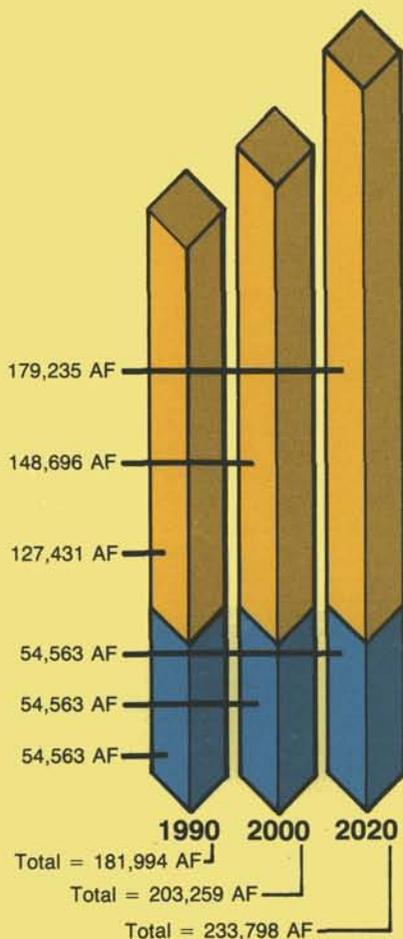
Land Treatment Measures — Measures to be applied to 630,000 acres of land.

Municipal Waste Treatment — Development of new and/or improvement of existing facilities in 15 communities serving 6,200 people.

Municipal Water Supply Treatment — Development of new and/or improvement of existing treatment facilities in two communities serving 1,361 people.

# WATER REQUIREMENTS

The State Water Plan Update process emphasizes reexamination of North Dakota's future water requirements. Bar graphs have been developed using the Future Without Plan base condition projections as depicted in the main report. To this base were added the impacts of recommended water development projects resulting in total annual water requirements for each of the three timeframes addressed in the planning process.



## JAMES RIVER BASIN RECOMMENDED PLAN — EARLY ACTION PROGRAM

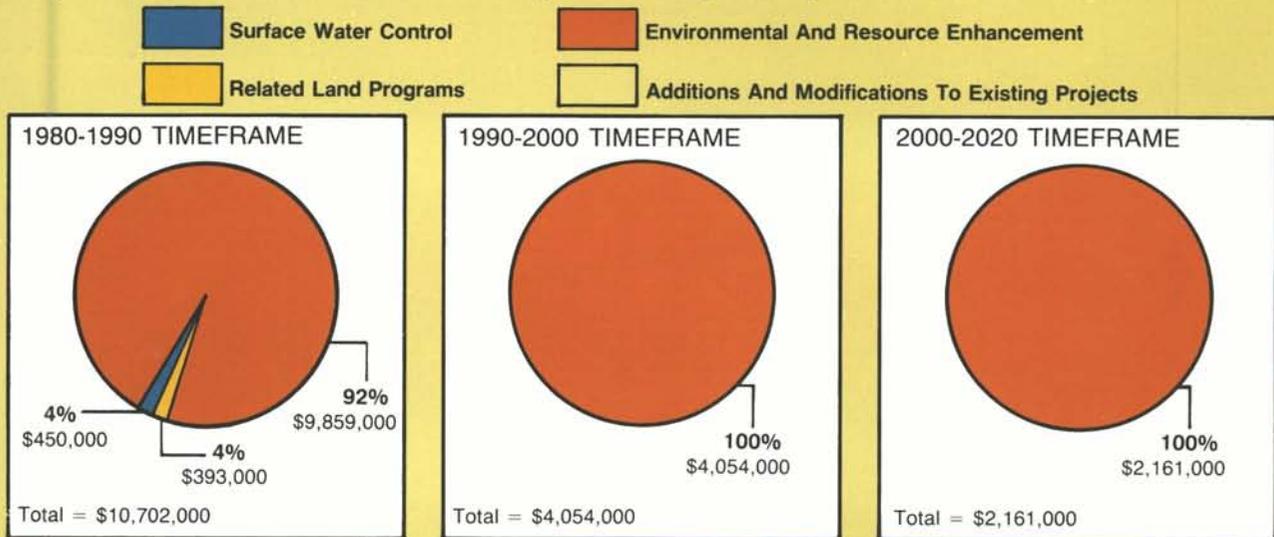
Project Description and Implementation Costs for the 1980-1990 Time Frame in 1980 Dollars.

Program Feature	Description	Federal	Initial Costs State/Local	Total
<b>SURFACE WATER CONTROL</b>				
<u>Instream Control Channel Improvements</u>	James River Snagging and Clearing — 85 miles of river channel, from Jamestown to the Dickey County line, needs snagging and clearing.	—	\$ 190,000	\$ 190,000
Levees, Flood-wall, etc.	Oakes Flood Control — A floodway is proposed to protect Oakes, Dickey County, from the one percent (100-year) frequency flood event.	\$ 234,000	\$ 26,000	\$ 260,000
<b>RELATED LAND PROGRAMS</b>				
<u>Drainage</u>	Oak Creek Drain — This project involves construction of a main channel diversion and mainstem channel improvements to Oak Creek, in addition to improvements to the Rocky Run Creek mainstem downstream of the Oak Creek Channel located in Eddy and Wells Counties.	—	\$ 321,600	\$ 321,600
	North Branch Rocky Run Creek Improvements — This project involves channel improvements to increase the capacity of the existing channel in Eddy and Wells Counties.	—	\$ 71,868	\$ 71,868
<b>ENVIRONMENTAL AND RESOURCE ENHANCEMENT</b>				
<u>Protection and Management</u>	Land Treatment Measures — Soil erosion protection is needed for 630,000 acres of land.	\$ 4,558,500	\$ 1,519,500	\$ 6,078,000
<u>Waste Water Management Municipal</u>	Development of new and/or improvement of existing municipal waste treatment facilities is needed for 15 communities serving 6,200 people.	\$ 2,137,500	\$ 712,500	\$ 2,850,000
<u>Water Supply Treatment Municipal</u>	Development of additional or improvement of existing treatment facilities is needed to meet the recommended limits for domestic water supplies in two communities serving 1,361 people.	—	\$ 930,000	\$ 930,000



## RECOMMENDED PLAN SUMMARY

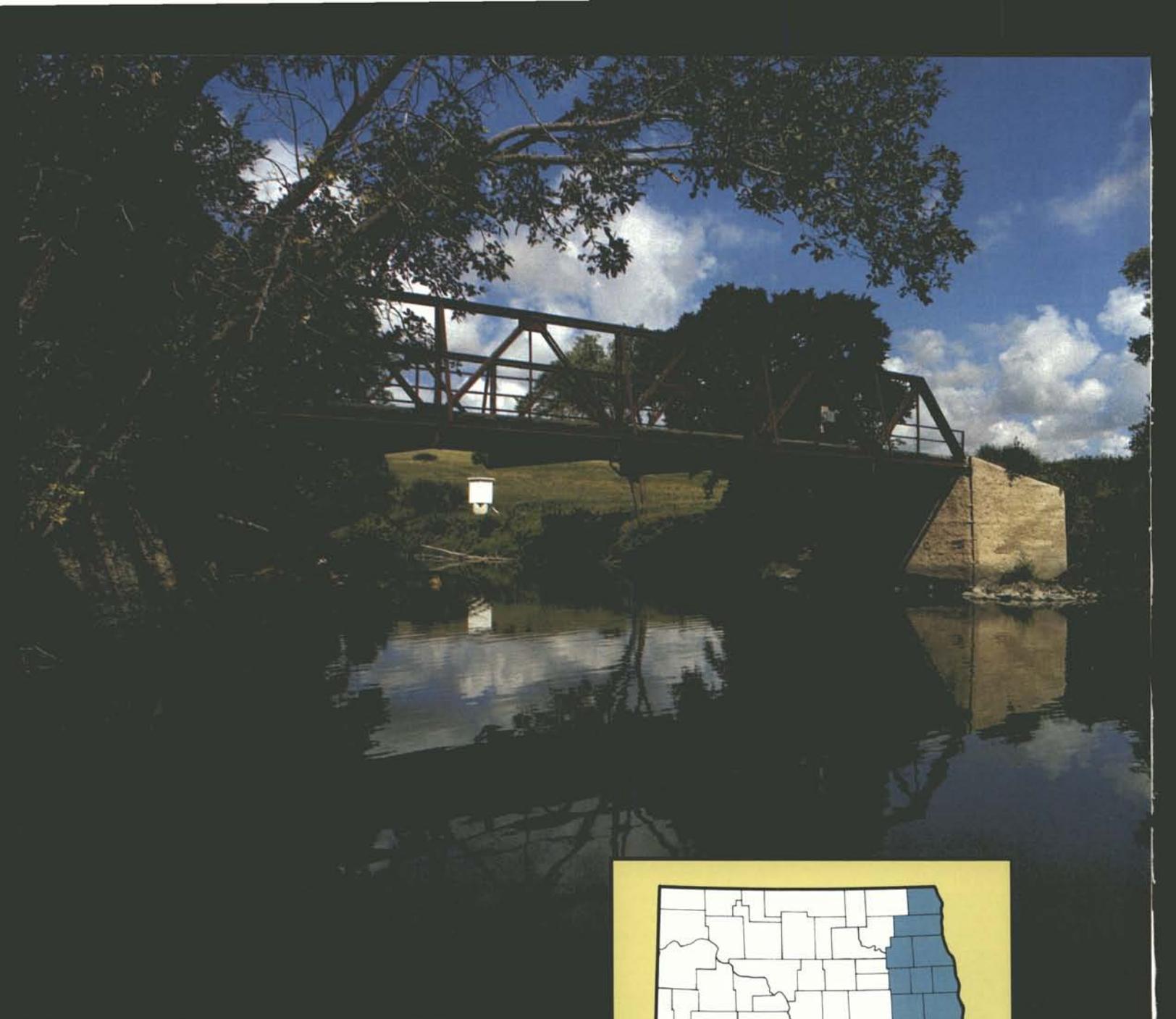
Implementation costs of the recommended plan are categorized by function



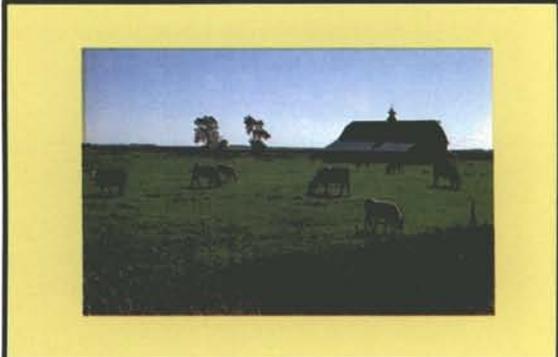
## JAMES RIVER BASIN

### Additional Special Studies and Programs

- Continued study is recommended in order to locate an alternate site to Edinger Dam — a recreation dam originally proposed on the James River in Wells County 10 miles east and five miles north of Fessenden.
- Continued study of a drainage project at Carrington is recommended. Channel improvements are necessary to correct the problem of flooding of residences and agricultural lands. The flooding is caused both from agricultural runoff and the City of Carrington discharging excess water from the storm drains and sewage lagoon into an unnamed watercourse northeast of Carrington.
- Continued study of Wells County Drain Number One is recommended. Channel outlet improvements or lateral drains are necessary to alleviate high water levels in a large slough west of Fessenden which has caused operation problems with the city sewage lagoons, in addition to agricultural flood damages.
- Continuation of the Weather Modification Programs is supported including: the North Dakota Cloud Modification Program, Drought Management Strategies, Atmospheric Water Resources Research in conjunction with the North Dakota Cloud Modification Program (NDCMP), and Public Awareness of Weather Modification.
- A review of the Pipestem and Jamestown Dams' discharge operations is recommended to determine if refinements could be made to stabilize flow downstream.
- A rising water table problem near the Ladish Malting Plant east of Jamestown should be investigated. There is a possibility that the plant's water disposal system has created the potential for larger than normal amounts of water to percolate through the root zone causing an elevated water table.
- A study is recommended to explore the potential for using sewage lagoon water to irrigate adjacent land, thus reducing the need for waste treatment or facility improvements in many communities.
- Further study into the possibility of plugging wetland drains in years when the land is summer fallowed should be considered. This practice could decrease erosion and movement of nutrients, fertilizers, and pesticides from the land.
- Further study is recommended concerning snagging and clearing of the James River above the Jamestown Reservoir.



**RED RIVER BASIN**





## PROBLEMS

The Red River of the North, formed by the confluence of the Ottertail and Bois de Sioux Rivers, flows almost 400 river miles in a tortuous northerly course, forming the boundary between North Dakota and Minnesota, to the International Boundary between the United States and Canada. From the Boundary, it flows generally northeast 155 river miles in Canada to Lake Winnipeg. The drainage area of the Red River in North Dakota is approximately 17,250 square miles. The Red River flows through the ancient lake bed of glacial Lake Agassiz. This lake bed is very flat, accounting for the meandering course of the river and its low gradient.

The major problem in this Basin is the destructive flooding by the Red River and its tributaries. Many communities including the cities of Wahpeton, Fargo, and Grand Forks and extensive areas of agricultural land are susceptible to flooding during spring snowmelt and heavy rainfall. Because of the mild gradient of the Red River and the nearly level floodplain, floods along the mainstem inundate wide areas and can persist for many weeks. Flooding occurs along all tributaries of the Red due to inadequate channel capacities. Additionally, restrictive bridge and culvert openings can result in backwater flooding. A lack of suitable upstream sites to provide sufficient flood storage further complicates the problem.

Wind and water erosion is responsible for the loss of topsoil and deposition of sediment in streams and lakes. As of 1980, approximately 3.2 million acres of land were in need of some type of land treatment.

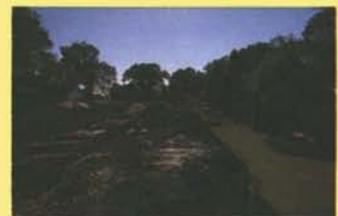
Low stream flows, occurring typically from August through March, in the Red and its tributaries and a general lack of local water-oriented recreation areas are among other important problems in the Red River Basin.

## OPPORTUNITIES

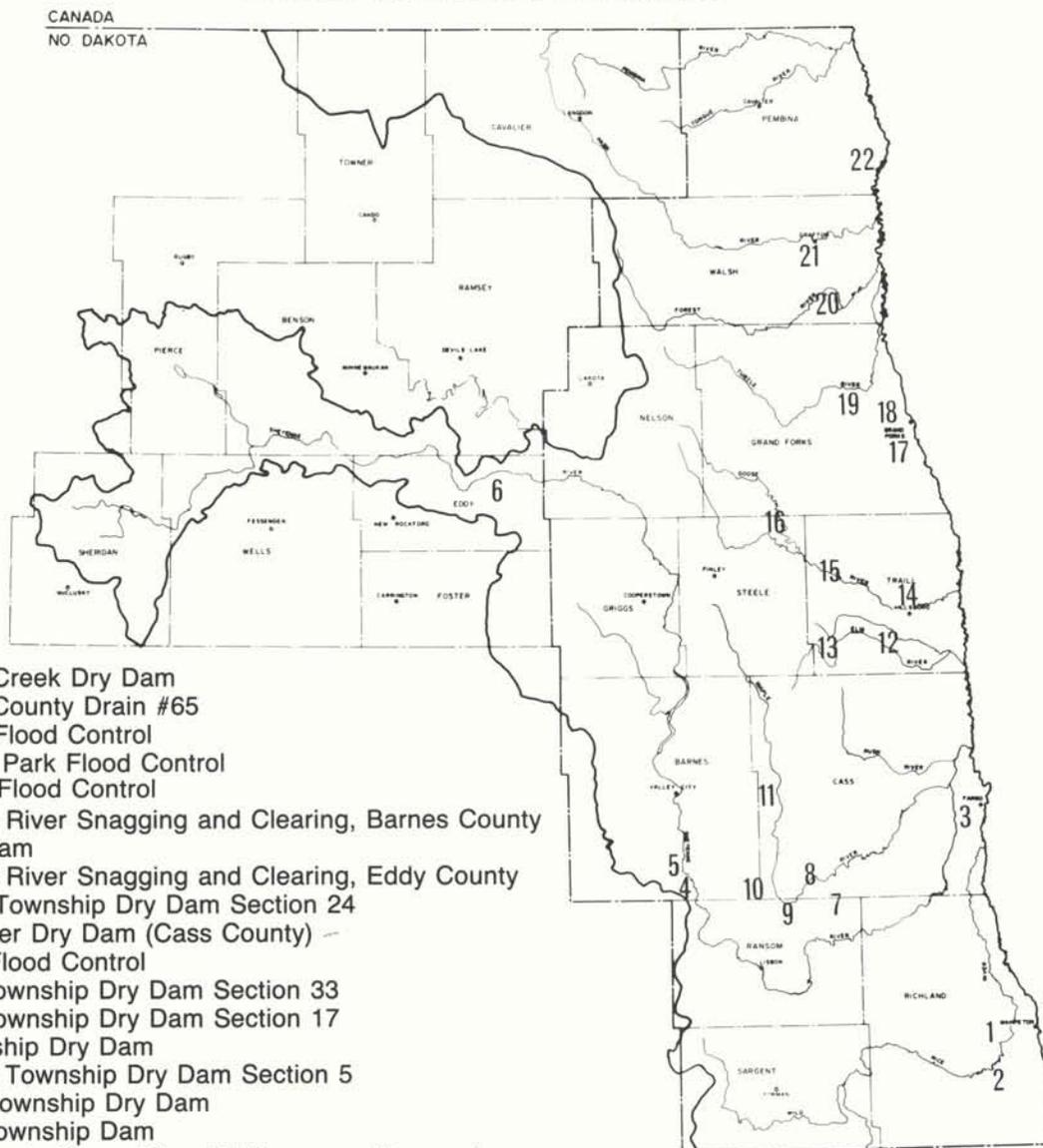
Most water development opportunities existing in the Red River Basin are directly related to the major problem — flooding. Several multi-purpose reservoirs have been proposed to serve such uses as flood control, water supply, fish and wildlife and outdoor recreation. However, the most acceptable opportunity in this Basin seems to be the construction of single purpose storage structures (dry dams in many cases) which would retain floodwaters. In addition to these structures, opportunities exist for flood control levees, farmstead ring levees and financial compensation for farmers who would hold floodwater on farmland until a major flood threat was over.

The installation and/or acceleration of land management practices are considered essential for protecting and preserving the basic soil and water resources. Assistance for the implementation of such practices, including windbreaks, grassed waterways and minimum or no-till farming, is available through agencies such as the Soil Conservation Service (SCS) and Agricultural Stabilization and Conservation Service (ASCS). Protection of wetlands, wildlife habitat preservation and funding of a State Water Bank Program, which would help restore and improve important migratory waterfowl nesting and breeding areas, are regarded as primary opportunities for the Red River Basin.

Also considered important is the need to control drainage through a watershed approach in which impacts on the total watershed must be considered before a drainage permit is issued.



# RED RIVER BASIN LOCATION OF RECOMMENDED PLAN — EARLY ACTION PROGRAM



1. Antelope Creek Dry Dam
2. Richland County Drain #65
3. Harwood Flood Control
3. Brooktree Park Flood Control
3. Rivertree Flood Control
4. Sheyenne River Snagging and Clearing, Barnes County
5. Hansen Dam
6. Sheyenne River Snagging and Clearing, Eddy County
7. Highland Township Dry Dam Section 24
8. Maple River Dry Dam (Cass County)
9. Enderlin Flood Control
10. Pontiac Township Dry Dam Section 33
10. Pontiac Township Dry Dam Section 17
11. Hill Township Dry Dam
12. Bohnsack Township Dry Dam Section 5
13. Norman Township Dry Dam
14. Norway Township Dam
15. South Branch Goose River Multi-purpose Reservoir
16. Newburg Township Dry Dam
17. Grand Forks Rural Flood Prevention Program
18. English Coulee Watershed Project (SCS)
18. English Coulee Flood Control — Corps of Engineers 205 Study
18. Belmont Road Dike
19. Emerado Flood Control
20. Minto Dam
21. Grafton Flood Control
22. Bowsmont Flood Control

## REGION-WIDE

Land Treatment Measures — Measures to be applied to 1,221,000 acres of land.

Municipal Waste Treatment — Development of new and/or improvement of existing facilities in 68 communities serving 184,382 people, in addition to three unincorporated communities.

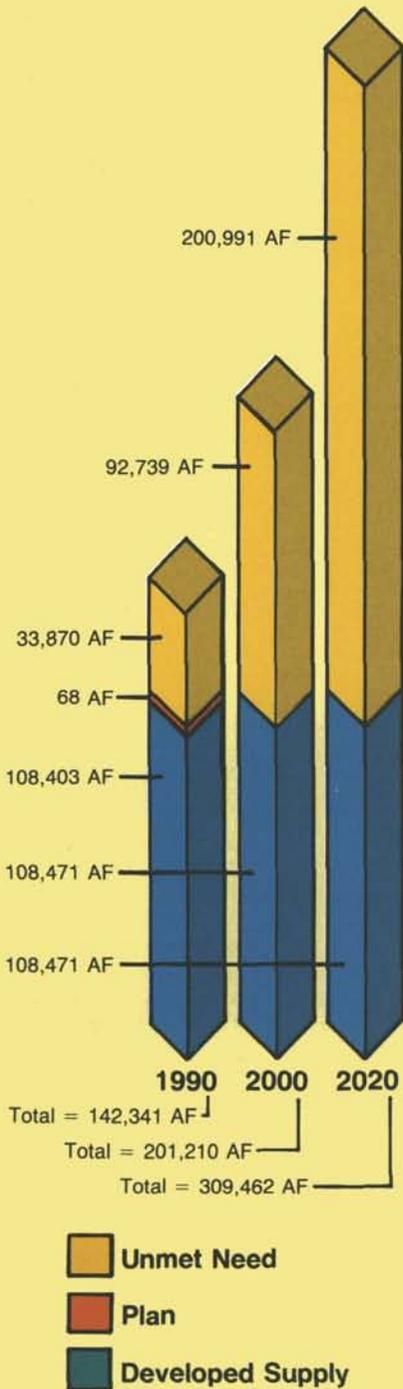
Municipal Water Supply Treatment — Development of new and/or improvement of water supply treatment facilities in seven communities serving 138,782 people.

Construction of farmstead levees around individual farmsteads in the 100-year floodplain.



# WATER REQUIREMENTS

The State Water Plan Update process emphasizes reexamination of North Dakota's future water requirements. Bar graphs have been developed using the Future Without Plan base condition projections as depicted in the main report. To this base were added the impacts of recommended water development projects resulting in total annual water requirements for each of the three timeframes addressed in the planning process.



## RED RIVER BASIN RECOMMENDED PLAN — EARLY ACTION PROGRAM

Project Description and Implementation Costs for the 1980-1990 Time Frame in 1980 Dollars.

Program Feature	Description	Federal	Initial Costs State/Local	Total
<b>SURFACE WATER CONTROL</b>				
<u>Multi-purpose Reservoirs</u>	South Branch Goose River Multi-purpose Reservoir — This 20,650 acre-foot (AF) reservoir would be located 3½ miles west of Portland in Traill County.	—	\$ 4,534,500	\$ 4,534,500
	Norway Township Dam — This reservoir would store 980 AF and be located two miles south and five miles east of Mayville in Traill County.	—	\$ 168,000 <sup>1</sup>	\$ 168,000 <sup>1</sup>
	Norman Township Dry Dam — This reservoir would store 700 AF and be located on a tributary of the Elm River seven miles south of Mayville in Traill County.	—	\$ 190,000	\$ 190,000
<u>Single Purpose Reservoirs</u>	Bohnsack Township Dry Dam Section 5 — This reservoir would store 1,085 AF. It would be located on the Elm River six miles south and 4½ miles west of Hillsboro in Traill County.	—	\$ 300,000	\$ 300,000
	Newburg Township Dry Dam — This 32,000 AF reservoir would be located on the North Branch of the Goose River one mile west and 4½ miles south of Northwood in Steele County.	—	\$ 2,750,000	\$ 2,750,000
	Minto Dam — This reservoir would store 68 AF and be located on the Forest River near Minto in Walsh County.	—	\$ 188,000	\$ 188,000
	Maple River Dry Dam (Cass County) — This 60,000 AF reservoir would be located seven miles east and four miles north of Enderlin in Cass County.	—	\$ 4,500,000	\$ 4,500,000
	Pontiac Township Dry Dam Section 17 — This 8,000 AF reservoir would be located on a tributary to the Maple River four miles north and one mile west of Enderlin in Cass County.	—	\$ 1,600,000	\$ 1,600,000
	Pontiac Township Dry Dam Section 33 — This reservoir would store 2,500 AF and be located on a tributary of the Maple River one mile northwest of Enderlin in Cass County.	—	\$ 825,000	\$ 825,000
	Hill Township Dry Dam — This 4,200 AF reservoir would be located on a tributary of the Maple River four miles south and one mile east of Tower City in Cass County.	—	\$ 1,000,000	\$ 1,000,000

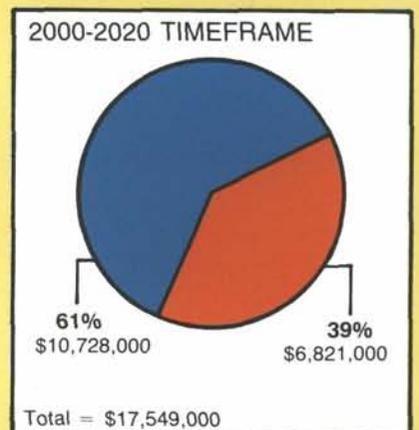
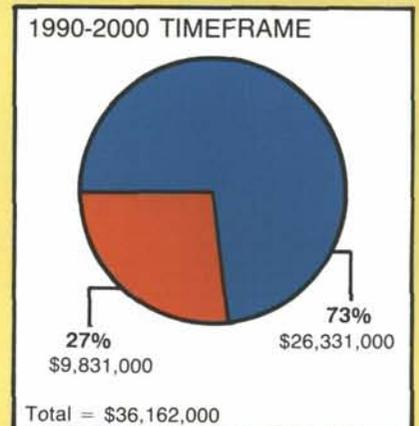
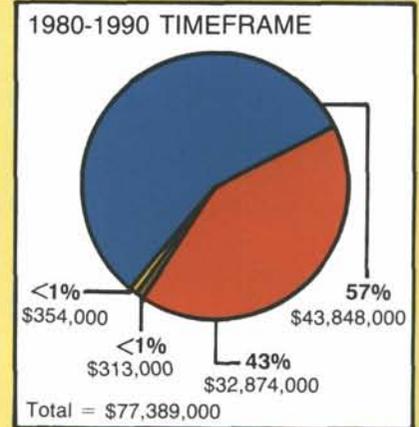
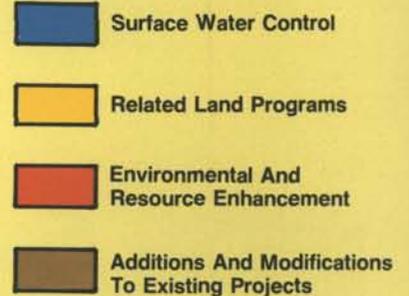
<sup>1</sup>Cost does not include modification to existing highways.

Program Feature	Description	Federal	Initial Costs State/Local	Total
	Highland Township Dry Dam Section 24 — This reservoir would store 2,650 AF and would be located on a tributary of the Maple River eight miles east and 2½ miles north of Enderlin in Cass County.	—	\$ 795,000	\$ 795,000
	Antelope Creek Dry Dam — This reservoir would store 300 AF located three miles north of Mooreton in Richland County.	—	\$ 20,000 <sup>2</sup>	\$ 20,000 <sup>2</sup>
<u>Instream Control</u> Channel Improvements Levees, Flood- wall, etc.	Sheyenne River Snagging and Clearing — Many reaches of the river through Barnes and Eddy Counties are in need of snagging and clearing.	—	\$ 138,000	\$ 138,000
	Belmont Road Dike — This project involves construction of a dike on the south edge of the City of Grand Forks, Grand Forks County, to provide protection from backwater of the Red River.	—	\$ 350,000	\$ 350,000
	Bowesmont Flood Control — Construction of a levee would provide protection in Bowesmont, Pembina County, against the one percent (100-year) frequency flood on the Red River.	\$ 141,930	\$ 29,070	\$ 171,000
	Enderlin Flood Control — Construction of levees would provide protection in Enderlin, Ransom County, against the 140-year frequency flood event on the Maple River.	\$ 2,988,000	\$ 612,000	\$ 3,600,000
	Harwood Flood Control — Construction of a levee would provide protection in Harwood, Cass County, against the one percent (100-year) frequency flood event on the Red River.	\$ 99,600	\$ 20,400	\$ 120,000
	Brooktree Park Flood Control (Harwood Township, Cass County) — Construction of levees would provide protection against the one percent (100-year) frequency flood event on the Red River.	\$ 53,950	\$ 11,050	\$ 65,000
	Rivertree (Harwood Township, Cass County) — Construction of levees would provide protection against the one percent (100-year) frequency flood event on the Red River.	\$ 53,950	\$ 11,050	\$ 65,000
	Farmstead levees — Construction of levees around individual farmsteads would provide protection in the one percent (100-year) frequency floodplain for the Goose, Lower Red, Lower Sheyenne and Wild Rice Public Involvement Regions. The cost is estimated at \$5,600 per individual levee.	NA	NA	NA

<sup>2</sup>The cost may increase substantially due to the type of emergency and principal spillways needed to accommodate high flows.

## RECOMMENDED PLAN SUMMARY

Implementation costs of the recommended plan are categorized by function.



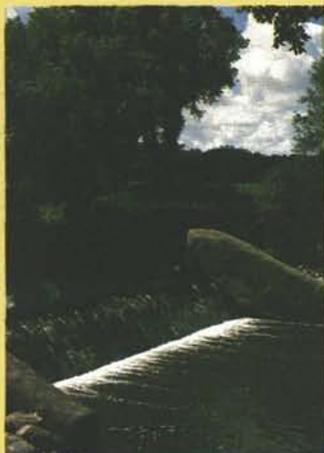
## RED RIVER BASIN RECOMMENDED PLAN — EARLY ACTION PROGRAM

Project Description and Implementation Costs for the  
1980-1990 Time Frame in 1980 Dollars.

Program Feature	Description	Federal	Initial Costs State/Local	Total
<u>Multi-Feature Project</u>	Grand Forks Rural Flood Prevention Program <sup>3</sup> — This is a multi-year project that is currently being installed involving nonstructural measures including flood-proofing a dike.	\$ 561,400	\$ 240,600	\$ 802,000
	English Coulee Watershed Project <sup>4</sup> — This SCS (PL-566) Project is located in Grand Forks County; project involves a dam and diversion floodway.	\$ 2,728,800	\$ 303,200	\$ 3,032,000
	English Coulee Flood Control — Corps of Engineers 205 Study — This project includes a control structure and nonstructural measures to provide protection from Red River backwaters at Grand Forks.	\$ 2,075,000	\$ 425,000	\$ 2,500,000
	Grafton Flood Control — This project involves construction of a floodway and a tie-back levee upstream and to the west of Grafton in Walsh County.	\$13,776,000	\$ 2,124,000	\$15,900,000
	Emerado Flood Control — This project involves construction of a floodway and dike for Emerado which will provide protection against the one percent (100-year) frequency flood event.	\$ 210,600	\$ 23,400	\$ 234,000
<b>RELATED LAND PROGRAMS</b>				
<u>Drainage</u>	Richland County Drain #65 — This project involves construction of a channel parallel to the existing channel in Richland County.	—	\$ 354,000	\$ 354,000
<b>ENVIRONMENTAL AND RESOURCE ENHANCEMENT</b>				
<u>Protection and Management</u>	Land Treatment Measures — Measures are needed to reduce soil erosion on 1,221,000 acres of land.	\$11,049,000	\$ 3,683,000	\$14,732,000
<u>Waste Water Management Municipal</u>	Development of new and/or improvement of existing municipal waste treatment facilities is needed for 68 communities serving 184,382 people, in addition to three unincorporated communities.	\$10,670,250	\$ 3,556,750	\$14,227,000
<u>Water Supply Treatment Municipal</u>	Development of additional or improvement of existing treatment facilities is needed to meet the recommended limits for a domestic water supply in seven communities serving 138,782 people.	—	\$ 3,915,000	\$ 3,915,000
<b>ADDITIONS AND MODIFICATIONS TO EXISTING PROJECTS</b>				
<u>Reservoir Storage</u>	Hansen Dam — Storage will be increased to 960 AF. The dam is located six miles south of Valley City in Barnes County.	—	\$ 313,000	\$ 313,000

<sup>3</sup>A multi-year program that is currently being installed. Total project funding has not been appropriated.

<sup>4</sup>The project is currently being implemented.





## RED RIVER BASIN

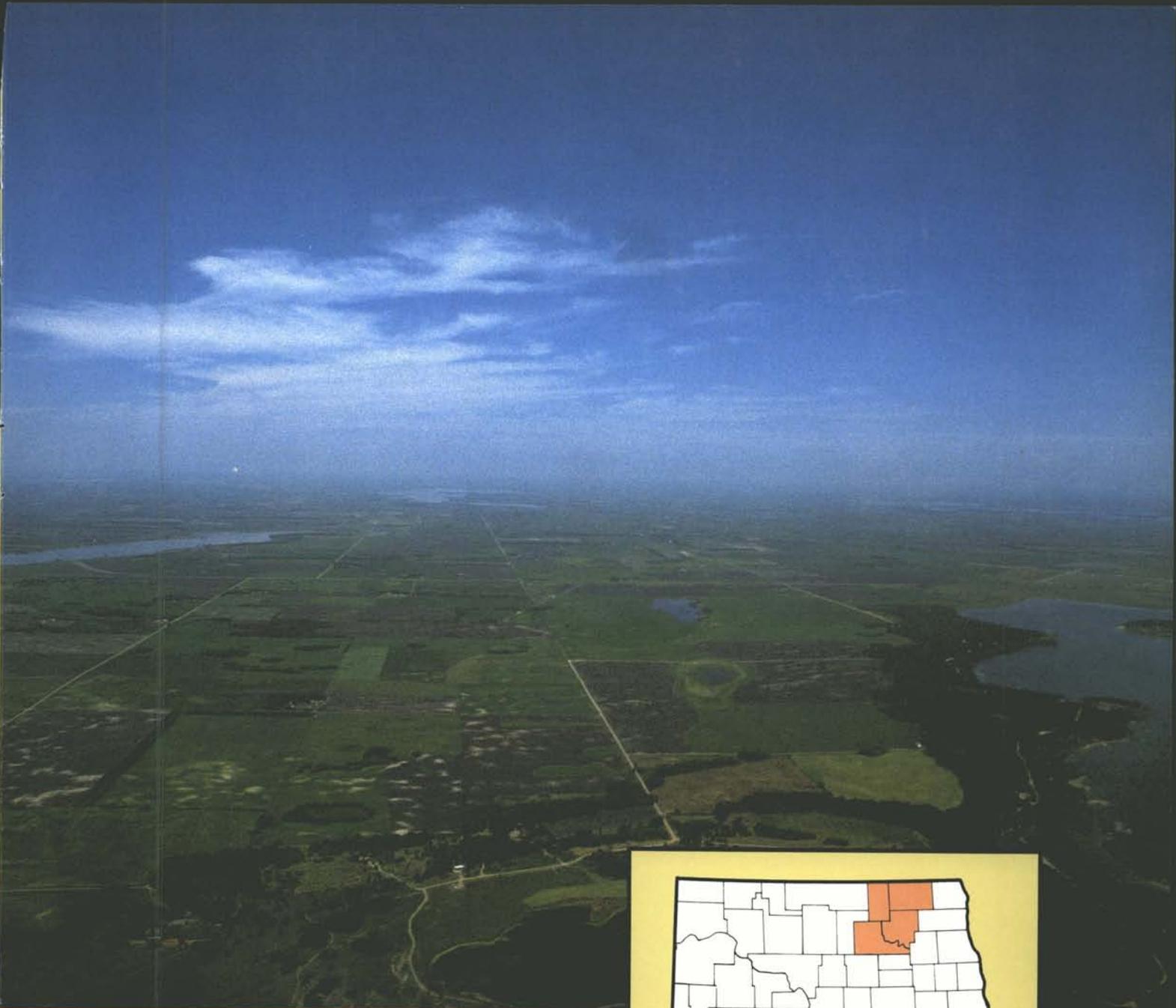
### Additional Special Studies and Programs

- Multi-purpose reservoirs requiring continued study include: A) Finley East Dam — A 1500 acre-foot (AF) reservoir located six miles east and three miles north of Finley in Steele County; B) Northwood Dam — a 510 AF reservoir located six miles west and three miles north of Northwood in Grand Forks County; and C) Moellenkamp Dam — a 490 AF reservoir located four miles south and three miles west of Lisbon in Ransom County.
- The Lower Red Citizens Advisory Board recommended that all potential retention structures be investigated from a total systems-type approach; the benefits accruing from one project in excess of what is needed for equity can be used to bolster another project whose benefit/cost ratio falls below equity. Reservoirs to be investigated include:
  - A) Lundene (Tiber-Vesta) Dam — a 17,700 AF multi-purpose reservoir located three miles north of Adams in Walsh County.
  - B) Langerud Dry Dam — a 5,000 AF dry dam located two miles northeast of Edinburg in Walsh County.
  - C) South Milton Dry Dam — a 7,370 AF dry dam located two miles south and four miles east of Milton in Cavalier County.
  - D) Milton Dry Dam — a 2,308 AF dry dam located one mile north of Milton in Cavalier County.
  - E) Dry Dam below Sarnia Dam — a 1,038 AF dry dam located 10 miles north and three miles east of Michigan in Nelson County.
  - F) Cart Creek Dry Dams — three dry dams totaling 300 AF storage located three miles west of Mountain in Pembina County.
  - G) Fremont Township Dry Dam — a 410 AF dry dam, including channel improvements and a dike, located 16 miles east and 14 miles north of Walhalla in Cavalier County.
- Single-purpose reservoirs requiring additional study include:
  - A) Hope Dry Dam — a 150 AF dry dam located one mile south and three miles west of Hope in Steele County.
  - B) Bohnsack Township Dry Dam Section 25 — a 9,367 AF dry dam located 1½ miles north and 3½ miles west of Grandin in Traill County.
  - C) Gunkel Township Dry Dam — a 943 AF dry dam located four miles east and one mile north of Arthur in Cass County.
  - D) Enger Township Dry Dam — a 55,000 AF dry dam located 4½ miles south and one mile west of Hatton in Steele County.
  - E) Kellys Slough Dam — a 6,250 AF dam located on Kellys Slough National Wildlife Refuge, nine miles west and two miles north of Grand Forks in Grand Forks County. This project also includes a diversion from Saltwater Coulee.
  - F) Watson Township Dry Dam — a 1,100 AF dry dam located 1½ miles north and six miles west of Leonard in Cass County.
  - G) Highland Township Dry Dam Section 16 — a 1,400 AF dry dam located four miles east and 3½ miles north of Enderlin in Cass County.
  - H) Moore Township Dry Dam — a 5,000 AF dry dam located four miles west and 1½ miles south of Enderlin in Ransom County.
  - I) Maple River Dry Dam (Steele County) — a 4,600 AF dry dam located four miles south of Hope in Steele County.
  - J) Swan-Buffalo Dry Dam — an 850 AF dry dam located five miles south of Wheatland in Cass County.
  - K) Rush River Dry Dam — a 560 AF dry dam located two miles south and five miles west of Hunter, Cass County.
  - L) Northland Township Dry Dam — a 1,060 AF dry dam located three miles north of Fort Ransom in Ransom County.
  - M) Billings Dry Dam — a 1,080 AF dry dam located four miles east and one mile north of Fort Ransom, Ransom County.

- N) Lund-Steen Dry Dam — a 2,300 AF dry dam located four miles east and two miles south of Fort Ransom in Ransom County.
- O) Maple River Dry Dam (Cass County) — a 60,000 AF dry dam located seven miles east and four miles north of Enderlin, Cass County.
- P) Antelope Creek Dry Dam — a 300 AF dry dam located three miles north of Mooreton, Richland County.
- Continued study is recommended for snagging and clearing 33 miles of the Pembina River from Neche in Pembina County to the mouth of the river.
  - Continued study is recommended for 46 miles of channel improvements on the Red River from Fargo in Cass County north to Perley, Minnesota.
  - Continued study of all water supply alternatives, including a new downstream reservoir, is recommended to assure an improved water supply for the City of Minto in Walsh County.
  - Further investigation is recommended for Belmont Road Dike which would be located on the south edge of the City of Grand Forks in Grand Forks County.
  - Future construction of levees should be studied for Drayton, Neche, Argusville, Mapleton, and First and Third Avenues along Second Street in north Fargo. These levees will provide protection from the one percent (100-year) frequency flood event.
  - Richland County Drain #65 should be studied in more detail with implementation of the most favorable alternative. A viable solution to the problem will reduce agricultural flood damages.
  - Continued study into lake restoration of Homme Reservoir is recommended, including dredging of the reservoir to enhance water-based recreation, fishery value, and flood control storage.
  - Consensus was not reached among the Public Involvement Regions of the Red River SPA to support the Weather Modification Programs. The regions supporting the programs include the Upper and Lower Sheyenne Public Involvement Regions.
  - A study is recommended to determine the feasibility of constructing small dams in the Sheyenne River's watershed to retain spring runoff which could be released throughout the year to enhance stream flow and water quality. This would include lowhead dams on the river mainstem.
  - The Corps of Engineers' tentative plan for flood control on the Sheyenne River is supported with the exception that the Lower Sheyenne Citizens Advisory Board opposes raising Baldhill Dam.
  - Recommended is studying the possibility of the Fish and Wildlife Service or North Dakota Game and Fish buying Rush Lake lands in Cavalier County for habitat purposes.
  - The Upper Sheyenne Board recommends that fish and wildlife easements should include annual rent payments and be limited in term and/or the lease should terminate with a change in land ownership.
  - Studies should be conducted to determine the extent to which flooding could be reduced by the installation of control features on legal drains. A watershed approach should be emphasized in the design of future drainage improvement projects.
  - It is recommended that the current level of research regarding wetland habitat values be accelerated.
  - The Wild Rice Citizens Advisory Board recommends that the State Water Commission reexamine the manner in which water permits are granted to irrigators or other heavy water users where high potential exists for such withdrawals to adversely impact on adjacent domestic wells.
  - It is recommended that reaches of the Forest and Park Rivers be identified for snagging and clearing.

- The Lower Red Citizens Advisory Board recommends that the State seek needed changes to the Principal and Procedure Guidelines to Federal Agencies in determining the feasibility of federal water projects for the benefit and protection of rural areas.
- The Lower Red Citizens Advisory Board recommends researching the amount of annual rainfall and spring snowmelt runoff for all past years of record in the Red River and its main tributary basins, in addition to conducting pilot studies on a few minor agriculture drainage areas in upper parts of the river basins by monitoring spring runoff flows. The study would be conducted to determine if the use of control structures at available sites could reduce flood damages and be cost effective if done on a broad scale.
- The Lower Sheyenne Citizens Advisory Board recommends that the State Water Commission draft a bill to present to the Legislature providing compensation or an incentive program to landowners willing to retain water on their land during peak flood periods.
- Farmsteads located in the 100-year floodplain should be identified and funding avenues for constructing individual farmsteads levees should be investigated.
- A study is recommended pertaining to a multi-purpose reservoir located on the Forest River in northern Grand Forks County. Possible multi-purpose uses include: flood control, irrigation, and municipal water supply.





**DEVILS LAKE BASIN**





## PROBLEMS

The Devils Lake Basin, located in northeastern North Dakota, is a closed or noncontributing basin encompassing approximately 3,580 square miles or five percent of the State's land surface. Runoff is trapped within the Basin and prevented from leaving by the topography. Devils Lake serves as the final collecting point for most of the Basin's surface runoff. Of the total drainage area, about 1,300 square miles are noncontributing.

The major problem in the Basin concerns the frequent overland sheet flooding of agricultural lands due to inadequate lake outlets and channel capacities which cannot accommodate flows associated with rapid snowmelt and/or heavy rainfall. Channel improvement measures have been proposed for approximately 212 miles of waterways.

Other problems include insufficient, good quality water to meet the needs of rural communities and farms and eutrophication of Devils Lake due to the infusion of nutrients from agricultural runoff and wind erosion.

Major fluctuations of the water level in Devils Lake have caused problems for the City of Devils Lake, shoreline developments and nearby roads. The maximum elevation of Devils Lake, as recorded by the U.S. Geological Survey, was 1438.3 feet mean sea level (msl) in 1867, after which the level showed a gradual downward trend to a low of 1,400.9 feet msl in 1940. Since then, the trend has reversed; the lake level reached 1426.6 feet msl in November, 1982.

Serious long-term changes in fish and wildlife habitat have also occurred due to changes in agricultural land-use practices; wind and water erosion have resulted in sediment deposition into lakes and streams thus degrading the water quality. As of 1980, approximately 775 thousand acres of cropland, 68 thousand acres of pasture, 79 thousand acres of rangeland and 5 thousand acres of forest required some type of land treatment practice such as strip cropping, windbreaks or grassed waterways.

## OPPORTUNITIES

Opportunities for water development in the Devils Lake Basin include both structural and nonstructural methods to control recurring sheet flooding caused by rapid spring snowmelt or heavy rainfall. Inadequate lake outlets and channel capacities in this closed Basin contribute significantly to the flooding. Improvement and maintenance of these outlets and natural channels to accommodate higher volume flows is an opportunity that should be pursued at a faster rate.

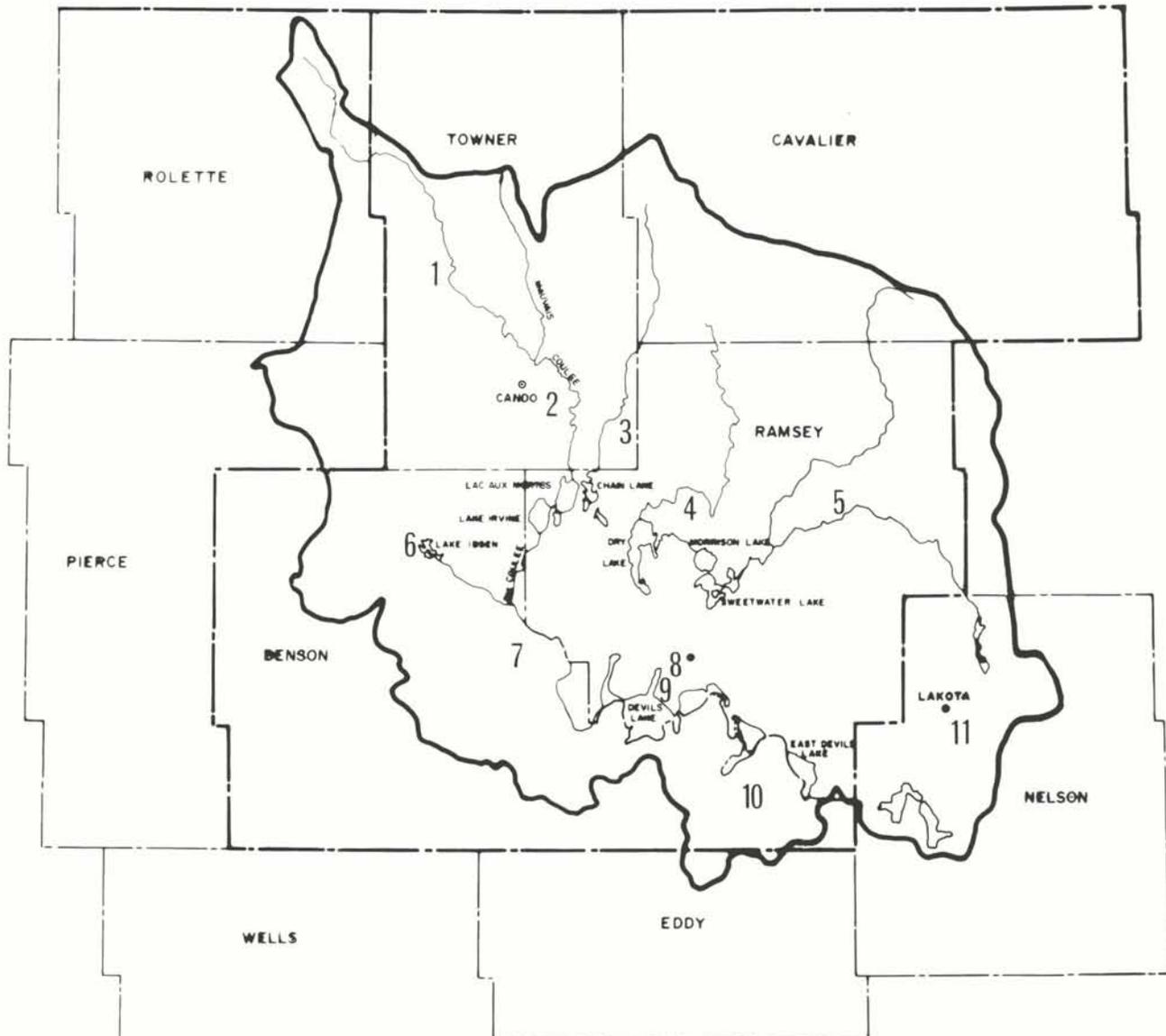
Land management practices are considered essential to protect both soil and water resources. Practices such as strip cropping, grassed waterways and conservation tillage farming could decrease land surface erosion as well as reduce the movement of nutrients, fertilizers and pesticides from the land. Assistance in land treatment implementation is available through the Soil Conservation Service (SCS) and the Agricultural Stabilization and Conservation Service (ASCS).

Two promising opportunities include the addition of rural water systems to meet the water quantity and quality requirements of rural communities and farms and the possibility of using community sewage lagoon waters to irrigate adjacent farmlands.

Stabilization of the water levels and water quality enhancement of Devils Lake and other lakes in the Devils Lake chain and the restoration of Stump Lake are also primary opportunities for the Basin.



## DEVILS LAKE BASIN LOCATION OF RECOMMENDED PLAN — EARLY ACTION PROGRAM



1. Big Coulee Dam (Bisbee Dam)
2. Mauvais Coulee Watershed Project
3. Chain Lake Watershed Project
4. Starkweather Watershed Project
5. Edmore Watershed Project
6. Hurricane Lake Watershed Project
7. Comstock Watershed Project
8. Creel Bay Levee
9. East Bay (Camp Grafton) Recreation Facility
10. South Slope Watershed Project
11. Stump Lake Watershed Project

### REGION-WIDE

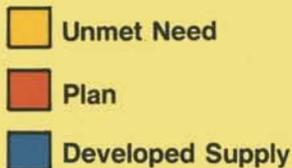
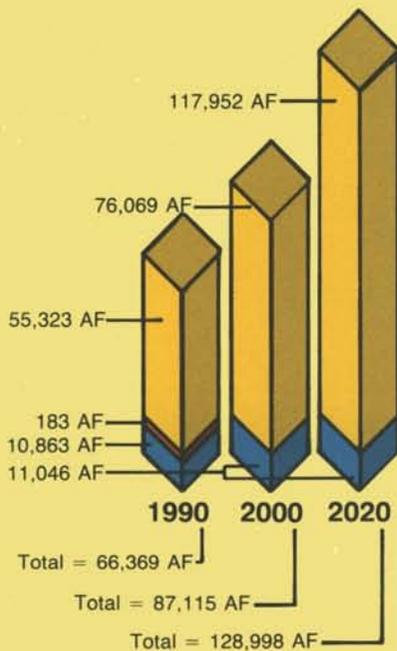
Land Treatment Measures — Measures to be applied to 467,000 acres of land.

Municipal Waste Treatment — Development of new and/or improvement of existing facilities in 14 communities and one unincorporated community serving 16,000 people.

Municipal Water Supply Treatment — Development of new or improvement of existing treatment facilities in two communities serving 1,193 people.

# WATER REQUIREMENTS

The State Water Plan Update process emphasizes reexamination of North Dakota's future water requirements. Bar graphs have been developed using the Future Without Plan base condition projections as depicted in the main report. To this base were added the impacts of recommended water development projects resulting in total annual water requirements for each of the three timeframes addressed in the planning process.



## DEVILS LAKE BASIN RECOMMENDED PLAN — EARLY ACTION PROGRAM

Project Description and Implementation Costs for the 1980-1990 Time Frame in 1980 Dollars

Program Feature	Description	Federal	Initial Costs State/Local	Total
<b>SURFACE WATER CONTROL</b>				
<u>Instream Control</u>	Starkweather Watershed Project	—	\$10,046,000	\$10,046,000
<u>Channel Improvements</u>	— Channel improvement is proposed for 56 miles of channel.			
Levees, Flood-wall, etc.	Creel Bay Levee — This project involves construction of a levee/dam at the 1,445 feet msl level, providing protection to the 1,440 feet msl elevation for the City of Devils Lake.	\$ 2,670,000	\$ 130,000	\$ 2,800,000
<u>Multi-feature Project</u>	Hurricane Lake Watershed Project — This project involves 24 miles of channel improvements, two new lake control structures and modification of one existing lake control structure. Phase development for the lake control structure is in progress.	—	\$ 999,800	\$ 999,800
	Comstock Watershed Project — This project involves five miles of channel improvement and one grade stabilization structure.	—	\$ 193,000	\$ 193,000
	Stump Lake Watershed Project — This project involves 26 miles of channel improvement, one lake control structure and two control structures on wetlands.	—	\$ 1,451,000	\$ 1,451,000
	Edmore Watershed Project — This project involves development of 55 miles of channel improvement and construction of grade stabilization structures.	—	\$ 4,651,000	\$ 4,651,000
	Chain Lake Watershed Project — This project involves 24 miles of channel improvement, new channel construction and two lake control structures.	—	\$ 9,007,000	\$ 9,007,000
	Mauvais Coulee Watershed Project — This project involves 19 miles of channel improvement, a new lake control structure and upgrading and replacing roadway openings that have insufficient capacities.	—	\$ 1,996,000	\$ 1,996,000
	South Slope Watershed Project — Three miles of channel improvement and four grade stabilization structures are proposed.	—	\$ 382,000	\$ 382,000
<b>ENVIRONMENTAL AND RESOURCE ENHANCEMENT</b>				
<u>Protection and Management</u>	Land Treatment Measures — Land treatment measures are needed to reduce soil erosion on 467,000 acres of land.	\$ 3,696,000	\$ 1,232,000	\$ 4,928,000
<u>Outdoor Recreation Facilities</u>	East Bay (Camp Grafton) Recreation Facility <sup>1</sup> — This multi-year project, developing public facilities and providing access to Devils Lake, is currently being implemented.	\$ 178,500	\$ 178,500	\$ 357,000

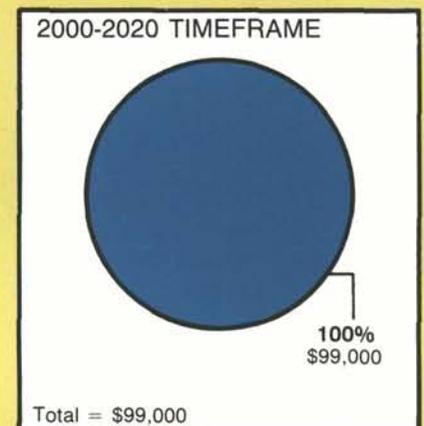
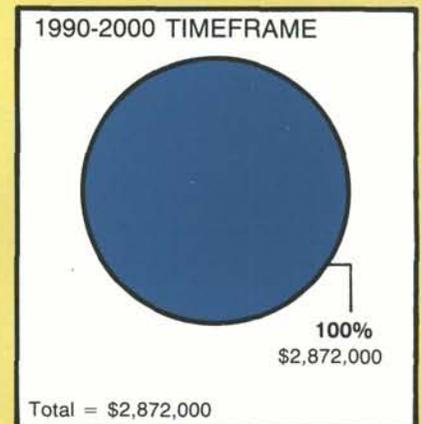
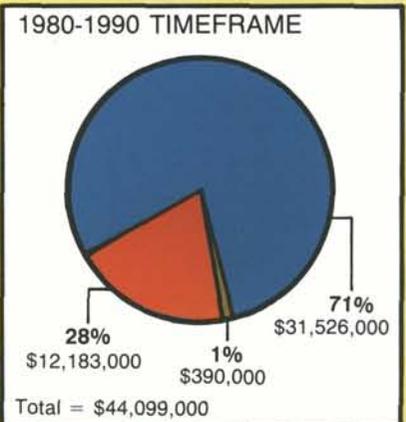
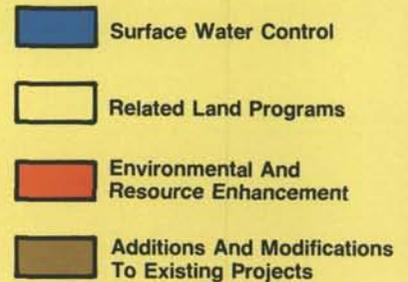
<sup>1</sup>The multi-year project is currently being installed; funding for the total project has not been appropriated.

Program Feature	Description	Federal	Initial Costs State/Local	Total
<u>Waste Water Management</u> Municipal	Development of new and/or improvement of existing municipal waste treatment facilities is proposed for 14 communities and one unincorporated community serving 16,000 people.	\$ 4,277,250	\$ 1,425,750	\$ 5,703,000
<u>Water Supply Treatment</u> Municipal	Development of additional or improvement of existing treatment facilities is required to meet the recommended limits for domestic water supply for two communities serving 1,193 people.	—	\$ 1,195,000	\$ 1,195,000
<b>ADDITIONS AND MODIFICATIONS TO EXISTING PROJECTS</b>				
<u>Reservoir Storage</u>	Big Coulee Dam (Bisbee Dam) — Repairing and raising the reservoir four feet is proposed. This would assure a water supply for the 257 residents of Bisbee and would enhance the sport fishery.	\$ 156,000	\$ 234,000	\$ 390,000



## RECOMMENDED PLAN SUMMARY

Implementation costs of the recommended plan are categorized by function.





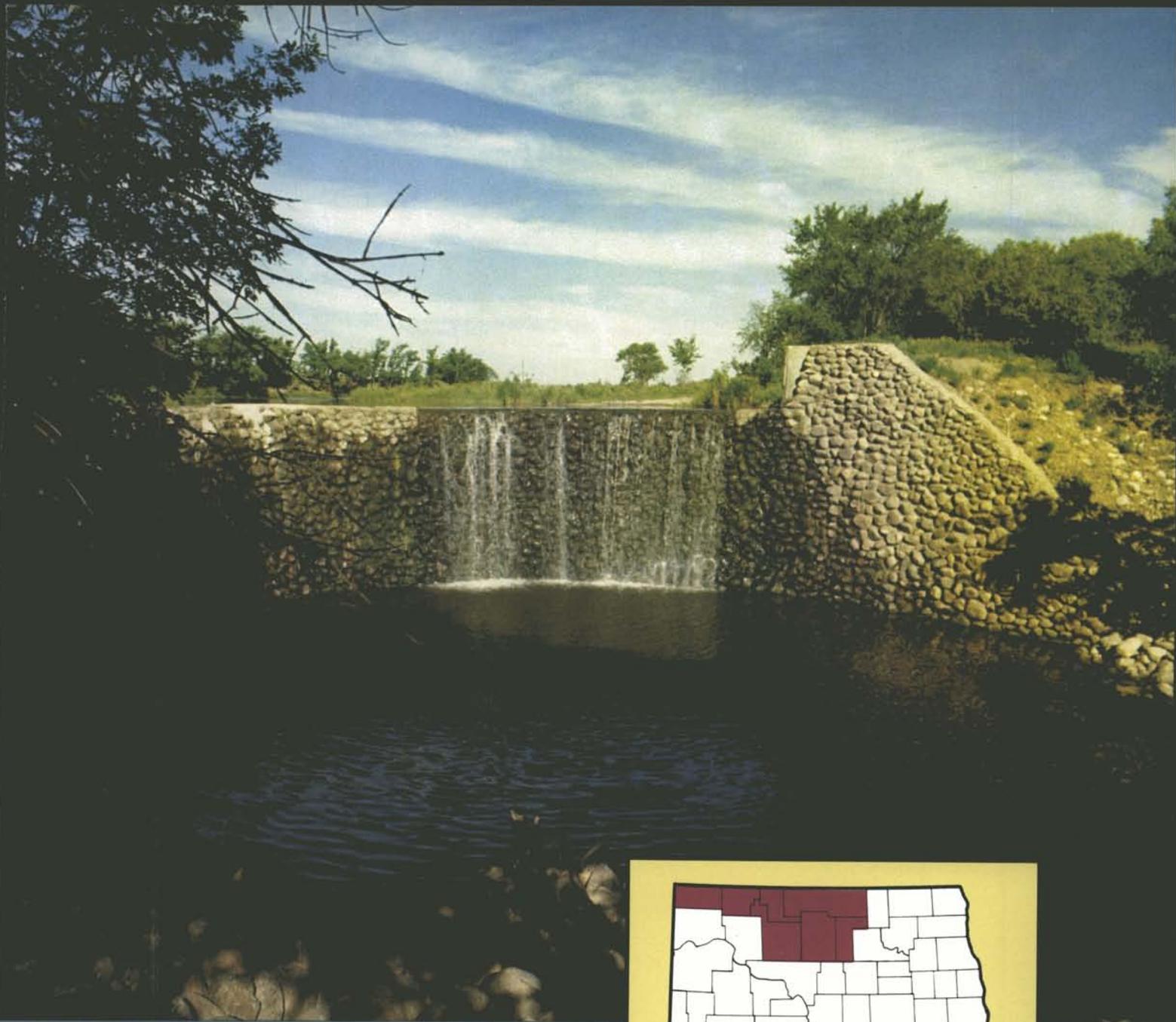
## DEVILS LAKE BASIN

### Additional Special Studies and Programs

- The State Water Commission should expedite studies to determine and set an optimum management level for Devils Lake. The Devils Lake Citizens Advisory Board recommends that the best management level be set at an elevation between 1425' msl and 1427' msl.
- Further studies are required with respect to the following:
  - A) The relationships between wetlands, soil salinity and salinity-caused reductions in crop yields.
  - B) The economics of the physical and biological relationships affecting water quality.
  - C) The value of wildlife and wetland habitat in the Devils Lake Basin.
  - D) The potential impact of flooding on communities in the Devils Lake Basin.
- A basin-wide, weather reporting system should be established.
- A basin-wide, water quality monitoring system should be established. It is recommended that the State Health Department tighten regulations pertaining to phosphate and nitrate discharges and that enforcement efforts be increased.
- Completion and use of a hydrologic model for the Basin is recommended.
- Determination of an acceptable outlet from the Basin is recommended. A Devils Lake Subbasin Flood Control Analysis Report under the Red River of the North General Authority will be initiated early in 1983 by the Corps of Engineers. The Devils Lake Citizens Advisory Board recognizes the Sheyenne River as the Basin's natural outlet and that Canadian concerns should not limit the full assessment of all alternatives. In addition, the Devils Lake Board recommends that the ordinary high water mark be established between 1435' msl and 1438' msl.
- Accelerating extensive soil studies is recommended for the Basin. The 1982 status of the county soil surveys is as follows: Benson County is completed; Cavalier and Ramsey Counties are in progress; and Rolette and Towner Counties have no soil surveys.
- A comprehensive floodplain zoning program for the land below the meander line of Devils Lake should be established.
- A study is encouraged to determine the need for rural water systems and possible alternative funding sources.
- The State Water Commission, in cooperation with the State Health Department, should expedite studies of alternative treatment measures, including cost and effectiveness of new sewage treatment facilities for the City of Devils Lake.
- A study is recommended to examine the possibility of cleaning channels through Fish and Wildlife Service easement lands to facilitate upstream flood control projects.
- The problem of roads washing out or being inundated by the rising lake level of Devils Lake should be studied.
- Efforts should continue at a faster pace to improve natural channels to contain high flows and to search for sites to construct small impoundments.
- Further study should be conducted concerning the possibility of using community sewage lagoon waters to irrigate adjacent farmlands.
- Funding of the State Water Bank Program is encouraged. The program should emphasize voluntary choice and include time limitations.
- More intensive development and management is recommended for wildlife habitat and wetlands under federal control.
- Continuation of studies for the restoration of Stump Lake is recommended.

- State and/or federal study is recommended for a farm drainage mitigation plan suggested by one of the Board members. This plan's purpose is to allow efficient farming by replacing drained croplands with acreage of wildlife habitat on marginal land on the same farm. The Board recommends that the State Water Commission develop and submit legislation to initiate the program as stated.
- Maintaining and increasing the stream gauging network within the Basin is recommended.
- The Devils Lake Citizens Advisory Board supports the Weather Modification Program titled "Atmospheric Water Resources Research in Conjunction with the North Dakota Cloud Modification Program."





**SOURIS RIVER BASIN**





## PROBLEMS

The Souris River flows southeasterly from its headwaters in southeastern Saskatchewan into North Dakota near the northeastern corner of Renville County. From this point, it continues in a southeasterly direction through the City of Minot in Ward County to Velva in McHenry County where its course changes to the northeast until north of Towner. Here, the river curves gradually to the northwest until it re-enters Canada west of the Turtle Mountains in north-central Bottineau County. The Souris River drains portions of Saskatchewan, Montana, North Dakota and Manitoba. In North Dakota, the area contributing to the Souris River is 9,112 square miles. Stream length in the State is 375 river miles.

Major problems identified in the Basin relate to inadequate quantity and quality of water to meet municipal and rural needs and frequent flooding of the Souris River and many tributary streams including the Des Lacs and Wintering Rivers, and Ox, Oak, Willow and Stone Creeks. Inadequate channel capacities and the topography contribute to flooding which causes extensive damage to agricultural and urban areas.

Flooding occurs in many areas because the topography hinders adequate drainage of excessive runoff. Spring snowmelt and/or heavy rainfall causes water from upper areas of the drainage basin to accumulate in closed, low areas which remain wet beyond the time cultivation normally begins. For example, in 1976, 8,393 acres of land were under water or had to be removed from production in the

Tolley Flats area of Ward and Renville Counties.

Serious riverbank erosion along the Souris and its tributaries and land surface and gully erosion, which strips topsoil from the land and deposits sediment into lakes and rivers, are two critical problems requiring attention.

## OPPORTUNITIES

Water development opportunities for the Souris River Basin include small, single purpose reservoirs which could be designed to decrease the high volume of water that flows into the Souris and Des Lacs Rivers and their tributaries during spring snowmelt. Flooding and bank erosion could be reduced and the stored water could be put to beneficial use.

Another proposal suggests the transfer of Wintering River flood flows into lakes that exist in the upper end of the Sheyenne River watershed in Pierce County for purposes of irrigation and lake enhancement.

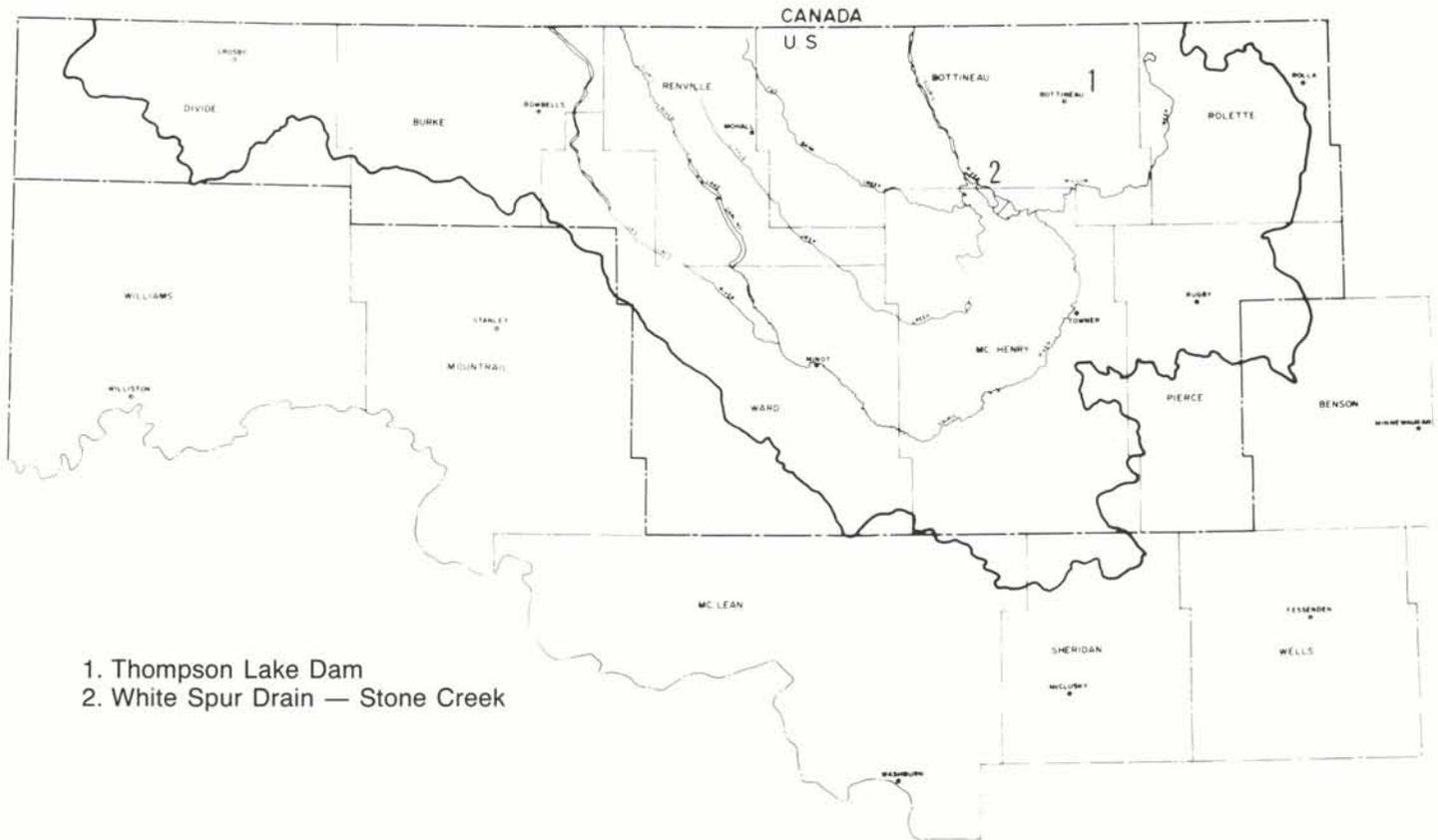
Channel improvement is considered essential for many streams in the Souris River Basin. Snagging and clearing debris and fallen trees from the stream channels would increase channel capacities and help minimize overbank flooding.

Also, an important opportunity is the acceleration of land management practices to protect the Basin's soil and water resources by reducing erosion as well as decreasing the movement of nutrients, fertilizers and pesticides from the land. Assistance for implementation of practices such as shelterbelts, strip cropping and grassed waterways is available through agencies such as the Soil Conservation Service (SCS) and the Agricultural Stabilization and Conservation Service (ASCS).

Many opportunities also exist to provide rural water systems that would serve the needs of individual farmers as well as small towns and more densely populated rural areas.



# SOURIS RIVER BASIN LOCATION OF RECOMMENDED PLAN — EARLY ACTION PROGRAM



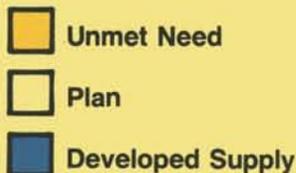
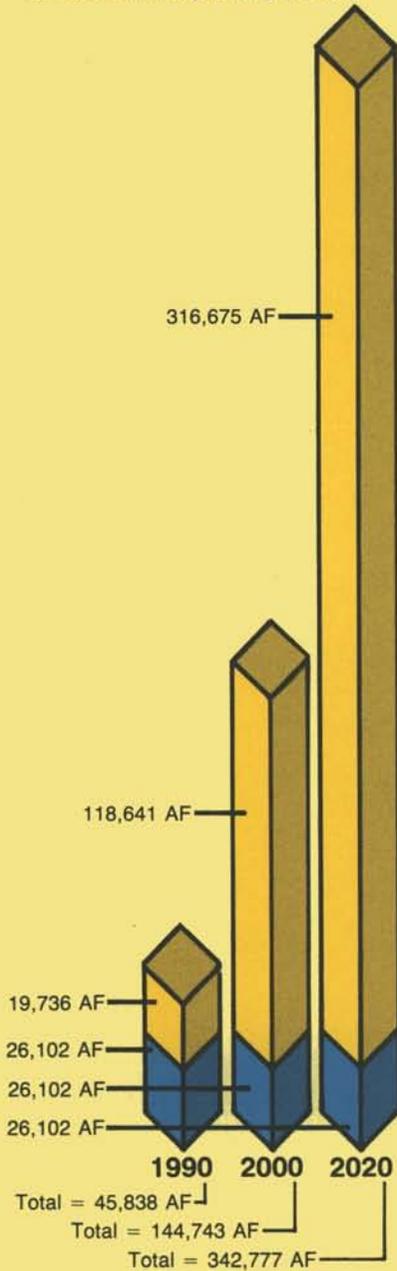
1. Thompson Lake Dam
2. White Spur Drain — Stone Creek

## REGION-WIDE

Land Treatment Measures — Measures to be applied to 963,000 acres of land.  
Municipal Waste Treatment — Development of new and/or improvement of existing facilities in 26 communities serving 63,180 people, in addition to Lake Metigoshe State Park.  
Municipal Water Supply Treatment — Development of new and/or improvement of existing treatment facilities in six communities serving 7,194 people.

# WATER REQUIREMENTS

The State Water Plan Update process emphasizes reexamination of North Dakota's future water requirements. Bar graphs have been developed using the Future Without Plan base condition projections as depicted in the main report. To this base were added the impacts of recommended water development projects resulting in total annual water requirements for each of the three timeframes addressed in the planning process.



## SOURIS RIVER BASIN RECOMMENDED PLAN — EARLY ACTION PROGRAM

Project Description and Implementation Costs for the 1980-1990 Time Frame in 1980 Dollars

Program Feature	Description	Federal	Initial Costs State/Local	Total
<b>SURFACE WATER CONTROL</b>				
<u>Single Purpose Reservoirs</u>	Thompson Lake Dam — Construction of a dam, raising the natural lake level three feet, would enhance the recreation value of the lake which is located in Bottineau County.	—	\$ 14,271 <sup>1</sup>	\$ 14,271 <sup>1</sup>
<b>RELATED LAND PROGRAMS</b>				
<u>Drainage</u>	White Spur Drain — Stone Creek — Improvements are proposed for Stone Creek watershed in Oak Creek Township of Bottineau County.	—	\$ 93,600	\$ 93,600
<b>ENVIRONMENTAL AND RESOURCE ENHANCEMENT</b>				
<u>Protection and Management</u>	Land Treatment Measures — Measures are required to reduce soil erosion of 963,000 acres.	\$ 7,244,250	\$ 2,414,750	\$ 9,659,000
<u>Waste Water Management Municipal</u>	Development of new and/or improvement of existing municipal waste treatment facilities is required for 26 communities serving 63,180 people, in addition to a treatment facility at Lake Metigoshe State Park.	\$ 3,976,500	\$ 1,325,500	\$ 5,302,000
<u>Water Supply Treatment Municipal</u>	Development of additional or improvement of existing treatment facilities is required to meet recommended limits for domestic water supplies in six communities serving 7,194 people.	—	\$ 4,915,000	\$ 4,915,000

<sup>1</sup>Represents an average of estimated costs for two alternatives.



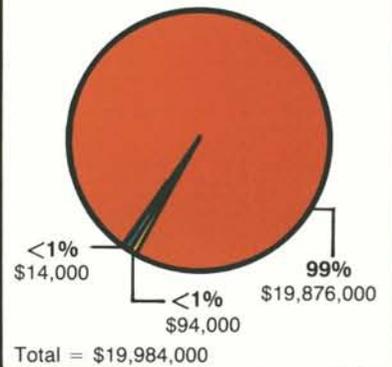


## RECOMMENDED PLAN SUMMARY

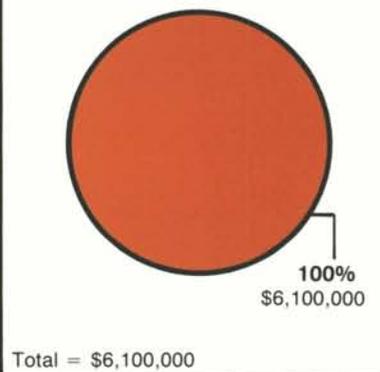
Implementation costs of the recommended plan are categorized by function.

- Surface Water Control
- Related Land Programs
- Environmental And Resource Enhancement
- Additions And Modifications To Existing Projects

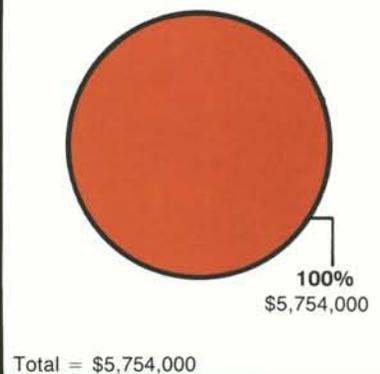
### 1980-1990 TIMEFRAME



### 1990-2000 TIMEFRAME



### 2000-2020 TIMEFRAME

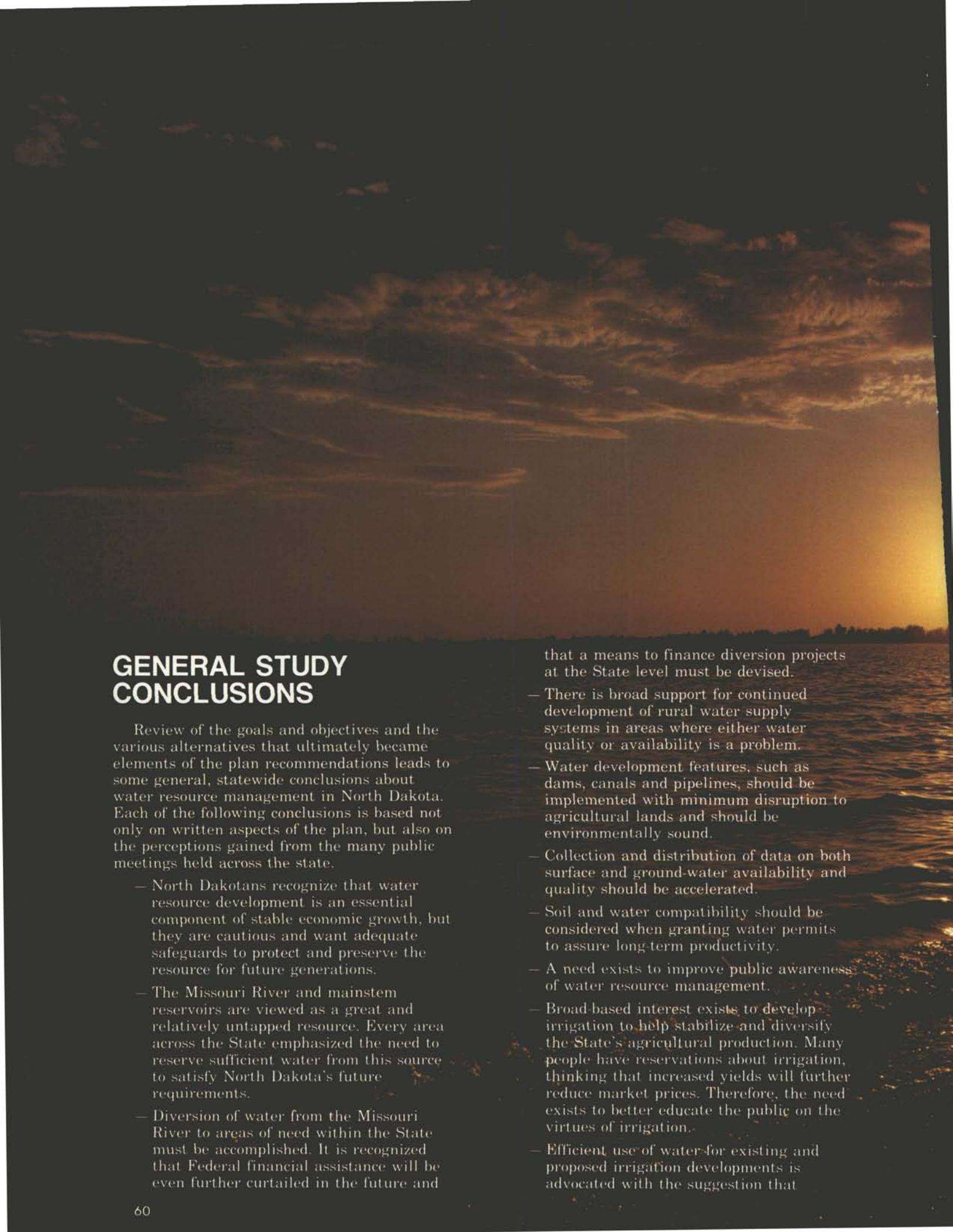




## SOURIS RIVER BASIN

### Additional Special Studies and Programs

- Alternatives should be investigated for the Souris River washout problem located five miles west and five miles north of Karlsruhe in McHenry County.
- Continued study of the Lake Metigoshe water quality problem is recommended in order to determine a viable solution.
- A detailed watershed study is recommended for Seven Mile Coulee which is located nine miles north of Tolley in Renville County.
- Consensus was not reached between the Upper and Lower Souris Public Involvement Regions regarding support of the Weather Modification Programs. The Upper Souris Region supports the programs.
- It is recommended that rural water lines better serve the needs of individual farmers as well as small towns and populated areas. Cost sharing alternatives should be investigated.
- A flooding problem with Rush Lake, Horseshoe Lake and Round Lake in Pierce County requires additional study.
- Studies are recommended to find solutions to the flooding and erosion problems caused by the Wintering River in McHenry County. An alternative that should be considered is the use of one of three potential diversion routes for transferring Wintering River flood flows into lakes at the upper end of the Sheyenne River watershed in Pierce County for irrigation and lake enhancement.
- Additional study should be considered for a flooding problem near Crosby in Divide County.
- A watershed study should be undertaken to find a solution to a flooding problem in Grover Township of Renville County.
- Review of existing studies of the Tolley Flats problem in Renville and Ward Counties is recommended. Studies should continue until a workable solution is found.
- Recommended is a detailed analysis of a flooding problem near Makoti, to include the additional problem of seepage in a roadway of Section 33 — Township 154 North — Range 87 West near Hiddenwood Lake, and determination of the feasibility of a flood control dam in Section 28 — Township 154 North — Range 87 West in Ward County.
- Studies should be continued to determine suitable measures for addressing flood damages that could occur after implementation of the Lake Darling Compromise Plan.
- Recommended is a study of flooding and erosion problems in the Des Lacs River Valley.
- A study is requested to identify and analyze potential multi-purpose reservoir sites and sites for small, single purpose dry dams in the Des Lacs and Souris River watersheds.
- A possible storage site 10 miles west of Rolette in Rolette County should be studied in greater detail. Although this particular site has questionable feasibility, support is voiced for the concept of water retention structures where landowners are willing to retain water.
- An engineering study should be conducted of a single purpose storage structure on Thompson Lake five miles northeast of Bottineau in Bottineau County.



## GENERAL STUDY CONCLUSIONS

Review of the goals and objectives and the various alternatives that ultimately became elements of the plan recommendations leads to some general, statewide conclusions about water resource management in North Dakota. Each of the following conclusions is based not only on written aspects of the plan, but also on the perceptions gained from the many public meetings held across the state.

- North Dakotans recognize that water resource development is an essential component of stable economic growth, but they are cautious and want adequate safeguards to protect and preserve the resource for future generations.
- The Missouri River and mainstem reservoirs are viewed as a great and relatively untapped resource. Every area across the State emphasized the need to reserve sufficient water from this source to satisfy North Dakota's future requirements.
- Diversion of water from the Missouri River to areas of need within the State must be accomplished. It is recognized that Federal financial assistance will be even further curtailed in the future and

that a means to finance diversion projects at the State level must be devised.

- There is broad support for continued development of rural water supply systems in areas where either water quality or availability is a problem.
- Water development features, such as dams, canals and pipelines, should be implemented with minimum disruption to agricultural lands and should be environmentally sound.
- Collection and distribution of data on both surface and ground-water availability and quality should be accelerated.
- Soil and water compatibility should be considered when granting water permits to assure long-term productivity.
- A need exists to improve public awareness of water resource management.
- Broad-based interest exists to develop irrigation to help stabilize and diversify the State's agricultural production. Many people have reservations about irrigation, thinking that increased yields will further reduce market prices. Therefore, the need exists to better educate the public on the virtues of irrigation.
- Efficient use of water for existing and proposed irrigation developments is advocated with the suggestion that



assistance be provided to renovate older systems and adopt improved irrigation techniques.

Maintenance and improvement of water quality in streams and lakes are statewide concerns. It is recognized that land management practices have a direct impact on water quality, thus broad support exists for improved land management to aid in the control of non-point source pollution.

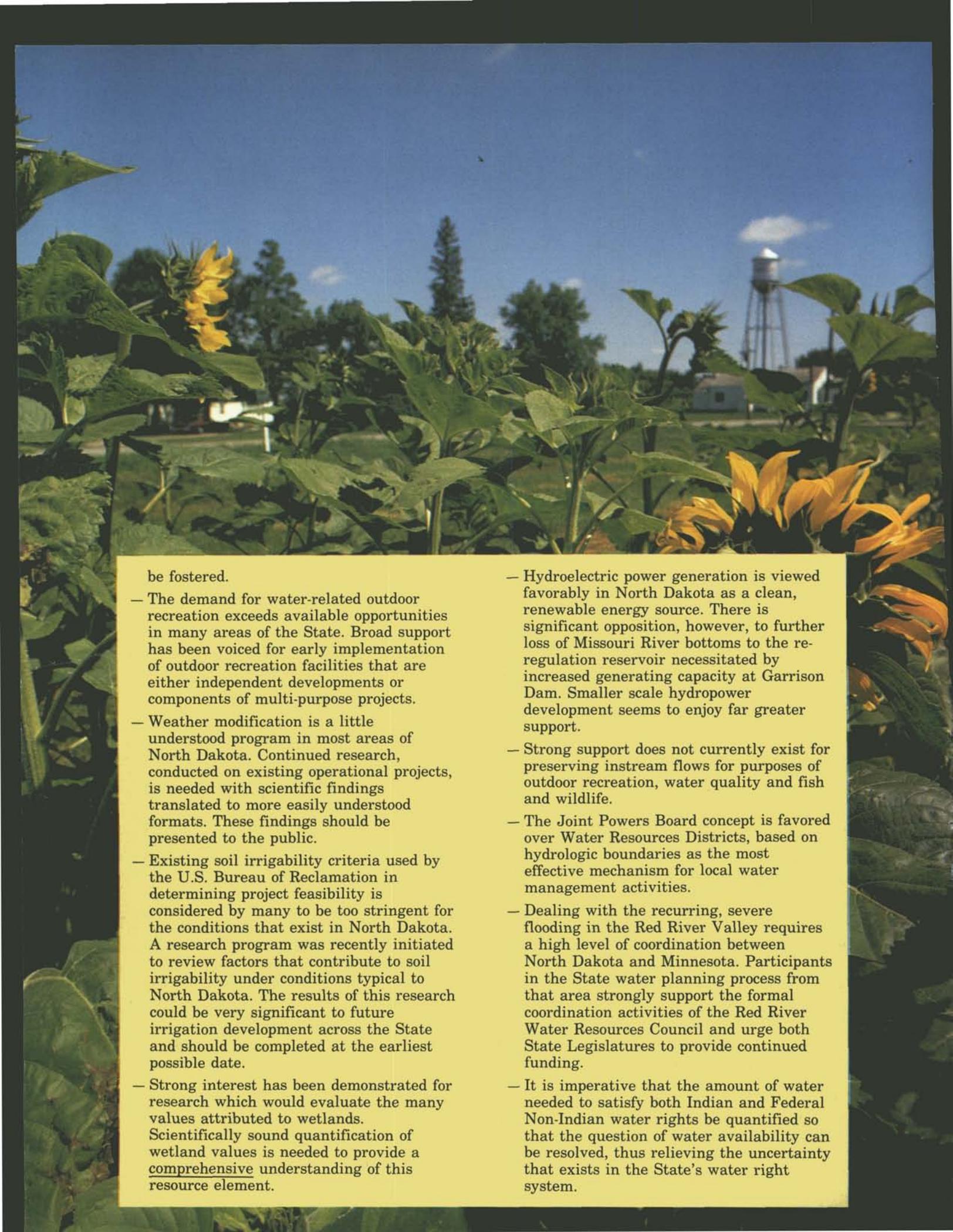
Funding for lake restoration programs is at a "demonstration" level. If the existing trend of accelerated lake eutrophication is allowed to continue, about half of the lakes currently managed as fisheries will be unsuitable within 15 to 20 years.

Federal funding for restoration programs is not expected to increase; therefore, state and local entities must consider assuming this burden.

- Flooding is a long-standing problem in many areas throughout North Dakota and North Dakotans recognize that both structural and nonstructural solutions must be pursued. Retaining water on the land could minimize the need for large, floodwater storage reservoirs.
- North Dakota's Flood Plain Management Act, adopted in 1981, signifies a new and strong commitment by the State to pursue

a comprehensive approach to flood plain management. A need exists to develop and disseminate flood plain information to the public and to local communities to facilitate participation in the National Flood Insurance Program. Flood prone communities must adopt and implement comprehensive flood hazard mitigation plans.

- North Dakota possesses invaluable fish and wildlife resources. Man's influence on the landscape has resulted in a loss of both numbers and diversity of species, thus it is important that "essential" habitat be secured if the quality of the resource is to be maintained or improved. In securing fish and wildlife habitat, more flexible programs, like the State and Federal Water Bank programs, are much preferred to permanent easement and fee title purchases.
- New acquisition of lands for fish and wildlife purposes is strongly questioned in most areas of the State since many acres have already been dedicated to habitat preservation. It is strongly recommended that land currently dedicated should be managed more intensively to meet fish and wildlife needs. Improved cooperation/coordination between fish and wildlife authorities and landowners should



be fostered.

- The demand for water-related outdoor recreation exceeds available opportunities in many areas of the State. Broad support has been voiced for early implementation of outdoor recreation facilities that are either independent developments or components of multi-purpose projects.
- Weather modification is a little understood program in most areas of North Dakota. Continued research, conducted on existing operational projects, is needed with scientific findings translated to more easily understood formats. These findings should be presented to the public.
- Existing soil irrigability criteria used by the U.S. Bureau of Reclamation in determining project feasibility is considered by many to be too stringent for the conditions that exist in North Dakota. A research program was recently initiated to review factors that contribute to soil irrigability under conditions typical to North Dakota. The results of this research could be very significant to future irrigation development across the State and should be completed at the earliest possible date.
- Strong interest has been demonstrated for research which would evaluate the many values attributed to wetlands. Scientifically sound quantification of wetland values is needed to provide a comprehensive understanding of this resource element.
- Hydroelectric power generation is viewed favorably in North Dakota as a clean, renewable energy source. There is significant opposition, however, to further loss of Missouri River bottoms to the re-regulation reservoir necessitated by increased generating capacity at Garrison Dam. Smaller scale hydropower development seems to enjoy far greater support.
- Strong support does not currently exist for preserving instream flows for purposes of outdoor recreation, water quality and fish and wildlife.
- The Joint Powers Board concept is favored over Water Resources Districts, based on hydrologic boundaries as the most effective mechanism for local water management activities.
- Dealing with the recurring, severe flooding in the Red River Valley requires a high level of coordination between North Dakota and Minnesota. Participants in the State water planning process from that area strongly support the formal coordination activities of the Red River Water Resources Council and urge both State Legislatures to provide continued funding.
- It is imperative that the amount of water needed to satisfy both Indian and Federal Non-Indian water rights be quantified so that the question of water availability can be resolved, thus relieving the uncertainty that exists in the State's water right system.

# CITIZENS ADVISORY BOARDS

## UPPER MISSOURI PUBLIC INVOLVEMENT REGION

John A. Anderson  
Dale Karlgaard  
Gene Emery  
Francis Goodall  
Lester Larson, Jr.  
Robert Walsh

## MIDDLE MISSOURI PUBLIC INVOLVEMENT REGION

Jim Eastgate  
Clifford Kahler  
Leonard Landenberger  
Kenny Doepke  
Duane Bohrer  
Clois Hetletved  
Fred Larson  
Warren Olson  
William C. Wocken

## LITTLE MISSOURI PUBLIC INVOLVEMENT REGION

E. A. Denowh  
Eugene Miller  
Orville Moe  
Dave Sonsolla  
Sidney Connell  
Don Erikson  
Keith Farstveet

## LAKE SAKAKAWEA PUBLIC INVOLVEMENT REGION

Lawrin H. Baker  
Clive Pelton  
Frank Heinzen  
Richard Anderson  
Wayne Johnson  
August Little Soldier  
Larry Ziegler

## KNIFE PUBLIC INVOLVEMENT REGION

Duane Bueligen  
Fred Galloway  
LeMore Greenshields  
Don Herbel  
Earl Pelton  
Walter Schwalbe

## HEART PUBLIC INVOLVEMENT REGION

Joe Braun  
Myron Burian  
Alfred Underdahl  
Herbert Urlacher  
Michael Obach  
Art Baumgartner  
Joe LaDuke

## UPPER SOURIS PUBLIC INVOLVEMENT REGION

Arden Haner  
E. C. "Bus" McCarroll  
Floyd Nelson  
David Reistad  
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