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THE NATION'S WATER RESOURCES 1975-2000

Volume 4: Souris-Red-Rainy Region

Second National Water Assessment by the U.S. Water Resources Council

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Foreword

The Water Resources Planning Act of 1965 (Public Law 89-80) directs the U.S. Water Resources Council to maintain a continuing study of the Nation's water and related land resources and to prepare periodic assessments to determine the adequacy of these resources to meet present and future water requirements. In 1968, the Water Resources Council reported the results of its initial assessment. The Second National Water Assessment, a decade later, provides a comprehensive nationally consistent data base for the water resources of the United States. The results of the Second National Water Assessment were obtained by extensive coordination and collaboration in three phases.

Phase I: Nationwide Analysis

The Council member agencies researched, analyzed, and prepared estimates of current and projected water requirements and problems and the implications of the estimates for the future.

Phase II: Specific Problem Analysis

Regional sponsors, one for each of the 21 water resources regions, surveyed and analyzed State and regional viewpoints about (1) current and future water problems, (2) conflicts that may arise in meeting State and regional objectives, and (3) problems and conflicts needing resolution.

Phase III: National Problem Analysis

The Council conducted this final phase in three steps: (1) An evaluation of phases I and II, (2) an analysis that identified and evaluated the Nation's most serious water resources problems, and (3) the preparation of a final report entitled "The Nation's Water Resources--1975-2000."

The final report of the Second National Water Assessment consists of four separate volumes as described below. These volumes can assist Federal, State, local, and other program managers, the Administration, and the Congress in establishing and implementing water resources policies and programs.

Volume 1, Summary, gives an overview of the Nation's water supply, water use, and critical water problems for "1975," 1985, and 2000 and summarizes significant concerns.

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Volume 2, Water Quantity, Quality, and Related Land Considerations, consists of one publication with five parts:

Part I, "Introduction," outlines the origin of the Second National Water Assessment, states its purpose and scope, explains the numerous documents that are part of the assessment, and identifies the individuals and agencies that contributed to the assessment.

Part II, "Water-Management Problem Profiles," identifies ten general water problem issues and their implications and potential consequences.

Part III, "Water Uses," focuses on the national perspectives regarding existing ("1975") and projected (1985 and 2000) requirements for water to meet offstream, instream, and flow-management needs. State-regional and Federal perspectives are compared.

Part IV, "Water Supply and Water Quality Considerations," analyzes the adequacy of fresh-water supplies (ground and surface) to meet existing and future requirements. It contains a national water budget; quantifies surface- and ground-water supplies, reservoir storage, and transfers of water within and between subregions; describes regional requirements and compares them to supplies; evaluates water quality conditions; and discusses the legal and institutional aspects of water allocation.

Part V, "Synopses of the Water Resources Regions," covers existing conditions and future requirements for each of the 21 water resources regions. Within each regional synopsis is a discussion of functional and location-specific water-related problems; regional recommendations regarding planning, research, data, and institutional aspects of solving regional water-related problems; a problem-issue matrix; and a comparative-analysis table.

Volume 3, Analytical Data, describes the methods and procedures used to collect, analyze, and describe the data used in the assessment. National summary data are included with explanatory notes. Volume 3 is supplemented by five separately published appendixes that contain data for the regions and subregions:

Appendix I, Social, Economic, and Environmental Data, contains the socioeconomic baseline ("1975") and growth projections (1985 and 2000) on which the water-supply and water-use projections are based. This appendix presents two sets of data. One set, the National Future, represents the Federal viewpoint; the other set, the State-Regional Future, represents the regional sponsor and/or State viewpoint.

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Appendix II, Annual Water Supply and Use Analysis, contains baseline water-supply data and baseline and projected water withdrawal and water-consumption data used for the assessment. Also included are a water adequacy analysis, a natural flow analysis, and a critical-month analysis.

Appendix III, Monthly Water Supply and Use Analysis, contains monthly details of the water-supply, water-withdawal, and water-consumption data contained in Appendix II and includes an analysis of monthly water adequacy.

Appendix IV, Dry-Year Conditions Water Supply and Use Analysis, contains both annual and monthly baseline and projected water-withdrawal and water-consumption data for dry conditions. Also, a dry conditions water-adequacy analysis is included.

Appendix V, Streamflow Conditions, contains detailed background information on the derivation of the baseline streamflow information. A description of streamflow gages used, correction factors applied, periods of record, and extreme flows of record, are given for each subregion. Also included is the State-Regional Future estimate of average streamflow conditions.

Volume 4, Water Resources Regional Reports, consists of separately published reports for each of the 21 regions. Synopses of these reports are given in Volume 2, Part V.

For compiling and analyzing water resources data, the Nation has been divided into 21 major water resources regions and further subdivided into 106 subregions. Eighteen of the regions are within the conterminous United States; the other three are Alaska, Hawaii, and the Caribbean area.

The 21 water resources regions are hydrologic areas that have either the drainage area of a major river, such as the Missouri Region, or the combined drainage areas of a series of rivers, such as the South Atlantic-Gulf Region, which includes a number of southeastern States that have rivers draining directly into the Atlantic Ocean and the Gulf of Mexico.

The 106 subregions, which are smaller drainage areas, were used exclusively in the Second National Water Assessment as basic data-collection units. Subregion data point up problems that are primarily basinwide in nature. Data aggregated from the subregions portray both regional and national conditions, and also show the wide contrasts in both regional and national water sources and uses.

The Second National Water Assessment and its data base constitute a major step in the identification and definition of water resources problems by the many State, regional, and Federal institutions involved. However, much of the information in this assessment is general and broad in scope; thus, its application should be viewed in that context, particularly in the area of water quality. Further, the information reflects areas of defici-

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encies in availability and reliability of data. For these reasons, State, regional, and Federal planners should view the information as indicative, and not the only source to be considered. When policy decisions are to be made, the effects at State, regional, and local levels should be carefully considered.

In a national study it is difficult to reflect completely the regional variations within the national aggregation. For example, several regional reviewers did not agree with the national projections made for their regions. These disagreements can be largely attributed either to different assumptions by the regional reviewers or to lack of representation of the national data at the regional level. Therefore, any regional or State resources-management planning effort should consider the State-regional reports developed during phase II and summarized in Volume 4 as well as the nationally consistent data base and the other information presented in this assessment.

Additional years of information and experience show that considerable change has occurred since the first assessment was prepared in 1968. The population has not grown at the rate anticipated, and the projections of future water requirements for this second assessment are considerably lower than those made for the first assessment. Also, greater awareness of environmental values, water quality, ground-water overdraft, limitations of available water supplies, and energy concerns are having a dramatic effect on water-resources management. Conservation, reuse, recycling, and weather modification are considerations toward making better use of, or expanding, available supplies.

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Physiography

Description

The Souris-Red-Rainy Region encompasses the drainage areas of the three rivers of these names within the United States. The Souris, Red, and Rainy Rivers are international streams inasmuch as they either form boundary waters or flow from one country to another. The headwaters of the Souris are in Canada, and after meandering through a portion of the United States, the river returns to Canada. The Rainy River rises on the international boundary in northeastern Minnesota and follows the boundary to its mouth at Lake of the Woods, which drains into Canada via the Winnipeg River. The Red River rises within the United States and flows northward into Canada. All three rivers eventually drain northward into Hudson Bay.

Figure 9-1 geographically portrays the Souris-Red-Rainy Region. The region covers approximately 54,720 square miles (about 35 million acres)[1] and consists of major portions of the States of Minnesota (44 percent of the region) and North Dakota (56 percent). The region also includes small portions of South Dakota and Montana which together account for less than 1 percent of the region. About 1,925 square miles (about 1.2 million acres) of this total surface area is water surface. Over four-fifths of the water surface area is in Minnesota, primarily in the Rainy River Basin. Total surface area in the region's reservoirs equals about 30 square miles (or 19,200 acres). Cropland, pastureland, and forests are important land uses in the region. Together, cropland and pastureland uses account for over two-thirds of the regional surface area. Forests cover almost one-fifth of the region (see Figure 9-2).

Geology

In relatively recent geologic time, the region was covered by a continental glacier, which makes the surface immature, flat, and poorly drained. It has broad divides and innumerable potholes, sloughs, and lakes. There are many closed basins which do not contribute to stream outflow. The Rainy River Basin has only a thin cover of glacial drift and is characterized by relatively deep lakes with rocky shorelines surrounded by timbered, rocky knolls.

Topography

The region's topography reflects recent continental glaciation. The general topography is immature, and much of its glacial drift-covered land

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[1]This is the sum of the areas of counties used to approximate the hydrologic area of the region. Land use and other socioeconomic data are related to this area. The drainage area within the hydrologic boundary is 59,370 square miles.

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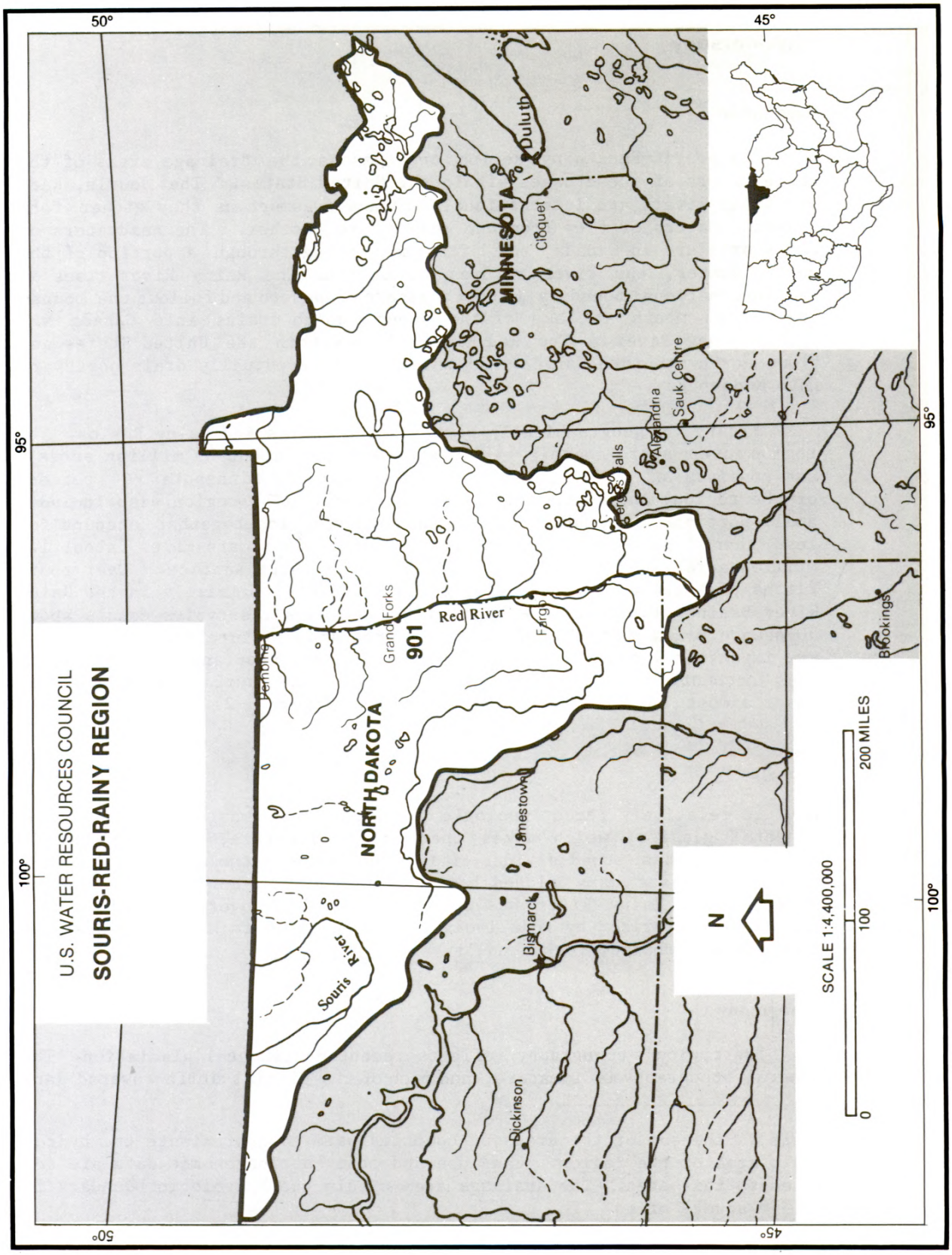

Figure 9-1. Region Map

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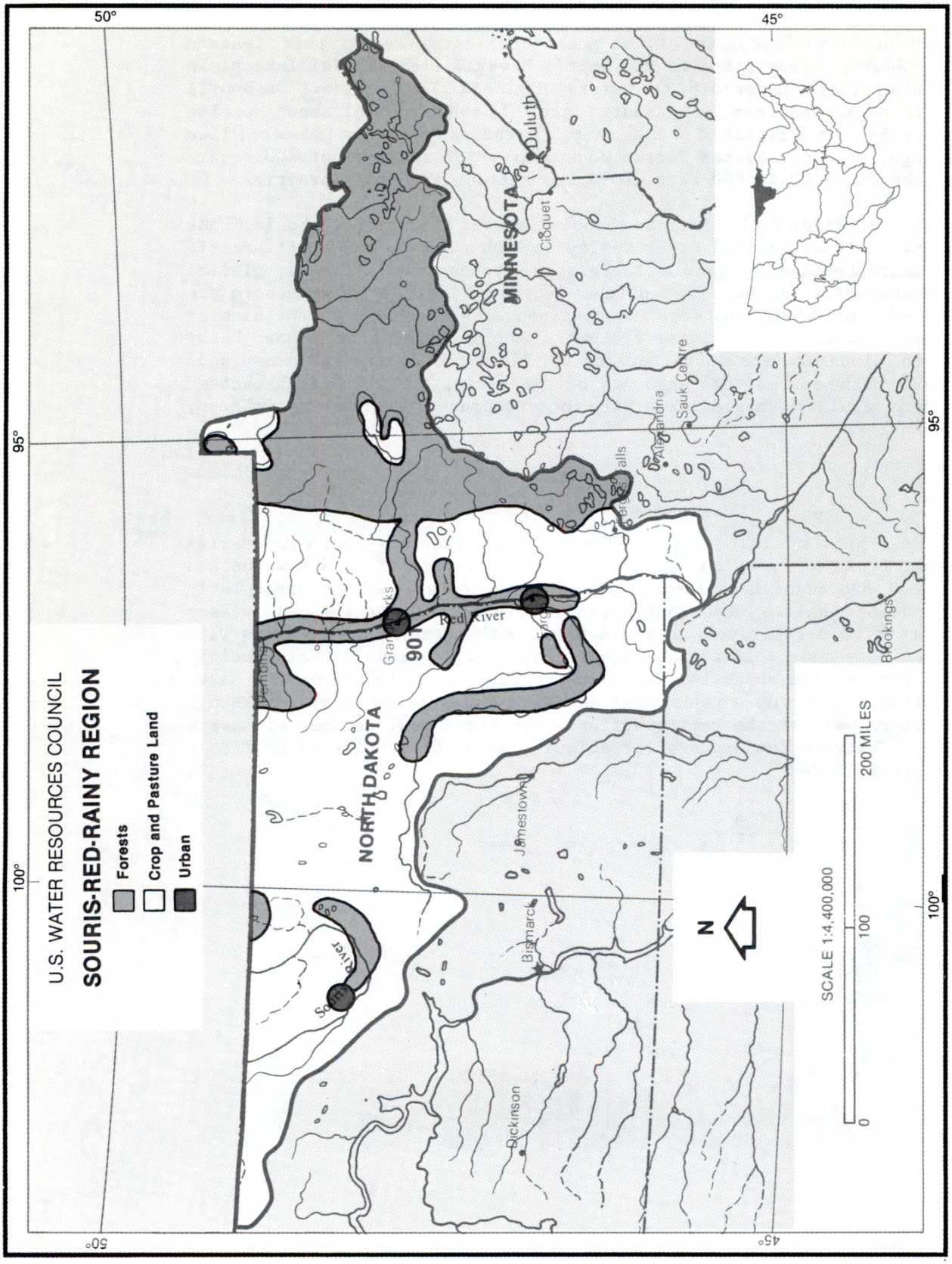

Figure 9-2. Present Land Use

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is flat or slightly rolling. The most outstanding topographic feature in the Souris River Basin is the Souris River Valley glacial lake plain which was formerly covered by the waters of glacial Lake Souris. The Souris Basin is separated from the Missouri Plateau by the Max or Altamont Moraine which reaches an altitude of 2,500 feet. To the east of this location, lies the rough, moraine-covered Turtle Mountains which cover about 400 square miles and rise 400 to 800 feet above the surrounding drift prairie.

The Red River Valley lies in the old lakebed of ancient, glacial Lake Agassiz. West of the Red River Valley in North Dakota are drift prairie lands characterized by gentle topography broken only by small, glacial ridges and small lakes. East of the Red River Valley in Minnesota are rugged morainic hills that form the continental divide between the Mississippi and Hudson Bay drainage systems. The western parts of the Rainy Basin in Minnesota are characterized by flat, poorly drained swampland. However, in the far eastern segments of the basin, the area is characterized by irregularly shaped lakes with rocky shores surrounded by timbered, rocky knolls.

Climate

The region's climate is generally of the continental type, which varies somewhat from the region's northern to southern extremities. Hot winds and periods of prolonged high temperatures do occur occasionally, particularly in the western half. The low humidity that prevails during the cold season renders the cold relatively less penetrating than many other regions with high humidity and similar temperature readings. Average annual precipitation ranges from about 14 inches in the west to 28 inches in the east. Precipitation for crop production is adequate during normal years, although the western half of the region suffers from occasional periods of severe drought. Extreme temperature variations ranging from minus 54 to 118° F have been recorded.

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People and the Resources

Basic to any identification of a region's problems and its critical water and related land resource needs is a comprehensive and coordinated analysis of the current and projected resource uses as well as resource management and conservation activities. To facilitate the identification of problems, estimates of population, economic growth, water and land resource use, and other factors were made for three time periods: 1975, 1985, and 2000. These data were prepared at the national, regional, and subregional levels of geographic detail and represent two viewpoints: national and State-regional.

The Souris-Red-Rainy Region includes only one subregion, subregion 901. The national viewpoint, referred to as the National Future, was prepared jointly by the U.S. Water Resources Council staff and Federal agencies represented on the Council's National Programs and Assessment Committee, whereas the State-regional viewpoint referred to as the State-Regional Future Condition was prepared jointly by the Upper Mississippi River Basin Commission (UMRBC) and its member agencies. A comparison of these two viewpoints and discussion, to the extent possible, of the basic differences between the two sets of data is included at the end of this section.

Population

Most of this region's residents are historically linked to rural families, communities, commerce, and social life. Although migration from rural areas to cities has recently resulted in increasing urbanization, the region can still be characterized as rural with over 50 percent of the population residing on farms.

The region's 1975 population was estimated to be about 649,000 of which 45 and 55 percent lived in urban and rural areas, respectively. The following is a breakdown of this region's population by State according to State-regional sources.

State	Percent of Population
Minnesota	45
North Dakota	55
South Dakota	--

The region's major urban center is the Fargo-Moorhead SMSA with a population of about 123,000 people, or approximately one-fifth of the region's total population. Other population centers in the region includes Minot, Wahpeton, Valley City, Devils Lake, Grafton, and Grand

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Forks, in North Dakota and East Grand Forks, Breckenridge, Detroit Lakes, Fergus Falls, Thief River Falls, Crookston, and International Falls in Minnesota. The regional population is expected to decline to 595,000 by 2000.

Economy

Agriculture is the area's major industry with 62 percent of the land (almost 21 million acres) in cropland use. The value of agricultural commodities produced in 1975 was estimated at about $1,024 million for crops and about $351 million for livestock products. Manufacturing is confined mainly to residentiary activities and the processing of locally grown agricultural products for export. Forest resources in the region's heavily forested eastern portion support a strong paper manufacturing industry.

Table 9-1 summarizes selected earnings according to NF projections. According to these figures, agriculture currently accounts for over 21 percent of earnings, whereas manufacturing currently accounts for less than 10 percent of total earnings. "Other" earnings shown in Table 9-1 represent almost 70 percent of the region's total 1975 earnings and include the following categories: wholesale and retail trade; government; services; transportation, communication, and public utilities; contract construction; and finance, insurance, and real estate. Table 9-1 indicates all earnings categories, except mining, in the Souris-Red-Rainy Region will have increased earnings by the year 2000.

Table 9-1.--Souris-Red-Rainy Region earnings -- 1975, 1985, 2000
(million 1975 dollars)

Earnings sector	1975	1985	2000
Manufacturing	227	319	486
Agriculture	514	500	583
Mining	6	6	6
Other	1,695	2,269	3,487
Total	2,442	3,094	4,562

The region's total employment in 1975 was about 241,000 of which approximately 71 percent were in the noncommodity-producing group and the remaining 29 percent in the commodity-producing group. Within the commodity-producing group, slightly less than 30 percent were engaged in the manufacturing of commodities, whereas the remainder were engaged in nonmanufacturing commodity production, predominantly agricultural production. By 2000, total employment in this region is expected to reach approximately 246,000.

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Natural Resources

Land use and vegetation patterns in the Souris-Red-Rainy Region are quite varied; however, the predominant land use is agriculture with cropland, pasture, and other agricultural uses accounting for about 71 percent of the total surface area. Wooded hills are located near the Canadian border in North Dakota, and extensive forest areas are common along the eastern edge of the region in Minnesota. Forests and woodlands cover almost 20 percent of the total area. However, most of the region is characterized by rolling to nearly level prairie where farming is the dominant land use. Primary crops include wheat, barley, oats, flax, corn, potatoes, soybeans, sunflowers, and sugar beets (see Table 9-2).

Table 9-2.--Souris-Red-Rainy Region surface area and 1975 land use

Surface area or land use type	1,000 acres	Percentage of total surface area
Surface area		
Total	35,021	100.0
Water	1,232	3.5
Land	33,789	96.5
Land Use		
Cropland	20,791	59.4
Pasture and range	3,376	9.6
Forest and woodland	6,831	19.5
Other agriculture	681	2.0
Urban	70	0.2
Other	2,040	5.8

Agriculture

The cropland base in the Souris-Red-Rainy Region currently is about 20.8 million acres. About 65 percent of the total cropland acreage is harvested cropland. It is projected that total cropland will increase only slightly (4 percent) between 1975 and 2000. Cropland harvested is projected to increase by about 34 percent during this period. Irrigated farmland is not extensive and accounts for less than one percent of the total cropland (see Table 9-3).

Table 9-3.--Projected changes in cropland and irrigated farmland in the Souris-Red-Rainy Region--1975, 1985, 2000
(1,000 acres)

Land category	1975	1985	2000
Total cropland	20,791	20,875	20,946
Cropland harvested	13,614	16,973	18,283
Irrigated farmland	36	106	311

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Energy

Total power generation from this region's three steam electric power plants with an installed capacity of over 25 megawatts (MW) equaled 956 gigawatt-hours (gWh) in 1975. Two of these three steam electric plants employ once-through water cooling systems. All of these plants are fossil fueled. As of 1970, there were eight hydroelectric power projects in the region, but they supplied only about 3 percent of the total power generated. According to national projections, total future power generation from plants larger than 25 MW in size in the region will be reduced to zero in the year 2000 as it was assumed that all such future power needs will be imported from adjacent regions (see Table 9-4).

Table 9-4.--Souris-Red-Rainy Region electric power generation--1975, 1985, 2000 (gigawatt-hours)

Fuel source	1975	1985	2000
Fossil	956	352	0
Nuclear	0	0	0
Conventional hydropower	0	0	0
Total generation	956	352	0

Most of the minerals production takes place in the western one-third of the region, with petroleum, natural gas, lignite, and sand and gravel being the major mineral products. Petroleum accounts for nearly two-thirds of total mineral values produced. Although petroleum reserves for future production are not believed extensive, the hydrocarbon reserves of lignite are large. Lignite beds occurring in the Fort Union Formation in the southwestern margin of the basin range in thickness from 7 to 14 feet and are generally good quality, low-sulfur, and strippable. Potential minerals development includes solution mining of potash deposits in the Souris River Basin that would increase water use considerably. A large resource of low-grade copper-nickel ore in the eastern portion of the region also provides mineral development potential.

Environmental Resources

The Souris-Red-Rainy Region's landscape varies substantially from west to east or from the Souris River Basin to the Rainy River Basin. In the Souris and Red River Basins vast stretches of open prairies, agricultural land, and prairie woodland dominate the landscape. The landscape of the Rainy River Basin is considerably different. Numerous lakes, streams, waterfalls, and extensive forests are common landscape features. The Rainy River Basin is also considerably more rugged and contains little high-quality agricultural land.

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The Souris-Red-Rainy Region contains nearly 2,000 square miles of surface water area 40 acres or larger in size. However, several wildlife refuges and Lake Metigoshe (Bottineau County) provide the only water surface areas of any real significance or importance as environmental resources for sport fishing, hunting, and recreation, and these resources are concentrated in the eastern half of the Souris River Basin. Similarly, the vast majority of the Red River Basin's surface water resources, with the exception of Devils Lake and several multipurpose reservoirs in North Dakota, are located primarily in the Minnesota portion of the basin. Major surface water resources in the Minnesota portion of this basin are the Red Lakes in Beltrami County and numerous smaller lakes in Becker and Otter Tail Counties. Surface-water resources in the Rainy River Basin are quite abundant.

The fishery resources of the Souris-Red-Rainy Region also vary considerably. The Souris River Baisn and the western half of the Red River Basin contain a comparatively low-quality fishery resource when compared to the remainder of the region. Streamflow fluctuations, natural and man-made pollution, and a limited supply of high quality fishery habitat have put considerable constraints on the area's fishery resource. In the eastern half of the Red River Basin and in the Rainy River Basin, these problems are not as apparent, and a high quality warm- and cold-water fishery resource exists in these areas.

The region also contains a little over 6.8 million acres of forestland supporting a great variety of wildlife. However, this forestry resource is not distributed evenly throughout the area. The Minnesota portion of the region contains over 90 percent of this forestland. The type and abundance of wildlife varies considerably in the region. Farmland species dominate the terrestrial wildlife population in the more agricultural North Dakota portion of the region. Few big game species are found in this prairie region. Large forested areas in the eastern one-third of the region, particularly the Rainy River Basin and far eastern portion of the Red River Basin, support a large population of white-tailed deer as well as moose and timber wolf in those areas which are still relatively unpopulated. Small game species also are abundant in these forested areas.

Waterfowl production in the region is of primary importance to continental waterfowl management. About half of all waterfowl production in the Central and Mississippi Flyways in the continental United States occurs within the Souris-Red-Rainy Region. The excellent waterfowl production in the Prairie Pothole region of North Dakota depends on the availability of a mix of wetland types and sizes.

Wetlands have long been known to have other values than those associated with production and maintenance of wildlife populations. Prairie wetlands provide water storage during spring runoff and during periods of extreme precipitation. The natural storage maintains excess water within the wetland basins located in the local area.

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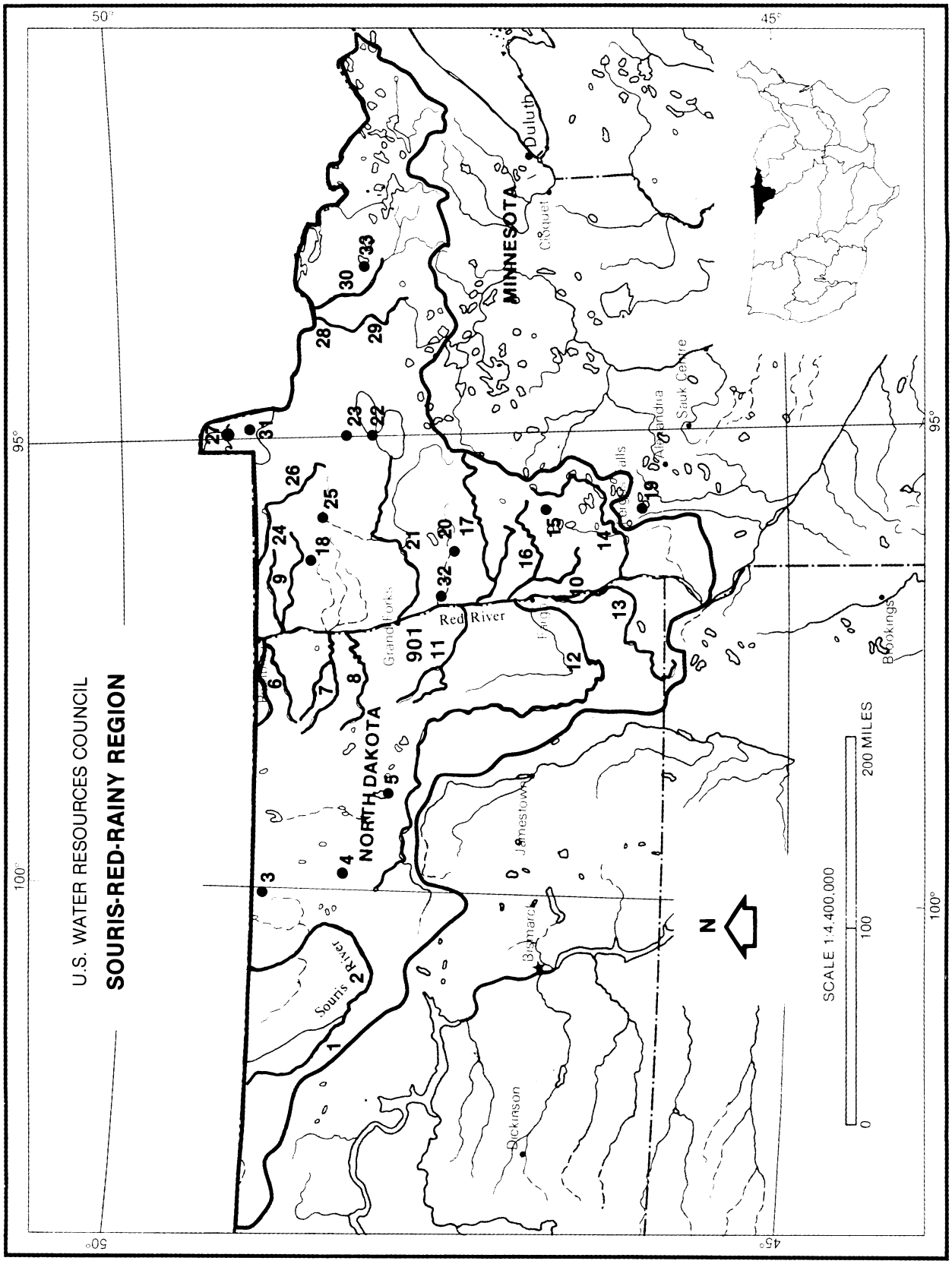

Figure 9-3. Environmental Resources

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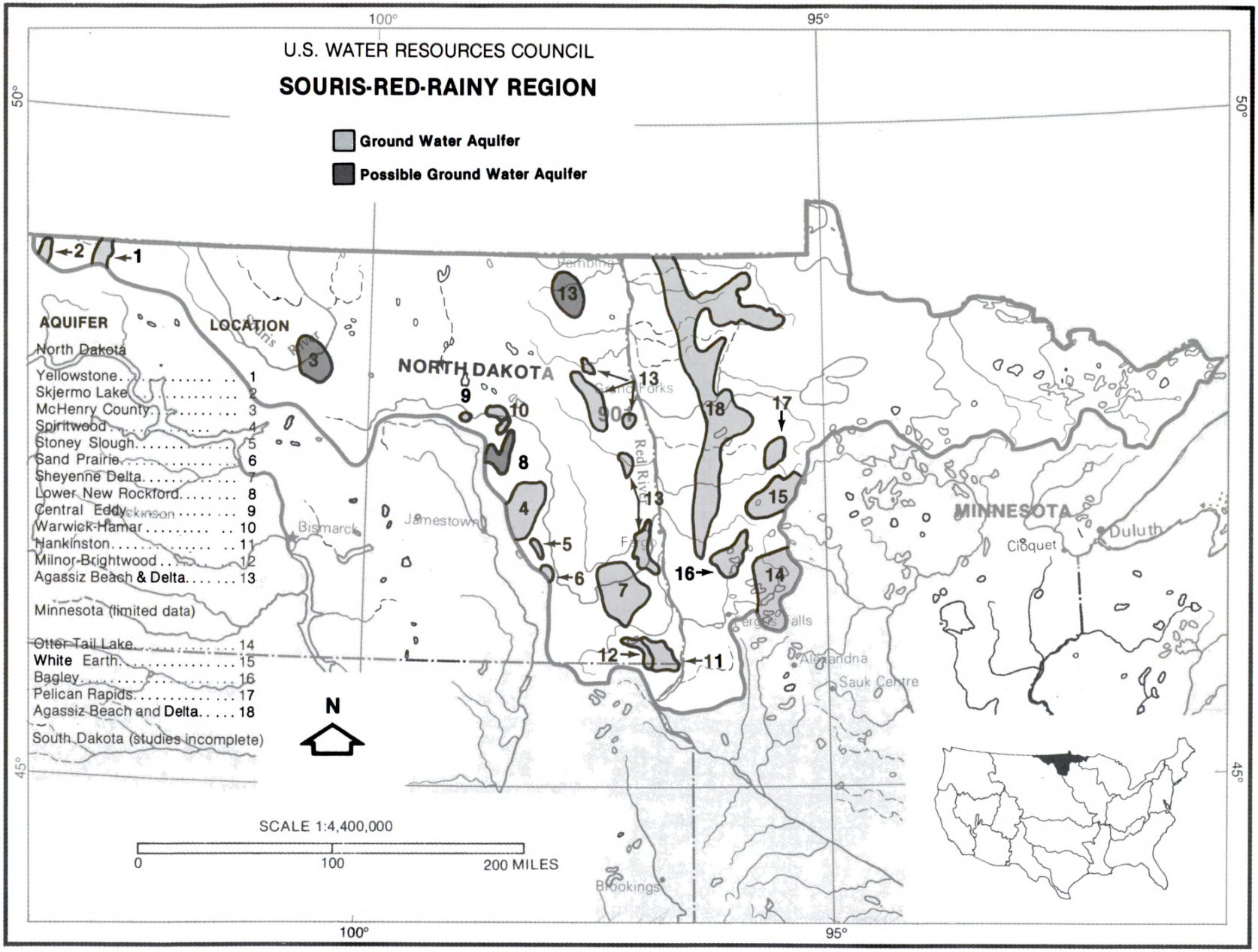

Figure 9-4. Major Aquifers

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Water storage benefits go beyond flood storage. Wetlands maintain ground-water supplies in semiarid areas such as North Dakota. Water table interactions with wetlands areas are complex and depend on physical and geological factors. It has been found that the decline in levels of wells is part of an areal decline in the water table, which is closely correlated to a decline in the level of surface wetlands.

Wetlands also function as sediment traps and in the regulation of nutrient outflow to downstream watersheds. Sediment, sand, and soil particles generally settle out in the wetlands basin. It has been found that nutrients, primarily nitrogen and phosphorus, are absorbed within the wetlands. Some phosphorus is physically bound in particles of sediment and remains locked on the bottom, while some leaves the wetlands in water flowing out. However, since outflow from wetlands basins is infrequent, and since often when overflow occurs, the discharges are collected or trapped in a larger basin, wetlands generally reduce the amount of phosphorus contributed to the watershed.

Clearly, the Prairie Pothole region in North Dakota is an excellent waterfowl production area as is the water-abundant eastern half of this region. However, extensive drainage has resulted in increasing concern, and there is competition between the agricultural and wildlife interests for the use of these resources.

Currently, almost 20,000 acres (1968 data) of Bureau of Outdoor Recreation (BOR) Class I and II lands are available to meet demands for land-based recreation uses. BOR Class I lands are high-density recreation areas or areas which are intensively developed and managed for mass use, such as playgrounds and urban parks. BOR Class II lands are general outdoor recreation areas or areas subject to substantial development for a wide variety of recreation uses such as State parks and recreation areas. Land-based recreation activities include horseback riding, outdoor play areas, snow skiing, and sledding. The total available supply of fishing surface-water acreage in the region is estimated at about 3,553,000 acres. The total available supply of recreation surface-water acreage is estimated at 478,000 acres. Total land area available for hunting purposes is estimated at about 32.9 million acres. This figure assumes that all lands, except urban and built-up areas, are potential hunting areas or resources. It must be recognized, however, that large portions of this land area are basically unusable for hunting purposes due to posting by landowners or because they are used for farmsteads and other rural developments.

Estimated demands (SRF) in activity-days for recreation, fishing, and hunting in 1975 and 2000 are delineated in the following chart:

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Category	1975	2000
	(million days)	
Recreation		
Water-based	7.3	9.7
Land-based	11.4	14.6
Fishing	4.5	5.3
Hunting	2.3	2.5

Water and related land resource requirements (in acres) to meet the foregoing demands are summarized below:

Category	1975	2000
	(thousand acres)	
Recreation		
Water-based	107	156
Land-based	38	60
Fishing	1,812	2,132
Hunting	51,993	58,574

The foregoing SRF figures indicate that, on a regionwide basis, water resources are quite adequate to meet current and projected water-based recreation and fishing demands, whereas the region's hunting land area and BOR Class I and II lands are insufficient to meet current demands. These figures, however, are complicated by the fact that many of the region's environmental resources are not readily accessible to the region's residents, particularly those living in the Minot, Grand Forks-East Grand Forks, and Fargo-Moorhead areas.

Although a significant portion of this area's environmental resources are privately owned, a considerable amount is currently protected and managed by a public sector, chiefly the States and the Federal Government. The States of Minnesota and North Dakota now have centralized State regulatory programs for the administration and enforcement of water quality standards. Both States also have established flood-plain management statutes and are currently administering flood-plain management programs. Both also regulate hunting and fishing to protect their wildlife resources. The State of Minnesota also has a wild and scenic rivers statute and a shoreland management statute. The Federal Government plays a less direct role in regulating water and related land resources in the area. While Federal agencies are directly involved in the management and preservation of valuable natural resources through public ownership, their basic role

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is that of cooperating with and providing assistance to State and local agencies and the general public relative to management, protection, and enhancement of the area's valuable environmental resources.

Both the States and the Federal Government are large landowners in the Souris-Red-Rainy Region. The Department of Interior, U.S. Fish and Wildlife Service, manages considerable acreages of valuable waterfowl habitat. For example, the Fish and Wildlife Service manages 32 National Wildlife Refuges and numerous waterfowl production areas. Portions of the Superior National Forest, managed by the U.S. Forest Service, U.S. Department of Agriculture, are also located in the region. The recently created Voyageurs National Park, managed by the National Park Service, United States Department of Interior, is also located along the region's northeastern fringe. State ownership is distributed chiefly among State parks, forests, and wildlife or game management areas. Figure 9-3 geographically portrays those areas which are deemed to be of critical environmental concern in the Souris-Red-Rainy Region. Table 9-5 presents a listing of these critical areas by State. Specific areas of environmental concern listed in this table and delineated on Figure 9-3 were identified according to the particular attributes (wild and scenic river, wetlands habitat, etc.) and concerns (pollution, residential development, etc.) of the areas. A complete explanation of Table 9-5 and its relationship to Figure 9-3 follows:

- The numbers shown in Column 1 are keyed to the areas of critical environmental concern delineated on Figure 9-3.

- Numbers in Column 2 indicate the source of information used from the list below in designating each area of critical environmental concern.

  1. Statewide comprehensive outdoor recreation plans for each State.

  2. Upper Mississippi River or Souris-Red-Rainy Rivers comprehensive basins studies.

  3. Islands of America, Bureau of Outdoor Recreation, 1970.

  4. National Register of Natural Landmarks, Federal Register, Volume 38, Number 171, September 5, 1973.

  5. Wisconsin Scientific Areas, Scientific Area Preservation Council, Wisconsin Department of Natural Resources, 1973.

  6. Bureau of Outdoor Recreation unpublished reports and studies.

- Where information concerning the size of certain areas was not available, "NA" was inserted in Column 4.

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- Roman numerals shown in Column 5 describe the environmental attribute(s) of each area of critical environmental concern identified in the region.

  I. Federal wild and/or scenic river (pursuant to Section 3 (a), Public Law 90-542, as amended by Public Law 93-621).

  II. State wild and/or scenic river (pursuant to State legislation).

  III. Potential wild and/or scenic river (pursuant to Sections 5 (a) or (d) of Public Law 90-542, as amended by Public Law 93-621, SCORP's Framework Level A and River Basin Level B Studies).

  IV. High-value recreation beach or shoreland.

  V. Unique water or water-related recreation area such as:

     - wetland (marsh, swamp, or bog)
     - island (high value recreation and of a fragile environmental nature)
     - scientific water related study area
     - waterfall
     - spring
     - gorge
     - canyon

  VI. Flood-plain recreation area.

  VII. Open space, scenic or natural area.

  VIII. High-value general recreation area.

- Letters shown in Column 6 describe the nature of the environmental concern for each area of critical environmental concern.

  A. Residential development

  B. Commercial development

  C. Industrial development

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D. Agricultural development

E. Mining and related energy resources development

F. Dams and irrigation projects

G. Navigation projects

H. Channelization projects

I. Water level fluctuations

J. Water pollution

K. Sedimentation

L. Erosion

M. Nuisance vegetation

N. Weed growth

O. Eutrophication

P. Adequate public areas

Q. Adequate streamflows

R. Overuse (recreation)

Available Water Supplies and Use

The availability of surface-water and ground-water resources varies considerably from one location to another in the Souris-Red-Rainy Region. In most of Minnesota, especially in the Rainy Basin, water resources are quite abundant and are generally more than sufficient to meet needs. However, in the far western portions of the region, water resources in drought periods can be quite limited, providing only enough water to sustain small communities and industries requiring only limited quantities of water.

Surface Water Resources

The region's surface-water resources consist of the following: Souris River Basin, Red River Basin, and Rainy River Basin. In the Souris River Basin, surface water is normally adequate to satisfy water needs. Surface water in the Red River Basin is satisfactory under normal conditions, and in the Rainy River Basin surface water is abundant. The mean monthly discharge for the region varies from 28,000 cfs or 18,000 mgd in April to 1,600 cfs or 1,030 mgd in February. The mean annual outflow is 9,300 cfs or 6,010 mgd. The total area of surface water is approximately

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Table 9-5.--Areas of critical environmental concern
Souris-Red-Rainy Region

Number	Source	Name	Size	Descriptor Attribute	Descriptor Concern
North Dakota:					
1	2	Des Lacs River	NA	VII	F,J
2	2	Souris River	NA	VII	F,H,J
3	2	Turtle Mountains	NA	V	F,H,J
4	2	Prairie Pothole	NA	V	D,H,K
5	2	Devils Lake	360 Acres	V	I
6	2	Pembina River	NA	III	F,J
7	2	Park River	NA	VII	F,H,J
8	2	Forest River	NA	VII	J
10	2	Red River	NA	III	J
11	2	Goose River	NA	VII	F,J
12	2	Sheyenne River	NA	III	F,J
13	2	Wild Rice River	NA	VII	F,J
Minnesota:					
9	2	Two Rivers	NA	VII	J
10	2	Red River	NA	III	J
14	1	Otter Tail River	NA	VII	J
15	1	Detroit Lakes Area	NA	V,VIII	A,J
16	2	Buffalo River	NA	VII	F
17	2	Wild Rice River	NA	VII	H
18	1	Twin Lakes State Wildlife Area	NA	V	
19	3	Big Star Island	1,155 Acres	V	
20	1	Agassiz Dunes	417 Acres	V	E
21	1	Red Lake River	41 Acres	III,VII	F
22	2	Red Lake	NA	VIII	P
23	1	Big Bog Area	NA	V	E
24	1	Roseau State Wildlife Area	NA	V	
25	1	Thief Lake State Wildlife Area	NA	V	
26	2	Roseau River	NA	VII	J
27	3	Islands of Lake of the Woods	2,787 Acres	V	A
28	2	Rainy River	NA	III	J
29	1	Big Fork River	NA	III,V	A,B,P
30	1	Little Fork River	132 Acres	III,V	A,B,P
31	1	Lake of the Woods	300,000 Acres	VIII	J
32	4	Lake Agassiz Area	NA	V	
33	3	Big Island in Nett Lake	178 Acres	V	

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1,925 square miles.

The quality of surface water in the region varies according to flow conditions, proximity to populated areas, and other factors. Water quality problems stem from both point and nonpoint pollution sources. Point sources of pollution stemming from industrial and municipal waste discharges can be found near many of the region's larger communities. Nonpoint pollution from agricultural runoff is quite severe in the region's major crop- and livestock-producing areas. High turbidity resulting from erosion and flooding also poses a significant problem. Emergency eutrophication problems are becoming significant throughout the region in late summer and fall months.

Ground-water Resources

The availability of ground-water resources varies according to location in the Souris-Red-Rainy Region. Of the 9,142 square miles in the Souris River Basin, about 837 square miles are underlain by known and potential areas of glacial drift aquifers. Notable aquifers in the basin are the Skjermo Lake and the Yellowstown Channel Aquifers located in Divide County with well yields of 50 to 500 gpm. Ground water in the Red River Basin is obtained mainly from aquifers in glacial drift such as glacial drainage channel deposits, lake deltas and beach deposits, outwash deposits, and small bodies of sand and gravel interbedded with till. Small yields of water, generally of inferior quality, are obtained from bedrock aquifers underlying the glacial drift. Major glacial aquifers underlie about 13 percent of the basin. Bedrock aquifers can be tapped nearly anywhere in the Red River Basin. The Rainy River Basin has no known aquifers with proven ground-water supplies. Demand for ground water is low due to an abundance of surface water. Figure 9-4 geographically portrays the major productive aquifers in the Souris-Red-Rainy Region.

Ground-water quality is a significant problem for many communities in the region. Excessive natural concentrations of total dissolved solids, sulfates, and chlorides are common in the western portion of the region. Iron and manganese concentrations have also been found to be excessive in many of the available water supplies. None of these constituents is hazardous to health, but, in excess, all are objectionable because of taste, color, staining, laxative effects, cooking properties, corrosion, and mineral deposits.

Water Withdrawals

Total water withdrawn from streams and ground water in 1975 was estimated at about 336 mgd. Of this amount, irrigation accounted for only about 14 percent of the withdrawals. However, this percentage is projected to increase to about 74 percent of total withdrawals by the year 2000, as the amount of water withdrawn for irrigation is expected to increase from an estimated 46 mgd in 1975 to about 434 mgd in the year 2000.

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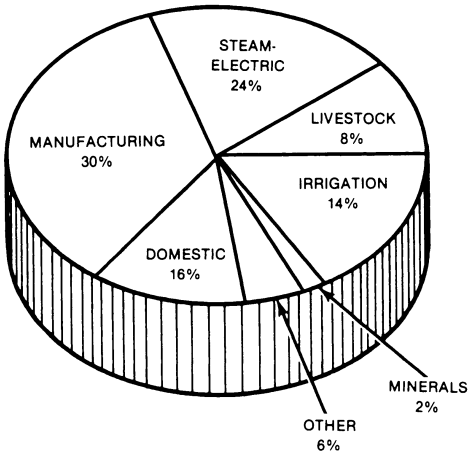
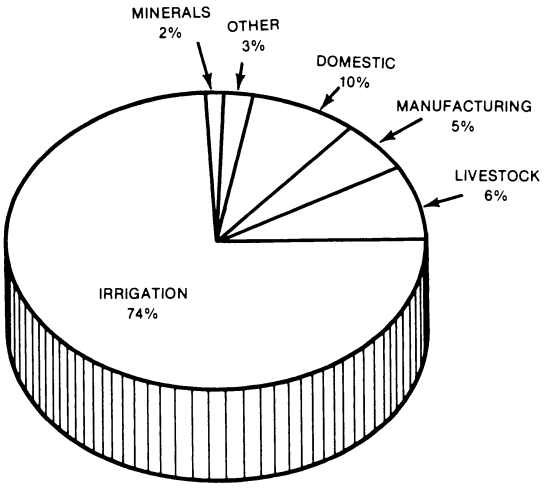
ANNUAL FRESHWATER WITHDRAWALS

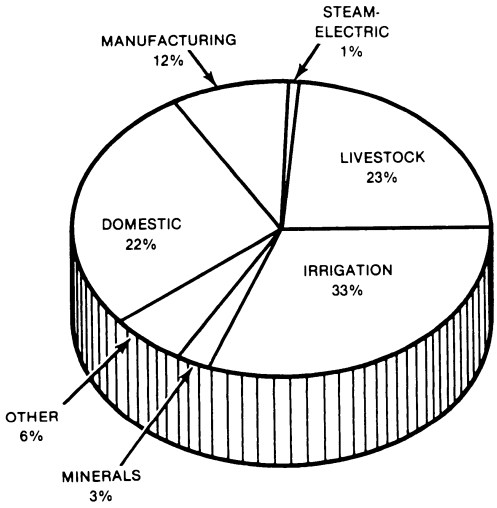


1975
Total Withdrawals — 336 MGD

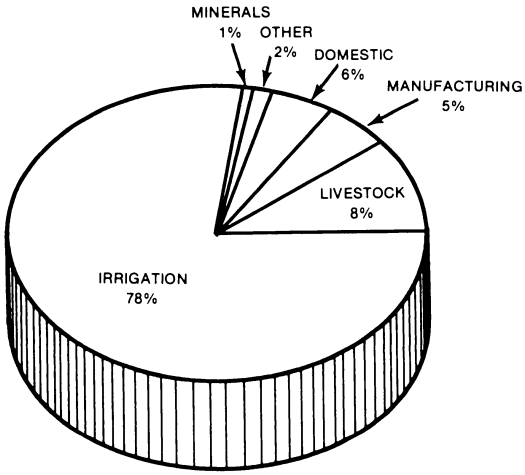


2000
Total Withdrawals — 587 MGD

ANNUAL FRESHWATER CONSUMPTION



1975
Total Consumption — 112 MGD



2000
Total Consumption — 446 MGD

Figure 9-5. Withdrawals and Consumption

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In 1975, manufacturing industries and thermal electric power generation plants accounted for an estimated 54 percent of total withdrawals. Large quantitites of water for these uses are required because of the once-through nature of these uses, especially for powerplant cooling. Future water withdrawals for these and other industrial uses are projected at a much lower level than present water use requirements. These projections are based on assumptions of (1) the phasing out of all power plants over 25 mW in the region and importation of future power needs from adjoining regions and (2) major manufacturing water reuse through recycling of water once it is withdrawn for use. On this basis, total water withdrawals for these two uses are projected to decline from 184 mgd in 1975 to 31 mgd in 2000. Figure 9-5 depicts current and projected water withdrawals in the region.

Data and information reflected in the foregoing narrative and figures represent National Future data. Except for irrigation water use, the national projections are either identical with or quite comparable to (usually within 10 percent) the State-regional projections.

Consumptive Water Use

The amount of water consumed in the Souris-Red-Rainy Region is projected to increase from a 1975 amount of about 112 mgd to 446 mgd in the year 2000, an increase of almost 300 percent. Water consumed is that water not returned to the streams. In 1975, irrigation uses accounted for about 33 percent of total consumption. However, in 2000, the percentage of total consumptive use attributed to irrigation is projected to be 78 percent. Other than for irrigation, total consumptive use for the other major water-use categories is projected to increase moderately or remain relatively constant during the 1975 to 2000 time frame. However, the percentage of total consumption in this time frame for these other uses is projected to decline significantly due to projected large increases in irrigation water use. Figure 9-5 depicts current and projected consumptive water use in the region. Evaporation from reservoir and ponds of about 16 mgd is not included.

Instream Water Use

Instream flow characteristics in the Souris-Red-Rainy Region vary considerably from west to east. In the western portions of the region in the Souris River Basin, streamflows are extremely variable with large fluctuations in flows. During late summer, fall, and winter months, the region's rivers are characterized by extremely low flows and, at times, no-flow conditions, resulting in a poor quality stream fishery and restricted usability for recreation purposes. In the Red River Basin, streamflows are considerably less variable than in the Souris River Basin. However, extreme low-flow conditions are still prevalent in many of the area's streams. In the Rainy River Basin, surface-water resources are quite abundant and instream flows are generally quite sufficient to meet needs.

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Water Resources Supply/Demand Adequacy Analysis

A comparison of the estimated surface- and ground-water resources currently available for development in the Souris-Red-Rainy Region with projected withdrawals and consumptive use indicates that on a gross basis, with proper regulation, available water supplies should be adequate to meet needs in the 1975 to 2000 time frame. NF estimates of total surface-water and ground-water withdrawals for all water supply needs are projected to increase from 336 mgd in 1975 to 587 mgd in 2000.

Under normal (mean) streamflow conditions, withdrawal requirements would equal about 5 percent of total streamflow in 1975 and 10 percent of total streamflow in 2000. Therefore, on a regionwide basis, it appears that available total streamflow supplies would be adequate to meet needs in the 1975 to 2000 time frame. However, while these overall annual figures show no water shortage in the region, they can be very misleading. A stream in the western part of the region can present very real problems for users during the drier months of the year. A local source anywhere in the region can fail to meet the needs of a community or major water-using plant. Such localized problems are identified in the individual problem area summaries at the end of this chapter. The water is available in the region, but its use requires facilities and management to provide it where it is needed.

Comparative Analysis

Table 9-6 compares the National Future (NF) and State-Regional Future (SRF) estimates of streamflows and water use in the Souris-Red-Rainy Region.

NF and SRF total withdrawals and consumption for 1975 and 1985 agree closely. In the year 2000, SRF total estimates are significantly larger than those of the NF because of larger SRF projections for irrigation water requirements.

The National Future and the State-Regional Future should both be considered in making decisions and future plans concerning water-related problems. Decisions on irrigation development will be made locally and its impact on the water supplies will be local. Over the region as a whole, the amounts of water involved in irrigation, in either case, are only a small percentage of available water.

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Table 9-6.--Socioeconomic and volumetric data summary: the Souris-Red-Rainy Region

Category	1975		1985		2000	
	NF	SRF	NF	SRF	NF	SRF
SOCIOECONOMIC DATA (1000)						
Total population	649	649	625	625	595	595
Total employment	241	241	244	244	246	246
VOLUMETRIC DATA (mgd)						
-Base conditions-						
Total streamflow	6,122	NE	6,122	NE	6,122	NE
Streamflow at outflow point(s)	6,010	6,010	5,974	NE	6,314	NE
Fresh-water withdrawals	336	330	329	364	587	980
Agriculture	72	66	177	212	471	865
Steam electric	82	82	23	23	0	0
Manufacturing	102	102	44	44	31	30
Domestic	53	53	56	56	56	56
Commercial	15	15	15	15	14	14
Minerals	8	8	9	9	10	10
Public lands	1	1	2	2	2	2
Fish hatcheries	3	3	3	3	3	3
Other	0	0	0	0	0	0
Fresh-water consumption	112	108	204	231	446	753
Agriculture	63	58	149	176	387	694
Steam electric	1	1	0	0	0	0
Manufacturing	13	14	19	19	23	23
Domestic	25	25	25	25	25	25
Commercial	6	6	6	6	6	6
Minerals	3	3	3	3	3	3
Public lands	1	1	2	2	2	2
Fish hatcheries	0	0	0	0	0	0
Other	0	0	0	0	0	0
Ground-water withdrawals	86	374	NE	142	NE	374
Evaporation	16	40	18	55	19	97
Instream approximation Fish and wildlife	3,673	3,673	3,673	3,673	3,673	3,673

NE - Not estimated.

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Severe Water-Related Problems

There are many severe water-related problems which, from the State-regional viewpoint, are affecting the lives and environment of the region's residents and deserve serious and early consideration for resolution. These problems have been identified and described by those States and Federal agencies participating in the region's assessment activities.

Water Quality

Water quality problems exist in many areas of the Souris-Red-Rainy Region. These water quality problems stem from both point and nonpoint sources. Principal point sources of pollution include municipal waste treatment facilities and industrial plants, primarily food processing industries. The major nonpoint pollution source is runoff from agricultural lands. Locally high concentrations of dissolved solids, bacteria, and nutrients and low dissolved oxygen levels are common in most surface-water resources. These problems are greater in late summer and fall months during periods of low streamflow due in part to inadequate waste treatment. Most of the region's streams are characterized by extremely low to zero streamflow conditions during these months. Eutrophication and aquatic weed growth problems are also a severe problem in many lakes.

A major problem identified in nearly all of the Souris-Red-Rainy Region is poor ground-water quality. High concentrations of dissolved solids, iron, and manganese are characteristic of the ground-water resources. Several communities are currently using ground-water supplies which do not meet State standards. In the Minnesota portion of the region, ground-water quality is generally more acceptable; however, in the Red River Basin, ground-water resources are occasionally characterized by excessive concentrations of dissolved solids. Ground-water quality in the Rainy River Basin is generally better than in the Red River Basin, with total dissolved solids content at less than 500 ml.

Water Supply

As mentioned previously, most of the Souris-Red-Rainy Region is characterized by extreme low-flow or zero-flow conditions in late summer and fall months. As a result, most of the surface-water resources are insufficient to meet minimum requirements for fish and wildlife and recreation needs. In addition, most surface-water resources are insufficient for municipal and industrial water supply needs. In most areas, these municipal and industrial needs are supplied exclusively by ground water.

The use of ground water for irrigation and urban purposes has significantly lowered the water table levels in some areas, especially in the vicinity of Kenmere and Minot in the Souris River Basin and Fargo-West, Fargo-Moorehead, and Hatton of the Red River Basin. Continued depletion of ground water could eventually force a change in the area's cropping patterns. Garrison Diversion, currently under construction to bring the waters of the Missouri into the Souris-Red-Rainy Basin, is expected to

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stabilize most of the problems concerned with ground-water depletion. The return flow from the Garrison Diversion can, however, be expected to increase the total dissolved solids in the Souris, Sheyenne, and Red Rivers, which may adversely affect the quality of waters entering Canada.

Another problem in some parts of the region is stream depths and surface-water area to adequately meet the needs of the region's residents for recreational purposes, including fishing and hunting. While considerable surface-water area exists, in many places this area is not readily accessible to the majority of the population and is concentrated largely along the eastern edge of the Souris-Red-Rainy Region away from the larger urban centers.

Flooding

An extremely severe problem in the region is urban and nonurban flooding. Recently, this area's flooding problems have been so severe that they have received continued national attention. Both urban and rural areas, including large tracts of productive agricultural lands, are subject to annual flooding. Over the years, flood stages and damages have been increasing at an alarming rate. Sheet-water flooding, particularly in the Red River Basin, has posed serious problems for landowners in preparation (tilling and seeding) and harvesting operations.

Flood damages along the Souris and Red Rivers occur primarily as a result of spring snowmelt; their effect is most heavily felt by agricultural products such as sugar beets and potatoes. Current agricultural flood damages are about $29 million; these are projected to rise 10 percent in the next 25 years. Agricultural losses to floods are equivalent to 5.7 percent of total agricultural earnings. In years of flood, water inundates over a million areas of cropland. Agricultural earnings are drastically reduced, and the region's economy becomes unstable. Urban and other losses in flooding are $10.3 million; on an average annual basis these are expected to rise by about 44 percent by the year 2000. Total flood losses are projected to be reduced by about $6.1 million due to anticipated flood control measures. It is projected, however, that total potential flood damages still will rise from $39.3 million to $46.6 million, an increase of 19 percent.

Erosion, Sedimentation, and Salinity

Wind and water erosion pose a serious problem in the Souris-Red-Rainy Region. The topsoil lost from the eroding areas has permanently reduced the productivity of the area's soils and, at the same time, deposited sediment on adjacent lands and in nearby streams. Sheet erosion is particularly acute during spring flooding. Soil salinity and alkalinity is also a problem, limiting crop production on several thousand acres of land in this area. These problems may be accelerated in the near future as a result of the projected conversion of idle cropland and forestland to productive cropland uses. These land conversions may

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necessitate extensive land-treatment measures to maintain soil loss within tolerable limits.

Land Use Conflicts/Changes

A major problem issue in the Souris-Red-Rainy Region is that of changing land uses and conflicts between competing land uses. Conversion of shoreland and flood-plain areas to agricultural, residential, and other land uses has accelerated flooding and erosion problems and contributed to increased degradation of water quality and loss of forestland resources. Another major land use conflict in the region is the conflict between agricultural and environmental interests over wetlands drainage in the Prairie Pothole region of North Dakota. Waterfowl production is of primary importance in the Central and Mississippi Flyways, which cross the Souris-Red-Rainy Region. The Prairie Pothole region in North Dakota is an excellent waterfowl production area. However, drainage is reducing waterfowl habitat, and there is competition between the agricultural and wildlife interests for the use of these resources.

Resource Management and Conservation

Pervading many of the individual problems and issues in the Souris-Red-Rainy Region are institutional and physical management problems. The various interests affecting the water resources of the region have different objectives and affect the water resources in different ways. Recreation requires access, quality environment, and implementation of health and safety measures. Fishermen require access to fishing areas and high quality habitat for the maintenance of fish populations. Travelers and inhabitants deserve an opportunity to view water resources and to have attractive riverscapes to enjoy. Industries require water for processing, cooling, and waste treatment. Cities need water for domestic and commercial uses, fire-fighting, maintenance of parks, and cleaning of streets.

Many of these uses degrade the water quality and the environment of the streams. Others cause streambank erosion, excessive noise, and fluctuation of streamflow. The potential for conflict is obvious; compromises and controls must be developed.

A major step toward the management of the region's water resources was the creation in 1973 of a regional office of the Upper Mississippi River Basin Commission in Fargo, North Dakota. This was to fill the void left in the region by the incorporation of the Souris-Red-Rainy Region into the commission's area of jurisdiction and to facilitate the continuation of comprehensive and coordinated planning in the region. Also in 1973, the commission created a regional committee to formulate the working policies and procedures of the regional office, and to guide and assist its staff. The committee's membership consists of representatives from the States of Minnesota and North Dakota (rotating as Chairman); the Federal Departments of Agriculture, Army, Interior, and the Environmental Protection Agency; and the Chairmen of the North Dakota and the Minnesota Citizen Advisory Councils. Serving as observers are representatives from the State of

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South Dakota and the Province of Manitoba, Canada. The Regional Committee, working closely with the States and local interests, has been involved in several study programs including the development of a Comprehensive Coordinated Joint Plan (CCJP) aimed at the optimum management and conservation of the water and related land resources in the Souris-Red-Rainy Region.

There are many obstacles to the preparation of a management strategy equitable to all interests. Although the Souris-Red-Rainy Regional Committee has the responsibility to plan and coordinate, it must rely upon individual agencies and units of government for improvement plans and programs. Many of these agencies and units of government operate under narrow authorities and have limited sources of funds for their projects and programs. Only extensive collaboration among many individuals and interests can effectively accomplish the wise management of the river system.

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Individual Problem Areas

Through the Specific Problem Analysis (SPA) portion of the 1975 National Water Assessment, the Upper Mississippi River Basin Commission identified a total of 29 water and related land resource problems which are perceived to be severe from the State/regional viewpoint in the Souris-Red-Rainy Region. Figure 9-6a displays the general location of these 29 problem areas. Problems have been identified by name and number, the States involved, and the degree of urgency for resolving the problem area's basic issues from the regional viewpoint on Table 9-7.

This section contains a brief geographic description of the region's individual problem areas and a summary of the basic problem issues which now exist or are expected to occur within each problem area by the year 2000. Among the basic problem issues identified are two institutional and financial problem issues which are common to all problem areas identified. These common problem issues can generally be stated as follows:

1. Current institutional arrangements and policies for controlling flood-plain development; reducing erosion and sedimentation; reducing point and nonpoint sources of pollution; power-plant siting; and protecting and enhancing the area's recreational and environmental resources are often ineffective due to inadequate funding, incentives, coordination, enforcement, and/or public awareness of existing Federal, State, and local programs.

2. Current legislation regarding (a) the definition of navigable water and the U. S. Army Corps of Engineers role in implementing the provisions of Section 404 of Public Law 92-500; and (b) the matter of Federal vs. State jurisdiction over the utilization of all water resources found beneath the surface or found on Indian reservations needs to be clarified and resolved.

Figure 9-6b provides a comparison of the various problem issues identified in the region by (1) Federal agency representatives during the Nationwide Analysis and (2) the Upper Mississippi River Basin Commission during the Specific Problem Analysis.

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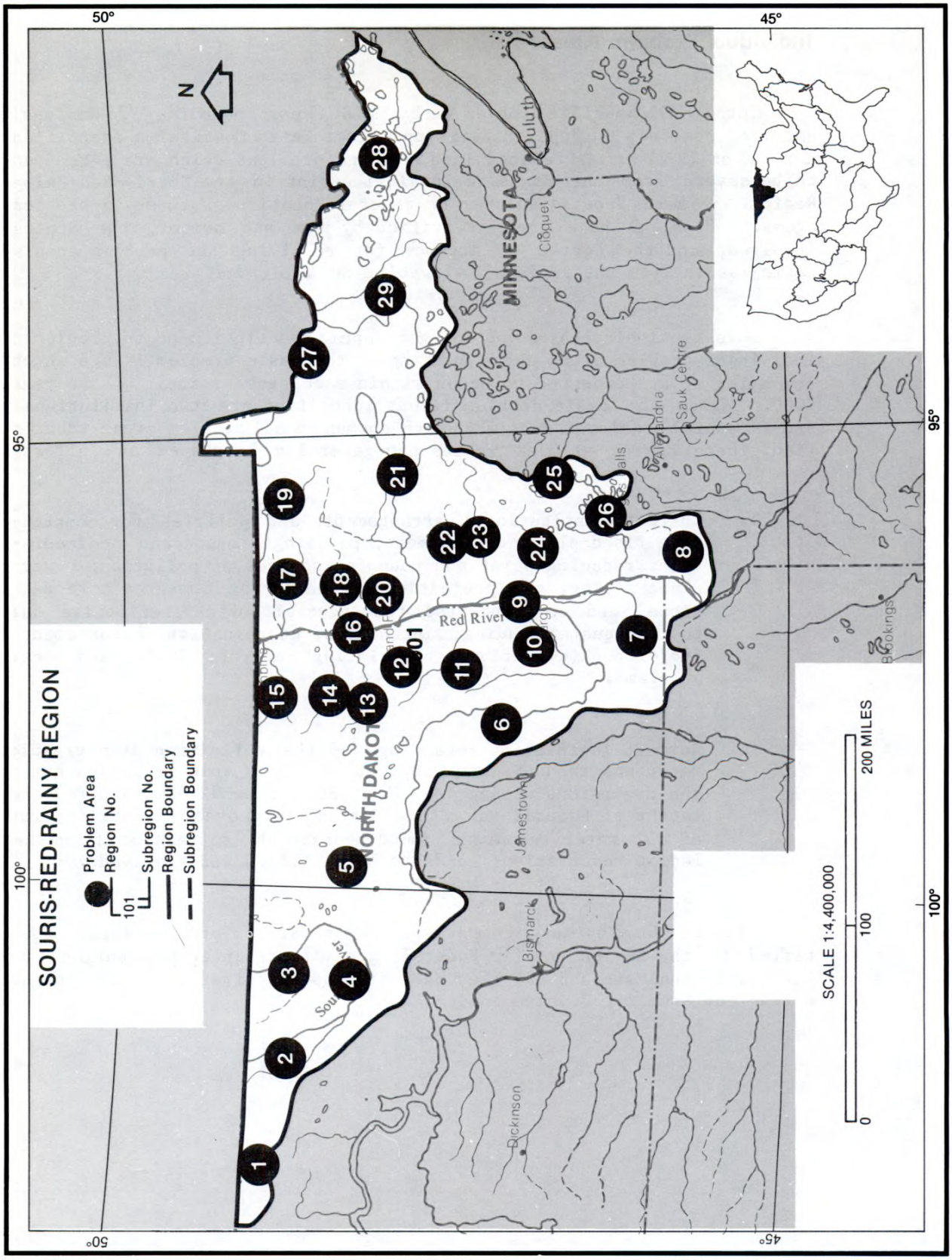

Figure 9-6a. Problem Map

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PROBLEM MATRIX

Problem area		Problem issues O= Identified by Federal Agency Representatives X= Identified by State-Regional Representative													
No. on map	Name	Water quantity				Water quality				Related lands					Other
		Fresh surface	Ground	Marine and estuarine	Surface/depth	Fresh surface	Ground	Marine and estuarine	Surface/depth	Flooding	Drainage	Erosion and sedimentation	Dredge and fill	Water related use conflicts	
Subregion 901	Souris-Red-Rainy		O			O	O			O	O			O	
Area 1	Long Creek, North Dakota	X				X	X								X
2	Glacial Lake Souris, North Dakota	X	X		X	X	X			X		X		X	
3	Lake Metigoshe, North Dakota	X	X			X	X			X	X	X		X	
4	Souris River Main Stem, North Dakota	X	X			X	X			X				X	
5	Devils Lake Basin, North Dakota	X			X	X	X			X	X	X		X	
6	Sheyenne River Basin, North Dakota	X	X			X	X			X	X			X	
7	Wild Rice River Basin, N. Dak. and S. Dak.	X			X	X	X			X					X
8	Bois de Sioux – Mustinka River Basin	X			X	X	X			X		X		X	
9	Red River Main Stem, Minnesota and North Dakota	X	X		X	X	X			X		X		X	
10	Lower Sheyenne, Maple and Rush River Basins, N. Dak.	X	X		X	X	X			X	X	X		X	
11	Goose River Basin, North Dakota	X	X			X	X			X	X	X		X	
12	Turtle River Basin, North Dakota				X	X	X			X				X	
13	Forest River Basin, North Dakota				X	X	X			X	X				X
14	Park River Basin, North Dakota	X	X		X	X	X			X	X			X	X
15	Pembina River Basin, North Dakota	X	X		X	X	X			X	X	X		X	
16	Red Lake River Basin and Red River Main Stem	X	X		X	X	X			X	X	X		X	
17	Two Rivers Basin, Minnesota	X	X		X	X	X			X	X	X		X	
18	Tamarac River Basin, Minnesota	X	X		X	X	X			X	X				
19	Roseau River Basin, Minnesota				X	X	X			X					
20	Middle and Snake River				X	X	X			X	X	X		X	
21	Upper Red Lake River Basin		X			X					X	X			X
22	Sand Hill River Basin, Minnesota				X	X	X			X	X	X		X	
23	North Branch of the Wild Rice-Marsh River, Minn.				X	X	X			X	X	X		X	
24	South Branch of the Buffalo River, Minnesota				X	X	X			X	X	X		X	
25	Detroit Lakes, Minnesota		X			X						X			
26	Otter Tail River Basin, Minnesota					X	X			X		X			
27	Rainy River Main Stem, Minnesota					X	X			X	X	X			
28	B.W.C.A. – Voyageur Nat'l Park & Perimeter, Minn.				X	X	X			X		X		X	
29	Little Fork – Big Fork River Basins, Minnesota									X		X		X	

Figure 9-6b. Problem Matrix

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Table 9-7.--Problem area rating by subregion and region
Souris-Red-Rainy Region

Problem area	
Number	Name (States included)
	PROBLEM AREAS OF MAJOR URGENCY
2	Glacial Lake Souris (North Dakota)
3	Lake Metigoshe (North Dakota)
4	Souris River Main Stem (North Dakota)
9	Red River Main Stem (Minnesota and North Dakota)
10	Lower Sheyenne, Maple, and Rush River Basins (North Dakota)
11	Goose River Basin (North Dakota)
14	Park River Basin (North Dakota)
15	Pembina River Basin (North Dakota)
16	Red Lake River Basin and Red River Main Stem (Minnesota and North Dakota)
	PROBLEM AREAS OF MODERATE URGENCY
5	Devils Lake Basin (North Dakota)
6	Sheyenne River Basin (North Dakota)
8	Bois de Sioux - Mustinka River Basin (Minnesota, North Dakota, and South Dakota)
12	Turtle River Basin (North Dakota)
13	Forest River Basin (North Dakota)
17	Two Rivers Basin (Minnesota)
18	Tamarac River Basin (Minnesota)
20	Middle and Snake River (Minnesota)
21	Upper Red Lake River Basin (Minnesota)
23	North Branch of the Wild Rice - Marsh River (Minnesota)
24	South Branch of the Buffalo River (Minnesota)
26	Otter Tail River Basin (Minnesota)
28	B.W.C.A. - Voyageurs National Park and Perimeter (Minnesota)
	PROBLEM AREAS OF MINOR URGENCY
1	Long Creek (North Dakota)
7	Wild Rice River Basin (North Dakota and South Dakota)
19	Roseau River Basin (Minnesota)
22	Sand Hill River Basin (Minnesota)
25	Detroit Lakes (Minnesota)
27	Rainy River Main Stem (Minnesota)
29	Little Fork - Big Fork River Basins (Minnesota)

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Long Creek-Western Souris Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: North Dakota PROBLEM AREA: 1

The Long Creek-Western Souris Problem Area lies in the northwestern corner of North Dakota and covers portions of Divide and Burke Counties. Long Creek, the area's principal stream, originates in Canada and drains approximately 2,400 square miles in the United States prior to reentering Canada. The area's total population is about 8,500. Crosby is the largest community with a population of 1,545. The area is characterized by rolling plains, low ridges of glacial hills, and shallow coulees. Surface water is distributed among shallow pothole lakes and meandering streams many of which are underlain by ground water. Ground water in bed rock (1,000 to 5,000 feet deep) and glacial drift (5 to 500 feet deep) aquifers underlie much of this problem area with average yields of between 50 and 500 gpm.

Water Issues

- Low- to zero-flow conditions during the later summer, fall, and winter months often result in high total dissolved solids (TDS) levels (averaging 2,150 milligrams per liter), low dissolved oxygen levels, high bacterial populations, and disagreeable physical characteristics. Waste treatment facilities at Ambrose, Columbus, Lignite, and Noonan are inadequate.
- Potential water supply shortages could affect development of potash resources.
- Nutrient levels and lake eutrophication are increasing.
- Surface-water area (streams and lakes) for recreation, fishing, and hunting is extremely shallow and limited.

Related Land Issues

- High alkaline and saline soil conditions affect approximately 332,500 acres of land in this problem area.

Adverse Effects

- Utilization of water supplies which do not meet minimum quality standards due to excessive mineral concentrations continues. Specific communities whose water supplies do not meet minimum standards (mg/1) include: Bowbells (TDS-2,361 and SO_4-535); Columbus (TDS-2,895), Crosby (Fe-0.6), Flaxton (TDS-2,820 and Cl-425), Fortuna (Mn-0.3; SO_4-680; and TDS-1,493), Lignite (Fe-2.7 and TDS-1,099), and Noonan (F-3.7 and TDS-2,211).

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- Grass and small grain production will continue to be restricted due to excessive soil alkalinity and salinity.

- Degradation of the area's limited recreation resources due to poor water quality will continue.

Glacial Lake Souris Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: North Dakota PROBLEM AREA NO.: 2

The Glacial Lake Souris Problem Area is located in northwestern North Dakota. The problem area encompasses about 2,500 square miles and covers portions of the following three counties: Bottineau, Renville, and Ward. The Des Lacs, Souris, and Deep are the area's major rivers. Kenmare (1,696) is the area's principal community. The area's total population is about 19,800. This area is characterized by rolling plains broken by low ridges of hills and flat plains left by ancient glacial beds. Surface water in the rolling plains is found in shallow potholes and meandering streams. The flat plains are poorly drained with few streams and only occasional areas of marsh. Ground water in bedrock aquifers at depths of 1,000 to 5,000 feet underlie much of this problem area, and average well yields range from about 50 to 350 gpm.

Water Issues

- Low- to zero-flow conditions in the Upper Souris and Des Lacs Rivers during the late summer, fall, and winter months cause low dissolved oxygen levels which are detrimental to stream fisheries and physical characteristics.

- Water supplies are inadequate for irrigation and power generation purposes during periods of low streamflows.

- Surface-water supplies are characterized by highly variable bacterial populations and high concentrations of total dissolved solids. The discharge of untreated wastes has caused low dissolved oxygen values and high bacterial populations in the Des Lacs River for several miles below Kenmare, North Dakota, restricting whole-body contact recreation. Lacs, Donnybrook, Maxbass, Mohall, and Tolley also have potential water quality problems.

- Surface-water resources and stream depths are inadequate to meet the recreational needs of the area's residents.

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- Excessive water use for municipal and power generation purposes has resulted in declining ground-water levels in the Kenmare area.

- Ground water in this area has an average TDS value of 1,500 mg/l, which exceeds acceptable State water quality standards (500 mg/l). Concentrations of dissolved solids at various communities include Mohall (TDS-1,113), Lansford (TDS-2,844 and Cl-1,075), Berthold (TDS-3,138 and Cl-400), and Kenmare (TDS-1,911 and Fe-9.8).

Related Land Issues

- Rural flooding is extensive on agricultural land in the flat, glacial lake plain areas and in a 20 square mile packeted area near Tolley, North Dakota.

- Valuable waterfowl habitat and flood-plain areas are being converted to agricultural and municipal uses.

- Approximately 25 percent of the area is subject to serious surface ponding and poor drainage which poses a serious problem to the area's agricultural interests.

Adverse Effects

- Use of existing surface-water sources will continue to be restricted due to high TDS levels.

- Surface-water availability will continue to limit irrigation. There are potential water supply problems for municipal and commercial purposes due to declining ground water levels.

- Sand and gravel mining and electric power generation facilities in this problem area are dependent upon limited water sources.

- Surface water for recreation activities is severely limited in much of the Upper Souris and Des Lacs Rivers and below Kenmare on the Des Lacs River.

- Rural flood damages average about $214,219 (1975 conditions) annually. Also, agricultural production is reduced due to sheet-water flooding.

- Loss and deterioration of valuable waterfowl habitat and recreation areas continue.

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Lake Metigoshe Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: North Dakota PROBLEM AREA NO.: 3

The Lake Metigoshe Problem Area covers about 1,000 square miles in north-central North Dakota. The major streams in the area are the Souris River and Willow Creek. Lake Metigoshe itself is surrounded by the Turtle Mountains (hills); flat plains characterize most of the remainder of the problem area. Some drift prairie is found along the east edge of the area. The area covers portions of the following three counties: Bottineau, McHenry, and Rolette. The area's total population is about 12,500. The largest community is Bottineau with 2,760 people. Ground water in bedrock aquifers (50 to 5,000 feet) underlies this area with well yields ranging between 5 and 350 gpm.

Water Issues

- Low- and zero-flow conditions occur frequently during the late summer, fall, and winter months; limited water supplies restrict irrigation development.
- Surface-water quality is poor due to excessive mineral content and high bacterial levels resulting from agricultural, municipal, domestic, and mining activities. Waste treatment facilities at Westhope and Bottineau are inadequate.
- Chemical concentrations in ground-water supplies are high. Specific supplies exceeding acceptable State standards (500 mg/l) include: Dunseith (TDS-1,950), Bottineau (TDS-1,148 and Mn-1.6), Souris (TDS-1,311), Willow City (Mn-0.6), Westhope (TDS-1,111 and Fe-1.8), and Upham (TDS-1,159 and Fe-1.9).

Related Land Issues

- Periodic overflow of Willow Creek inundates the municipality of Willow City and damages crops in agricultural areas. Flooding results in high turbidity and silt loads and causes serious erosion of agricultural land.
- Prairie wetlands important for waterfowl production are being drained for agricultural purposes.

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Adverse Effects

- The communities of Bottineau, Upham, and Willow City as well as rural residences rely on ground water which has objectionable taste and color properties. Water supplies for irrigation purposes are inadequate resulting in reduced agricultural production.

- Flooding will continue to damage homes, businesses and agricultural land. Rural flood damages average about $308,000 (1967 conditions) in the Willow City area.

- Erosion will continue to interfere with agricultural production and will result in high silt loads in rivers and streams.

- The area's waterfowl production will be reduced due to continued wetland drainage.

- Eutrophication of Lake Metigoshe is increasing.

- Erosion and changing land uses continue to alter the area's natural character.

Souris River Main Stem Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: North Dakota PROBLEM AREA NO.: 4

The Souris River Main Stem Problem Area covers about 1,770 square miles in portions of the following two counties: Ward and McHenry. Minot is the largest community with a population of 32,290. The total area population is about 40,000, which, in addition to Minot, includes Velva (1,241) and Towner (870). The area is characterized by drift prairie south of the Souris River and flat plains north of the river. The flat plains are poorly drained with few streams and occasional large areas of marsh. The drift prairie is an area characterized by rolling plains broken by low ridges and shallow coulees. Surface water is distributed among shallow potholes. Glacial drift aquifers at depths of 50 to 5,000 feet underlie much of this area with well yields ranging from 5 to 350 gpm.

Water Issues

- Streamflows are insufficient during periods of low flow (late summer and winter) to meet minimum requirements for recreation and fish and wildlife needs.

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- Current water supply sources from the Minot Aquifer and Souris River will be insufficient to met Minot's projected water requirements, including supplying the U.S. Air Force Base, and municipal, industrial, and power generation needs. Whenever withdrawals from the Minot Aquifer exceed 3 mgd for a sustained period of time (as from 1961 to 1964), the aquifer's ground-water levels have declined noticeably. Surface-water supplies for expanded sand and gravel mining operations are insufficient.

- Excessive concentrations of total dissolved solids average about 1,500 in the Souris River during periods of low flow. The area's streams and lakes are polluted by agricultural, municipal, and industrial sources. Waste treatment facilities at Minot and Velva are inadequate.

- The Souris River below Minot has bacterial levels three times greater than State standards (3,000/100 ml). Below Towner, the Souris River exceeds State standards for bacterial levels by over 100 fold.

- Surface water area is inadequate to meet recreational needs.

Related Land Issues

- Flood damages to both urban and rural areas are extensive along the Souris River from Minot to Velva.

- Flood-plain and wetland areas are being converted to urban and agricultural uses.

Adverse Effects

- Declining ground-water levels may result in a need to import water for existing municipal and commercial uses, restricting future growth of Minot. The safe yield of Minot's present water supplies is about equal to the average daily water use of 4.5 mgd.

- Use of existing surface-water sources is restricted due to high levels of dissolved solids.

- Flood damages in Minot are excessive due to dense urban development in the flood plain. The communities of Sawyer and Velva are also vulnerable to flooding. A summary of average annual flood damages (1975 Dollars) is as follows:

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	1973	1980	1990	2000
Minot	$3,220,219	$3,394,215	$3,870,825	$4,347,281
Sawyer	10,731	11,344	13,337	15,483
Velva	151,153	155,752	169,243	182,733

- Surface-water availability will continue to limit irrigation and livestock production.
- Sand and gravel mining, electric power generation facilities, and manufacturing in this problem area are dependent upon limited water sources.
- Surface water for recreation activities is severely limited. Whole-body contact activities are unsafe for 20 miles below Towner and 40 miles below Minot. Water quality for aquatic life is marginal.
- Flood-water and sediment damages on agricultural lands is increasing. Estimated flood damages in agricultural areas during 1976 total about $13.0 million (1975 dollars).
- Recreational lands and environmental resources are being lost as a result of the conversion of flood-plain and wetland areas to agricultural and urban uses resulting in increased flooding and erosion problems.

Devils Lake Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: North Dakota PROBLEM AREA NO.: 5

Problem Area 5, the Devils Lake Basin, is a closed drainage basin in the western portion of the Red River Basin in north-central North Dakota. There are no major rivers in the area. The major water bodies are Devils Lake, Sweetwater Lake, Dry Lake, and Stump Lake. The drainage area of the Devils Lake subbasin is approximately 3,600 square miles. The problem area covers portions of seven counties which are as follows: Rolette, Towner, Cavalier, Ramsey, Nelson, Benson, and Pierce. The area has a population of about 40,000, and its largest cities are Devils Lake, Rolla, Cando, Belcourt and Rugby. The topography is generally flat to gently rolling prairie where farming is the dominant land use. Surface water in the area is distributed among shallow pothole lakes, a few meandering streams, manmade impoundments, and small marshes. Ground water in bedrock aquifers, at depths of from 280 to 2,000 feet, underlies much of this area with well yields of 1 to 500 gpm.

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Water Issues

- Instream flows are insufficient to maintain lake levels, particularly in Devils and Stump Lakes. Fluctuating water levels pose serious problems to urban, agricultural, recreation, and environmental uses of the area's water and land resources.

- High TDS concentrations in Devils Lake and Stump Lake are due to municipal, industrial, and agricultural pollution.

Related Land Issues

- Flooding often inundates large acreages of agricultural and recreational land. The communities of Sweetwater and Hampden are frequently flooded in the spring.

- Sheet and bank erosion of agricultural land during rapid runoff periods is severe.

- Drainage and conversion of wetlands areas to agricultural use results in loss of waterfowl habitat.

Adverse Effects

- Increased municipal and commercial flood damages and reduced agricultural production result from sheet-water flooding and high lake levels. The total average annual flood damages for the Devils Lake Basin are:

Year	Damages (1975 dollars)
1967	$2,006,697
1980	2,393,013
2000	2,796,192
2020	3,182,508

- The lack of proper drainage of excess runoff from agricultural land prevents farmers from achieving maximum economic benefits from farming operations.

- Ground-water supplies with undesirable taste, odor, and hardness are used. Specific communities experiencing this problem include Edmore (TDS-1,177); Lakota (Fe-2.8 and Mn-0.6); and Rolla (Mn-0.2).

- Water-based recreation on Stump Lake and Devils Lake is restricted due to high saline conditions.

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- Waterfowl hunting may be reduced due to losses of wetlands habitat.

- Continued erosion causes decreased property values in urban and rural areas, deterioration of recreational lands and facilities, and degradation of agricultural land with decreased production.

Sheyenne River Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: North Dakota PROBLEM AREA No.: 6

The Sheyenne River Basin Problem Area is located in the west-central portion of the Red River Basin in central North Dakota. It covers approximately 6,700 square miles extending from Warwick to Kindred, North Dakota, and covers portions of eight counties: Eddy, Nelson, Griggs, Steel, Barnes, Ransom, Richland, and Cass. The area has a population of approximately 32,100 and includes the communities of Valley City (7,843), Cooperstown (1,485), and Lisbon (2,090). The problem area's terrain is predominately rolling drift prairie characterized by a gently undulating-to-hilly surface. Ground-water resources in bedrock and glacial drift aquifers underlie much of this area at depths ranging from 10 to 2,000 feet. Potential well yields range from 1 gpm of artesian flow in the Dakota Aquifer, which underlies most of the problem area, to a range of 25 to 750 gpm when pumped.

Water Issues

- Instream flow (during late summer and fall) is insufficient to meet minimum requirements for fish, wildlife, and recreation purposes. Water supplies for irrigation are also insufficient. There are scattered water supply shortages for domestic uses.

- Surface-water resources are characterized by excessive mineralization, including dissolved solids, sulfates, chlorides, iron, and manganese concentrations. Municipal, agricultural, and industrial pollution is serious. Bacterial counts in the Sheyenne River below Valley City exceed the EPA water quality standard (10,000/100 ml) on 14 to 21 samplings taken in 1973 and 1974. High bacterial pollution is also evident near the 4-H camp adjoining the Sheyenne River and the communities of Fort Ransom and Kindred, North Dakota. The fecal coliform-fecal streptococcal ratio for the river indicates a high degree of human and animal contamination. Salmonella species were consistently found below Baldhill Dam. These factors contribute to eutrophication and low dissolved oxygen values in the area's rivers and streams.

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- Ground-water quality is generally poor due to excessive concentrations of TDS, iron, manganese, sulfates, and fluorides. The potential exists for bacteriological problems if wells are not properly located, constructed, and maintained.

Related Land Issues

- High flows during spring snowmelt and heavy rains frequently flood Valley City and Lisbon and inundate rural areas including many small communities, agricultural land areas, farmsteads, and transportation facilities from Warwick to Kindred.

- Conversion of shoreland and flood-plain area to urban, residential and agricultural land uses accelerates erosion problems.

- Sheet-water flooding results in ponding of water on agricultural and rural areas due to a lack of natural drainage resulting in the controversial problem of drainage of wetlands areas.

- Soil alkalinity limits agricultural land use in portions of Steele County.

Adverse Effects

- Water supplies are insufficient to permit the development of potentially irrigable land to enhance crop and livestock production.

- Agricultural productivity is restricted due to flooding and soil alkalinity.

- Continued development in the flood plain and conversion of waterfowl habitat to urban and agricultural land uses result in decreased waterfowl production and increased flooding. Average annual flood damages are estimated at $276,614 (1975 conditions). This includes damages of $205,422 to Valley City and $49,056 in Lisbon. Rural and agricultural losses make up the remaining damage with floods inundating about 37,000 acres of land along the Sheyenne Valley floor. This includes flood-plain areas equaling about 350 acres in Valley City and 200 acres in Lisbon.

- Water supplies characterized by high mineral concentrations continue to be utilized. Specific communities and chemical inadequacies (mg/1) include: Aneta (Mn-0.7), Elliott (TDS-2,961; SO_4 - 1,435, Cl-329; FE-0.4; and F-2.7), Hannaford (Mn-1.5 and NO_3 - 66), Kindred (TDS-1,020 and Mn-0.5), Lisbon (TDS-1,288), McVille (Mn-0.4), Sheldon (TDS-2,816; SO_4-1,300; and Fe-1.7), Tolna (TDS-1,292; Fe-0.4; and Mn-0.8), and Valley City (Mn-0.4).

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- Continued degradation of environmental resources and severe water quality problems during the late summer and fall months severely restrict the use of this area's limited recreation resources for whole-body water contact recreation. There is moderate impairment to other forms of recreation.

Wild Rice River Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATES: North Dakota and South Dakota PROBLEM AREA NO.: 7

The Wild Rice River Basin Problem Area is located in both North and South Dakota. The Wild Rice River drains the southwestern portion of the Red River of the North Basin and covers approximately 2,200 square miles. Of this figure, 200 square miles are in South Dakota and 2,000 square miles are in North Dakota. The area's largest community is Britton, South Dakota, with a population of 1,465. Lidgerwood and Hankinson, North Dakota, have populations of 1,000 and 1,125 respectively. This area's total population is estimated at about 16,100. The topography of the area varies from rolling glacial drift prairie in the west to nearly level glacial lake plain in the east. The glacial drift prairie has a poorly defined drainage system with numerous depressions and potholes ranging to 40 acres in size. The glacial lake plain area contains heavy, fertile soil. The area's drainage pattern is not well developed and a high water table underlies portions of the area. Ground-water studies in Richland County have identified five aquifers. They are the Colfax, Milnor Channel, Hankinson, Brightwood and Sheyenne Delta Aquifers. Well yields in these aquifers average between 50 and 500 gpm.

Water Issues

- Streamflow conditions are highly variable with extensive periods of low- to zero-flow conditions during the late summer and winter months, particularly during years with below average runoff. Scattered water supply shortages occur during drought periods for private irrigation developments and livestock purposes.

- High mineral concentrations exceeding acceptable standards are evidenced in both ground- and surface-water supplies throughout the area as a result of municipal and agricultural pollution. Surface-water supplies are currently being degraded by municipal waste discharges at Forman, Milnor, Barney, Dwight, Great Bend, Havana, Cayuga, and Wyndmere.

- Surface-water runoff from intensively farmed agricultural land is adding nutrients to the area's lakes and accelerating the eutrophication process.

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- Agricultural production is reduced due to flooding and erosion. Excess water interferes with farming operations by increasing costs, delaying planting, and reducing quantity and quality of crops produced.

- A significant rise in the level of Lake Elsie has posed serious problems during recent years for lakeshore developments.

Related Land Issues

- Spring snowmelt and heavy summer rains cause severe flood damage to rural areas and properties, nonurban communities, and agricultural, recreational, and environmental land resources due to heavy runoff, insufficient stream channel capacities, and poor drainage patterns.

- Sheet, gully, and bank erosion pose problems in the basin.

- Sheet-water flooding in agricultural areas seriously hinders land preparation (tilling and seeding) and harvesting leading to the drainage of some wetland areas.

- A portion of this basin's agricultural land is characterized by highly alkaline soil conditions.

Adverse Effects

- Water supply problems increase during drought periods.

- Inadequate quality water supplies requiring extensive treatment for domestic usage continue to be utilized. Specific communities in North Dakota whose water supplies are characterized by excessive mineral concentrations (mg/l) include: Cogswell (TDS-2,480; Fe-0.9; F-4.0; SO_4-1,076; and Cl-300), Forman (SO_4-745 and TDS-1,460), Gwinner (Fe-0.8; Mn-0.3; SO_4-576; and TDS-1426), Hankinson (Mn-0.3), Lidgerwood (Mn-0.1), Mooretown (TDS-2,560; SO_4-1,150; and Cl-272), Rutland (Fe-1.7 and Mn-0.7) and Wyndmere (Mn-0.1).

- Urban and rural flood damages are rising and there is continued commercial and residential development in the flood plain. By 1980, flood damages in rural areas are projected to equal about $50,589 annually along the Wild Rice River, Antelope Creek, and the Veblin watershed. Total flood damages in the Wild Rice River Basin are projected to equal about $294,336 annually by 1980.

- Irrigation is restricted due to insufficient water supplies.

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- Sport fishing deteriorates and recreation activities are restricted due to point and nonpoint pollution.

- The area's limited environmental resources continue to be degraded and/or lost due to pollution and flooding.

Bois de Sioux—Mustinka River Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATES: Minnesota, North Dakota, and South Dakota PROBLEM AREA NO.: 8

The Bois de Sioux - Mustinka River Basin Problem Area covers approximately 2,000 square miles in portions of Richland County in North Dakota, Roberts and Traverse Counties in South Dakota, and Grant and Wilkin Counties in Minnesota. The major rivers in the area are the Bois de Sioux, Mustinka, and Rabbit Rivers. The area's major cities are Wheaton (2,029) and Elbow Lake (1,484), Minnesota. Total area population is approximately 19,000. Topographically the area's eastern portion consists of a nearly level glacial lake plain, while the western part is characterized by gently rolling uplands. Surface water covers approximately 29,000 acres. Most of the area is underlain by major glacial drift aquifers with potential yields to wells of between 10 and 1,000 gpm.

Water Issues

- Insufficient streamflows and shallow depths during periods of low flow in the late summer and fall months do not meet minimum requirements for fish, wildlife, and recreational purposes.

- Water supplies are inadequate for potential irrigation development purposes. Water supply distribution systems are inadequate at Campbell, Nashua, Dumont, Graceville, Norcross, Wheaton, and Donnelly, Minnesota, to handle peak summer demands.

- Lake Traverse and other surface-water resources are subject to increasing eutrophication and serious degradation from feedlot wastes, domestic wastes, and siltation.

- Ground-water quality is generally poor due to excessive concentrations of TDS, iron, manganese, sulfates, and fluorides.

- Bacteriological problems can occur if wells are not properly located, constructed, and maintained.

Related Land Issues

- Agricultural lands and rural properties are subject to frequent and widespread flooding to shallow depths due to the flat topography and inadequate capacity of stream channels.

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- About 452,100 acres of this area's cropland are characterized by excessive wetness conditions.

- Rural and agricultural areas, including roads and other transportation facilities, suffer severe sheet, gully, and bank erosion damages.

- There are potential land use conflicts between agricultural and fish and wildlife interests due to drainage of wetlands.

Adverse Effects

- Poor quality water supplies continue to be utilized. Specific communities experiencing water quality problems include: Donnelly (TDS-1,966; Mn-0.2; and SO_4-985), Dumont (Fe-1.3 and Mn-0.1), Herman (TDS-1,396; Fe-4.2; and Mn-0.1), Nashua (Fe-1.0), Norcross (Fe-1.1) and Mn-0.3), Wendell (Fe-1.1), and Wheaton (Fe-1.1 and Mn-0.1) in Minnesota; Fairmount (Fe-0.4) in North Dakota; and Rosholt (As-0.015; Fe-2.1; and Mn-0.4) in South Dakota.

- Water-based hunting decreases due to conversion of wetland areas to agricultural uses.

- Continued agricultural and rural community flood damages, averaging about $689,850 annually by 1980, result in loss of cropland and pastureland and decreased agricultural production. Specific communities affected include Fairmount, Nashua, Tintah, Norcross, Graceville, and Dumont in Minnesota.

- Continued erosion and sediment damages result in decreased property values in rural areas, deterioration of recreational lands and facilities, and loss of productive agricultural acreages and decreased agricultural production.

- Use of the area's surface-water resources for fishing and body contact water-oriented recreation activities is restricted due to severe water quality problems.

- The area's limited environmental resources are further degraded and/or lost.

Red River Main Stem Problem Area

WRC REGION: 9 SUBREGION: 901

STATES: Minnesota and North Dakota PROBLEM AREA NO.: 9

The Red River Main Stem flood-plain area extends from just south of Wahpeton-Breckenridge to just south of Grand Forks-East Grand Forks. The problem area covers approximately 300 square miles and includes portions

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of Richland, Cass, Traill, and Grand Forks Counties in North Dakota and Polk, Norman, Clay, and Wilkin Counties in Minnesota. The major urban areas are Wahpeton-Breckenridge (10,653) and Fargo-Moorhead (79,259). The total population of the problem area is approximately 111,460. The topography of the area is that of a flat plain left by an ancient glacial lake bed.

Water Issues

- Streamflows during late summer and winter months are insufficient for recreation purposes and to maintain a favorable aquatic environment for fish life. Surface-water resources are inadequate to meet water-oriented recreation needs.

- There are potential water supply problems in the Fargo-Moorhead area due to declining water levels and expanding water requirements, especially in the sugar beet industry. Water supply problems are especially acute during drought periods when it becomes necessary to supplement ground-water supplies to prevent excessive aquifer drawdown. Surface-water supplies during drought periods also preclude large-scale irrigation development.

- The Red River is undesirable as rated by the North Dakota Public Health Service recommended standards for drinking water and by the Minnesota State Water Quality Standards (a "desirable" rating requires a maximum of 500 mg/1 TDS). Waste treatment facilities at Abercrombie, Fargo, Georgetown, Kent, and Moorhead are inadequate. The coliform bacterial population of the Red River exceeds water quality standards for an airline distance of about 30 miles below the Fargo-Moorhead S.M.S.A. (1969 reports). The high populations of coliform persist below Fargo in spite of the routine chlorination of sewage effluent at both Fargo and Moorhead treatment plants. A serious waste treatment problem is caused by four sugar beet processing mills.

- Ground-water supplies are characterized by excessive concentrations of TDS, iron, manganese, and sulfates.

Related Land Issues

- High flow conditions result in flood-water inundation of residential, business, industrial, and city property at Wahpeton and Fargo, North Dakota, and at Breckenridge, Moorhead, Hendrum and Perley, Minnesota. Cropland and livestock areas located in the flood plain along the Red River Main Stem are also periodically inundated.

- Excess water resulting from snowmelt and/or heavy rains stands on the relatively flat agricultural land areas (sheet-water flooding) causing serious problems for land owners during seed-

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ing and/or harvesting operations. Attempts by land owners to minimize these damages via the construction of levees have resulted in land use conflicts which are both regional and international in nature.

- Sheet, rill, and gully erosion (wind and water) poses a serious problem throughout this area.

- Conversion of flood-plain areas to urban and agricultural land uses is also a severe problem.

Adverse Effects

- Water supply problems increase during drought periods, particularly if water reuse and recycling do not play a major role in meeting industry's future demands. The severity of the problem is increased due to wide variations in streamflow, frequent periods of no flow, and lack of reservoir sites. These water supply shortages limit irrigation development and further manufacturing growth.

- Inadequate quality water supplies requiring extensive treatment for domestic usage are utilized. Pollution problems of the Red River such as septic conditions, oxygen depletion, high total dissolved solids concentrations, high bacterial densities, and nuisance concentrations of other materials have resulted in interference with established beneficial water uses such as municipal and industrial water supply, fishery propagation, and recreation.

- Rising urban and rural flood damages result in a reduction in property values, curtailed agricultural and industrial production, and deterioration of recreational lands and facilities. Average annual flood damages along the Red River Main Stem are estimated as follows:

Year	Damages (1975 dollars)
1967	$3,372,600
1980	4,054,785
2000	5,107,756
2020	6,187,188

- Further erosion damages result in decreased property values in urban and rural areas, deterioration of recreational lands and facilities, and degradation of agricultural land areas resulting in decreased production.

- Loss of recreational lands occurs as a result of urban and agricultural development in flood-plain areas. Acceleration of flooding and erosion problems result from this flood-plain development.

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- Sport fishing deteriorates and recreation activities downstream from the Fargo-Moorhead Area continue to be restricted due to point and nonpoint pollution.

Lower Sheyenne, Maple, and Rush River Basins Problem Areas

WRC REGION: 9 SUBREGION: 901

STATE: North Dakota PROBLEM AREA NO.: 10

Problem Area 10 encompasses the Lower Sheyenne River (from Kindred to the confluence with the Red River), the Maple, and the Rush River Basins. This area is located in east-central North Dakota and is in the southcentral portion of the Red River Basin. Problem Area Ten is approximately 1,600 square miles in size. The major cities are West Fargo (4,340), Casselton (1,394), and Enderlin (1,596). The problem area covers portions of two North Dakota counties: Cass and Barnes. The total population of the problem area is about 15,700. This area lies within the Red River Valley and consists of a flat plain with a few meandering streams and scattered wetland areas. The Page, West Fargo, and Sheyenne Delta glacial drift aquifers underlie this problem area and serve as the sources for both rural, domestic, and municipal purposes. Well yields from these aquifers range between 50 and 750 gpm.

Water Issues

- Streamflows are not adequate during late summer and winter months to meet the minimum requirements for fish, wildlife, and recreational use.

- TDS concentrations in excess of 500 mg/l are characteristic of this area's surface-water resources.

- Bacterial analysis of the surface water in this problem area indicates high fecal coliform counts and a fecal coliform/fecal streptoccal ratio that indicates a mixture of human and animal contamination. Sources of this pollution are precipitation runoff from feedlots and the seepage of inadequate septic drain fields. Releases from municipal lagoon systems are probable sources of bacterial pollution of surface waters. Waste treatment facilities at Alice, Argusville, Ayr, Gardner, Kindred, West Fargo, Enderlin, and Hope are inadequate.

- Serious declines of the ground-water table have been experienced in West Fargo due to municipal and industrial pumpage (approximately 500 million gallons per year). Excessive concentrations of TDS, iron, and manganese are characteristic of the ground-water supplies in this area.

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Related Land Issues

- There is extensive flood-water inundation of urban and rural areas on the lower Sheyenne River from Kindred to West Fargo, the upper Maple River to Enderlin, the lower 50 miles of the Maple River, and the Lower Branch Rush River watershed.

- Excess water stands on the area's relatively flat agricultural land posing serious problems to agriculture.

- Agricultural areas experience serious sheet, gully, and bank erosion.

- Urban and agricultural land uses encroach upon flood-plain areas that may best be suited for less intensive development.

Adverse Effects

- Water supply problems increase during drought periods, particularly if water reuse and recycling do not play a major role in meeting industry's future demands. Serious declines of the ground-water table in the vicinity of West Fargo, due to municipal and industrial pumpage of about 500 million gallons annually, indicate future problems in securing an adequate water supply from this aquifer. Development of irrigation is restricted due to insufficient water supplies.

- Poor quality water supplies requiring extensive treatment for domestic usage are utilized. An important consideration in the concentration of pollutants in the Lower Sheyenne River is the dilution factor which varies in relation to releases from Baldhill Dam.

- Recreational use of the area's surface-water resources is restricted due to low streamflow conditions and poor water quality.

- Urban and rural flood damages are rising and there is continued commercial and residential development in the flood plain. Average annual flood damages for the Sheyenne River Main Stem (river mile 0.0 through 270.5) and the Rush River Main Stem are as follows:

	1967	1980	2000	2020
	(thousands of 1975 dollars)			
Sheyenne River Main Stem	1,607	2,028	2,614	4,051
Rush River Main Stem	187	224	267	304

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Damages along the Lower Sheyenne River are largely urban. A recent Corps of Engineers study indicated that annual damages on the Sheyenne River average about $13.8 million to urban facilities, $245,280 to agriculture, and $45,990 to transportation.

- Excess-water conditions continue to interfere with farming operations by increasing costs, delaying planting, and reducing the quantity and quality of crops produced.

- Continued erosion damages result in decreased property values in urban and rural areas, deterioration of recreational lands and facilities, and degradation of productive agricultural land areas resulting in decreased agricultural production.

- Recreational lands are lost as a result of agricultural and urban development in flood-plain and shoreland areas. The availability of high quality hunting areas is reduced due to continued drainage and filling of wetland areas.

Goose River Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: North Dakota PROBLEM AREA NO.: 11

The Goose River Basin Problem Area lies in eastern North Dakota and in the central portion of the Red River Basin. The problem area spans approximately 600 square miles and includes portions of Steele and Traill Counties. The major cities in the area are Hillsboro (1,278) and Mayville (2,168). The total problem area population is approximately 14,000. This area's topography is that of a flat plain left by an ancient glacial lake bed which is poorly drained with a few meandering streams. It is characterized as a prairie landscape where farming is the dominant land use. Ground water is the area's major source of water supply. Well yields range from 5 to 500 gpm in buried outwash deposits and a large glaciofluvial deposit.

Water Issues

- Streamflows are insufficient during late summer and winter months for recreation purposes and to maintain a favorable aquatic environment for fish life. Snags that occur on the river are also a problem. Surface-water area is inadequate for water-oriented recreation. Water supplies are inadequate for domestic and industrial purposes, particularly at Mayville, Hatton, and Portland. A sugar beet plant and two local potato processing plants are affected by these shortages.

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- Surface-water supplies in this area are characterized by excessive concentrations of TDS, low dissolved oxygen values, and lake eutrophication or algae growths due to municipal, industrial, and agricultural pollution. Waste treatment facilities at Finley and Hatton are inadequate.

- This area's ground water is characterized by high TDS, iron, and manganese concentrations.

- There is a potential water-supply problem for irrigation.

Related Land Issues

- Flood flows frequently overtop channel banks and inundate adjacent farmland along the lower 60-mile reach of the Goose River and low-lying developments in Hillsboro and Mayville. Excess water stands on the relatively flat agricultural land posing serious problems to agriculture.

- Erosion problems are acute, particularly along the Goose River.

- Flood-plain areas are being converted to residential and agricultural uses.

Adverse Effects

- Utilization of poor-quality water supplies requires extensive treatment for domestic usage. Specific communities affected by this problem include: Finley (TDS-1,175; Fe-1.6; and Mn-0.5), Hatton (Fe-1.4), Hillsboro (TDS-1,541; Fe-0.6; and Mn-0.2), Hope (TDS-1,237; Fe-0.5; and Mn-1.0), Northwood (TDS-1,463), Portland (TDS-1,181 and Mn-2.0), Sharon (TDS-1,122 and Mn-0.7).

- Urban and rural flood damages are rising, and commercial and residential development in the flood plain continues. Average annual flood damages in this area total approximately $183,960 (1975 conditions). Of this amount, about $58,254 represents agricultural damages, $58,254 domestic damages, and $67,452 transportation damages.

- Irrigation is restricted due to insufficient water supplies. Water supplies are also inadequate to meet peak demands and future needs at Mayville, Hatton, and Portland.

- Agricultural production is reduced by flooding, erosion, and urban encroachment. Excess water interferes with farming operations by increasing costs, delaying planting, and reducing the quantity and quality of crops produced.

- Sport fisheries are deteriorating and recreation activities in general are restricted.

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- The area's water quality continues to deteriorate and limited environmental resources, including valuable waterfowl habitat areas, are gradually being degraded or lost.

Turtle River Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: North Dakota PROBLEM AREA NO.: 12

The Turtle River Basin is located in eastern North Dakota. The Turtle River is a tributary of the Red River and drains approximately 700 square miles. This area is located entirely within Grand Forks County, and its largest city is Larimore (population, 1,469). The total area population is approximately 17,500. The topography is that of a flat plain left by an ancient glacial lake bed. The area is poorly drained and ground water serves all communities in this area. Well yields average from 1 to 100 gpm.

Water Issues

- Streamflows in late summer, fall, and winter months are insufficient to satisfy minimum requirements for recreational and environmental uses.
- Surface-water areas are inadequate for water-oriented recreation activities.
- Serious water quality problems exist as a result of municipal and agricultural pollution. Waste treatment facilities are inadequate at Larimore, Manvel, and Niagara.
- Ground-water supplies in this area are characterized by excessive TDS levels.

Related Land Issues

- Flood damages to rural properties, small communities, agricultural and recreation lands, and to environmental resources are extensive in the Turtle River Basin. The communities of Manvel and Mekinock are very susceptible to flood damages.
- Conversion of valuable flood-plain areas to intensive agricultural uses has accelerated the potential for increased flood damages. Recreation and environmental resources are being converted to agricultural uses.
- Approximately one-fourth of this area's land resources are characterized by saline soil conditions.

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Adverse Effects

- Poor quality water is used for municipal and domestic purposes. At Michigan, North Dakota, the ground-water supply is characterized by TDS concentrations of 1,566 mg/l.
- Agricultural production has been reduced by flooding, erosion, and soil salinity.
- Average annual flood damages are estimated at $3,036,873 (1975 conditions) of which $2,676,618 are agricultural damages.
- Sport fisheries are deteriorating and general recreation activities are restricted.
- There is continued degradation and/or loss of valuable wildlife resources, recreation areas, and environmental areas as a result of erosion, flooding, and changing land uses.

Forest River Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: North Dakota PROBLEM AREA NO.: 13

The Forest River Basin Problem Area is located in northeastern North Dakota. The problem area covers approximately 500 square miles and includes portions of Grand Forks and Washington Counties. The major city in the area is Minto (population, 636). The total population of the problem area is about 6,000. The area is characterized by flat plains with farming the dominant land use. Surface water is limited and distributed in a few meandering streams. The area is underlain by Cretaceous formations of Pierre Shale and Dakota Sandstone which supply an adequate quantity of ground water to the area. Ground-water well yields range from 50 to 500 gpm.

Water Issues

- Streamflows are insufficient during late summer, fall, and winter months to maintain a favorable aquatic environment for fish life and recreation.
- Surface water is inadequate to meet the area's water-oriented recreation demand.
- Serious water quality problems arise from municipal, industrial, and agricultural pollution. Waste treatment facilities at Arcoch, Forest River, Inkster, and Lankin are inadequate.
- Ground-water supplies in the basin are characterized by excessive concentrations of TDS, iron, and manganese.

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Related Land Issues

- Flood damages to rural properties, small communities, agricultural and recreation lands, and environmental resources are extensive. The communities of Forest River and Minto are susceptible to flood damages.

- Excess water stands on the relatively flat agricultural land, inhibiting agricultural production. Wetlands, small lakes, and ponds are being drained to facilitate agricultural development.

- Saline soil conditions affect approximately one-fifth of this problem area.

Adverse Effects

- Poor quality water supplies are used for domestic and some agricultural purposes. Minto's water supply is characterized by high concentrations of iron (2.0 mg/l), manganese (1.0 mg/l), and TDS (1,012 mg/l).

- Flood damages, averaging about $1,099,161 (1975 conditions) annually, occur in rural and nonurban areas.

- Sport fisheries are deteriorating and general recreation activities are restricted.

- Water supply problems are increasing during drought periods, particularly where water reuse and recycling do not play a major role in meeting industry's demands.

- Agricultural production is decreasing as a result of flooding and erosion.

- Further loss and/or deterioration of water quality, wetland habitat areas, and environmental resources will occur.

Park River Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: North Dakota PROBLEM AREA NO.: 14

The Park River Basin Problem Area is located in northeastern North Dakota in the north-central portion of the Red River Basin. The problem area covers approximately 1,000 square miles in Cavalier, Pembina, and Walsh Counties. The major cities in the area are Park River (population, 1,680) and Grafton (population , 5,946). The total area population is about 8,300. This area is characterized by a flat glacial lake plain

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with a prairie landscape. The dominant land use is farming. The area is poorly drained with few meandering streams. Ground-water yields in this area range from 5 to 100 gpm.

Water Issues

- Serious water quality problems include: low oxygen levels due to inadequate streamflow, high organic loads and temperature levels, and lake eutrophication.

- Surface-water supplies in the Park River are characterized by excessive mineral concentrations. TDS levels of 738 mg/l occur in the Park River near Grafton. Municipal, industrial, and agricultural pollution contribute to these water-quality problems. Waste treatment facilities at Ardoch, Forest River, Gardar, Grafton, Lankin, Nekoma, and St. Thomas are inadequate.

- Ground-water supplies in this area are characterized by excessive concentrations of TDS, iron, manganese, and sulfates.

- There are potential deficiencies in water supplies for municipal and industrial users.

- Streamflows during late summer, fall, and winter months are inadequate to maintain high quality streamflow conditions. Surface-water supplies for water-oriented recreation demand are also inadequate.

Related Land Issues

- There is recurrent flooding of agricultural land and the communites of Grafton and Crystal.

- Excess water stands on the area's relatively flat agricultural land posing serious problems to agriculture.

- Flood-plain and wetlands areas are being converted to agricultrual and urban uses.

- Saline soil conditions affect a small portion of this problem area.

Adverse Effects

- Use of untreated surface water and ground water as potable water supplies for domestic and livestock uses and as a suitable water supply for food processing industries is restricted. Potential deficiencies exist in water supplies for large scale municipal, agricultural, and industrial uses.

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- Urban flood damages occur at Grafton and Crystal to residential, commercial, and public properties. There is widespread flooding of agricultural land and rural areas, particularly roads and farmsteads. Average annual flood damages in the Park River Basin are estimated as follows:

Year	Damages (1975 dollars)
1967	$2,377,683
1980	2,871,309
2000	3,679,200

- Agricultural production is reduced as a result of excess wetness conditions which interfere with farming operations by increasing costs, delaying planting, and reducing the quantity and quality of crops produced. Productivity is also reduced by the soil salinity conditions of prime agricultural land.

- Waterfowl habitat is reduced as a result of wetlands damage.

- Deterioration of sport fish habitats are deteriorating and recreation activities are restricted due to poor surface-water quality and insufficient streamflows.

  Facilities are inadequate to meet the area's needs for boating, water skiing, etc. Use of parks and river-associated camping facilities are restricted by periodic flooding. Recreation lands are being lost to agricultural and urban development in flood-plain areas.

Pembina River Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: North Dakota PROBLEM AREA NO.: 15

The Pembina River Basin Problem Area consists of a portion of the Red River of the North Basin and lies in the northeastern portion of the State of North Dakota. This area covers about 1,900 square miles in parts of Cavalier and Pembina Counties. The largest cities in the area are Cavalier (population, 2,250), Langdon (population, 3,200), and Wahalla (population, 1,600). The total area population is approximately 11,600. The topography consists of flat plains, hills, and drift prairie. The flat plains lie in the eastern portion of the problem area and are the evidence of an ancient glacial lake bed. The hills are characterized by knobs with small tops and steep sides and plateaus with broad, smooth tops. Surface water is contained in deep lakes, rivers, and wetlands areas. Drift prairie covers the western portion of the area and is characterized by rolling plains broken by low ridges of hills and shallow

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coulees. Surface water is distributed among shallow pothole lakes and a few meandering streams. The Pierre Aquifer underlies much of this area and yields between 1 and 6 gpm to wells.

Water Issues

- Surface water is insufficient to satisfy area water supply and recreation demands. Fluctuating streamflows restrict fish habitat. Surface-water supplies are characterized by low oxygen levels and high organic loads.

- There is a lack of sufficiently developed ground-water sources for projected population growth and industrial expansion. Ground-water supplies are very limited and contain iron, sulphates, and dissolved solids in quantities which exceed accepted drinking water standards. The communities of Neche, Pembina, Altona, and Gretna in Manitoba, Canada, obtain their water supplies from the Pembina River at Neche. In addition, Neche serves the North Valley System which is a rural water supply distribution system. Other communities in the area depend on private wells, small dugout reservoirs, or truck transportation for potable water.

Related Land Issues

- Extensive flooding occurs over much fertile land. The water stands on relatively flat agricultural land for extended periods, posing serious problems to the area's agricultural interests because wetness restricts cultivation. The communities of Wahalla, Pembina, and Neche are prone to flooding.

- Severe bank, sheet, and gully erosion problems are caused by both wind and water.

- Flood-plain and wetlands areas are being converted to residential and agricultural land uses.

Adverse Effects

- Water supply problems are increasing, particularly at Pembina and Neche. Industries dependent on agricultural products have been reluctant to locate in the area, because water supplies from the Pembina River are not reliable.

- Excessive flood water interferes with farming operations by increasing costs, delaying planting, and reducing quantity and quality of crops produced. Natural drainage is poor in the drift-covered plateau west of the Pembina Escarpment.

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- Urban and rural flood damages continue to rise as commercial and residential development continues in the flood plain. The average annual flood damage (1975 dollars) is $2,355,301 to rural and urban property, including business losses.

- Excessive agricultural drainage has reduced recharge capabilities of ground-water aquifers for domestic supplies, particularly in Cavalier County. Wetlands are being lost to agricultural drainage.

- Valuable topsoil is displaced and wildlife habitat destroyed by wind and water erosion.

- Water quality deterioration restricts recreation activities.

- Reduction of wetlands habitat reduces waterfowl production.

Red Lake River Basin and Red River Main Stem Problem Area

WRC REGION: 9 SUBREGION: 901

STATES: Minnesota and North Dakota PROBLEM AREA NO.: 16

The Red Lake River Basin and Red River Main Stem Problem Area includes the Red Lake River Main Stem from below Crookston to its confluence with the Red River, and the Red River Main Stem, from its confluence with the Red Lake River downstream to the international boundary. The area occupies portions of Grand Forks, Walsh, and Pembina Counties in North Dakota and Kittson, Marshall, and Polk Counties in Minnesota. This area encompasses approximately 660 square miles and covers primarily the flood-plain area adjacent to the two rivers. The major communities in the area are Crookston (population, 8,312) and East Grand Forks (population, 7,607) in Minnesota and Grand Forks (population, 39,008) in North Dakota. The area's total population is approximately 65,000. The topography of the area is characterized by a flat glacial lake bed containing a rich soil for agricultural purposes, but the land is poorly drained with a few meandering streams. A portion of the area is underlain with the Pierre bedrock aquifer with well yields ranging between 1 and 6 gpm.

Water Issues

- Local consumption demands during low-flow periods are high and may cause serious local streamflow problems posing potential future water supply problems.

- Serious water quality problems exist in the Red Lake River and the Red River Main Stem as a result of high concentrations of municipal, industrial, and agricultural waste pollutants.

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Waste treatment facilities at Crookston and East Grand Forks, Minnesota, and Manvel and Grand Forks, North Dakota are inadequate. Severe nonpoint pollution problems stem from pesticide, fertilizer, and animal waste runoff. Bacterial pollution fluctuates substantially. Ranges of bacterial densities for the year 1968 indicate wide fluctuations and include measurements far in excess of the 5,000 parts per 100 milliliters recommended for general uses and the 1,000 parts per 100 milliliters recommended for full body contact. Coliform densities will exceed the recommended levels for water contact sports in the Red Lake River below Crookston due to the city's unchlorinated effluents. The coliform density rises again below the discharge of effluent from East Grand Forks and Grand Forks. Downstream at Oslo, Minnesota, the coliform density has been read as high as 25.2 x 10^3 per 100 ml. Eutrophication problems also exist in late summer and fall months.

- Concentrations of iron and manganese are high in certain ground-water supplies. The deeper bedrock aquifer contains highly saline waters. There are potential deficiences in ground-water supplies for rural water needs.

- Surface-water resources are inadequate to meet the water-oriented recreation needs of the area's residents.

- Streamflows during summer, fall, and winter months are insufficient to satisfy recreation and fish habitat requirements.

Related Land Issues

- Urban flood damages are severe in Grand Forks, North Dakota, and East Grand Forks, Minnesota, along the Red River, and in Crookston, Minnesota, along the Red Lake River. Extensive flood damages occur to rural properties, small communities, agricultural and recreation lands, and to environmental resources. Privately developed levees along the Red River Main Stem have increased flood stages in downstream areas, including Canada. Flood damages to rural properties, small communities, and agricultural and recreation lands are extensive. Two separate types of flooding occur: the usual type associated with streambank overflow and another type which occurs when runoffs from snowmelt or heavy rainfall are entrapped by plugged culverts and ditches within sections of land bounded by raised roadways.

- Ponding and excess water on relatively flat agricultural land inhibits agricultural production.

- Wetlands, small lakes, and ponds are being drained to facilitate agricultural development.

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- Extensive streambank and sheet erosion damages rural properties, agricultural and recreation lands, and environmental resources.

- Conversion of valuable flood-plain areas to urban, residential, and agricultural uses increases the potential for flood damages.

Adverse Effects

- Surface water and ground water are restricted for use as potable water supplies for domestic and livestock uses and as a suitable water supply for food processing industries. Treatment is required prior to its use for municipal and food-processing purposes.

- There are potential deficiencies in surface water and ground water for large-scale water demands due to low aquifer yields and periodic low streamflow conditions.

- Though urban and rural flood damages are rising, commercial and residential development in the flood plain continue. With existing flood control projects, average annual flood damages for the Red Lake River Area total over $820,155. Abrupt failure of one of the Crookston levees could result in the loss of many lives.

- Streambank and sheet erosion decreases property values in rural areas, damages recreation lands and facilities, and degrade productive agricultural acreages, decreasing agricultural production.

- Excess wetness conditions increase costs, delay planting, and reduce quality and quantity of crops produced.

- There are severe limitations to the use of this area's surface water for body contact recreation on the Red River downstream from Grand Forks-East Grand Forks and on the Red Lake River below Crookston.

- Recreation lands are being lost as a result of the conversion of flood-plain areas to urban and agricultural uses. Erosion and flooding problems accelerate as a result of this development. Wildlife habitat is being lost due to wetland drainage. Sport fisheries in the Red and Red Lake Rivers are deteriorating due to pollution problems.

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Two Rivers Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: Minnesota PROBLEM AREA NO.: 17

The Two Rivers Basin Problem Area is located in the northwestern corner of Minnesota. The major rivers in this problem area are the north and south branches of the Two Rivers, both of which drain into the Red River of the North. This problem area covers approximately 1,000 square miles, including portions of Kittson and Roseau Counties. The major city is Hallock (population, 1,477). The estimated population of the entire problem area is about 8,000. The topography is characterized by a flat to gently rolling prairie landscape where farming is the dominant land use. Water is not present to a large extent, but does occur occasionally in the form of rivers, potholes, and lakes. Three major glacial drift aquifers underlie this problem area: (1) surficial beach-ridge zone, (2) sand lenses in till, and (3) buried channel and beach-ridge deposits. These aquifers yield between 5 and 1,000 gpm to wells.

Water Issues

- There is a potential deficiency in surface-water supplies along the south branch of the Two Rivers since flows from the Bronson Lake Reservoir are not adequate to provide a dependable water supply for this area. This will be particularly true during the late summer, fall, and winter months.

- Low dissolved oxygen levels and excessive nutrient concentrations are evident in the Two Rivers during low-flow periods as a result of municipal and agricultural pollution. Waste treatment facilities at Greenbush, Halma, Lake Bronson, and Strathcona are inadequate.

- Ground-water yields are inadequate in the majority of the problem area. Bedrock aquifers are of poor quality because they contain high levels of dissolved solids, iron, and manganese. Yields from glacial drift aquifers also contain high concentrations of iron and manganese.

Related Land Issues

- Flood damage to nonurban properties, agricultural lands, and recreational and environmental resources is extensive. The Two Rivers watershed flood problems are aggravated by overflow flood waters from the Roseau River entering the tributary ditches via Big Swamp. Cropland accounts for 75 percent of the area's total flood problem. Hallock is the principal community subject to flooding, although a few low-lying areas within the community of Lake Bronson are subject to inundation.

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- Excess water stands on the relatively flat agricultural land posing serious problems for landowners. Small ponds and wetland areas are being drained to facilitate agricultural development.

- Erosion damages to rural properties, agricultural and recreation lands, and environmental resources are extensive.

- Flood-plain and wetland areas are being converted to residential and agricultural uses.

Adverse Effects

- Water supply problems during drought periods are increasing, particularly where water reuse and recycling do not play a major role in meeting industry's demands.

- Poor quality water supplies requiring extensive treatment are used for domestic purposes. Specific communities supplied by such water include Greenbush (Fe-0.7) and Lake Bronson (Mn-0.1).

- Though urban and rural flood damages are rising, commercial and residential development in the flood plain continues. Average annual flood damages exceed $153,300 (1976 conditions) of which $91,980 are agricultural damages.

- Agricultural production is reduced by flooding, erosion, and urban encroachment.

- Sport fisheries are deteriorating and recreation activities in general are restricted.

- Valuable waterfowl habitat areas, recreational resources, and environmental resources are being degraded and/or lost.

Tamarac River Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: Minnesota PROBLEM AREA NO.: 18

The Tamarac River Basin Problem Area is located in northwestern Minnesota in the Red River of the North Valley. The problem area covers approximately 200 square miles, including land in Marshall and Kittson Counties in Minnesota. The major cities in this problem area are: Stephen (population, 904) and Karlstad (population, 727). The area's total population is approximately 3,900. The topography is that of a flat plain left by an ancient glacial lakebed. The area is poorly drained and is underlain by buried channel and beach-ridge aquifers with well yields ranging from 50 to 1,000 gpm.

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Water Issues

- Water quality problems result from municipal, industrial, and agricultural pollution, particularly during the late summer, fall, and winter months. Waste treatment facilities at Karlstad, Stephen and Strandquist are inadequate.

- Surface water is less than adequate for water-based recreation, livestock production, and municipal and commercial uses.

- Ground-water resources in this area are characterized by excessive levels of TDS, and iron and manganese concentrations.

Related Land Issues

- There is occasional flooding of nonurban and agricultural land areas as well as recreational and environmental resources. Excess water stands on the relatively flat agricultural land posing serious problems for land owners. Valuable flood-plain and wetland areas are being converted to residential and agricultural land uses.

Adverse Effects

- There are potential water supply problems at Stephen during drought and/or peak demand periods.

- Poor quality water supplies are used at Strandquist (Fe-0.6).

- Though urban and rural flood damages are rising, commercial and residential development continues in the flood plain.

- Flooding, erosion, and urban encroachment have reduced agricultural production. Sheet-water flooding interferes with farming operations by increasing costs and delaying planting and harvesting.

- The area's limited water resources for recreational purposes are being degraded and their use is restricted. Lake eutrophication problems are quite common during the late summer months.

- The area's limited, but valuable, waterfowl habitat and environmental resources are being degraded and/or lost.

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Roseau River Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: Minnesota PROBLEM AREA NO.: 19

The Roseau River Basin, which is a portion of the Red River of the North Basin, lies in northwestern Minnesota. The area covers approximately 1,000 square miles of Roseau County. The largest city is Roseau with a population of 2,552. The total problem area population is approximately 8,000. The area is characterized by a flat to gently rolling prairie landscape where farming is the dominant land use. Surface-water resources are distributed among a few shallow lakes and potholes and a few meandering rivers and streams. Most of this area is underlain by major glacial drift aquifers which yield between 10 and 1,000 gpm to wells.

Water Issues

- Instream flows during late summer and fall months are insufficient for maintenance of a high quality stream fishery and recreation resource.

- Water quality problems result from municipal and agricultural waste pollution during low streamflow periods. Waste treatment at the communities of Badger, Humboldt, and St. Vincent is inadequate. Excessive bacterial concentrations approaching 1,700 coliforms per 100 ml occur during lowstream flow periods. Minnesota State Standards limit coliform concentrations to less than 1,000 coliform/100 ml for full body contact recreation activities.

- Limited surface-water area restricts water-oriented recreation activity.

- Ground-water resources are characterized by high iron concentrations.

Related Land Issues

- The entire community of Roseau is subject to flood-water inundation. Rural and agricultural flooding is extensive. Approximately 87,000 acres of agricultural land is subject to periodic inundation.

Adverse Effects

- Poor quality ground-water supplies are used for municipal purposes at Badger (Fe-1.4) and Roseau (Fe-0.6).

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- Urban and rural flood damages average about $1,020,978 annually of which $646,926 is attributed to agricultural damages and the remainder to urban and transportation damages.

- Water-oriented recreation facilities to meet the needs of the residents are inadequate.

- Fish habitat and scenic value of the riverine environment of this problem area are being degraded.

- Low flows and poor surface-water quality severely limit the use of this area's surface-water resources for recreational activities involving whole-body contact with water.

Middle and Snake River Basins Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: Minnesota PROBLEM AREA NO.: 20

The Middle and Snake River Basins Problem Area is part of the Red River of the North Basin. The area is located in the northwestern portion of the State of Minnesota and covers approximately 900 square miles of Marshall County. The major water bodies are the Middle River and the Snake River and both drain into the Red River. The largest city is Warren (population, 1,999). The total area population is approximately 10,000. The area is characterized by flat to gently rolling prairie landscape where farming is the dominant land use. Surface-water resources are quite variable as both the Middle and Snake Rivers have wide fluctuations in streamflow. Both of these rivers exhibit the meandering course characteristic of the Red River. Most of the area is underlain with known glacial drift aquifers (sand lenses in till) with well yields ranging between 10 and 1,000 gpm.

Water Issues

- Streamflows during low runoff periods are inadequate to assimilate wastes and meet minimum streamflow requirements for recreation and environmental uses.

- Water quality problems on both the Middle and Snake Rivers result from municipal and agricultural pollution. Waste treatment facilities at Holt, Middle River, and Viking are inadequate.

- Surface-water area for recreation purposes, particularly boating and water-skiing, is insufficient.

- There are potential deficiencies in ground-water supplies for rural, municipal and agricultural water needs.

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- Ground-water resources in the problem area are characterized by excessive TDS, iron, manganese, and chloride levels.

Related Land Issues

- Extensive flood damages occur to small communities (Argyle, Warren, Alvarado, Middle River, Newfolden), rural properties, agricultural and recreation lands, and to environmental resources. Privately developed levees along the Middle and Snake Rivers have increased flood stages in downstream areas.

- Excess water stands on relatively flat agricultural land in this problem area, necessitating extensive drainage activities to facilitate agricultural development.

- Severe sheet, gully, and streambank erosion damages rural properties, agricultural and recreation lands, and environmental resources.

- Conversion of flood-plain lands to domestic and agricultural uses increases the chances for accelerated flood damages. Valuable recreational and environmental resources are being converted to agricultural and other nonurban uses.

Adverse Effects

- Water supply problems during drought periods are increasing.

- There is continued utilization of inadequate quality water supplies requiring extensive treatment for domestic usage at Alvarado (Mn-0.2; Cl-600; and TDS-1,800), Argyle (Fe-1.0 and Mn-0.2), Middle River (Fe-0.4), Newbolden (Fe-7.4), and Warren (Cl-335).

- Though urban and rural flood damages are rising, commercial and residential development in the flood plain continues. Average annual flood damages equal about $714,378 of which $459,900 are agricultural damages.

- Irrigation is restricted by insufficient water supplies.

- Agricultural production has been reduced by sheet-water flooding, erosion, and changing land uses.

- All recreational uses in the Middle and Snake Rivers are severely limited, especially those uses involving whole-body contact.

- Valuable waterfowl habitat areas and enviromental resources are being severely degraded and/or lost.

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Upper Red Lake River Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: Minnesota PROBLEM AREA NO.: 21

The Upper Red Lake River Basin Problem Area includes the Upper and Lower Red Lakes and the Upper Red Lake River. The problem area spans approximately 5,000 square miles and includes portions of the following Minnesota counties: Red Lake, Pennington, Clearwater, and Beltrami. The major cities are Red Lake Falls (population, 1,740) and Thief River Falls (population, 8,618). The total problem area population is approximately 30,000. The area's topography ranges from nearly flat plains north of Red Lake to rolling prairie south of Red Lake. The flat plains area has little natural drainage and contains a few meandering streams and large areas of muskeg and marsh. Most of the problem area is underlain with buried channel aquifers or ice channel deposits. The former yields between 50 and 1,000 gpm to wells, while the latter yields generally more than 500 gpm.

Water Issues

- There are localized water quality problems in the Red Lake River stemming from municipal, industrial, and agricultural waste pollution. Waste treatment facilities at Brooks, Goodridge, Grygla, Gully, Lengby, Mentor, Mizpah, Oklee, Tenstrike, and Traill are inadequate.

- Ground-water resources in the area are characterized by excessive iron and manganese concentrations.

Related Land Issues

- Excess water stands on the area's flat agricultural land. There is extensive drainage of wetlands and small lakes.

- Erosion damages rural properties, agricultural and recreation lands, and environmental resources.

- Access to prime recreation resources, particularly the Red Lakes, is insufficient.

- Valuable recreation and environmental resources are being converted to agricultural uses.

Adverse Effects

- Use of ground water for domestic and livestock purposes is restricted. Specific communities currently utilizing poor quality water supplies include Clearbrook (Fe-0.9 and Mn-0.2), Erskine

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(Fe-1.0), Fisher (Fe-2.0 and Mn-0.1), Gonvick (Fe-2.0 and Mn-0.1), Goodridge (Fe-1.5 and Mn-1.0), Kelliher (Fe-1.3), McIntosh (Fe-0.9), Northhome (Fe-3.7 and Mn-0.8), Oklee (Fe-1.3), Plummer (Fe-0.9), and St. Hilaire (Fe-0.4).

- Agricultural production has been reduced by sheet-water flooding and erosion.
- Water quality problems result in the degradation of fish and wildlife habitat, recreational resources, and environmental areas.
- Erosion and changing land uses cause further losses of valuable wetland areas and environmental resources.

Sand Hill River Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: Minnesota PROBLEM AREA NO.: 22

The Sand Hill River Basin Problem Area lies in northwestern Minnesota. The problem area is approximately 500 square miles in size and includes portions of Pook and Norman Counties in Minnesota. The largest communities in the area are Fertile (population, 955) and Fosston (population, 1,684). The total problem area population is approximately 6,000. The western portion of this basin is a flat glacial lake plain, while the eastern portion is characterized by hills. This area is underlain with glacial drift aquifers of the buried channel and ice contact deposit type. The former yields between 50 and 1,000 gpm, while the latter generally yields more than 500 gpm.

Water Issues

- Streamflows during late summer, fall, and winter months are inadequate to meet minimum streamflow requirements for recreation and environmental uses.
- Water quality problems in the Sand Hill River Basin stem from municipal and agricultural waste pollution. Waste treatment facilities at Beltrami and Winger are inadequate.
- Surface-water areas are inadequate to meet the water-oriented recreation needs of the area's residents.
- Ground-water resources in the Sand Hill River Basin are characterized by excessive iron and manganese concentrations.

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Related Land Issues

- Flood damages to rural areas, small communities, agricultural and recreation lands are significant. Excess water stands on relatively flat agricultural land in this problem area. There is extensive drainage of wetlands and small lakes and ponds to facilitate agricultural development.

- Severe wind and water erosion damages rural areas, agricultural and recreational lands, and environmental resources.

- Valuable flood-plain areas are being converted to agricultural and residential uses.

Adverse Effects

- There is continued utilization of poor quality water supplies requiring extensive treatment for domestic usage at Fosston (Fe-1.5), Climax (Fe-1.1 and Mn-0.1), Fertile (Fe-0.9 and Mn-0.2), Neilsville (Fe-1.3), and Winger (Fe-2.7). Highly mineralized ground-water supplies are used by creameries and potato processors.

- Rising urban and rural flood damages average about $597,870 annually of which $518,154 is attributed to agricultural damages. Commercial and residential development in the flood plain continues. Excess water interferes with farming operations by increasing costs, delaying planting, and reducing the quantity and quality of crops produced.

- Sport fisheries are deteriorating and recreation activities in general are restricted.

- Further deterioration of the area's water quality destroys valuable fish and wildlife habitat areas and restricts use of the area's limited recreation and environmental resources.

North Branch of the Wild Rice—Marsh River Problem Area

WRC REGION: 9 SUBREGION: 901

STATES: Minnesota PROBLEM AREA NO.: 23

The North Branch of the Wild Rice-Marsh River Problem Area encompasses approximately 1,000 square miles and includes portions of Norman and Mahnomen Counties in Minnesota. The major cities in the problem area are Ada (population, 2,076) and Mahnomen (population, 1,313). The population of the entire area is approximately 10,000. The topography of the area can be characterized as a flat glacial lake plain with farming the dominant land use. The area is poorly drained and has few meandering

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streams and rivers. The major rivers are the Marsh and the North Branch of the Wild Rice. Most of this area is underlain by major glacial drift aquifers whose well yields vary between 10 and 1,000 gpm.

Water Issues

- Streamflows during the late summer, fall, and winter months are inadequate to meet minimum streamflow requirements for recreation and environmental uses.

- Water quality problems in the problem area stem from municipal and agricultural waste pollution. Waste treatment facilities at Bejou, Borup, and Hendrum are inadequate.

- Surface-water area is inadequate to meet the water-oriented recreation needs of the area.

Related Land Issues

- Extensive floods damage rural properties, several small communities, agricultural and recreation lands, and environmental resources.

- Excess water stands on relatively flat agricultural land in this problem area. There is extensive drainage of wetlands and small lakes and ponds to facilitate agricultural development.

- Severe wind and water erosion damages rural properties, agricultural and recreation lands, and environmental resources.

- Agricultural and residential development in flood-plain areas continues. Much of the area's recreation and environmental resources are being converted to agricultural uses.

Adverse Effects

- Use of ground water for domestic, crop, and livestock production is restricted. Specific communities now utilizing inadequate quality supplies include Ada (Fe-0.8), Bejou (Fe-0.7 and Mn-0.3), Hendrum (TDS-1,300 and Fe-0.6), Mahnomen (Fe-1.9), Shelly (TDS-1,150; Fe-0.5; and Cl-460), and Twin Valley (Fe-0.8 and Mn-0.1).

- Average annual flood damages are more than $1.5 million (1975 conditions) of which $1,180,410 is suffered by agriculture. Sheet-water flooding increases production costs, delays planting, and reduces the quantity and quality of crops produced.

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- Agricultural production is decreasing and rural facilities, such as roads, farmsteads, bridges, etc., are deteriorating as a result of continued erosion and flood problems.

- Continued degradation of available surface-water supplies results in severe impairment of all recreational uses, especially those involving whole-body contact.

- Valuable waterfowl-producing areas and environmental resources are deteriorating and being lost as a result of changing land uses.

South Branch of the Buffalo River Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: Minnesota PROBLEM AREA NO.: 24

Problem Area 24 is located in west-central Minnesota. The major river in the area is the South Branch of the Buffalo River. The problem area spans approximately 600 square miles and covers portions of Clay and Wilkin Counties in Minnesota. The major city in the area is Barnesville which has a population of 1,782. This area's total population is approximately 6,000. The topography of this area is a flat glacial lake plain with wheat and sugar beets cultivation the dominant land use. Most of this area is underlain by major glacial drift aquifers with well yields varying between 10 and 1,000 gpm.

Water Issues

- Streamflow during the late summer, fall, and winter months is inadequate to meet minimum streamflow requirements for recreational and environmental uses.

- Water quality problems in the Buffalo Basin stem from municipal and agricultural waste pollution. Waste treatment facilities at Barnesville, Georgetown, and Sabin are inadequate.

- Surface-water area to meet the water-oriented recreation needs of the area's residents is inadequate.

- Ground-water resources in the problem area are characterized by high iron and manganese concentrations.

Related Land Issues

- Extensive floods damage crops, farmsteads, transportation facilities, recreational lands, and environmental resources. The communities of Barnesville, Georgetown, Hawley, and Kragnes are subject to inundation.

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- Excess water stands on relatively flat agricultural land in this problem area. Wetlands and small lakes and ponds are being drained to facilitate agricultural development.

- Severe wind and water erosion damages rural properties, agricultural and recreation lands, and environmental resources.

- Much of this area's flood plains and recreation and environmental resources are being converted to agricultural and residential land uses.

Adverse Effects

- There is continued utilization of inadequate quality water supplies for both agricultural and domestic uses. Specific communities experiencing this problem include Barnesville (Fe-1.2 and Mn-0.1), Hawley (Fe-1.7 and Mn-0.2), Hitterdahl (Fe-1.5 and Mn-0.2), and Sabin (Fe-1.4 and Mn-0.3).

- Excess water interferes with farming operations by increasing costs, delaying planting, reducing quantity and quality of crops produced, and contributing to erosion. Current flood damages average over $933,597 (1975 conditions) of which about $766,500 represent agricultural flood damages.

- Sport fisheries are deteriorating and whole-body contact recreation activites are restricted by poor water quality.

- Agricultural production is decreasing as a result of erosion and sheet-water flooding.

- Waterfowl production may decrease as a result of changing land uses.

- The area's limited, but valuable, environmental resources are being degraded and/or lost.

Detroit Lakes Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: Minnesota PROBLEM AREA NO.: 25

The Detroit Lakes Problem Area is approximately 1,000 square miles in size and covers portions of Becker and Mahnomen Counties in Minnesota. The largest city in the area is Detroit Lakes with a population of 5,797. The total area population is approximately 20,000. The entire area is characterized by mounds with small tops and steep sides. Surface water is contained in deep lakes, meandering streams, and marshes. There are

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no major rivers in this problem area. Most of the area is underlain with glacial drift aquifers of the buried channel and ice contact deposit type. The former yields between 50 and 1,000 gpm, while the latter generally yields more than 500 gpm.

Water Issues

- Water quality problems in several of the lakes in this problem area have resulted from heavy recreation use and improperly designed residential septic drain fields. Municipal sewage treatment plant discharges and agricultural point and nonpoint pollution are also contributing factors in water quality problems. Many lakes are experiencing severe eutrophication.

- There are locally high concentrations of iron and manganese in the area's ground-water resources.

Related Land Issues

- Severe wind and water erosion damages rural properties and agricultural and recreation lands.

Adverse Effects

- Poor quality ground-water supplies are used for crop, livestock, domestic and manufacturing purposes, especially near Frazee (FE-3.1 and Mn-0.1) and Callaway (Fe-1.0 and Mn-0.3).

- Increased wind and water erosion damages farmland, recreational areas, and wildlife habitat resulting in decreased agricultural production, possible losses in waterfowl production, and deteriorating water quality and recreation facilities.

- The quality of the Detroit Lakes area is declining because of increasing eutrophication and related propagation of undesirable species of fish.

Otter Tail River Basin Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: Minnesota PROBLEM AREA NO.: 26

The Otter Tail River Basin Problem Area covers approximately 1,000 square miles in portions of Otter Tail and Wilkin Counties. The largest city in this problem area is Fergus Falls (population, 12,443) and its

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total population is approximately 35,000. This area is characterized by hills with small tops and steep sides. Surface water is contained in many deep-water lakes, meandering streams, and marshes. The major rivers in the area are the Otter Tail and Pelican Rivers. The area is underlain with glacial drift aquifers of the buried channel and ice contact deposit type. The former yields between 50 and 1,000 gpm, while the latter generally yields in excess of 500 gpm.

Water Issues

- Streamflows in the Pelican River and small tributaries of the Otter Tail River are inadequate during the late summer, fall, and winter months to meet minimum streamflow requirements for recreational uses.

- Water quality problems in the Otter Tail River Basin are the result of high concentrations of municipal, industrial, and agricultural pollutants. Waste treatment facilities at Pelican Rapids, Vining, Otter Tail, Dent, Elizabeth, and Erhard are inadequate.

- Bacterial counts on the Otter Tail River (below Fergus Falls) fluctuate widely, ranging between 20 and 17,000 per 100 milliliters. Minnesota State standards limit coliform group organisms to not over 5,000 per 100 milliliters for general uses and less than 1,000 per 100 milliliters for full body contact. There are eutrophication problems in several of the area's lakes.

- High iron and manganese concentrations occur in certain of the area's ground-water supplies.

Related Land Issues

- Extensive floods damage rural properties, agricultural and recreation lands, and environmental resources in the Otter Tail Basin. Flooding problems are especially severe within the Red River Valley portion of the Otter Tail River Basin.

- Severe wind and water erosion damages occur in the problem area.

- There are land-use conflicts between agriculture and wildlife interests over wetlands drainage.

Adverse Effects

- Poor quality water supplies are used for municipal and domestic purposes at the following communities: Donnelly (TDS-1,966; Mn-0.2; and SO_4-985), Dumont (Fe-1.3 and Mn-0.1), Herman (TDS-1,396; Fe-4.2; and Mn-0.1), Nashua (Fe-1.0), Norcross

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(Fe-1.1 and Mn-0.3), Wendell (Fe-1.1), and Wheaton (Fe-1.1 and Mn-0.1), Battle Lake (Mn-0.1), New York Mills (Fe-4.0 and Mn-0.1), and Underwood (Fe-7.5 and Mn-0.2).

- Continued agricultural and rural community flood damages result in loss of cropland and pastureland and decrease agricultural production. Average annual damages total about $272,874 per year of which $234,459 represent agricultural damages (1975 conditions).

- Irrigation is restricted by inadequate water supplies.

- Water-based hunting is decreasing due to conversion of wetland areas to agricultural uses.

- Continued erosion and sediment damages result in decreased property values in rural areas, deterioration of recreational lands and facilities, and loss of productive agricultural acreages.

- Increasing water quality problems limit the usefulness of this area's surface-water resources for body contact and other water-related recreational activities.

- Valuable environmental resources are being degraded or lost.

Rainy River Main Stem Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: Minnesota PROBLEM AREA NO.: 27

Problem Area 27 is located in north-central Minnesota and covers a hydrologic drainage area of approximately 2,900 square miles of Lake of the Woods and Koochiching Counties. The principal river in the area is the Rainy River, which flows northwesterly from International Falls to the Lake of the Woods, forming a segment of the international border between the United States and Canada. This area's topography is relatively flat, consisting of low wetlands covered with marshes, bogs, and/or forest vegetation. The area is sparsely populated with the majority of its residents in the communities of International Falls (population, 6,439), Baudette (population, 1,547) and Warroad (population, 1,086).

Water Issues

- Pulp and paper mill discharges from two plants located at International Falls, Minnesota, and Fort Francis, Ontario, create a significant industrial pollution problem consisting of an organic load of about 625,000 PE (population equivalent). These dis-

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charges degrade the color of the Rainy River water. While present treatment is generally inadequate, significant efforts are being made to correct the problem. In general, however, the quantity and character of the waste from existing mills is such that after the removal of 95 percent of the waste constituents, water quality problems still exist in the river.

- Ground-water supplies in this area are characterized by excessive concentrations of iron and/or manganese.

Related Land Issues

- Flood waters from snowmelt and high intensity rainfall inundate rural and agricultural areas near Beltrami State Forest. High lake stages accompanied by high winds result in severe flood damage and shoreline erosion near the Lake of the Woods. Three principal types of flood problems exist in this area: (1) those associated with sluggish overland runoff, (2) those related to stream overflows, and (3) those attributable to high lake levels, both regulated and natural. In most of the area, flood occurrences have been of minor consequence since the basin is lightly populated and occupation of the flood plains has been limited. Nevertheless, serious flooding of fertile agricultural lands frequently occurs along some western tributaries.

- Wind and water erosion displaces valuable topsoil from agricultural land in the southwestern portion of this problem area.

- Excess wetness conditions due to sheet-water flooding are common on cropland, pasture, and forestland. Wetlands and wildlife habitat areas are being drained. Agriculture is encroaching on forest acreages.

Adverse Effects

- Failure to provide adequate treatment of municipal ground-water supplies results in the utilization of water which is hard and has objectionable taste and color properties. Although water quality is improving, continued degradation of the Rainy River due to municipal and industrial pollution will restrict this area's fish and recreation potential.

- Floods damage agricultural land and bridges. The average annual flood damages in the Rainy River Basin are estimated as follows:

Year	Damages (1975 Dollars)
1967	$228,417
1980	271,341
2000	318,864
2020	357,189

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- Sediment loads are increasing in streams and rivers due to erosion.

- Degradation and eutrophication of the area's surface water results in restriction of whole-body contact recreation activities.

- Municipal and industrial pollution is seriously degrading the valuable commercial fishery of this area.

- Wind erosion removes topsoil from cropland and pastureland, reducing productivity. Water erosion damages logging roadbanks and skid trails. High lake levels in combination with high winds cause serious damage to beaches and shorelines.

- Forests and marshy bogs are being converted to agriculture uses, decreasing waterfowl habitat and production and altering natural, wild, and scenic areas.

B.W.C.A—Voyageurs National Park and Perimeter Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: Minnesota PROBLEM AREA NO.: 28

Problem Area 28 is located in the north-central portion of Minnesota and covers a drainage area of approximately 4,500 square miles of St. Louis and Lake Counties. The area is heavily forested with rough, rocky ridges and many lakes. Its lakes are relatively deep with rocky shorelines and, in the northern sections of the problem area, they interconnect to form a vast maze of waterways and forested islands. Streams and small rivers are numerous and are often quite rocky and rapid. They become meandering and sluggish where they cross swamps and muskeg. Ely is the area's largest community with a population of about 5,800. The area's total population is about 14,200. Large portions of the area are sparsely populated and nationally recognized for their natural, wild, and scenic qualities.

Water Issues

- Occasional periods of low streamflows occur on some streams during the late summer and fall months.

- Rates of lake eutrophication are accelerating due to the introduction of excessive nutrients from domestic waste disposal at Crane Lake, Minnesota. Providing adequate waste disposal facilities at campsites in the B.W.C.A. is a problem.

- Excessive concentrations of iron and manganese are common to the area's ground-water supplies. Tower, Minnesota, has a municipal water supply (Fe-0.6 and Mn-0.1) which does not meet minimum standards.

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Related Land Issues

- Severe annual flooding results from the spring snowmelt and heavy rains.

- Spring flooding, high lake levels, and wave action seriously damage recreational resources.

- Reserves of copper-nickel and taconite deposits are in and adjacent to the Superior National Forest, an area very high in recreation and fish and wildlife values. Competition between the mining interests and recreation and environmental uses for this area's water and related land resources poses serious water quality problems and land-use conflicts.

- Development of wilderness areas for recreation uses and preservation of the environment causes continuing controversy. Deterioration of logging dams is also a problem.

Adverse Effects

- Failure to provide adequate treatment of municipal ground-water supplies results in the utilization of water which is hard and has objectionable taste and color properties. Continued degradation of the Rainy River due to municipal and industrial pollution results in decreased fish and recreation potential.

- Algae blooms in about 10,000 surface acres of the B.W.C.A. lakes are severe and limit recreational uses. This situation could worsen rapidly as most of the lakes in the B.W.C.A. are interconnected, and the soft water is very susceptible to pollution problems.

- Potential mining of copper-nickel and taconite could result in a significant loss of recreational lands, deterioration of fish and wildlife habitat, depletion of the area's forest resources, and severe degradation of the problem area's surface-water quality.

- Severe flooding and erosion damage lake homes and resorts along Namakin and Rainy Lakes.

- Deterioration of the area's recreation lands and facilities results from recreation overuse of the area's natural resources.

- Lack of adequate waste disposal facilities within the B.W.C.A. results in the degradation of the area's surface-water quality.

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Little Fork—Big Fork River Basins Problem Area

WRC REGION: 9 SUBREGION: 901

STATE: Minnesota PROBLEM AREA NO.: 29

Problem Area 29 is located in north-central Minnesota and covers about 2,900 square miles in Koochiching, St. Louis, and Itasca Counties. The area's principal streams are the Big Fork and Little Fork Rivers which flow in a northwesterly direction to join the Rainy River. This area's topography is generally flat with a gradual slope toward the north. The land area is composed of a glacial drift overlain with lacustrine deposits. Streams in this area occasionally cross granite outcrops forming series of rapids. Large portions of the area consist of low wetlands covered with marshes and/or forest vegetation. Little Fork (population, 824) and Big Fork (population, 534) are the area's principal communities. Its total population is about 6,400.

Water Issues

- Excessive nutrient and other chemical and biological concentrations are common in rivers and streams due to municipal and agricultural pollutants. Waste treatment facilities at Effie and Squaw Lake are inadequate.

- Excessive concentrations of iron and/or manganese have been identified in ground-water supplies at Big Falls (Fe-2.5 and Mn-0.5) and Little Fork (Fe-0.5 and Mn-0.1).

Related Land Issues

- Head-water marshes are insufficient in size and capacity to retard sudden inflows of water from heavy rains and rapid snowmelt resulting in occasional flooding.

- Wind and water erosion removes valuable topsoil from cropland, forest, and pastureland in the extreme southwestern sector of the problem area.

- Recreation development may occur along the scenic waterways of the Little Fork and Big Fork Rivers which have not been assured adequate protection as outstanding stream environments.

- There is not adequate access to the area's valuable recreation and environmental resources. Selected entry points to high quality recreation areas should be developed.

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Adverse Effects

- Failure to provide adequate treatment of municipal ground-water supplies results in the utilization of water which is hard and has objectionable taste and color properties. Specific communities experiencing this problem include Big Falls and Little Fork.

- Floods damage agricultural land, bridges, and culverts.

- Sediment loads in the streams and rivers are increasing due to erosion and flooding.

- Degradation and eutrophication of the area's surface-water resources results in restriction of recreational use for whole-body contact recreation activities.

- Water-based hunting could decrease as a result of conflicting or competing land uses.

- Reduced agricultural production results from flooding and erosion.

- High quality environmental resources are being degraded and/or lost.

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Summary

The Souris, Red, and Rainy Rivers flow northward into Canada's Hudson Bay. Distribution of the region's surface area is as follows: over 60 percent cropland and other agricultural uses, 20 percent forest, 10 percent pasture and rangeland, 6 percent urban and other, and 4 percent water. Seven Indian reservations, seven games refuges, Chippewa and Superior National Forests, and Voyageurs National Park are in this region.

Vegetation and land forms vary from the flat, dry grasslands in the Souris River Basin, to farmlands in the fertile Red River Valley, to the humid northern forests on rugged, rocky terrain in the Rainy River Basin. Dry-land farming and open range give way to grain, sugar beets, and potatoes and then to timber as one moves from west to east across the region.

Temperatures range from about -50° F to 120° F and average just about 40° F. The frost-free period is around 100 days. Mean annual precipitation varies from about 14 inches on the western side of the region to 28 inches on the eastern side.

The 1975 population (estimated 649,000) is projected to decline by 54,000 by the year 2000. Approximately, one-quarter of the region's residents live in the larger urban areas of Grand Forks, Minot, and Fargo, North Dakota, and Moorehead and East Grand Forks, Minnesota. The population density is about 12 persons per square mile and is projected to drop to 11 persons per square mile by the year 2000. More than 33 percent of the people in the region do not receive water from a central system, and 7 percent do not have running water under pressure in their homes.

Earnings of about $2.4 billion in 1975 within the region are expected to almost double by the year 2000. Growth ratios will be largest for services (partially resulting from recreational activities), government, and manufacturing. Gains will be average for trade, and small for agriculture. Per capita income for 1975 averaged $5,000, which is low when compared to the rest of the Nation.

The Souris-Red-Rainy Region contains an array of water and related land resources problems and issues. Some of these problems, such as flooding, drought, wetness, wind erosion, water erosion, and loss of waterfowl habitat, are lingering. They have long been recognized as problems, and while much has been done to reduce their impact on the economic and social well-being of the region's inhabitants, much more remains to be done. Other problems, including a shortage of water-based recreation opportunities, pollution of streams, lake eutrophication, and inadequate municipal and industrial water supplies, have been recognized only recently as being serious, but are of equal if not greater importance. Ultimately these problems must be faced and resolved if the economic and social well-being of the region's people is to be achieved and the quality of the human environment is to be maintained and enhanced.

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Conclusions and Recommendations

While the initial or overriding purpose of the Second National Water Assessment, as outlined in the plan of study of the Water Resources Council dated October 1974, was to identify and describe the Nation's severe water-related problems from the national and State/regional viewpoint, one of the major outcomes of the assessment was the development of basic conclusions and recommendations for resolving each region's critical water resources needs and problems. More specifically, conclusions and recommendations reflecting both the State/regional and national viewpoints were developed in each of the following categories:

- Needs for planning studies (Table 9-8).
- Needs for further research and data collection, including those program modifications which are necessary to provide adequate information and data to support further planning activities and an improved assessment process (Table 9-8).
- Needs for changes in existing institutional or legal arrangements, water policies, and water-related programs.
- Delineation of the Federal role in helping to resolve each region's water-related problems.

It should be noted that the conclusions and recommendations delineated on the following pages reflect only the consensus of the Upper Mississippi River Basin Commission members, but are not "official" recommendations which have been formally approved or adopted by either a State or Federal agency or governing body, such as a State department of natural resources, a State Legislature, the U.S. executive branch, or the Congress. The conclusions and recommendations presented below indicate: (1) what needs to be done in several major problem categories in various parts of the region, and (2) which agencies, Federal or State, should lead the efforts for meeting each identified need. Wherever the lead agency for the resolution of a particular need is unknown, a dash has been used to denote this. A list of abbreviations used in identifying the suggested lead agency follows:

BLM	-	Bureau of Land Management
COE	-	Corps of Engineers
EWGCC	-	East-West Gateway Coordinating Council
GERPDC	-	Greater Egypt Regional Planning and Development Commission
HUD	-	Housing and Urban Development
IADEQ	-	Iowa Department of Environmental Quality

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IADSC	-	Iowa Department of Soil Conservation
ILDOT	-	Illinois Department of Transportation
ILEPA	-	Illinois Environmental Protection Agency
ISU	-	Iowa State University
MNDNR	-	Minnesota Department of Natural Resources
MNEA	-	Minnesota Energy Agency
MNPCA	-	Minnesota Pollution Control Agency
MODNR	-	Missouri Department of Natural Resources
NDHSD	-	North Dakota State Health Department
NDSU	-	North Dakota State University
NDSWC	-	North Dakota State Water Commission
SCS	-	Soil Conservation Service
SIMRPC	-	Southwest Illinois Metropolitan and Regional Planning Commission
UIL	-	University of Illinois
UMN	-	University of Minnesota
UMO	-	University of Missouri
UMRBC	-	Upper Mississippi River Basin Commission
USDA	-	United States Department of Agriculture
USDI	-	United States Department of Interior
USDOT	-	United States Department of Transportation
USGS	-	United States Geological Survey
UW	-	University of Wisconsin

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Table 9-8. Planning Studies

	Federal	State	Suggested Lead Agency
Water Quality Planning Needs			
o Detailed Plans for Waste-water Treatment Facilities. Steps I and II detailed plans and specifications for waste-water treatment works in the Souris-Red-Rainy Region.		X	MNPCA NDSHD
o Statewide Water Quality Management Plans. Plans to provide the water quality assessment and program management information necessary to make centralized, coordinated, water quality management decisions in the Souris-Red-Rainy Region (Section 208 of Public Law 92-500).		X	MNPCA NDSHD
Water Supply and Hydrology Planning Needs			
o Studies to determine low-flow characteristics of streams at gaged and ungaged stations.	X		USGS
o Study of Ground-water Problems. Framework for a ground-water management program in Minnesota.			
Transportation and Energy Planning Needs			
o Coal Transportation Policy Development in Minnesota. A special study for storage and transfer of coal.		X	MNEA
o Peat-mining Feasibility. A study to determine the potential for and feasibility of mining peat as an alternative source for power production.		X	MNDNR
Fish and Wildlife, Recreation, Preservation of Environmental Quality Planning Needs			
o St. Louis County Recreation Navigation Study	X	X	COE
o Cooperative programs for the acquisition and management of fish and wildlife resources	X		USDI MNDNR

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	Federal	State	Suggested Lead Agency
o Review of all major Federal projects to evaluate impacts on fish and wildlife resources	X		USDI
o Study and protection of endangered species	X		USDI
o Categorical grants-in-aid to States for the preparation and use of comprehensive fish and wildlife service guidelines to Federal aid programs.	X		USPI
Flood Damage Reduction and Watershed Protection Planning Needs.			
o Small watershed planning (Public Law 83-566) for watershed protection and flood prevention in the following watersheds: Minnesota - Tamarac River, Burnham Creek, South Hawley, and Norman-Polk; North Dakota - Boundary Creek, North Branch of the Park River, Lower Forest River, Middle Branch of the Park River, St. Thomas-Lodema watershed, Middle and South Branches of the Forest River, Upper Turtle River, and Lower Buffalo Creek.	X		USDA
o Resource Conservation and Development (RC&D) Planning via the Resource Conservation and Development Act in the following areas: Minnesota - Headwaters, Arrowhead, and Wes Min; North Dakota - Souris River Basin, North Central, South Central, Lake Agassiz, and Red River.	X		USDA (SCS)
o State Soil and Water Conservation Program. Expansion of State soil and water conservation measures to assure that additional conservation needs are met.		X	---
o Preliminary or feasibility studies to evaluate flood control and flood-related problems in the following areas: Minnesota - Middle River subbasin, Kawishiwi River, Upper and Lower Red Lake Reservoir and Lake subbasin, Red Lake River subbasin, Sand Hill River subbasin, and Buffalo River subbasin;	X		COE

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	Federal	State	Suggested Lead Agency
North Dakota - Devils Lake, Goose River subbasin, Maple River subbasin, and Wild Rice River subbasin.			
o Corps of Engineers urban studies of water-related problems and solutions in the Fargo-Moorhead and East Grand Forks-Grand Forks Areas.	X		COE
o Red River of the North Basin study: An overall basin study to determine the best plan for development of all water-related resources in the basin.	X		COE

Table 9-8.--Needs for Modified and/or Research and Data Collection

o Preparation of detailed soil maps and interpretations for counties lacking such information in the Souris-Red-Rainy Region.	X		USDA
o Expansion of water resources research in Minnesota and North Dakota.		X	UMN NDSU
o Identification and labelling of flood-prone areas on topographic maps.	X		USGS
o Collection of detailed flood hazard data for the National Flood Insurance Program.	X		HUD
o Collection of data on small area floods at selected bridge sites.	X		USGS
o Continued collection of surface-water and ground-water data as well as water quality and sediment data.	X		USGS
o Data collection and research to measure changes in population levels of migratory birds including mortality and survival rates of selected game birds.	X		USDI
o Development of regional environmental information needs regarding stream alteration practices and the siting, construction, and operation of powerplants.	X		USDI
o Delineation and mapping of wetlands in the region to evaluate fish and wildlife resources.	X		USDI
o Cooperative Federal-State fish and wildlife surveys and research.	X		USDI

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	Federal	State	Suggested Lead Agency
o Initiate further research and data collection to determine determine: (1) a basinwide inventory of fish and wildlife resources; (2) instream flow requirements for fish and wildlife; (3) water quality requirements for fish and wildlife; and (4) habitat requirements for fish and wildlife.	X		USDI
o Urge the Minnesota Subcommittee on Underground Water Surveys to give careful consideration to funding requests for statewide ground-water inventories.		X	---
o Small areas suitable for temporary storage of excess runoff water should be identified and mapped in all portions of each problem area watershed.	X		USGS SCS
o Adequate funding should be provided to appropriate agricultural experiment stations for research to develop perennial forage plants adaptable to growing in flooded areas but with higher nutritional value than native marsh grass.	X		USDA
o Studies to provide flood-plain information in the region.	X		USGS
o Red River of the North Main Stem farm diking survey.	X	X	COE
o A review study of sample representative areas within the Red River Basin analyzing the flood contributions originating from agricultural drainage. The research should include the monitoring of flows, locating holding areas, and designation of slow release methods needed for managing the spring runoff.			
Comprehensive and Multifaceted Planning Needs			
o State Water and Related Land Resources. Framework plans to develop a statewide framework policy plan utilizing possible futures concept.		X	---
o Comprehensive Coordinated Joint Plan (CCJP) and Priorities Reports. Development of a plan to assure coordination and integration of private interest, local government, Federal agency and nongovernmental plans. The priorities report establishes time frames and priorities for such studies as are necessary	X	X	UMRBC

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	Federal	State	Suggested Lead Agency
in the preparation of the CCJP and for implementation of projects and programs which are part of the CCJP recommendations.			
o More interagency special planning and implementation studies (short, medium, and long range) designed to minimize the effects of use conflicts between fish and wildlife resources and man's developments should be initiated and coordinated.	X	X	---
o Red River Basin Level B Study. The potential Red River Basin Level B Study area is defined as the Red River of the North Basin with a special focus, as indicated above, on the Red River glacial lake bed. The study area involves about 38,700 square miles covering 16 counties in Minnesota and 16 counties in North Dakota. The area's population is approximately 539,500 with the largest cities being Fargo, Grand Forks, and Wahpeton, North Dakota, and Moorhead, East Grand Forks, and Breckenridge, Minnesota. The topography of the area is generally flat, but hills and lakes are characteristic of the eastern portion of the basin. This area is nationally significant in the production of small grains, sugar beets, and potatoes and is experiencing a growth of agriculture-related industry. Serious flooding, unstable water supplies, and nonpoint pollution of surface waters are major problems in the proposed Level B Study area.	X	X	UMRBC

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Changes in Institutional Arrangements, Water Policies, Water-related Programs

- Federal and State agency water policies and water-related programs should be examined and changed, if necessary, to more adequately consider the needs of fish and wildlife.

- The existing Level B Study Program (Section 209 of Public Law 92-500) should be reexamined and revised in order to more adequately reflect State goals and objectives and to modify State financial and institutional requirements.

- The comprehensive planning process should be strengthened at both the State and regional levels by formalizing the procedures for joint participation and for expanded citizen and public official involvement.

- Efforts to collect, analyze, and disseminate resource information should be coordinated to avoid duplication and maximize usefulness. Priority should be given to data collection programs which fill data gaps for the most pressing land resource decisions. Research and data collection to relate gross erosion to sedimentation and water quality are needed, especially to measure the physical and economic effects of land treatment.

- The appropriations under Title III of the Water Resources Planning Act should be increased to keep up with inflation and to allow expansion of State participation in water and related land resources.

- River Basin Commission studies should be designed in a format which makes them easier to update, eliminates collection of unnecessary data, makes data available in a format useful to various governmental planning needs, and facilitates early and meaningful participation by the public.

- Regional and local governments, private enterprise, concerned citizen and special interest groups, and individuals should become more actively involved in River Basin Commission planning programs with the goal of making plans more acceptable and more likely to be implemented.

- The Minnesota Legislative Commission on Minnesota Resources should be urged to give careful consideration to funding requests for development of statewide water plans.

- The Minnesota Water Resources Council should be strengthened and assigned sufficient personnel to delineate the State's water-related problems and outline alternatives for a State water plan.

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Federal Role in Regional Problems

- The Federal Government should continue to expand its efforts to provide for quality outdoor recreation opportunities. The Federal Land and Water Conservation Fund, already hard-pressed to provide for potential requests, must be expanded. Appropriations at authorized levels are recommended. Additionally, the Contingency Reserve Fund should be significantly expanded.

- Establish with certainty future levels of funding for construction of municipal waste treatment plants. Continuity in the Federal grant program is essential to assure needed cooperation of communities in completing the many stringent planning and design requirements.

- Federal funding of State administrative programs (in water quality) needs to be increased if further authority is to be delegated to the States.

- A national steering committee should be formed to encourage and coordinate States' efforts in developing a water-use information system.

- The priority of water-use information at the State level should be improved with a cooperative funding program spearheaded by the U. S. Geological Survey. The National Steering Committee (referred to in the foregoing recommendation) should encourage State/Federal matching funds for implementaton and operation.

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NATIONAL PROGRAMS AND ASSESSMENT TASK GROUP

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Lewis D. Walker, Water Resources Council, Chairman of Task Group

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- Karl Klingelhofer
- Arthur Flickinger
- David K. Bowen
- Adrian Haught
- Roger Strohbehn
- Marlin Hanson
- Roy M. Gray

Department of the Army:
- William T. Whitman
- Theodore Hillyer
- George Phippen
- Walter Schilling
- Jack Lane

Department of Commerce:
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- Don Willen
- Ralph Baumer
- Brent Paul
- Dick Nash

Water Resources Council:
- Jack R. Pickett
- W. James Berry
- Kerie Hitt

Water Resources Council—Con.
- Raymond E. Barsch (IPA, California)
- Edith B. Chase (Detail, USGS)
- Art Garrett (Detail, USGS)
- Clive Walker (Detail, SCS)
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- Robert Mathisen
- Albert Spector
- Judith B. Smith

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State and Other Representatives[2]

Alabama:
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- Rahim Oghalai

Wyoming:
- Clem Lord

Puerto Rico:
- Guillermo Barreto

Virgin Islands:
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Principal Advisors and Reviewers

Jack Gladwell, University of Idaho
Ronald M. North, University of Georgia
Warren Viessman, Jr., Library of Congress
James Wade, University of Arizona
Mark Hughes, Consultant
Lance Marston, Consultant
H. James Owen, Consultant
Harry A. Steele, Consultant
Pat Waldo, Consultant
Francis M. Warnick, Consultant
Bernard J. Witzig, Consultant
Leo R. Beard, University of Texas

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THE NATION'S WATER RESOURCES — 1975-2000

Volume 4: Souris-Red-Rainy Region

Authorization

The United States Water Resources Council was established by the Water Resources Planning Act of 1965 (Public Law 89-80).
The purpose of the Council is to encourage the conservation, development, and utilization of water and related land resources on a comprehensive and coordinated basis by the Federal government, States, localities, and private enterprises with the cooperation of all affected Federal agencies, States, local government, individual corporations, business enterprises, and others concerned.

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