NEBRASKA SOIL AND WATER
CONSERVATION COMMISSION

STATE WATER PLAN
PUBLICATION NUMBER 101C

Report on

THE FRAMEWORK STUDY

APPENDIX C

LAND AND WATER RESOURCES PROBLEMS AND NEEDS

SEPTEMBER, 1971

J. James Exon
Governor

NEBRASKA'S
STATE WATER PLAN

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Report Prepared by the Planning Division
James Owen, Chief

Carroll Hamon, Head, Comprehensive Planning Section
Russell Batie, Consultant
Robert Roumph, Engineer
Ralph Waddington, Hydrologist

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The following committees and work group reviewed this report and offered comments and advice for improvement prior to submission for Commission approval. Names shown are those serving at the time the report was finalized and are not necessarily those serving when the report was being prepared.

Technical Advisory Committee

Keith Myers	- U. S. Department of Agriculture
Gus Karabatsos	- U. S. Department of Defense
Paul Harley	- U. S. Department of Interior
Stan Matzke, Jr.	- Nebraska Department of Economic Development
William Rapp	- Nebraska Department of Health
Thomas Doyle	- Nebraska Department of Roads
Dan S. Jones, Jr.	- Nebraska Department of Water Resources
Willard Barbee	- Nebraska Game & Parks Commission
Don Nelson	- Nebraska Office of Planning & Programming
Warren Viessman	- College of Engineering, University of Nebraska
E. C. Reed	- Conservation and Survey Division, University of Nebraska
E. S. Wallace	- Bureau of Business Research, University of Nebraska
David P. McGill	- College of Agriculture, University of Nebraska
Howard Ottoson	- Agricultural Experiment Station, University of Nebraska
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Robert M. Bell	- Chairman

Water Inventory and Needs and Problems Work Group

Norman Hadenfeldt	- U. S. Department of Agriculture
D. M. Sedrel	- U. S. Army Corps of Engineers
John Mayne	- U. S. Bureau of Reclamation
Glen Kirk	- U. S. Bureau of Reclamation
Kenneth MacKichan	- U. S. Geological Survey
Gerald Chaffin	- Nebraska Game and Parks Commission
William Rapp	- Nebraska Department of Health
Marion Ball	- Nebraska Department of Water Resources
Deon Axthelm	- College of Agriculture, University of Nebraska
Vernon Souders	- Conservation and Survey Division, University of Nebraska
Ralph Waddington	- Chairman

NEBRASKA'S STATE WATER PLAN

Nebraska Revised Statutes § 2-1507 (7) (Supp. 1967) directs the Nebraska Soil and Water Conservation Commission to "plan, develop, and encourage the implementing of a comprehensive program of resource development, conservation and utilization for the soil and water resources of this state in cooperation with other local, state and federal agencies and organizations."

Legislative Resolution 5, of the 1967 Legislature, (Reaffirmed by L.R. #72 -- 1969 Session) specifically directed the Nebraska Soil and Water Conservation Commission to "...prepare a comprehensive water and related land plan for the State of Nebraska, such framework plan to be completed no later than June 30, 1971, and to be known as the State Water Plan." In addition to an analysis and evaluation of the state's water and land resources, the Resolution directed that the State Water Plan include an examination of legal, social, and economic factors associated with resource development.

Nebraska's State Water Plan, as established by the Commission, will consist of the following four sections:

Section 1. The Framework Study - The framework study is based on reconnaissance type investigations and makes use of presently available planning data in formulation of the framework plan. Basic objectives of the study were to assess the present quantity, distribution, quality, and use of Nebraska's water and land resources and to provide a broad, flexible guide to the best uses of these resources to meet current and future needs.

Section 2. Basin Studies - This section will consist of studies of individual river basins. The studies will be made in the detail necessary to identify potential projects, estimate project costs and benefits, suggest the order of development, show the relationship of each project to the state's framework plan, and recommend local action to accelerate resource development.

Section 3. Status Summary - Significant water resource development projects which have been proposed for future development are described in the Status Summary of Potential Projects. It will be updated periodically to reflect new proposals and progress in resource planning. The Status Summary section of the State Water Plan will also include a report summarizing the present status of water resource development in the State.

Section 4. Special Recommendations - This section consists of recommendations for action by the Legislature, Governor, and various units of government to improve the conservation, development, management, and utilization of Nebraska's land and water resources. The recommendations will be prepared as the need for action becomes apparent and are to include a thorough study of the legal, social, and economic aspects of major problems of resource development.

THE FRAMEWORK STUDY

The Framework Study is the central feature of Nebraska's State Water Plan. Results of the study are presented in a main report and four appendices. The appendices generally present summations of basic data and miscellaneous supporting material for the main report.

Appendix A, "Land Inventory," is an inventory of the land resources of the State. Three major topics (1) existing land use, (2) land ownership, and (3) land capability are discussed. This appendix was printed in preliminary form in June, 1969.

A summary of the ground and surface water resources of the State is included in Appendix B, "Inventory of Water Resources." That volume deals with the location, quantity, quality, availability, and present use of the state's ground and surface water. In addition, Appendix B summarizes those climatic factors related to water resource development. Appendix B was printed in preliminary form in December, 1969 and published in June, 1971.

This Appendix C, "Land and Water Resources Problems and Needs," is an inventory of the present and anticipated future water requirements and water related problems of the State. The primary objectives of this Appendix are to:

1. Summarize existing water related problems and needs with regard to the quantity, quality, and management of resources,

2. Summarize existing water use and anticipated future requirements up to 2020 for domestic, municipal, industrial, and agricultural uses, and

3. Summarize anticipated future water related problems and needs such as drainage, recreation, power, fish and wildlife, flood control, watershed protection, and navigation.

Appendix C was printed in preliminary form in September, 1970.

Appendix D, "Survey of Nebraska Water Law," is a summary of federal and state laws, compacts and court decrees which are important to water resource development in the State. It was printed in preliminary form in June, 1970 and published in June, 1971.

The main report on the Framework Study is based on information presented in the appendices and the sources given in them. It presents a generalized statewide reconnaissance of Nebraska's water and related land resources, problems and needs, and a general framework for development. It does not provide detailed evaluations or time schedules for specific projects but a flexible guide into which properly designed projects can be fitted. The report also presents recommendations for action necessary for proper development of Nebraska's water resources. The report was published in May, 1971.

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INTRODUCTION

This Appendix presents an inventory of Nebraska's land and water resource problems and needs in support of the State Water Plan Framework Study Report published by the Commission in May, 1971. The main purposes of this Appendix are to inventory and analyze the water related problems that prevent efficient utilization of Nebraska's resources, to estimate future water demands up to 2020, and to suggest further development opportunities.

Studies and accumulation of data required for preparation of this Appendix were initiated in 1967, soon after approval of Legislative Resolution 5. Only data already available were used. However, all available sources were contacted and use was made of both published and unpublished data from federal, state, and local agencies. When necessary to describe certain features of the water or related land resources, estimates were made if no specific data were available. No attempt is made in the report to present detailed basic data, but references are included for sources. Summaries of information and data are presented to provide the user with readily available materials.

The State has been divided into 13 river basins for planning purposes. Figure 1, "River Basin Delineation," shows the location of the basins.

Most of the information contained in this Appendix was contributed or collected by federal and state agencies and it could not have been completed without their generous assistance.

The Nebraska Soil and Water Conservation Commission gratefully acknowledges the help and advice received from government agencies, private organizations, and individuals during preparation and review of this report.

Special thanks is accorded to the following:

<u>Federal Agencies</u>

Bureau of Reclamation
Corps of Engineers
Soil Conservation Service
Forest Service
Agricultural Stabilization and Conservation Service
Farmers Home Administration
Geological Survey
Fish and Wildlife Service
Water Quality Administration

<u>State Agencies</u>

Department of Water Resources
Bureau of Environmental Health Services, State Department of Health
Game and Parks Commission
Conservation and Survey Division, University of Nebraska

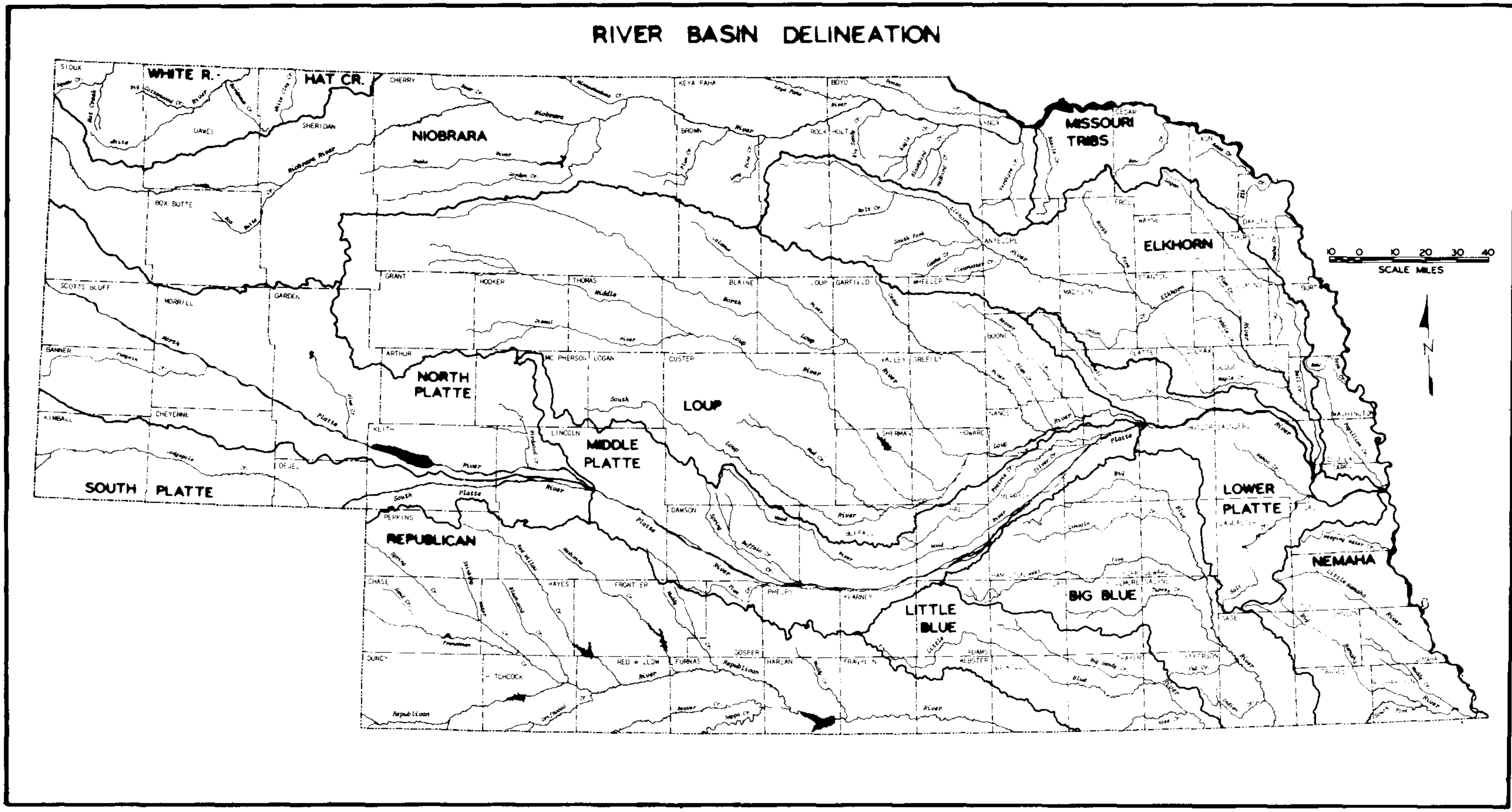

RIVER BASIN DELINEATION
WHITE R.
HAT CR.
NIOBRARA
MISSOURI TRIBS
ELKHORN
NORTH PLATTE
LOUP
MIDDLE PLATTE
SOUTH PLATTE
REPUBLICAN
LOWER PLATTE
NEMAHA
LITTLE BLUE
BIG BLUE
SCALE MILES
10 0 10 20 30 40
N

Fig. 1

Private Organizations and Individuals

Nebraska Power Industry Committee
Members of the Technical Advisory and Special Representatives Committees and the Needs and Problems Work Group whose names are listed near the beginning of this report.

Appendix C was printed in preliminary form in September, 1970. The main report of the Framework Study was subsequently published in May, 1971. This publication updates material presented in the preliminary appendix report and in a few cases utilizes more current information than presented in the main report. Also, in summarizing the information from the preliminary appendix for use in the main report and in the finalization of this appendix, attempts have been continuously made to correct any previous errors or omissions. For these reasons, some data and information presented in this volume may differ from corresponding figures in the main report.

SUMMARY

Municipal, Industrial, Rural Domestic, and Livestock Water Use

Presently, about 402,200 acre-feet of water from both surface and ground water sources are used annually to supply the needs for municipal, rural domestic, livestock, and industrial purposes (not including generation of electrical energy). About 45 percent is used by 451 municipal systems for domestic, municipal, commercial, and industrial purposes; about 22 percent is used by private systems for industrial purposes only; about 7 percent is used by rural farm and nonfarm households for domestic purposes; and 26 percent is used for livestock purposes. The projected 2020 usage for these purposes is estimated at 1,021,300 acre-feet, a 150 percent increase over present usage. This includes a 200 percent increase by municipal systems; a 60 percent increase by private systems for industrial purposes; a 30 percent increase for rural domestic purposes; and a 180 percent increase for livestock purposes. Ground water of adequate quantity is generally available throughout the State except in the White River-Hat Creek, lower portion of the Niobrara, Lower Platte, Republican, and Nemaha River Basins. Both surface and ground water are generally of "usable" quality but there is some objection to the hardness characteristics of ground water.

Irrigation

About 3,355,000 acres of land in the State are presently (1968) irrigated. This is about 17 percent of the acreage suitable for irrigation. About 15,800,000 acres of additional land are suitable for development of which nearly 8,700,000 acres are of the better suitability types. Relatively large blocks of highly suitable lands, which lend themselves to project-type developments, are located in the Niobrara, South Platte, Elkhorn, Lower Platte, Republican, Little Blue, and Big Blue River Basins. Some of these areas and numerous smaller tracts scattered throughout the State are underlain with ground water, making pump irrigation development a possibility.

About 670,000 acres of land irrigated by surface supplies have problems which reduce the efficiency of irrigation water use. About 215,000 acres in 34 systems receive an average of only 65 percent of the farm delivery requirement for the crops being irrigated; about 1,720 miles of canals and laterals in over 50 systems have high water losses; and about 196,000 acres in 31 systems have rising water tables which are causing crop losses. The most serious problem affecting pump irrigators is declining water tables. This condition affects over a million acres of irrigated land in the Niobrara, Middle Platte, Little Blue, and Big Blue River Basins.

Drainage

About 1,797,500 acres of land have drainage problems, of which about 670,000 acres are primarily cropland requiring project-type measures for solution. It is estimated that about $12,000,000 (1960 prices) of annual income is foregone on these acreages because drainage measures have not been installed.

Water Quality Control

Sediment is the greatest pollutant to Nebraska's surface waters. It arises from inadequately protected cultivated land, overgrazed grasslands, unprotected roadside cuts, unstable streambanks and gullies, and highway and building construction sites. Agricultural chemicals, including pesticides, may be washed into surface waters along with sediment. Analyses of surface waters, however, have indicated that the water quality parameter most frequently violated is the coliform density which results from inadequate treatment of municipal, industrial, or agricultural (animal) wastes.

Sewage collection systems have been constructed in 389 of the 468 Nebraska communities (July, 1969). Three communities (population 1,785) discharge their sewage into water courses without treatment; 46 communities (population of 418,000) remove the settleable and floatable materials; and 340 communities (population 528,000) provide additional biological or chemical treatment before discharge.

Of 563 industrial plants inventoried (1968), 408 delivered their wastes to municipal sewage systems or had facilities to adequately treat their wastes, 17 plants had treatment facilities under construction, and nine plants needed to provide treatment. The other 129 plants, mostly sand and gravel producers, were under study to determine treatment needs. The rapid expansion of confined feeding of cattle is causing concern among those responsible for protecting the quality of Nebraska's streamflows. Methods of treating feedlot wastes are under study by the University of Nebraska and the Nebraska Water Pollution Control Council. A State Legislative Study Committee is considering the feedlot waste problem.

Flood Control and Erosion Abatement

Floods occur frequently with a severe flood occurring some place in the State nearly every year. The average annual tangible damage from floods is estimated at nearly $21,000,000. About 93 percent occurs in rural areas with crop and pasture flood damage amounting to over $14,000,000 annually. Flood damage to urban property is estimated at $1,494,000. So far, 411 waterflow control structures, 421 grade stabilization structures, 188 miles of channel improvements, and 70 miles of levees have been installed. These improvements prevent about $10,000,000 of average annual damage.

Soil erosion occurs in all parts of the State but is most severe in the eastern part where the rainfall is greater. Sheet, rill, and small gully erosion problems require the application of land treatment measures and conservation management practices by individual landowners. Large gully and channel degradation problems usually require project-type action. Gully erosion and channel degradation problems are causing an estimated average annual loss of about $2,075,000 on 412,500 acres of land.

Streambank erosion is closely related to flood flows. It occurs along major streams throughout the State at mild to moderate rates.

Navigation

Movement of freight by navigation on the Sioux City to Kansas City reach of the Missouri River has increased from about 130,000 tons in 1955 to over 1,380,000 tons in 1969. Over 50 percent of the total 1969 Missouri River tonnage was moved into or out of ports in the Sioux City to Rulo reach. The main needs to increase use of navigation transport are the construction of grain handling facilities at the ports and the development of standardized shipping containers that can be readily transferred between railroad cars, trucks, and barges.

Electric Power

The electric power industry is one of the fastest growing industries in the State with electrical power usage roughly doubling every ten years. It is expected to expand in the future at a slightly slower rate. The annual power requirements are projected to increase from about 10,400,000 megawatt hours (MWH) in 1970 to over 210,000,000 MWH by 2020. This growth is expected to be supplied by thermal (steam) generation. About 622,000 acre-feet of water annually are used for cooling purposes under current conditions. This is expected to increase to more than 1,986,000 acre-feet by 1980 and 2,320,000 acre-feet by 2020. The rate of increase of cooling water diversions slows considerably after 1980 due to the expected use of cooling towers in all plants constructed after that date. If cooling towers are used for all thermal generation in 2020, the water diversion requirement would be lowered to 358,000 acre-feet.

Fish and Wildlife

Increased numbers of fish and wildlife will be needed in the future to meet both consumptive and nonconsumptive demands. Adequate amounts of the proper habitat is the most critical need to increase the populations. While the reduction of pollution and proper regulation of streamflow would improve the fishery resources, the primary potential for increasing fish production rests in the construction of multipurpose reservoirs. If wildlife populations are to be increased, future destruction of habitat must be prevented and more habitat provided through the application of good land conservation measures.

Some of the state's streams can be protected from further habitat destruction through designation as wild or scenic rivers. Protection of these streams would also preserve many of their values for other functions. Nine particularly valuable streams or reaches of streams in the State should be investigated for possible protection.

Outdoor Recreation

The demand for water-based recreation has increased rapidly during the last few years. About 35 percent of the male population over age 16 presently purchases hunting and/or fishing licenses. Boat registrations increased over 50 percent between 1960 and 1966.

Nebraska has about 136,800 acres of standing water and 8,800 miles of streams suitable for fishery purposes which would be sufficient to meet the present fishing demand if located where the demand occurs. This, however, is not the case. Most of the surface water area is in the Sandhills lakes and large water supply reservoirs located in the central and western part of the State while the big demand for water-based recreation is in the eastern part of the State. It is estimated that by 1972 as much as 133,700, 48,100, and 27,400 additional acres of water surface area will be needed for fishing, boating and water skiing, respectively. By 2000, these same uses will require as much as 264,500, 150,000, and 119,600 more acres, respectively, of surface water area than now exist. These amounts are not necessarily cumulative since the same waters can provide opportunities for several recreational functions. These waters are needed near the high population centers in eastern Nebraska for ready access by the day user.

Watershed Protection

About 16,192,000 acres of agricultural lands are now adequately treated to provide good watershed protection. Conservation treatment is needed on 13,705,000 acres of cropland, 15,854,000 acres of pasture and range, 767,000 acres of forests and woodlands, and 389,000 acres of land in other agricultural uses. About 11,022,000 acres require the application of simple-type conservation measures, 16,261,000 acres require the application of moderate-type conservation measures, and 3,694,000 acres require the application of intensive-type conservation measures.

CHAPTER 1. MUNICIPAL WATER

Present Use

Quantity

About 987,900 people, 70 percent of the state's 1960 population,[1/] are supplied with water distributed by central water supply systems, hereafter referred to as municipal systems. The rest, 424,000 people, obtain their water from individual systems which are discussed in Chapter 3. The present annual usage through municipal systems is about 183,100 acre-feet, an average of about 163 million gallons per day (mgd). This averages 165 gallons per capita per day (gpcd).

These estimates are based upon data of normal usage by about 270 systems[2/] and the assumption that the normal per capita usage of other systems equals the future per capita municipal water use rates established for planning purposes.

Since 1960, the population has continued to shift from rural areas to urban areas and new central supply systems have been installed, further increasing the number of persons supplied through municipal systems. This situation is expected to continue throughout the projection period. The projection of future usage takes these shifts into account. Table 1 shows present municipal usage by basins.

Municipal water systems supply water for various functions including household use; fire protection; street cleaning; irrigation of lawns, gardens, parks, and golf courses; watering livestock; and manufacturing. These fall into broad classes referred to as domestic, agricultural, and industrial. The division of water usage between these classes was not attempted. Therefore, municipal water as used in this discussion is all the water supplied through a central public system.

Records of the Nebraska Department of Health[3/] show that on January 1, 1969, 463 cities, towns, and villages were served by water supply systems. All but Omaha, Chadron, and Crawford obtain their supplies from ground water sources. Omaha has recently developed a well field in the Platte Valley to supplement its surface supply. Chadron developed a well field in 1969 and will eventually abandon its surface supply.

1/ Unless otherwise noted, all population data referred to in this volume as "1960" or "present" is taken from 1960 data of the U. S. Bureau of the Census.

2/ 1963 Inventory Municipal Water Facilities - Region VI, Public Health Service, U. S. Department of Health, Education and Welfare.

3/ Index of Public Water Supplies, Sewers, Sewage Treatment Plants and Swimming Pools, Nebraska Department of Health, 1969.

TABLE 1

PRESENT MUNICIPAL WATER USE
(July 1, 1969)

River Basin	Number of Systems	People Served	Present Water Use[a] Average GPCD	MGD	AF/Yr
White River-Hat Creek	3	6,670	211	1.41	1,580
Niobrara	26	23,263	167	3.88	4,340
Missouri Tributaries	39	354,580	183	64.83	72,630
North Platte	16	47,160	178	8.39	9,390
South Platte	13	24,565	142	3.50	3,920
Middle Platte	26	63,606	185	11.76	13,200
Loup	46	42,800	123	5.26	5,890
Elkhorn	62	82,977	139	11.51	12,915
Lower Platte	41	160,222	149	23.94	26,810
Republican	47	40,445	176	7.13	7,990
Little Blue	33	22,264	130	2.90	3,240
Big Blue	59	81,010	173	14.00	15,680
Nemaha	40	38,364	129	4.93	5,540
STATE TOTAL	451	987,926	165	163.44	183,125

a/ Includes usage of industries now served by municipal systems

Source of Data: Missouri River Basin Comprehensive Framework Study and Nebraska Department of Health

The usage data[4/] show wide differences in amount of water per capita per day withdrawn by municipal systems with the high being 397 gpcd and the low 40 gpcd. The extremes are not confined to any particular area. All basins show wide differences in per capita usage. In the listing are 47 systems showing usage rates of less than 80 gpcd, and 35 with usage rates of more than 200 gpcd. The average usage rate for the approximately 270 systems inventoried is 178 gpcd, with systems serving communities of less than 2,500 persons averaging 140 gpcd, those serving 2,500 to 10,000 persons averaging 161 gpcd, and those serving over 10,000 persons averaging 192 gpcd. Reported and estimated water usage for municipal systems by stream reaches is included in Attachment 1.

Standards for future municipal per capita water use rates established by the Nebraska Soil and Water Conservation Commission for planning purposes are shown in Table 2. The amounts vary by size of community and location within the State. The P.E. Line, located at about the 98° meridian, refers to the precipitation effectiveness.[5/]

TABLE 2

PROJECTED FUTURE MUNICIPAL WATER USE RATES

	Water Requirements in gpcd	
	East of PE Line	West of PE Line
Municipal Systems (people served)		
Under 2,500	80	120
2,500-10,000	125	150
Over 10,000	200	200

Ninety-four of the 270 municipal systems report water delivery at less than the rates established in these standards. About one-third of the systems serving less than 2,500 people fall in this group, as do about one-half the systems serving 2,500 to 10,000 people and three-fourths of the systems serving over 10,000. Over all, 73 percent of the people served by reporting systems are in the group falling below the rate adopted for planning purposes.

If these systems are representative of all the systems in the State, then about 140 systems serving over 700,000 people are now using less than the established future per capita use rate.

Many of the communities reporting low normal usage rates are in areas of plentiful supplies of good quality ground water. Therefore,

4/ (See Footnote 2).

5/ Climate and Man, USDA, 1941.

lack of an adequate available supply of good quality water is not necessarily the only reason for low usages. Other reasons may be one or more of the following:

1. Low demand due to a majority of the users being older citizens accustomed to using minimum amounts of water,

2. Inadequate sewerage or waste removal systems that discourage installation of facilities, such as kitchen waste disposals and automatic washers,

3. Relatively new systems with users not yet equipped to require high rates, and

4. Little demand for water to irrigate lawns, gardens, and parks or to fill swimming pools.

The unusually high rates indicate that the system may be supplying water for manufacturing, wasting the excess to keep the water fresh, or losing it through an inefficient distribution system.

The areas of the State where problems are sometimes encountered in locating ground water sources adequate for local needs are the White River-Hat Creek Basin, the lower portion of the Niobrara River Basin, the Lower Platte River Basin, the Nemaha River Basin, and the Republican River Basin.

Quality

Most ground waters in the State are of a quality suitable for domestic purposes with chlorination of public supplies the only treatment required. However, additional treatment, especially the removal of iron and manganese and the reduction of hardness, would make them more acceptable to most consumers.

Quality refers to the bacteriological, chemical, and physical properties of water which determine its suitability for specific uses. The Nebraska Soil and Water Conservation Commission, in cooperation with other state and federal agencies, developed water quality criteria for various water uses for planning purposes. These are included in Attachment 7. They were adopted from the quality criteria used for comprehensive framework planning of the Missouri River Basin and are generally in accord with the State Water Quality Standards and the criteria contained in the Report of the Committee on Water Quality Criteria (1968) published by the Water Pollution Control Administration, USDI.

The criteria for domestic purposes, including food processing, is used to measure the suitability of raw water for municipal systems.

The types are defined as follows:

(a) Desirable - Those characteristics and concentrations of substances in the raw surface water which represent high-quality water in all respects for use as public water supplies. The treatment cost of water meeting these criteria is less than is possible with waters meeting usable criteria.

(b) Usable - Those characteristics and concentrations of substances in raw surface waters which will allow the production of a safe, clear, potable, aesthetically pleasing, and acceptable public water supply which meets the limits of Public Health Service Drinking Water Standards[6/] after removal of sediments and conventional treatment including chlorination.

(c) Undesirable - Water not meeting the usable criteria but, with additional treatment, can be made acceptable for public supplies by application of existing treatment processes.

The Nebraska Department of Health conducts a continuous program of analyzing the quality of raw water supplies. Tests of nearly a thousand wells in 400 communities show that samples in slightly over 200 communities had one or more chemical components in concentrations greater than allowed under usable quality criteria. This does not necessarily mean that all the supplies for the municipality have undesirable characteristics since a number of wells may be supplying water to the systems. It does indicate that there are local problem areas or specific water-bearing strata with water having undesirable characteristics.

Deep well waters in the State contain relatively few bacteria and usually no harmful types. Chlorination of public supplies is recommended because of the chances for contamination within the distribution system.

Excess iron and manganese combined are the most prevalent chemical components that degrade the state's ground water below "usable." This condition was found in 189 locations, mostly in the eastern third of the State (Figure 2). Although these chemicals usually produce no adverse physiological effects, they do give water an objectionable taste and stain water fixtures.

Excess sodium, sulfates, chlorides, and nitrates are found in some well samples from widely scattered locations. These may cause physiological distress in humans. Excess sodium was found in 30 communities (Figure 3), excess sulfates in nine communities, excess chlorides in two communities, and excess nitrates in one community. Locating another source of supply is usually less costly than trying to remove these substances.

6/ Public Health Service Drinking Water Standards, U. S. Department of Health, Education & Welfare, PHS Pub. 956, Washington, D. C., 1962.

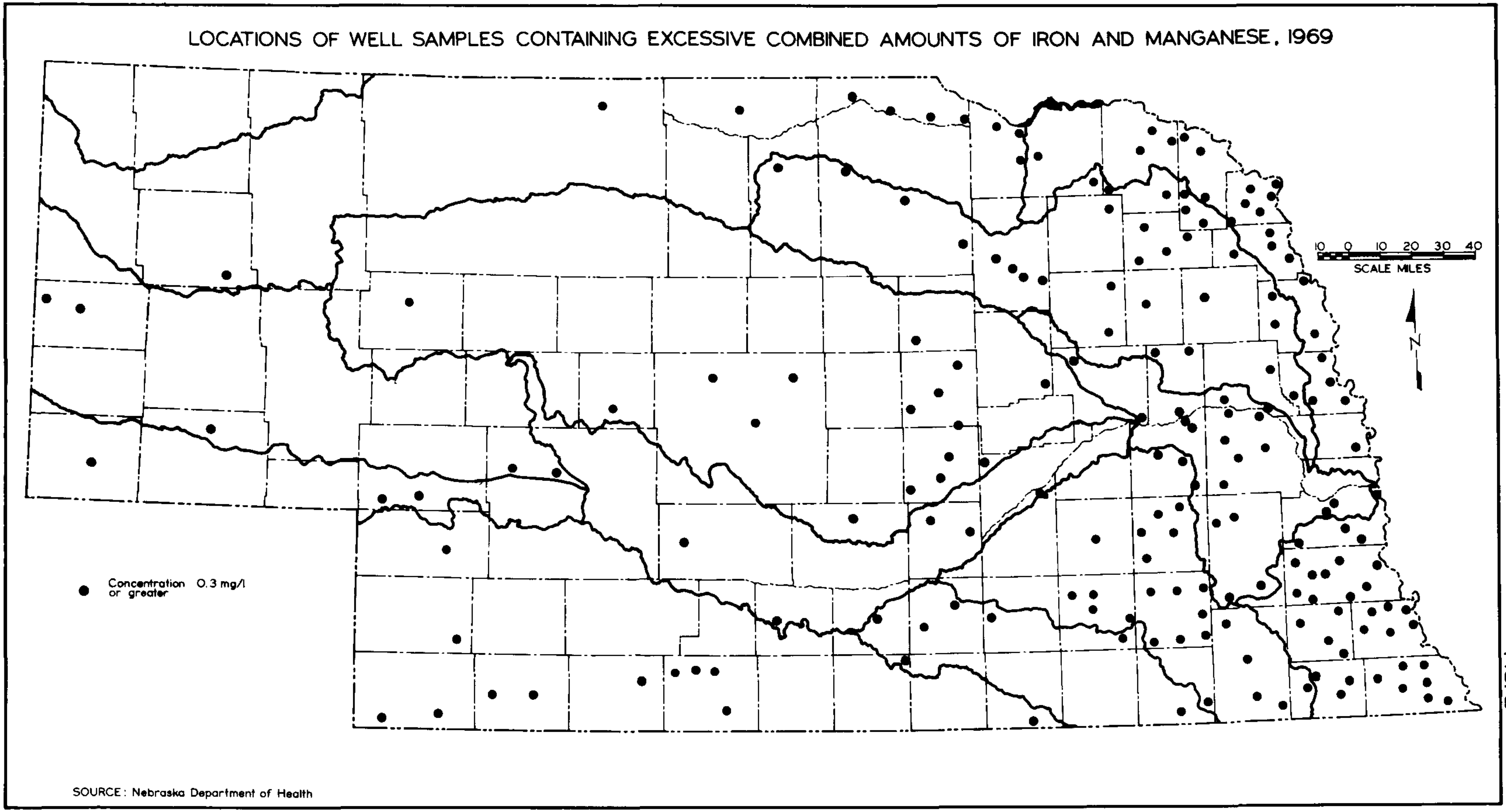
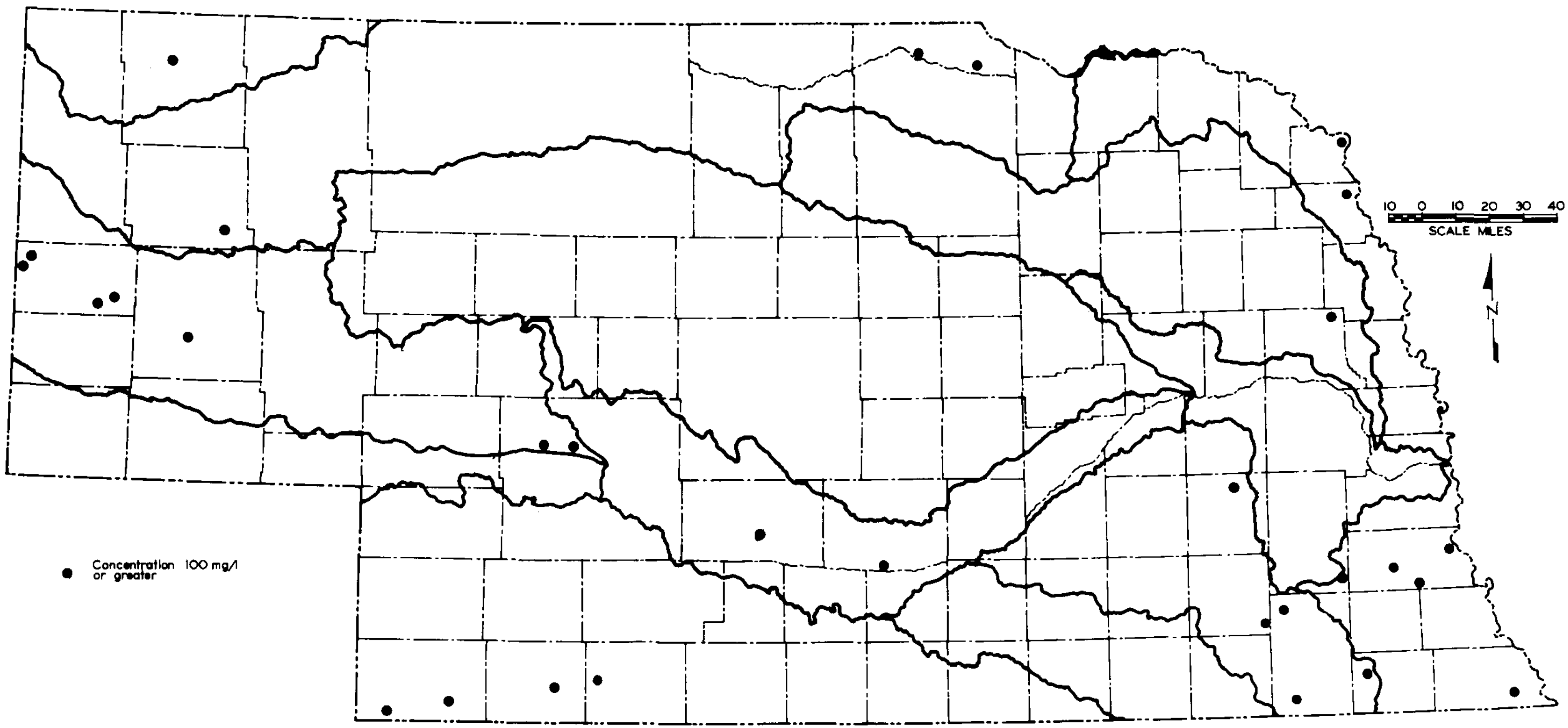

LOCATIONS OF WELL SAMPLES CONTAINING EXCESSIVE COMBINED AMOUNTS OF IRON AND MANGANESE, 1969
10 0 10 20 30 40
SCALE MILES
N
Concentration 0.3 mg/l or greater
SOURCE: Nebraska Department of Health

FIG. 2

LOCATIONS OF WELL SAMPLES CONTAINING EXCESSIVE AMOUNTS OF SODIUM, 1969



SOURCE: Nebraska Department of Health

FIG. 3

Most of the state's waters are hard, exceeding 150 milligrams per liter (150 mg/l) as calcium carbonate. Most consumers object to water harder than this although their sensitivity is related to the hardness to which they have become accustomed.

Ground Water Availability and Quality by River Basins

White River-Hat Creek Basin - Ground water is not available in quantities required to meet the municipal demands. Crawford obtains its water from the White River. Chadron depended upon a surface water supply from Chadron Creek until 1969, but has now developed a ground water supply in the Niobrara River Basin.

The quality of ground waters over most of the Basin is "undesirable." Surface water quality is generally "usable" for domestic purposes.

Niobrara River Basin - Ground water is plentiful except in Keya Paha, Boyd, and Knox Counties. The quality of ground water is generally "desirable" for domestic purposes, except in the lower portion of the Basin where samples from wells and springs in ten communities show excess chemical substances, mostly iron and manganese combined. Outside the Sandhills the hardness is generally in excess of 150 mg/l.

Missouri Tributaries River Basin - The quantity of ground water is limited over most of the Basin. The scarcity is particularly noticeable near the high population centers. The quality of the ground water is generally "undesirable," with samples from 22 communities showing excessive iron and manganese combined, four showing excessive sulfates, two showing excessive sodium, and one showing excessive nitrates. Hardness is generally in excess of 150 mg/l.

North Platte River Basin - Ground water availability is adequate to plentiful. The quality is generally "usable," but excessive sodium and/or iron and manganese combined were found in samples of well water from nine communities.

South Platte River Basin - The quantity of ground water is adequate. The quality is generally "usable," but samples of water from wells in five communities showed excessive chemical concentrations including four with excessive iron and manganese combined, one with excessive sulfates, and one with excessive sodium.

Middle Platte River Basin - The quantity of ground water is plentiful. The quality is generally "desirable," but samples from wells in seven communities show undesirable characteristics; five with excessive iron and manganese combined and two with excessive sodium.

Loup River Basin - Ground water is in plentiful supply. The quality ranges from "usable" to "desirable" with well samples from 16 communities showing excessive iron and manganese combined.

Elkhorn River Basin - There is a plentiful supply of ground water for domestic purposes except in the northeast corner where aquifers are thin and water yields low. The quality is "usable" for domestic purposes although samples from wells in 32 communities contained excess chemical substances. Thirty-one samples had excess iron and manganese combined, two samples had excess total dissolved solids, and one sample each with excess sulfates and sodium. Most water tested showed hardness in excess of 150 mg/l.

Lower Platte River Basin - Ground water is limited in the glacial drift area and adequate to plentiful in the Platte Valley. Omaha gets part of its water supply and Lincoln almost all of its water supply from well fields along the Platte River. The quality is generally "usable" for domestic uses throughout the Basin, but over one-third of the samples tested contained excess iron and manganese combined--some severe. Hardness is generally in excess of 150 mg/l.

Republican River Basin - Ground water is generally adequate except in the lower portion of the Basin. Along the southern boundary, it is often difficult to find an aquifer with adequate yield. The quality is generally "usable" for domestic purposes. Excessive iron and manganese combined was found in samples from wells in 12 communities and excessive sodium in four communities. Hardness is generally in excess of 150 mg/l.

Little Blue River Basin - Adequate ground water supplies are available except on the south side of the river. There, several communities secure their supplies outside the immediate area. The quality is "usable" for domestic purposes with seven communities having well samples showing excessive iron and manganese combined.

Big Blue River Basin - Ground water is in good supply except in the glacial drift area in the eastern and southern part of the Basin. Here, municipalities usually go outside their immediate area to get supplies to meet their needs. Most ground water meets "usable" quality criteria for domestic purposes. Samples of water from wells in 27 communities showed excessive concentrations of chemicals; 25 with excessive iron and manganese combined, five with excessive sodium, one with excessive sulfates, and two with excessive total dissolved solids.

Nemaha River Basin - The supply of ground water is limited over most of the Basin and severely limited in some areas. The quality is mostly "usable," but less than "desirable" with excessive iron and manganese combined found in well samples from 33 communities, excessive sodium in five communities, and excessive total dissolved solids in one community. Hardness generally exceeds 150 mg/l.

Projected Future Requirements

Quantity

The withdrawal of water by municipal systems is expected to triple to 557,000 acre-feet during the next 50 years. Nearly all will be ground water. This estimate considers all communities with a population in excess of 100 having a central supply system and all of those now with systems, even though their population is less than 100. It also considers a future water usage rate at least equal to the use rate established for the State Water Plan. The present usage rate was used for the systems with rates higher than the established future use rate. In addition, the usage for each system was increased 80 gallons per capita as a reserve for minor industrial plants which may be connected to the system. This industrial reserve amounts to about 30 percent of the projected withdrawal for each of the planning periods.

The future projected requirements by basins for the three selected planning years are shown in Tables 3, 4 and 5. The big increase in projected usage over present usage is caused by (1) assuming installation of 16 additional central supply systems, (2) adjusting usage rates for the present low users up to the established future per capita water use rates, and (3) the reserve for industrial use. The additional quantities reserved for industrial use alone amount to 114,000 acre-feet for 1980, 137,500 acre-feet for 2000, and 163,000 acre-feet for 2020.

The biggest increase in projected needs is in the Missouri Tributaries River Basin, including the Omaha Metropolitan Area, where the 2020 requirement is expected to be nearly four times the present usage. The Lower and Middle Platte River Basins follow in order with approximately 270 and 190 percent increases in need respectively.

Future water requirements for municipal systems by stream reaches are included in Attachment 2. Included are projected usages from private industrial systems. The non-municipal system withdrawals are included because of the possibility of mutual interference between systems in the event the source of supply becomes inadequate.

<u>Quality</u>

Raw water sources, principally ground water, are generally expected to remain at the present quality. This is contingent upon the prudent use of fertilizers, pesticides, etc., and the effective regulation of both natural and man-made sources of pollution. Local quality problems, particularly where the water table is near the surface, may be increasingly evident. Water quality is discussed further in Chapter 6.

SUMMARY OF PROJECTED FUTURE MUNICIPAL WATER REQUIREMENTS
1980

River Basin	Projected 1980 Basin Population	Population Served	Percent of Population Served	Projected Per Capita Usage[a] Minimum (gpcd)	Projected Per Capita Usage[a] Maximum (gpcd)	Annual Water Requirement (mgd)	Annual Water Requirement (AF/Yr)
White River-Hat Creek	10,500	7,900	75	200	477	2.2	2,500
Niobrara	40,000	23,220	58	160	324	5.6	6,200
Missouri Tributaries[b]	589,200	567,490	96	160	336	157.7	176,800
North Platte	76,800	51,870	68	200	355	14.3	16,000
South Platte	30,400	20,230	67	200	274	4.9	5,500
Middle Platte	113,100	82,550	73	160	343	24.5	27,600
Loup	81,600	47,015	58	160	350	9.2	10,300
Elkhorn	118,300	95,820	81	160	413	23.7	26,400
Lower Platte[c]	262,700	188,440	72	160	320	51.4	57,600
Republican	62,200	42,310	68	200	370	11.1	12,300
Little Blue	37,000	19,550	53	160	353	4.2	4,700
Big Blue	127,200	85,660	67	160	405	23.9	26,700
Nemaha	61,000	40,240	66	160	366	8.9	10,000
STATE TOTAL	1,610,000	1,272,295	79			341.6	382,600

a/ Includes 80 gpcd industrial reserve
b/ Includes Omaha Metropolitan Area (Douglas and Sarpy Counties)
c/ Includes Lincoln Metropolitan Area (Lancaster County)

TABLE 4

SUMMARY OF PROJECTED FUTURE MUNICIPAL WATER REQUIREMENTS
2000

River Basin	Projected 2000 Basin Population	Population Served	Percent of Population Served	Projected Per Capita Usage[a/] Minimum (gpcd)	Projected Per Capita Usage[a/] Maximum (gpcd)	Annual Water Requirement (mgd)	Annual Water Requirement (AF/Yr)
White River-Hat Creek	11,500	9,200	80	200	477	2.5	2,700
Niobrara	37,000	22,570	61	160	324	5.6	6,300
Missouri Tributaries[b/]	746,400	726,720	97	160	336	202.4	226,800
North Platte	81,500	59,240	73	200	355	16.5	18,700
South Platte	29,700	19,980	67	200	274	4.7	5,400
Middle Platte	128,800	96,910	75	160	343	29.3	32,800
Loup	78,000	48,325	62	160	350	9.3	10,400
Elkhorn	119,000	106,300	89	160	413	27.0	30,100
Lower Platte[c/]	328,200	249,640	76	160	320	68.4	76,600
Republican	56,500	42,610	75	200	370	11.5	12,900
Little Blue	35,000	18,250	52	160	353	4.0	4,400
Big Blue	135,200	92,330	68	160	405	25.5	28,700
Nemaha	63,200	43,320	69	160	366	9.8	10,800
STATE TOTAL	1,850,000	1,535,395	83			416.5	466,600

a/ Includes 80 gpcd industrial reserve
b/ Includes Omaha Metropolitan Area - (Douglas and Sarpy Counties)
c/ Includes Lincoln Metropolitan Area - (Lancaster County)

TABLE 5

SUMMARY OF PROJECTED FUTURE MUNICIPAL WATER REQUIREMENTS
2020

River Basin	Projected 2020 Basin Population	Population Served	Percent of Population Served	Projected Per Capita Usage[a/] Minimum (gpcd)	Projected Per Capita Usage[a/] Maximum (gpcd)	Annual Water Requirement (mgd)	Annual Water Requirement (AF/Yr)
White River-Hat Creek	12,800	10,500	82	237	477	2.7	3,100
Niobrara	35,500	22,200	63	160	324	5.6	6,300
Missouri Tributaries[b/]	912,300	891,820	98	160	336	248.7	278,600
North Platte	88,400	64,990	74	200	355	18.4	20,500
South Platte	29,300	19,630	67	200	274	4.7	5,300
Middle Platte	147,000	111,480	76	160	343	34.1	38,300
Loup	77,500	49,595	64	160	350	9.4	10,600
Elkhorn	124,300	118,850	96	160	413	30.5	34,200
Lower Platte[c/]	418,200	321,330	77	160	320	88.7	99,200
Republican	56,300	43,100	77	200	370	12.0	13,400
Little Blue	34,500	16,900	49	160	353	3.6	4,000
Big Blue	144,500	99,120	69	160	405	27.9	31,200
Nemaha	69,400	47,720	69	160	366	10.7	12,000
STATE TOTAL	2,150,000	1,817,235	85			497.0	556,700

a/ Includes 80 gpcd industrial reserve
b/ Includes Omaha Metropolitan Area - (Douglas and Sarpy Counties)
c/ Includes Lincoln Metropolitan Area - (Lancaster County)

CHAPTER 2. INDUSTRIAL WATER

Present Use

Records on industrial water use are sketchy. The most complete data is available from a survey made by the Nebraska Department of Health in 1968 as a part of the water pollution control program. Data was obtained from 563 firms. This section is based upon an analysis of that data.

One hundred-two of the firms surveyed were sand and gravel producers. Water usage by these plants was not obtained during the survey nor were estimates subsequently made. Nearly all the water required for their operations is returned to the source of supply.

Some water use data were obtained on the remaining 461 plants. Three hundred-fifty one of these are engaged in food processing with meat producers heading the list with 263 plants. The plants vary in size from an average kill of a few head of livestock a week to over 4,000 head per day. Nearly 200 have an average kill of less than 5 head per day, many serving a single retail outlet. Fourteen firms report an average kill in excess of 500 head per day. The small plants are located throughout the State while the large plants are located near population centers or in areas where livestock feeding operations are concentrated.

Fifty-one firms process dairy products. These are scattered throughout the State in about the same intensity as population. Other food is processed in 37 plants, four of which are sugar processors. Sugar processing requires large amounts of water during the operating season of four months. All the sugar processing plants now operating are located in the North Platte Valley. The other 33 food processing plants are distributed widely over the State, with a number located in and near Omaha.

Eight fertilizer manufacturing plants have located in the State during recent years. Five of these are located in the Big Blue River Basin. They require moderate to large quantities of water depending upon the type of operation.

Over 330 industrial firms obtain their water requirements from municipal systems. Omaha, Lincoln, Grand Island, Norfolk, McCook, and Nebraska City furnish the water requirements for most of the industrial firms in their communities. The remaining 130 firms have private wells and/or surface diversions to meet their requirements. A summary of industrial firms by basins, source of water supplies, and amount of water provided from private systems is shown in Table 6. The water usage was estimated for each firm by applying a liberal water use rate to the plant capacity. It was assumed that water requirements for industrial firms connected to municipal systems are included in the municipal requirements shown in Chapter 1.

TABLE 6

PRESENT USAGE OF INDUSTRIAL WATER
FROM PRIVATE SYSTEMS

River Basin	Industrial[a/] Firms	Source of Supply: Municipal Systems	Source of Supply: Private Systems	Water Usage[b/] Through Private Systems (AF/Yr.)
	------------ (Number of Firms) --------			
White River-Hat Creek	3	2	1	0
Niobrara	16	9	7	60
Missouri Tributaries	77	66	11	25,660
North Platte	27	12	15	25,130
South Platte	13	10	3	7,110
Middle Platte	45	18	27	14,140
Loup	31	21	10	410
Elkhorn	72	53	19	6,570
Lower Platte	36	26	10	3,780
Republican	37	28	9	220
Little Blue	20	17	3	1,410
Big Blue	53	40	13	4,300
Nemaha	31	29	2	0
STATE TOTAL	461	331	130	88,790

a/ Industrial firms surveyed by Nebraska Department of Health in 1968 exclusive of sand and gravel producers

b/ Quantity by plants using in excess of five acre-feet per year

Annual water usage from private systems is estimated at nearly 90,000 acre-feet. The manufacture of fertilizer shows the largest annual usage, nearly 27,000 acre-feet, most of which is used for cooling. Sugar processing uses over 19,000 acre-feet annually, part of this from surface supplies which is used to flume and wash the beets. Secondary petroleum recovery and oil refining are estimated to require about 12,000 acre-feet annually. Most of the water requirement for meat processing is supplied by municipal water systems. However, many recent installations are supplying their needs through private systems. This amount used from private systems is estimated at over 11,000 acre-feet annually.

Future Requirement

The processing of agricultural products is expected to remain the major heavy water using industrial activity in the State. It is expected that there will be considerable change in the size and location of plants, especially those processing meats. Increased meat processing facilities will be needed to handle the projected increase in livestock production. However, many of the 200 smaller processors will be forced to terminate their operations because of the sanitation requirements now being instituted. Meat processing is expected to become concentrated in medium to large plants located near central cities in major livestock feeding areas. Nearly all basins will share in the increased operations with the Elkhorn, Middle and Lower Platte, and Big Blue River Basins showing the greatest increase. The trend toward a higher degree of processing by packers will add to the water requirement of the meat packing industry.

Sugar processing is expected to increase moderately and will be confined to the North Platte Valley. Dairy processing is expected to increase moderately with the increase occurring near the population centers.

The manufacture of fertilizer will likely show the greatest increase in water requirement for the projection period. The new plants are likely to be located in the areas of greatest fertilizer use.

An industrial reserve of 80 gallons per capita per day was included in the projection of municipal water requirements. This is for projection purposes only and is not to be considered as a restriction. By 2020 this amounts to 163,000 acre-feet annually. This appears adequate to supply industrial users likely to connect to municipal systems.

The bigger users, particularly larger meat packing plants, sugar processors and manufacturers of fertilizers, are likely to develop their own water supplies. The water requirement for industries to be supplied from private systems is estimated to be about 144,000 acre-feet annually by 2020.

Tables 7, 8, and 9 show the projected industrial water reserve in municipal systems and estimated water requirement of private industrial

TABLE 7

PROJECTED INDUSTRIAL WATER REQUIREMENT BY 1980

River Basin	Reserve in Municipal Systems AF/Yr	Private Systems AF/Yr	Total AF/Yr
White River-Hat Creek	700	---	700
Niobrara	2,100	90	2,190
Missouri Tributaries	51,000	30,200	81,200
North Platte	4,600	25,410	30,010
South Platte	1,800	7,370	9,170
Middle Platte	7,400	14,780	22,180
Loup	4,200	600	4,800
Elkhorn	8,600	8,550	17,150
Lower Platte	16,900	5,730	22,630
Republican	3,800	540	4,340
Little Blue	1,700	2,130	3,830
Big Blue	7,600	5,600	13,200
Nemaha	3,600	---	3,600
STATE TOTAL	114,000	101,000	215,000

TABLE 8

PROJECTED INDUSTRIAL WATER REQUIREMENT BY 2000

River Basin	Reserve in Municipal Systems AF/Yr	Private Systems AF/Yr	Total AF/Yr
White River-Hat Creek	800	---	800
Niobrara	2,000	150	2,150
Missouri Tributaries	65,100	35,300	100,400
North Platte	5,300	28,540	33,840
South Platte	1,800	7,700	9,500
Middle Platte	8,700	22,200	30,900
Loup	4,300	3,100	7,400
Elkhorn	9,500	13,200	22,700
Lower Platte	22,400	7,330	29,730
Republican	3,800	1,070	4,870
Little Blue	1,600	2,960	4,560
Big Blue	8,300	7,450	15,750
Nemaha	3,900	---	3,900
STATE TOTAL	137,500	129,000	266,500

TABLE 9

PROJECTED INDUSTRIAL WATER REQUIREMENT BY 2020

River Basin	Reserve in Municipal Systems AF/Yr	Private Systems AF/Yr	Total AF/Yr
White River-Hat Creek	900	---	900
Niobrara	2,000	200	2,200
Missouri Tributaries	79,900	36,500	116,400
North Platte	5,800	33,000	38,800
South Platte	1,800	8,000	9,800
Middle Platte	10,000	23,800	33,800
Loup	4,500	3,600	8,100
Elkhorn	10,700	15,000	25,700
Lower Platte	28,800	10,000	38,800
Republican	3,900	1,500	5,400
Little Blue	1,500	3,400	4,900
Big Blue	8,900	9,000	17,900
Nemaha	4,300	---	4,300
STATE TOTAL	163,000	144,000	307,000

systems for 1980, 2000, and 2020. The projected water requirements of private systems, including cooling water use in presently operated electric power plants, are shown by stream reaches in Attachment 2.

CHAPTER 3. RURAL DOMESTIC AND LIVESTOCK WATER

Rural Domestic Water

Present Use

About 424,000 people,[1/] 30 percent of the state's 1960 population, obtain their domestic water supply from private water systems usually serving individual households. Included in this group are people living on farms and acreages and in villages and built-up areas not served by municipal systems.

About 332,800 people, almost 80 percent of the above group, are members of households served by piped running water. The rest, 91,200, obtain their water mostly from hand-operated pumps. These estimates were made from agricultural census data[2/] which indicates that about 70 percent of the farms had running water in 1954. Adjustments were made for the installation of additional systems and the loss of farm households, most of which would be without running water. It was assumed that rural non-farm households had a slightly greater proportion of their population served by running water systems.

Present water use was estimated using per capita water use rate standards (see Table 10) established for planning purposes by the Nebraska Soil and Water Conservation Commission. The application of these rates to rural population estimates indicates a present water requirement for domestic purposes of about 27,300 acre-feet annually. The usage estimates by river basins are shown in Table 11. Nearly all the water for rural domestic purposes is from ground sources. No attempt was made to estimate that which is not.

TABLE 10

ESTIMATED RURAL DOMESTIC WATER USE RATES

	Per Capita Water Req't. in gpcd	
	East of PE Line[a/]	West of PE Line
Present:		
Households w/o running water	10	15
Households with running water	60	75
Future: (1980, 2000, 2020)		
Households w/o running water	--	--
Households with running water	80	120

a/ PE (precipitation effectiveness) line located at about the 98° meridian

1/ 1960 Population, Bureau of Census, U. S. Department of Commerce, and 1963 Inventory Municipal Water Facilities-Region VI, Public Health Service, U. S. Department of Health, Education and Welfare.

2/ 1954 Agricultural Census, Bureau of Census, U. S. Department of Commerce.

TABLE 11

PRESENT RURAL DOMESTIC WATER USE
(FARM AND NON-FARM)

River Basin	Without Pressure Systems			With Pressure Systems			Total		
	Pop. Served	MGD	Usage AF/Yr	Pop. Served	MGD	Usage AF/Yr	Pop. Served	MGD	Usage AF/Yr
White River-Hat Creek	738	.01	12	2,700	.20	228	3,438	.21	240
Niobrara	5,096	.08	90	18,000	1.35	1,510	23,096	1.43	1,600
Missouri Tributaries	12,008	.13	150	54,000	3.22	3,600	66,008	3.35	3,750
North Platte	4,302	.06	70	20,000	1.47	1,650	24,302	1.53	1,720
South Platte	978	.02	20	9,000	.67	750	9,978	.69	770
Middle Platte	5,265	.08	90	27,000	2.02	2,260	32,265	2.10	2,350
Loup	8,887	.13	150	35,000	2.63	2,950	43,887	2.76	3,100
Elkhorn	14,374	.14	160	42,000	3.14	3,520	56,374	3.28	3,680
Lower Platte	12,249	.13	140	30,000	2.23	2,500	42,249	2.36	2,640
Republican	8,794	.13	140	24,400	1.84	2,060	33,194	1.97	2,200
Little Blue	3,205	.05	50	16,700	1.25	1,400	19,905	1.30	1,450
Big Blue	7,930	.08	90	33,000	1.97	2,210	40,930	2.05	2,300
Nemaha	7,387	.08	90	21,000	1.26	1,410	28,387	1.34	1,500
STATE TOTAL	91,213	1.12	1,252	332,800	23.25	26,048	424,013	24.37	27,300

Several areas of the State do not have adequate amounts of good quality ground water for domestic purposes in some local areas. In such cases it may be necessary for individual users to organize community pipeline systems and generally obtain a community source of water from outside their immediate area.

Six rural community pipeline systems have been installed (1969) in the White River-Hat Creek Basin to serve 52 ranches. Additional systems are being considered. Installing systems in this Basin is simplified because good quality water is available at elevations considerably higher than the areas to be serviced.

Several rural community systems are being investigated to serve parts of the Nemaha River Basin. Locating a source of supply is the primary problem. Ground water is not plentiful and the quality of some sources is poor.

Installation of rural community systems in the lower Niobrara River Basin also depends upon the location of central supplies. Ground water is not available in large quantities near the areas of need. Consideration is being given to securing surface supplies.

In the Republican River Basin, the possibility of providing water through community developments poses greater problems. The density of need is low and potential sources of central supplies are limited.

Future Water Requirement

For this study the people considered as rural domestic water users in the future are all those not being served by municipal water systems. The number is the difference between the total projected population and the projected population of cities and towns expected to have municipal systems. It was assumed that all present systems would be continued and that systems would be installed in all towns of over 100 population that do not now have systems.

The past trend of installing running water systems is expected to continue. It is assumed that by 1980 all of the rural households will have running water. The availability of ground water and wide distribution of electric power will make conversion to running water rather simple. The installation of community pipelines in areas of inadequate amounts or quality of ground water will encourage the installation of running water for domestic purposes.

The established future rural domestic per capita use rate is the same as the established use rate for domestic purposes in towns under 2,500 population. This is 80 gallons per capita per day in eastern Nebraska and 120 gallons per capita per day in central and western Nebraska (Table 10). Most of the rural domestic users will receive their water supplies from private systems. Where adequate supplies of ground water are not available in the immediate area, it is assumed that rural water districts will be organized.

The number of people considered as rural domestic water users is expected to drop from about 424,000 in 1960 to a low of about 315,000 in 2000. The water required for rural domestic purposes is expected to be about 35,000 acre-feet annually during the planning period, over 25 percent more than present use. The increase is all due to the estimated increase in per capita requirement. The estimated water requirement by basin for the planning years is shown in Table 12. The increase in rural domestic water requirement between 2000 and 2020 is due to the projected increase in rural non-farm population near major cities.

TABLE 12

PROJECTED RURAL DOMESTIC WATER REQUIREMENTS

	Water Requirements in AF/Yr		
River Basin	1980	2000	2020
White River-Hat Creek	350	300	300
Niobrara	2,300	1,900	1,800
Missouri Tributaries	2,000	1,800	1,800
North Platte	3,400	3,000	3,300
South Platte	1,450	1,300	1,300
Middle Platte	4,100	4,200	4,800
Loup	4,700	4,000	3,800
Elkhorn	4,600	4,300	4,800
Lower Platte	4,000	3,700	4,400
Republican	2,700	1,900	1,800
Little Blue	2,400	2,300	2,400
Big Blue	3,800	4,000	4,100
Nemaha	1,900	1,800	2,000
STATE TOTAL	37,700	34,500	36,600

Livestock Water

Consumption Requirements

The quantity of water used by livestock varies widely depending upon the kind and age of the animal, the feeding and grazing conditions and other environmental factors. The present consumption requirements of livestock were estimated using the livestock numbers on hand January 1, 1966 (Table 13).

About 92 million gallons of water are needed to supply the daily consumptive requirements of livestock. Beef cattle and calves consume over 75 percent of the total amount followed in order by hogs, milk cows, sheep, and chickens. The annual livestock consumptive water requirement is more than 100,000 acre-feet. The distribution of the requirement is shown by basin in Table 14. The Loup River Basin has the highest livestock water requirement followed in order by the Elkhorn, Republican, and Middle Platte River Basins.

Source of Water

Ground water is the most important source of livestock water in Nebraska. Currently, about 81 percent of the total requirement comes from this source. The widespread availability and use of ground water has helped stabilize the livestock industry in the State. Water from

TABLE 13

DAILY WATER REQUIREMENTS FOR LIVESTOCK

Kind[a/] of Animal	Number[b/] of Animals	Daily Requirement Per Head (Gallons)	Daily Requirement Total (Million Gallons)
Milk Cows	269,000	30.00	8.1
Beef Cattle & Calves	5,990,000	12.00	71.9
Sheep	577,000	1.80	1.1
Hogs	2,561,000	4.00	10.2
Chickens	6,791,000	0.06	.4
		STATE TOTAL	91.7

a/ Horses, turkeys, etc. require a small amount of water but are not included.

b/ Source: Nebraska Agricultural Statistics, 1966

TABLE 14

PRESENT LIVESTOCK WATER USE BY BASINS
(Livestock on Hand January 1, 1966)

River Basin	Daily Req't. (Million Gallons)	Annual Req't. (Acre-Feet)
White River-Hat Creek	1.0	1,100
Niobrara	7.9	8,900
Missouri Tributaries	7.2	8,100
North Platte	4.1	4,600
South Platte	1.4	1,600
Middle Platte	9.0	10,100
Loup	15.1	17,000
Elkhorn	14.5	16,300
Lower Platte	5.3	5,900
Republican	9.6	10,800
Little Blue	4.3	4,800
Big Blue	7.5	8,400
Nemaha	4.8	5,400
STATE TOTAL	91.7	103,000

ground supplies is usually more uniform in quality and more dependable than water from surface supplies. The source of livestock water by basins is shown on Table 15. These estimates were made by a committee composed of U. S. Department of Agriculture representatives from ERS, SCS, FHA, and ASCS.

Even in areas with adequate ground water supplies, some of the livestock water requirements are met from surface sources. Most of the wells on the ranges are powered by windmills. These are subject to occasional breakdown or failure to run due to the absence of winds. To overcome these deficiencies, as well as to secure better distribution

TABLE 15

SOURCE OF LIVESTOCK WATER UNDER CURRENT CONDITIONS

River Basin	Ground (Percent)	Surface (Percent)	Livestock Water Ponds & Dugouts Number	Total Surface Area (Acres)	Evaporation Losses (AF/Yr)
White River-Hat Creek	40	60	600	1,200	2,900
Niobrara	75	25	2,200	3,000	6,000
Missouri Tributaries	80	20	1,400	840	1,100
North Platte	80	20	200	240	620
South Platte	80	20	200	240	660
Middle Platte	85	15	1,600	1,120	2,400
Loup	90	10	4,000	2,800	5,600
Elkhorn	80	20	700	420	670
Lower Platte	90	10	300	300	450
Republican	65	35	5,000	5,000	13,300
Little Blue	85	15	1,800	1,440	3,100
Big Blue	90	10	1,400	980	1,800
Nemaha	70	30	650	650	920
STATE TOTAL	81	19	20,050	18,230	39,520

of grazing, stockmen construct farm ponds or rely on lakes and streams to furnish part of the livestock water needs.

Most of the farm ponds and all of the dugouts serving as water supply facilities for livestock have less than five acre-feet total storage capacity and have a short effective life. Replacement is a continual problem. Another problem is the loss of water by evaporation. The evaporation losses are estimated to be about twice the amount consumed by livestock from this source.[3/] Information on farm ponds and dugouts is shown in Table 15.

Localized areas that have inadequate supplies of ground water, either because of quantity or quality or both, depend upon surface supplies stored in farm ponds or dugouts. These supplies may be depleted during periods of prolonged droughts. When the supplies fail, water must be hauled or the livestock moved. In either case a loss of production and considerable inconvenience is experienced.

Areas with inadequate supplies of ground water that must use surface supplies for at least part of the livestock requirements are:

(1) White River-Hat Creek Basin--Northern parts of Dawes, Sioux, and Sheridan Counties,

(2) Niobrara River Basin--Parts of Boyd and Knox Counties,

(3) Republican River Basin--Scattered areas along the Kansas border, mostly south of the Republican River,

(4) Nemaha River Basin--Localized areas scattered throughout the Basin, and

(5) Localized areas in other river basins where bedrock lies near the surface.

The biggest improvement in livestock water supplies can be made in the White River-Hat Creek Basin, now the most deficient. The installation of community water systems using ground water can reduce the dependence on surface supplies for livestock from the present 60 percent to 25 percent by 2000, and increase the amount of grazing land adequately supplied with water from 50 percent under present conditions to 90 percent under conditions expected to prevail by 2000.

The installation of community water systems and the proper spacing of watering facilities on grazing land is expected to improve the adequacy of livestock water in the State from the present 68 percent to 88 percent by the year 2000. This remaining deficiency is not considered serious since it comprises fringe and odd areas in corners of pastures, areas of difficult accessibility, or areas of such low production that it is not economically feasible to develop additional water supplies.

3/ Missouri River Basin Comprehensive Framework Study.

Projected Livestock Water Needs

Livestock production is expected to double by 2000 and approximately triple by 2020. This will increase the water requirement to 200,000 acre-feet and 284,000 acre-feet respectively for those years. Obtaining these water requirements is not expected to be a serious problem except in those areas now with inadequate supplies.

Ground water will remain the principal source of livestock water and will furnish most of the additional requirements. But even in areas with ground supplies adequate to meet the needs, some of the requirements will be met from surface sources. The number of ponds and dugouts for livestock water is expected to remain fairly constant. However, there is expected to be a shift toward installation of larger reservoirs for a more dependable supply. Table 16 summarizes estimated future livestock water requirements by basin.

A major problem in developing supplies from surface sources is locating sites for replacement reservoirs. The best sites have been used and often times additional sites are not available at locations required for the proper spacing of watering facilities. These problems can be solved by constructing dams on larger drainage areas and piping water to the locations required for proper utilization of the grazing area. The larger reservoirs would provide a more dependable supply by collecting water from larger drainages and reducing the proportion of water lost by evaporation and seepage.

Rural community pipeline systems provide a means of improving livestock water supplies. In the White River-Hat Creek Basin, six systems serve 52 ranches at 343 locations. Additional systems are being investigated in this Basin and in the Nemaha and Niobrara River Basins.

TABLE 16

PROJECTED FUTURE LIVESTOCK WATER REQUIREMENTS

River Basin	Water Requirements in AF/Yr		
	1980	2000	2020
White River-Hat Creek	1,540	2,130	3,030
Niobrara	12,860	17,220	24,490
Missouri Tributaries	10,450	13,930	20,900
North Platte	6,650	8,900	12,660
South Platte	2,310	3,100	4,400
Middle Platte	14,590	19,540	27,800
Loup	24,560	32,900	46,780
Elkhorn	23,550	31,540	44,860
Lower Platte	8,520	11,420	16,240
Republican	15,970	22,200	31,020
Little Blue	7,100	9,870	13,790
Big Blue	12,430	17,270	24,130
Nemaha	6,970	9,290	13,930
STATE TOTAL	147,500	199,310	284,030

CHAPTER 4. IRRIGATION

Introduction

The application of water on hay and crop land to supplement precipitation began almost as early as settlement. By 1860 four miles of canals had been constructed near North Platte to divert streamflow for irrigation. Numerous small systems were developed during the following years until about 9,000 acres had been developed by 1889. Since then there has been a steady growth, with rapid expansions in each drouth period.

The drouth in the 1890's coupled with the enaction in 1895 of a statute establishing a filing system for water rights brought a mass of filings for rights to divert water from streams. The normal streamflows during the irrigation season in western Nebraska became greatly overappropriated. A number of projects developed during this period had to be abandoned soon after construction due to lack of a dependable water supply. This situation pointed up the need for reservoirs to store off-season flows. About this time a number of storage projects were proposed, but construction was prevented due to legal and financial difficulties, or deferred because greater and more uniform distribution of rainfall increased the production of dryland crops.

The Federal Reclamation Act of 1902 authorized the development of projects to supply water to government lands being opened for settlement. The North Platte Project, which included construction of the Pathfinder Dam and canals to irrigate lands in eastern Wyoming and western Nebraska, was one of the early projects authorized.

About 1910 farmers began tapping the ground water aquifers for irrigation. The development of the internal combustion engine and its application to tractors made irrigation by low head centrifugal pumps practical. At first, irrigation from wells was limited to valley lands which had water-bearing gravels at shallow depths.

The growth of irrigation development was slow but steady until the major drouth in the 1930's intensified irrigation interest. Storage project proposals made as early as the turn of the century were revised and funded, assisted by enactment of the Nebraska Public Power and Irrigation District Law in 1933. This resulted in the construction of facilities of the Platte Valley Public Power and Irrigation District to supplement direct flow rights of several irrigation systems and of the Central Nebraska Public Power and Irrigation District to irrigate lands in Gosper, Phelps, and Kearney Counties.

Development of the turbine pump made irrigation from deep wells practicable and irrigation spread to the tablelands of western and central Nebraska. The first big increase in well development came in 1941 when about 1500 wells were installed. The drouth of the mid-1950's brought another surge with the peak reached in 1955 when over 3500 wells were installed. Voluntary registration of irrigation wells began in

1938. An act passed by the Legislature requiring the registration of all new and existing irrigation wells became effective in September, 1957. By January 1, 1969, 32,430 wells had been registered. It is estimated, however, that in some areas up to 20 percent of the operating wells are still not registered.

Present Situation

Based on information collected in 1967, it was estimated that about 3,355,000 acres were irrigated annually. This is about 17 percent of the land in the State that is classified as suitable. The estimated distribution of irrigated land by basins and by suitability types is summarized in Table 17. Unpublished land use data prepared for the Missouri River Basin Comprehensive Framework Study were used as a guide in making the distribution estimates. About 2,065,000 acres (61 percent) of the area irrigated are soils of high suitability (Type A), 570,000 acres (17 percent) are soils of moderate suitability (Type B), 660,000 acres (20 percent) are soils with limited suitability (Type C), and 60,000 acres (2 percent) are soils requiring major improvements such as drainage or flood control (Type D).

About 1,108,000 acres of land are supplied with water from surface sources. The remaining 2,247,000 acres are supplied from ground water sources. About 130,000 acres irrigated from surface water supplies are also supplied with ground water, usually because the surface supplies during the irrigation season are insufficient.

Present Problems

Surface Water Systems

Irrigation systems supplying surface water to about 670,000 acres annually have problems which lower irrigation efficiency. The major problems are insufficient water supplies, high canal losses, and rising water tables. These problems affect 57 community irrigation systems as shown in Table 18 by basin. Numerous private individual installations are also affected but these were not inventoried and are not included in Table 18.

Water Shortage. Thirty-four irrigation systems servicing about 215,000 acres do not have an adequate supply of water. Water shortages of individual systems vary between 25 and 60 percent of the farm delivery requirement for the crops being irrigated. The weighted average shortage is about 35 percent. These systems depend mostly on direct flow diversion rights although a few have access to some storage waters. The present situation is a big improvement over the conditions existing before 1940. Enactment of the 1933 Public Power and Irrigation District Act provided the authority for construction of storage reservoirs in the Platte and Loup River Basins. A major purpose of some reservoirs was to supplement direct flow rights of existing systems. At about this time a number of systems furnishing water to about 73,000 acres in the

TABLE 17

PRESENTLY IRRIGATED LAND BY SUITABILITY TYPE - 1,000 ACRES
(January, 1968)

River Basin	Total	Suitability Type A	B	C	D
White River-Hat Creek	28	6	6	14	2
Niobrara	143	57	45	40	1
Missouri Tributaries	18	13	1	2	2
North Platte	388	105	105	175	3
South Platte	79	35	20	20	4
Middle Platte	859	645	90	120	4
Loup	354	230	49	70	5
Elkhorn	107	25	55	15	12
Lower Platte	96	60	13	13	10
Republican	319	170	80	60	9
Little Blue	283	211	30	40	2
Big Blue	670	500	75	90	5
Nemaha	11	8	1	1	1
STATE TOTAL	3,355	2,065	570	660	60

TABLE 18

IRRIGATION SYSTEMS WITH PROBLEMS
(1969)

River Basin	Number of Systems With Problems	Acreage With Problems	Major Problems: Insufficient Water Supply: Area In Acres	Major Problems: Insufficient Water Supply: Percent of Requirement Delivered	Major Problems: Miles of Canal With High Losses	Major Problems: Acreage With High Water Table
White River-Hat Creek	1	9,200	9,200	50	11	
Niobrara	1	12,000	12,000	73		
North Platte	35	307,900	143,500	64	765	44,300
South Platte	1	3,000	3,000	40		
Middle Platte	8	204,800			786	150,500
Loup	2	43,250	43,250	70	133	
Republican	9	92,100	3,650	60	26	1,000
STATE TOTAL OR AVERAGE	57	672,250	214,600	65	1,721	195,800

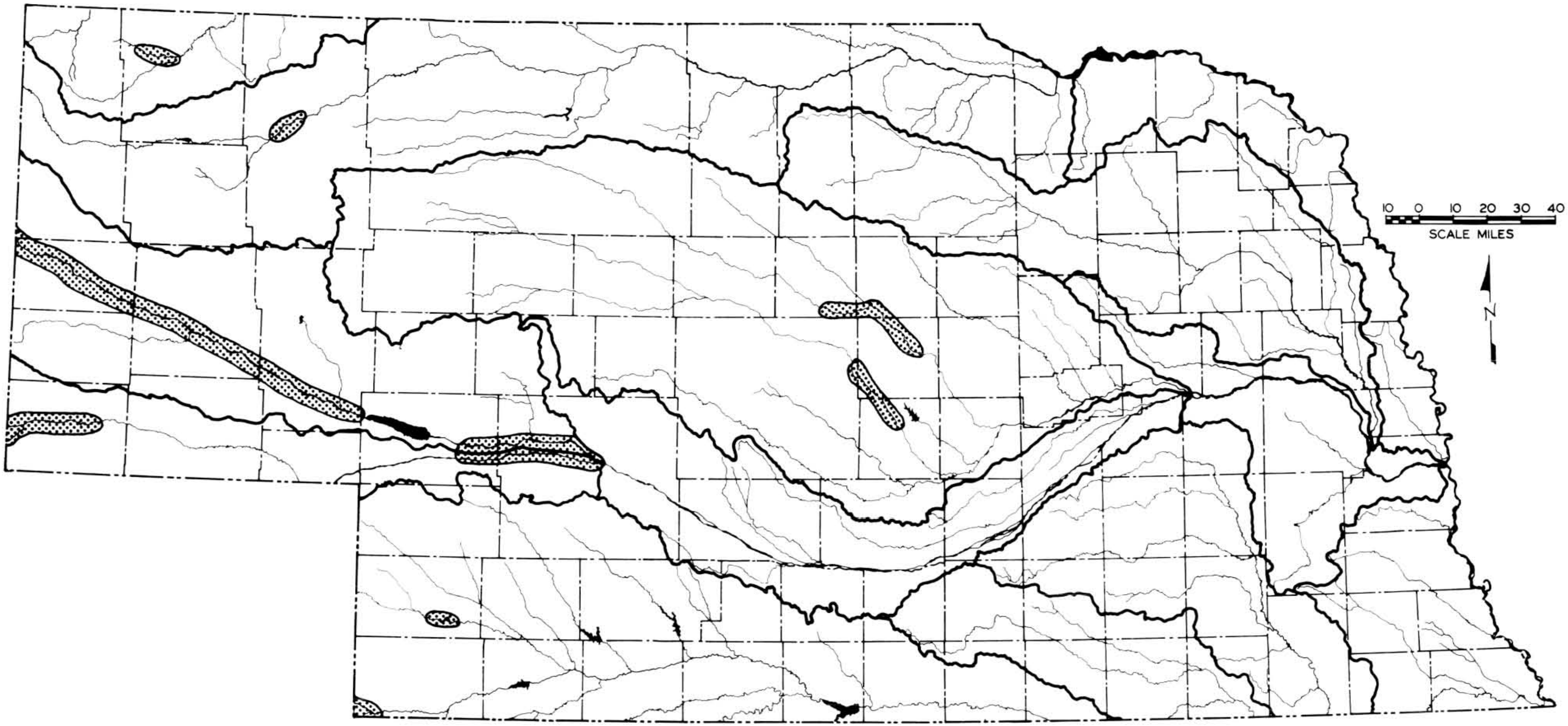
Source of Data: Missouri River Basin Comprehensive Framework Study

upper North Platte Valley contracted for storage water from the North Platte Project under the Warren Act. There was also a big increase in the installation of irrigation wells. Irrigators with insufficient surface water supplies turned to wells for supplemental water. This was particularly true in the Lodgepole Creek and Platte River Valleys. The location of systems with insufficient water supplies is shown on Figure 4.

High Canal Losses. The location of irrigation systems with high canal losses is shown on Figure 5. About 40 percent (1,720 miles) of the total length of canals and laterals in those systems have excessive water losses. Losses occur from seepage, evaporation, and transpiration of plants growing in the water or on ditch banks. These losses occur in varying degrees on all systems, but become serious problems when the canals are long and inadequately maintained or are constructed without lining through soils with high permeability. Seepage losses result not only in a reduced amount of water for beneficial uses but often cause the water table to rise on nearby lands, eventually affecting plant growth, sometimes severely. In areas of declining water levels, however, high canal losses may have a beneficial effect by stabilizing the water table.

Rising Water Tables. About 196,000 acres of land distributed throughout 31 irrigation systems have high water tables that adversely affect plant growth. Locations of these systems are shown in Figure 6. The problem has resulted from the combination of high seepage losses

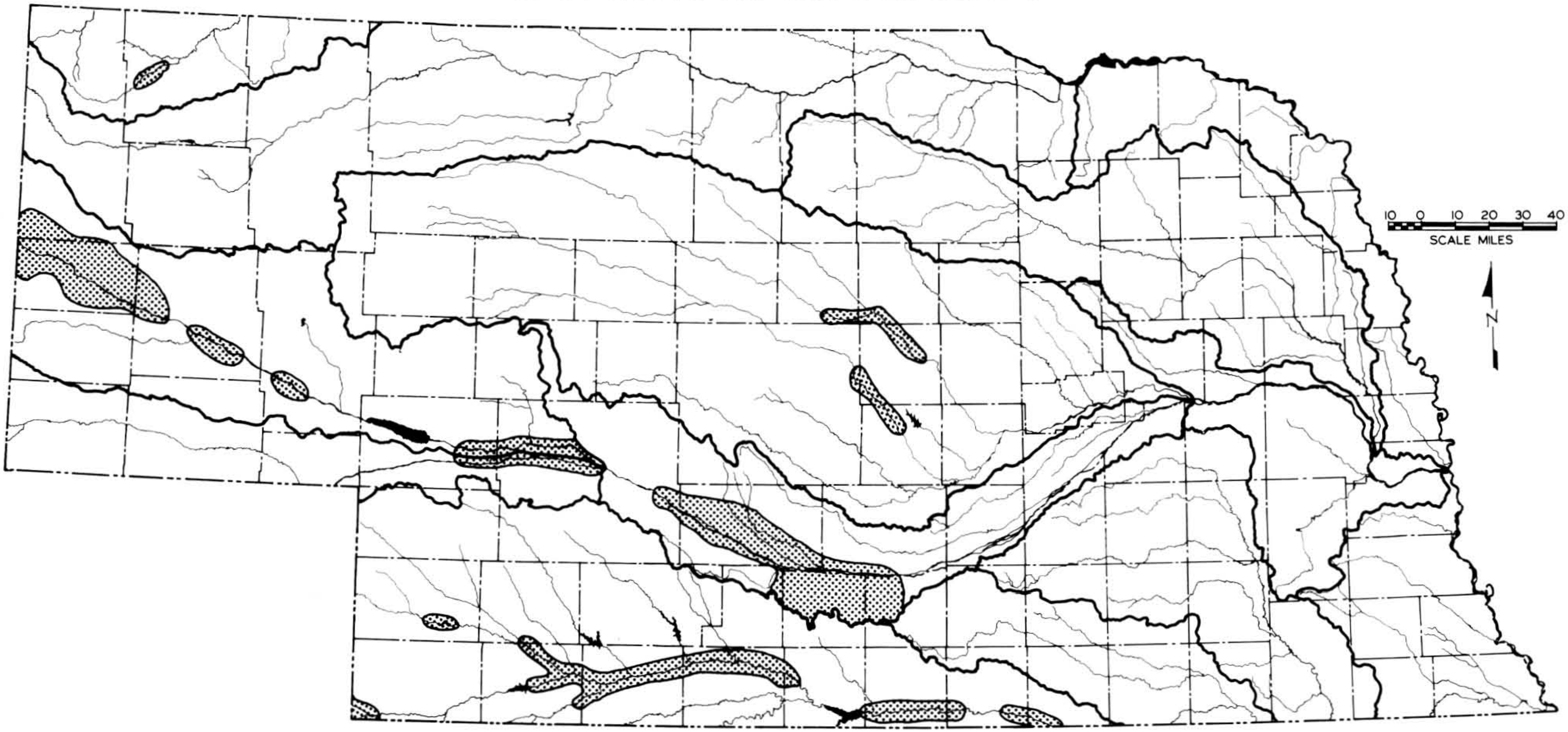
IRRIGATION SYSTEMS WITH INSUFFICIENT WATER SUPPLIES, 1969



SOURCE: Missouri River Basin Comprehensive Framework Study

Fig. 4

IRRIGATION SYSTEMS WITH HIGH CANAL LOSSES, 1969



SOURCE: Missouri River Basin Comprehensive Framework Study

Fig. 5

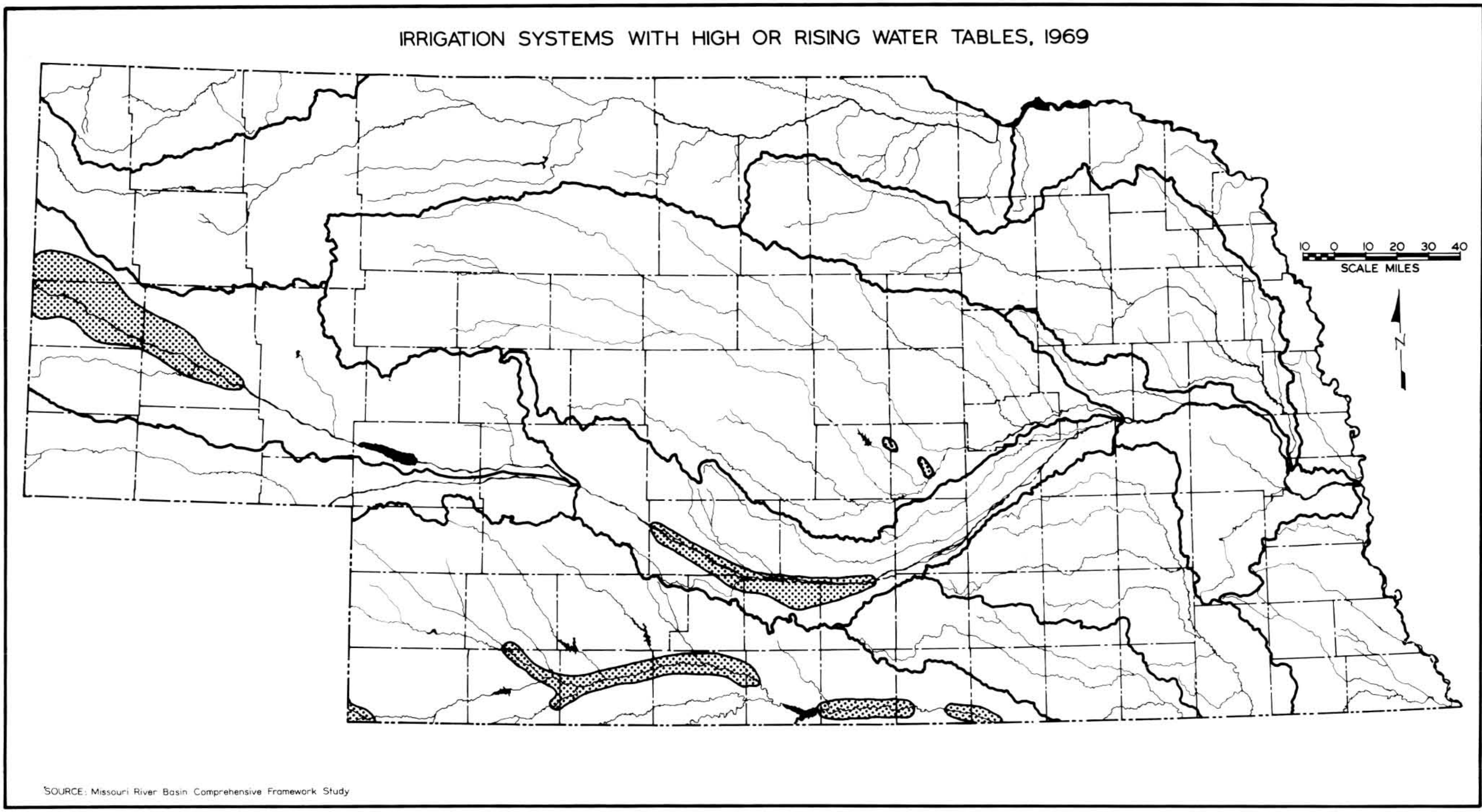

IRRIGATION SYSTEMS WITH HIGH OR RISING WATER TABLES, 1969
10 0 10 20 30 40
SCALE MILES
N
SOURCE: Missouri River Basin Comprehensive Framework Study

Fig. 6

from irrigation canals and excess application of water to irrigated crops. A rise in the water table of more than 90 feet has been measured in the Tri-County service area in the Middle Platte River Basin. This area of ground water rise is shown in Figure 7.

Other Problems. Flooding, degradation of drainage channels, bed-load sediments, and dilapidated or obsolete canal structures are other problems which reduce the efficiency of irrigation systems. Floods interrupt water deliveries by destroying diversion works, and by over-topping canals causing breaks or filling them with sediment. This problem occurs in all parts of the State and these flood damages by watershed areas are included in Chapter 7. Degradation of drainage channels, a serious problem in the North Platte Valley, causes under-mining and destruction of crossing structures. These damages are included in the gully and streambank erosion sections of Chapter 7. Most irrigation projects constructed 50 or more years ago require a heavy schedule of maintenance to repair dilapidated and obsolete structures. Many of the smaller systems are faced with continuous emergency maintenance problems because funds are not available at any one time to do a complete renovation. This problem is expected to increase on the small systems operating without a permanent maintenance force.

Ground Water Systems

The most serious problem affecting pump irrigators is declining water tables. This condition is significant in four main areas containing over a million acres of land irrigated from ground water. These areas are shown in Figure 7. In each area the lowering of the water table is ascribed to pump irrigators withdrawing ground water faster than it is being recharged (Appendix B, Inventory of Water Resources).

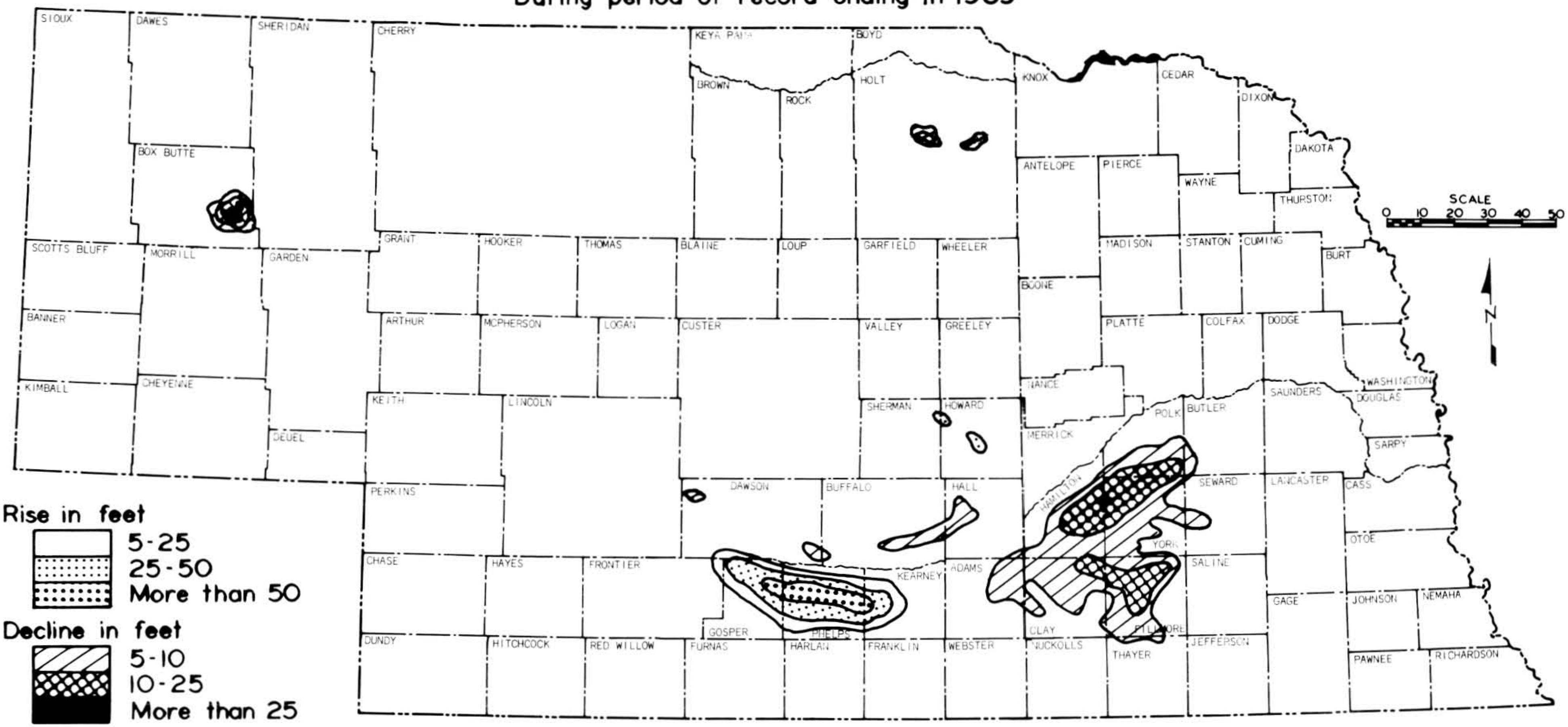
The largest area affecting well over one-half million acres of irrigated land is located in portions of the Big and Little Blue River Basins. It covers parts of Polk, Butler, Hall, Hamilton, York, Seward, Adams, Clay, Fillmore, and Saline Counties. The declines from assumed normals are generally less than ten feet, but in over one-fourth of the area it is greater. The largest decline is 20 feet. Presently less than half of the land suitable for irrigation in this area is being irrigated. Additional irrigation pump installation will increase the rate of water table decline.

About 150,000 acres along the north side of the Platte Valley in Dawson, Buffalo and Hall Counties in the Middle Platte River Basin have experienced a declining water table. The amount of decline from assumed normals is generally ten feet or less.

There are two areas of declining water tables in the Niobrara River Basin. The Alliance area in the upper portion of the Basin has the most severe problem with several locations showing declines of 30 feet or more. The area contains over 40,000 acres of irrigated land. A small area in the vicinity of O'Neill has declines of considerable variation, but generally less than 10 feet. However, the installation of pumps in this area has been relatively recent.

AREAS WHERE GROUND WATER LEVELS HAVE RISEN OR DECLINED FIVE FEET OR MORE

During period of record ending in 1969



Source: Conservation & Survey Division, University of Nebraska

Fig. 7

Application of Irrigation Water

Many irrigators do not get the most effective use out of the water they apply to crops. This failure may be due to one or more of the following conditions:

(1) Applying water in excess of plant requirements causing moisture penetration below plant roots,

(2) Allowing excess to flow out of fields unused,

(3) Failure to apply water at the optimum time for plant use,

(4) Failing to have fields properly shaped for even distribution of irrigation water, and

(5) Wasting water through inefficient field distribution systems.

Present Needs and Opportunities

Surface Water Systems

Table 19 summarizes the opportunities for improving the 57 surface water systems presently experiencing problems. Improvement opportunities according to the type of problem are discussed in the following paragraphs.

Water Supply. The water supply of water-short systems can be improved by developing new sources of supply, either surface or ground, and by reducing present losses. Reservoirs to store off-season and flood flows are usually given first consideration. This course has already been used by most irrigation systems to improve their supplies. They are presently using the better reservoir sites and have obtained permits to store and use most off-season flows originating above presently irrigated areas. Ground water has been used by individual irrigators to supplement surface supplies in systems in the Lodgepole Creek and Platte River Valleys as well as in other areas. A proposal has been advanced to install 17 wells along canals and major laterals of the Mirage Flats Project. The operation of these wells would be integrated with existing surface water supplies and facilities to reduce the amount of water presently being lost out the ends of the canals.

A primary remaining opportunity of improving water supplies is reorganization and rehabilitation of distribution systems. Additional storage for regulation has been proposed for the Tri-County Irrigation District in the Middle Platte River Basin. This would enable the district to re-regulate water supplies to better meet the irrigation water demands and decrease the period of time that the main canal would need to be operated at its full capacity, thereby decreasing losses. Supplemental water storage is also needed for the North and Middle Loup Projects.

Canal Losses. A major irrigation system need is to reduce water losses from the canals and laterals. Nearly all systems have this

TABLE 19

SUMMARY OF IRRIGATION SYSTEM NEEDS TO IMPROVE WATER SUPPLY AND DECREASE LOSSES (1969)

River Basin	Number of Systems with Problems	System Needs: Reduce Distribution System Length mi.	Line Canals mi.	Storage Reservoir AF	Drainage Channels mi.	Est. Percent of Full Water Supply with Improvement[a/]
White River - Hat Creek	1		11			60
Niobrara	1[b/]					96
North Platte	35	140	765		180	88
South Platte	1	(No specific plans for improvement)				--
Middle Platte	8		786	300,000	655	--
Loup	2		133			80
Republican	9		26		5	75
STATE TOTAL OR AVERAGE	57	140	1,721	300,000	840	86

a/ For systems presently with insufficient water supply
b/ Potential plan for 6,300 AF to be pumped from ground water

Source of Data: Missouri River Basin Comprehensive Framework Study

problem in varying degrees. Two opportunities exist to correct this condition to tolerable limits. They are:

(1) Reorganizing irrigation systems to eliminate unnecessary canals and laterals, and

(2) Lining canals in areas of high seepage losses.

Thirty-three systems with problems in the North Platte Valley have 1,080 miles of distribution canals. In many places canals run close together. It is estimated that 140 miles of canals could be eliminated by the reorganization of 11 systems. This would reduce the canal mileage of these systems by about 13 percent.

High canal losses due to seepage occur on about 1,720 miles of irrigation supply canals and distribution laterals. This is a major problem in the North Platte and Middle Platte River Basins. The installation of canal lining would increase the amount of water available to irrigators of some systems by as much as 50 percent. In addition, it would remove one of the causes of rising water tables.

It should be noted that under the U. S. Supreme Court Decree on division of the North Platte River water, the areas between the Tri-State Diversion Dam and Lake McConaughy are expected to obtain their water supplies from return flows of the canal systems in the North Platte Project. Records for the last ten years show that the average annual discharge of the drains between the state line and Bridgeport averages 100,000 acre-feet less than that for the ten year period 1931-40 which was used as a basis for the Supreme Court Decree. Further reduction of the canal losses along this river reach could severely affect the water supply for the Platte River system below Bridgeport. Should this happen, adjustments in upstream diversions may be required to meet the demands of prior downstream rights.

Rising Water Tables. Reducing seepage by lining canals and laterals would alleviate the problem of rising water tables. In addition on-farm drainage measures are needed on about 196,000 acres to lower and maintain the water level below root zones. It is estimated that 840 miles of drain channels are needed to provide outlets to farm drainage systems. This is a major problem in the North Platte and Middle Platte River Basins. Using wells to provide part of the water supply in areas serviced by surface water systems will help maintain water levels below root zones.

Other Losses. The reduction of losses from flooding and degrading channels may require the installation of flood prevention and grade stabilization measures. These needs are discussed in Chapter 7. Improved maintenance is needed in many small systems. In the North Platte River Basin there are 28 small systems serving about 75,000 acres annually, an average of 2,700 acres per system. Higher unit costs and lack of proper maintenance on these systems are problems.

Ground Water Systems

Opportunities to reduce excessive use of ground water due to irrigation pumpage include the following:

1. Limit withdrawals to the irrigation water requirements for the crops grown,

2. Regulate annual withdrawals from the ground water reservoir to prevent serious declines in water levels,

3. Locate and divert surface water supplies for direct use and storage to supplement ground water supplies in areas of seriously declining water levels, and

4. Encourage use of waste collection and reuse systems.

Early consideration should be given to locating supplemental sources of irrigation water supplies for the areas with declining water levels, particularly the Alliance area and the upper Big and Little Blue River Basins.

Application of Irrigation Water

Improvement in applying water to crops can be accomplished best by conducting a continuing educational program. Such a program should include, but not be limited to, measures and methods to improve the effective application and use of irrigation water such as:

1. Reshaping lands to grades or installing sprinkler systems for more even distribution of water on lands,

2. Lining farm supply laterals or installing closed conduits to reduce distribution losses,

3. Installing measures to collect, store and transport tail water for reuse, and

4. Managing water applications for efficient crop use and to hold erosion losses to a minimum.

Opportunities for Additional Irrigation Development

Irrigating one acre of land adds over $300 annually to the economy of the State. This includes both the increase in agricultural production and the business activity generated by irrigation. In addition, irrigation assists in stabilizing the agricultural economy by reducing hazards arising from the variations in quantities and timeliness of precipitation. This is affirmed by the number of irrigation facility installations occurring during and immediately following drouth periods.

Land Availability

About 19,200,000 acres of land in the State have soils that are suitable for irrigation (Land Inventory, Appendix A). This is slightly over 40 percent of the agricultural land in the State. About 7,000,000 acres have soils capable of sustained irrigated crop production under good irrigation and conservation management (Type A). An additional 4,300,000 acres have soils with hazards that require moderately intensive irrigation and conservation management for sustained use (Type B). The balance, 7,900,000 acres, comprises soils with restricted crop adaptability which usually require intensive irrigation and conservation management or major development (Types C & D).

The better grades of land suitable for project-type irrigation development but not presently irrigated from surface water systems are shown on Map 1. Some areas, however, contain pump irrigation developments. The amount of land remaining available for irrigation development is shown by river basins in Table 20. Of the 15,840,000 acres classified as suitable for irrigation development but not presently irrigated, nearly 30 percent of the total, 4,950,000 acres, are soils of the highest suitability type (Type A).

Large tracts of land with highly suitable soils are located in the Big and Little Blue River Basins. Relatively large blocks of mostly moderately suitable land available for irrigation development are located in the Niobrara, South Platte, Elkhorn, Lower Platte, and Republican River Basins. Most of this acreage is in small tracts located within presently irrigated areas or on narrow ridges between drainageways.

TABLE 20

LAND SUITABLE FOR FUTURE IRRIGATION DEVELOPMENT - 1,000 ACRES (1968)

River Basin	Total	Suitability Type			
		A	B	C	D
White River-Hat Creek	198	36	54	103	5
Niobrara	2,040	528	552	741	219
Missouri Tributaries	778	185	172	369	52
North Platte	874	238	258	278	100
South Platte	1,142	352	334	402	54
Middle Platte	545	176	73	175	121
Loup	1,645	417	320	564	344
Elkhorn	2,204	732	429	789	254
Lower Platte	1,049	246	262	483	58
Republican	2,207	797	546	761	103
Little Blue	747	438	117	176	16
Big Blue	1,336	648	280	378	30
Nemaha	1,077	157	343	542	35
STATE TOTAL	15,842	4,950	3,740	5,761	1,391

Irrigation Opportunities by Basins

White River-Hat Creek Basin. This Basin has the least amount of suitable lands available for irrigation. It also has the least proportion of the better types of irrigable soils. The lands are in small scattered tracts. Installation of project-type measures would be costly. Normal summer streamflows are overappropriated under present conditions. Indian claims to surface waters limit the storing of off-season flows.

Niobrara River Basin. This Basin has large amounts of land suitable for irrigation with a small amount already developed. Relatively large blocks of suitable land are available in Box Butte, Dawes, Sheridan, and Holt Counties. Other suitable lands are in small tracts scattered throughout the Basin. Privately installed wells provide the greatest opportunity for increasing the irrigated acreage. The Alliance and O'Neill areas have declining water tables under present pump irrigation development.

Missouri Tributaries River Basin. The present irrigated acreage is small. This is partly due to normally adequate rainfall during the growing season. In addition, there is only a limited amount of highly suitable land. Most of this is in the Missouri River Valley where the best opportunity for irrigation development exists. There are large blocks of moderately suitable soils in Knox, Cedar, and Dixon Counties, but ground water supplies are limited. Development in this area would depend upon locating a suitable surface water source.

North Platte River Basin. Intensive irrigation development in the North Platte River Valley makes full use of the available surface water supplies. The remaining available lands of the better suitability types are widely scattered. The opportunity for more project-type irrigation development is slight. There is a limited potential for irrigation development with privately installed wells in the Pumpkin Creek Valley.

South Platte River Basin. Present irrigation development is low. There are large blocks of high suitability lands in Cheyenne, Deuel, and Keith Counties, but these have a limited potential for irrigation development because of lack of available ground or surface water. Normal summer surface water flows on Lodgepole Creek and the South Platte River are overappropriated.

Middle Platte River Basin. This Basin has the largest acreage of land under irrigation. Most of it is on high quality (Type A) soils. Ground water is used for much of the acreage although surface supplies are delivered to well over 200,000 acres in the Platte Valley between North Platte and Kearney and tablelands in Gosper, Phelps, and Kearney Counties. Some lands have access to both surface and ground water supplies. Ground water is the principal source in the Platte Valley below Kearney and in the Wood River Valley. Most of the land remaining available for irrigation development is in small tracts interspersed among or bordering presently irrigated areas. A strip of land along the northern side of the Platte Valley in Buffalo and Hall Counties does not have an adequate supply of ground water. It borders a larger area that has experienced a decline in the water table.

Loup River Basin. Most of the land classified as suitable for irrigation is in the southern and eastern parts of the Basin. It is located in narrow valleys and on ridges. Almost 20 percent of the suitable land, mostly in the valleys, is now being irrigated. The land remaining available for development is on the uplands. Also, numerous small tracts of land throughout the Sandhills area are available for irrigation development by privately installed wells.

Elkhorn River Basin. This Basin has the second highest amount of suitable land remaining available for irrigation development. Nearly 750,000 acres are soils of the top irrigation suitability class. Less than 5 percent of the suitable land, mostly in the valleys, is presently irrigated. This is partly due to the favorable climatic conditions for dryland cropping. Relatively large blocks of highly suitable land are located in the Elkhorn, Logan, and Maple Creek Valleys. A large block of hayland in Holt County has a high water table. Installation of drainage measures would make this area suitable for irrigation development.

Lower Platte River Basin. Less than 10 percent of the land suitable for irrigation is presently being irrigated. This amount is low because of relatively favorable climatic conditions for dryland cropping. Most of the presently irrigated land is in the Platte Valley and in eastern Saunders County in the Todd Valley area. About 500,000 acres of moderately to highly suitable soils remain available for development. These are in reasonably large blocks of land on bottoms and terraces in Platte, Colfax, Dodge, and Saunders Counties. The amount of ground water available for irrigation is extremely variable.

Republican River Basin. This Basin has a large amount of land suitable for irrigation, over 2,500,000 acres. Of this, 319,000 acres have been developed. Storage reservoirs on the Republican River and major tributaries supply water for the valley lands. Ground water irrigation development is scattered throughout the Basin. The land remaining available for development amounts to about 2,200,000 acres of which approximately 1,340,000 acres have moderately to highly suitable soils. Large blocks of highly suitable lands are available in Perkins, Chase, Dundy, Hitchcock, Frontier, Phelps, Kearney, Franklin, and Harlan Counties. Smaller tracts in narrow strips of highly suitable lands are located in the dissected plains. Water supplies, both surface and ground, are limited.

Little Blue River Basin. This Basin has large areas of land suitable for irrigation development, about a fourth of which are presently irrigated--almost entirely from ground water. There remains unirrigated over 400,000 acres of highly suitable lands. The supply of ground water is limited.

Big Blue River Basin. The upper portion of this Basin has about 1,150,000 acres of land classified as highly suitable for irrigation development. It is estimated that about a half million acres of the highly suitable soils have been developed for irrigation, mostly by the installation of wells. This leaves about 650,000 acres interspersed throughout the loess plains area of this Basin remaining available for development. Additional lands along the eastern side of the Basin can be irrigated by developing surface water supplies. An outside source of water to supplement the ground water supplies is needed if existing development is to be sustained and additional lands in the central and western area are to be developed.

Nemaha River Basin. Only 11,000 acres of land in this Basin are irrigated. This is the lowest total of any basin. Although over a million acres of land are classified as suitable only 15 percent are in the top suitability class. Most of this is bottom land along the major streams. Weather conditions are usually favorable for crop production which limits interest in irrigation development.

CHAPTER 5. DRAINAGE

Present Conditions

Excess water is the dominant problem on approximately 3,800,000 acres of agricultural land in the State. This problem is caused by a fluctuating or rising water table, or by temporary flooding or inundation. The acreages of land by capability classes and major uses are shown in Table 21.

About 2,440,000 acres are in land capability classes II, III, and IV, usually considered suitable for cropping under proper conservation treatment and management. About 1,275,000 acres are presently cropped, 1,015,000 acres are in pasture and range, and 94,000 acres are forest or woodland. The primary hazard is wetness due to imperfect drainage or a high water table. None of these lands has a significant amount of standing surface water except during short periods of excess precipitation.

TABLE 21

SUMMARY OF AGRICULTURAL LANDS WITH DOMINANT PROBLEM OF EXCESS WATER (1967)

Capability Class[a/]	Cropland	Pasture and Range	Forest and Woodland	Other	State Total
	- - - - - - - - - -	thousand acres	- - - - - - - - - -		
II	820.8	623.4	70.7	43.4	1,558.3
III	424.2	315.1	19.5	15.1	773.9
IV	29.1	74.9	3.5	0.7	108.2
Subtotal II, III & IV	1,274.1	1,013.4	93.7	59.2	2,440.4
V	33.0	456.5	21.3	11.0	521.8
VI	54.5	530.9	161.0	24.4	770.8
VIII			3.6	40.1	43.7
Subtotal V, VI & VIII	87.4	987.4	185.9	75.5	1,336.2
STATE TOTAL	1,361.6	2,000.8	279.6	134.7	3,776.7

a/ For a description of capability classes, see Chapter 12.

Source: Nebraska Conservation Needs Inventory, 1969

Not included in the acreages is saline and alkaline soils with a secondary problem of excess water and lands having drainage problems resulting from irrigation.

About 1,335,000 acres in land capability classes V, VI and VIII have an excess water problem. Nearly 430,000 acres are frequently flooded bottom lands. Of the remaining, about 50,000 acres are cropland and 730,000 acres are grassland. These lands should be returned to, or remain in permanent vegetation.

The primary purpose of drainage is to increase crop production and lower net production costs. Measures to dispose of excess surface water include land forming to eliminate pockets and depressions, and lateral ditches installed at regularly spaced intervals. Tile drains are the most common measures used for subsurface drainage. Both types of drains require outlets into deeper channels or water courses. Development of main drainage channels usually requires group or project-type action.

The 1967 Watershed Project Inventory made by the Soil Conservation Service identifies about 1,800,000 acres of land in 300 watersheds that have drainage problems. This acreage is shown by basins in Table 22. Not included in this acreage are the wetlands in the Sandhills area. About 830,000 acres in 124 watersheds require project-type action to install outlets for on-farm measures. It is estimated that nearly $12,000,000 of annual income is foregone by the operators because drainage measures have not been installed on about 670,000 acres of cropland. The watersheds containing 1,000 acres or more of land needing project-type measures to correct drainage problems are shown on Map 2. Attachment 3 includes a detailed summary of drainage needs by watershed areas.

Future Needs

The drainage problem is not expected to increase except in areas under irrigation. Where this problem develops, it would be considered a part of the irrigation development.

The installation of drainage measures on wetlands should presently be limited to about 586,000 acres of cropland where the efficiency of crop production can be improved. Slightly over 1,000,000 acres of pasture, range, and forest use in land capability classes II and III, with drainage, could be converted to cropland if crop production from these areas is needed to supply the demands for food and fiber. This situation, however, is unlikely in the foreseeable future.

TABLE 22

SUMMARY OF DRAINAGE NEEDS
(1967)

River Basin	Area With Drainage Problem (Acres)[a/]	
	Total	Area Requiring Project Action
White River-Hat Creek	3,600	0
Niobrara	55,900	29,000
Missouri Tributaries	84,600	42,300[b/]
North Platte	90,700	53,000[b/]
South Platte	100,900	28,200[b/]
Middle Platte	407,000	225,600[b/]
Loup	284,000	46,000[b/]
Elkhorn	290,000	207,900
Lower Platte	182,300	46,000[b/]
Republican	97,300	31,750[b/]
Little Blue	41,700	25,500[b/]
Big Blue	118,000	89,450[b/]
Nemaha	41,500	6,000[b/]
STATE TOTAL	1,797,500	830,700

a/ Excludes wetlands in the Sandhills
b/ Primarily in cropland use

Source of Data: Nebraska Conservation Needs Inventory, 1969

CHAPTER 6. WATER QUALITY CONTROL

Introduction

The Water Pollution Control Council, presently a part of the Nebraska Department of Health but whose duties will be assumed by the Environmental Control Council formed by the 1971 Legislature, is responsible for the protection, maintenance and improvement of the quality of raw public water supplies, the proper treatment of wastes before discharge into state waters and watercourses, and the abatement and regulation of existing and new sources of pollution. The Council adopted and published Water Quality Standards applicable to Nebraska waters in January, 1969. These include a statement of policy, a classification of waters, a definition of water quality criteria, a nondegradation statement, and a plan for the implementation and enforcement of water quality standards.

The general policy of the Water Pollution Control Council is to protect and enhance the receiving waters for designated uses (according to the classification of the waters) by preventing the degradation of water quality beyond the limits prescribed in the water quality criteria contained in the Standards. Where the existing quality is better than the criteria, it is the intent of the Council to maintain the existing high quality commensurate with present and future water uses.

The Water Quality Standards applicable to Nebraska waters contain the following general water quality criteria:

> "All surface waters shall meet general aesthetic standards and shall be capable of supporting desirable diversified aquatic life. These waters shall be free of substances attributable to discharges or wastes having materials that will form objectionable deposits, floating debris, oil scum and other matter producing objectionable color, odor, taste or turbidity--materials including radionuclides, in concentration or combinations which are toxic or which produce undesirable physiological responses in human, fish or other animal life or plants and substances and conditions or combinations thereof in concentrations which produce undesirable aquatic life.
>
> "Facilities for expediting mixing and dispersing all waste water into receiving waters shall be provided when deemed necessary by the Nebraska Water Pollution Control Council to maintain the quality of the receiving waters in accordance with applicable water quality criteria."

Pollution Problems and Future Control Needs

Municipal Wastes

Household and other wastes from cities and towns have long been major pollutants to streams. At first the wastes were hauled and dumped into streambeds where high flows washed them away. The first sewage collection systems installed in the 1890's discharged the wastes directly into watercourses untreated. As of July 1, 1969, three towns in the State with a combined population of 1,785 still used this means of waste disposal. In addition, Lincoln and Omaha have areas served by combination storm and sanitary sewers. During heavy rainstorms or snowmelts much of the runoff, including sewage, bypasses the treatment plants and flows untreated into streams.

Forty-six communities with a combined population of slightly over 418,000 provide primary treatment of their wastes before discharging the effluent into watercourses. This treatment includes grit removal, skimming, and settling basins to remove the settleable and floatable materials from the sewage. Such treatment removes only a limited amount of the biodegradable materials and the effluent has a high oxygen requirement. In many places, immediately downstream from the sewage treatment plant outlets, the natural oxidation of such materials reduces the amount of available oxygen in the water to less than that required to sustain fish life.

Three hundred forty communities with a total population slightly over 528,000 are providing secondary treatment for their sewage. This is a biological or chemical process to remove pollutants. Properly operated efficient plants remove 85 percent or more of both BOD (Biochemical Oxygen Demand) and suspended solids.

Seventy-eight small communities with a combined population of about 13,600 do not have sewage collection systems. Pollution problems arising from the cesspools and septic tanks used to treat individual household wastes are mainly local in extent.

Table 23 contains a summary of an inventory of municipal sewage treatment facilities. Detailed reports showing the types of treatment provided and treatment needs of communities by river basins are contained in Attachment 7. This inventory is believed correct to July 1, 1969. Since new systems are continually being installed and old systems replaced or improved, the summary tables on sewage treatment are soon outdated.

In addition to sewage collection systems serving municipalities, there are seventeen federal installations in the State with separate surface discharges. These plants process about 1.25 million gallons of sewage daily, an amount equal to that produced by a city of 20,000 people. All of these installations provide secondary treatment at present or are constructing additional facilities to provide such treatment. Plants of two federal installations are in need of remodeling or enlargement.

TABLE 23

SUMMARY OF MUNICIPAL SEWAGE TREATMENT FACILITIES
(July 1, 1969)

River Basin	Communities Inventoried							
				No. With Sewer System				
				Treatment Provided				
	No.	Combined 1960 Pop.	No. Without Sewer System	None	Prim. Only	Prim. and Sec.	Total	No. Needing Improved Facilities
White River-Hat Creek	3	6,765	1	0	0	2	2	1
Niobrara	26	23,364	11	0	4	11	15	7
Missouri Tributaries[a/]	39	347,253	7	2	5	23	30	9
North Platte	17	45,626	0	0	0	17	17	1
South Platte	13	22,463	0	0	0	13	13	3
Middle Platte[b/]	30	63,584	1	0	2	28	30	2
Loup	47	42,915	8	0	5	34	39	8
Elkhorn	64	82,525	9	1	13	41	55	19
Lower Platte	42	150,550	5	0	2	35	37	4
Republican	50	42,014	17	0	6	27	33	10
Little Blue	35	22,480	6	0	3	26	29	6
Big Blue	62	81,000	4	0	2	56	58	7
Nemaha	40	38,567	9	0	4	27	31	5
STATE TOTAL	468	969,106	78	3	46	340	389	82

a/ South Sioux City and Ralston deliver sewage to Sioux City, Iowa, and Omaha respectively.
b/ Kearney has 2 plants.

Source: Nebraska Department of Health

The Water Pollution Control Council has set as a goal a minimum of secondary treatment of municipal sewage and expects to reach this goal by 1972 for all facilities except those located along the Missouri River. The compliance date for the Missouri River communities is the end of 1975.

As of July 1, 1969, 49 communities with a combined population of about 420,000 need to install new facilities to bring their treatment facilities up to this standard. In addition, 33 communities with a combined population of about 168,000 have secondary plants which need to be improved to adequately treat their sewage wastes. Five of these are badly overloaded and should have additional facilities and eight have plants in poor repair which need replacement. The rest need to increase the efficiency of the plants. Improved treatment facilities are a major need in the Missouri Tributaries, Lower Platte, Elkhorn, and Nemaha River Basins. These basins have the greatest concentration of population which adds to the potential pollution problem.

Careless maintenance and management of sewage treatment facilities is a continual problem.

Industrial Wastes

A survey by the Nebraska Water Pollution Control Council in 1968 lists 563 concerns which produce industrial wastes. Of these, 408 either deliver their wastes to a municipal sewage system or have facilities which adequately treat the wastes produced. Seventeen others have treatment facilities under construction. Treatment facilities are needed by nine industrial plants. The treatment needs of the remaining concerns are under study. This group contains 102 sand and gravel processors, 4 meat processors, 8 processors of meat by-products, 1 dairy processor, 4 sugar processors, and 10 plants manufacturing miscellaneous products. A summary of the survey is shown in Table 24.

Over 60 percent of the industries inventoried are food processors. Meat processing heads the list with 263 plants, followed by dairy with 51, and other food products with 37. Many small meat processing plants are closing down because of unsanitary inplant conditions or obsolescence. The number of medium to large plants located near central cities or concentrated feeding areas is increasing, however. The major packing plants in Omaha are now constructing pretreatment plants. The pretreated wastes will be discharged into the municipal sewage system. This will make a substantial reduction in the amount of untreated wastes entering the Missouri River.

Nine industries, including 8 meat processors and one meat by-products processor, should provide for treatment of their wastes either by constructing facilities or by connecting to a municipal sewage system that has the capacity to handle their wastes. It is expected that most of the 129 plants under study will be required to construct treatment facilities, or in the case of sand and gravel processors to manage their operations in a manner that the wastes will not pollute streams.

TABLE 24

SUMMARY OF INDUSTRIAL WASTE TREATMENT IMPROVEMENTS REQUIRED
(1968)

Improvement Required	Number and Type of Industry							State Total
	Meat Process.	Other Meat Products	Dairy Mfg.	Other Food Products	Hide Process.	Misc. Mfg.	Sand & Gravel Operations	
None	236	15	50	33	4	70	0	408
Provide Treatment Facility or Connect to Municipal Sewer	8	1	0	0	0	0	0	9
Waste Treatment Facility Under Construction	15	1	0	0	1	0	0	17
Under Study	4	8	1	4	0	10	102	129
STATE TOTAL	263	25	51	37	5	80	102	563

Source of Data: Nebraska Department of Health

A potential water quality problem which should be given early consideration is the effect of the brine solutions discharged into Salt Creek near Lincoln. Presently eight commercial and industrial concerns have brine wells to supply water for their cooling systems. This water is discharged into the Lincoln sewer system which outlets into Salt Creek.

Some industries have proposed deep wells for disposal of wastes. But, in general, the geological formations of the State do not lend themselves to this type of disposal.

Increased industrial development in the future will materially increase the amount of industrial wastes produced. Most of the increased wastes during the next 50 years are expected to be from food processing plants which can be treated by the same methods used to treat municipal wastes. The construction of efficient waste treatment facilities at the same time the plants are established should largely eliminate industrial wastes as stream pollutants.

Livestock Wastes

Up to the end of World War II, farm operators considered animal wastes a tremendous asset. In fact, the need for manure to maintain soil fertility was an added incentive for farmers to market their grain and hay through livestock feeding, but this has since changed. Commercial fertilizers have replaced barnyard manure as the major source of crop nutrients on most farms.

Confined feeding of livestock in outdoor lots located near watercourses, particularly large cattle and swine operations, produces waste runoff that is becoming a major source of stream pollution. These operations are expanding rapidly over the State. On a statewide basis, however, most of the feedlot wastes do not become stream pollutants.

In 1968 the Nebraska Water Pollution Control Council adopted a regulation requiring the registration of all feedlots in the following categories:

A. If the maximum number of feedlot animals in confinement at any one time is:

(1) 300 or more feeder or fat cattle,
(2) 100 or more beef cows,
(3) 100 or more dairy cattle,
(4) 500 or more swine,
(5) 2,000 or more sheep,
(6) 3,000 or more turkeys, or
(7) 10,000 or more chickens, ducks or geese;

B. Any feedlot that is smaller than the above but is located within 500 feet of any watercourse;

C. Any other feedlot that has a water pollution potential; or

D. Any feedlot whose operator elects to register.

By June 15, 1969, 1896 registrations had been received. The summary shows that the feeding facilities registered have a capacity of 1,164,000 cattle; 226,000 swine; 76,000 sheep; and over 1,000,000 poultry, including turkeys. About one-third of the feeding facilities registered are located within 500 feet of a watercourse. An abbreviated tabulation by counties is included in Attachment 7. Cuming County with a feedlot capacity of 112,000 head of cattle leads; Dawson County follows with 93,000 head; and Scotts Bluff County comes next with 67,000 head. Other counties with feedlot capacities in excess of 40,000 head of cattle are Douglas, Hall, Polk, Sarpy, and Stanton. The counties with registered feedlot capacities in excess of 10,000 head of cattle are shown on Map 3.

The Nebraska Water Pollution Control Council estimates that 10 percent of the feedlots contribute 90 percent of the stream pollution caused by animal wastes. These are lots that straddle or are adjacent to streams or large drainageways. The remaining 10 percent comes during periods of excessive runoff due to rainstorms and snowmelts.

The confined feeding of livestock is expected to continue at a rate of increase slightly greater than the increase in livestock numbers. This will materially boost the potential for livestock wastes to become stream pollutants. Regulation on the location of feedlots and waste treatment requirements may be needed to insure that wastes from such operations do not pollute streamflows.

Sediment

Sediment is the greatest contributor to the degradation of the physical quality of the state's surface waters.[1/] Excessive suspended sediments limit the uses of water, increase the costs of water treatment, and impair algal growth thereby affecting the dissolved oxygen balance in a water. Sediment may trap inorganic (pesticide) and organic (sludge) materials. In addition, the sediments are deposited in stream channels, irrigation canals, farm ponds, and reservoirs thereby reducing their capacities.

The sediment burden in streams comes from different sources through the erosion process. It is the top soils from cultivated lands that are inadequately protected, and overgrazed grasslands. It also arises from unprotected roadside cuts, unstabilized stream banks, gullies, and highway and building construction sites.

The application of recommended conservation measures and the proper management of agricultural lands are needed to make a major reduction in the amount of sediment produced and transported by streams.

1/ Report on the Framework Study, Inventory of Water Resources, Appendix B, Soil and Water Conservation Commission, 1971.

More intensive use of agricultural land and additional land used for highway and building construction sites materially raises the potential sediment problem. The application of recommended conservation treatment measures, the proper management of agricultural lands, and the installation of effective protection measures on construction sites are needed to reduce the amount of top soil lost to the streams.

Agricultural Chemicals

The use of agricultural chemicals, fertilizers, herbicides, and insecticides has increased rapidly in the past few years. In the hands of careless operators, these materials can become serious pollutants to both ground and surface water supplies. An intensive educational campaign is needed to encourage dealers, distributors and users (both farm and urban) to select and properly apply pesticides whose active life does not extend beyond the time necessary to control the target species.

Greater use of agricultural chemicals is expected in the future. This will increase the potential for pollution of ground and surface supplies.

CHAPTER 7. FLOOD CONTROL AND EROSION ABATEMENT

Flooding Problem

Nearly every year some section of Nebraska experiences a serious flood event. Drought periods are no exception; in fact, some of the most devastating floods have occurred during a so called dry cycle.

Most floods in the State are localized, resulting from thunderstorms of cloudburst proportion. These storms gather quickly and strike with little warning. They catch people unprepared. Individuals incur severe financial losses and experience considerable inconvenience.

General rainstorms and snowmelts occur occasionally in sufficient intensity to flood lowlands along major streams, causing widespread damage. Often ice jams and debris clog channels, materially increasing the degree of flooding.

The Corps of Engineers and Soil Conservation Service appraised the flood damage for the Comprehensive Framework Study of the Missouri River Basin. The basic data from the study, with revisions furnished after completion of the study, were used to prepare the flood control and erosion control needs for the Framework Study of Nebraska's State Water Plan.

Over 3,000,000 acres of land, about six percent of the state's total area, are subject to flooding. For this report an event which would occur once in a hundred years was taken as a standard. The average annual tangible damages under present conditions are estimated to be nearly 21 million dollars. These damages are distributed as shown in Table 25. This includes the residual damages in the areas protected by existing improvements.

About 93 percent of the damage occurs in rural areas. The damage to crops and pasture amounts to over 14 million dollars, slightly over two-thirds of the total estimated damage. About five million dollars of damage annually is caused to other rural property which includes farm buildings and fences, railroads, and private, county, and state roads and bridges. Average annual damage to urban properties is estimated at about $1,490,000, or about 7 percent of the total damage. For this report the losses in all cities, towns and villages were classed as urban regardless of their population.

More detailed information on the flood losses by river basins is included in Attachment 4.

Nature of Flood Damage

Floods experienced on main rivers and major tributaries usually differ materially from floods occurring on creeks and headwater streams. Floods on the larger rivers rise and fall slowly and often inundate

TABLE 25

DISTRIBUTION OF FLOOD DAMAGE

River Basin	Area Subject To Flooding (1000 Acres)	Average Annual Tangible Flood Damage - 1,000 Dollars[a/]			
		Crop & Pasture	Other Rural	Urban	Total
White River - Hat Creek	36.0	67.1	41.2	1.0	109.3
Niobrara	118.2	209.9	136.7	16.4	363.0
Missouri Tributaries	390.9	1,138.4	396.3	371.1	1,905.8
North Platte	184.2	962.1	272.6	64.1	1,298.8
South Platte	142.2	442.3	213.2	115.2	770.7
Middle Platte	367.9	835.7	278.6	50.0	1,164.3
Loup	214.7	663.5	282.3	206.3	1,152.1
Elkhorn	410.9	2,432.3	733.6	208.3	3,374.2
Lower Platte	331.9	1,288.7	684.0	203.0	2,175.7
Republican	320.1	1,704.3	600.0	23.2	2,327.5
Little Blue	109.0	739.8	210.8	13.0	963.6
Big Blue	267.9	1,930.6	371.7	178.4	2,480.7
Nemaha	265.5	1,797.4	698.5	43.9	2,539.8
STATE TOTAL	3,159.4	14,212.1	4,919.5	1,493.9	20,625.5

a/ Based on 1960 price levels, 1963 to 1965 level of land use and development, and flood control improvements existing as of 1968

Source: The Missouri River Basin Comprehensive Framework Study, 1967, (Including revisions) the flood plains for days or even weeks. Floods on great rivers like the Platte are caused by long, continuous storms or series of storms, by melting snow, or by a combination of snowmelt and general rainfall. These floods usually involve large contributing areas and great volumes of water and do not necessarily involve extremely high rates of runoff from any given local area.

Floods in the upstream areas also are caused by a variety of events. Chief among them are the floods resulting from intense rains of the summer thunderstorm type, often referred to as "flash floods" because of the speed with which they rise and fall. Storms of this type occur throughout the State and cause a major portion of flood damages in upstream areas. Floods in headwater streams are also caused by long, continuous storms or series of storms, by melting snow, or by a combination of snow and rainfall. Peaks are generally lower than those associated with the thunderstorm type, although the period of inundation for part of the flood plain may be longer.

Although occurring infrequently, ice jams do cause severe local flooding, damaging bridges and other flood plain installations. The period of inundation is usually short, but the high velocity flows around the jams scour the flood plain and allow heavy sediment loads to be transported and deposited on it farther downstream causing high losses, especially to the land and crops. Such floods impose particular hazards to urbanized areas in their path due to the lack of warning of their occurrence.

Flood damage to crops is complex and varies widely, depending largely on the characteristics of the flood but also on crop factors. Flood characteristics include such factors as time of year, depth and duration of inundation, velocity of flow, and sediment and debris content. Topography of the flooded area and other conditions such as the direction of tillage in relation to flood currents also have some effect. Losses occur from reduced yields, lower quality crops, increased tillage and weed control requirements, and increased production and harvesting costs. Considerable delay in spring planting because of flooding is frequently experienced in many bottom land areas. This is often true in the more intensively farmed areas. Planting is often so delayed that normal yields cannot be obtained. Replanting damaged crops is common, resulting in increased production costs and a greater frost hazard.

Irrigated lands are usually located on river terraces or other areas well above the flood plain and are not ordinarily subject to overbank flooding. However, damages that in the aggregate are serious occur to crops on irrigated lands as a result of flood runoff from upland areas. This runoff flows down gullies, gulches, and other small tributary streams that rise in the uplands above the irrigated lands. When these flows reach the gently sloping to level irrigated areas, they spread out and inundate a considerable area, often breaking irrigation canals which adds to the flood volume. The irrigation systems, especially the canals and ditches, may be filled with sediment and debris, and structures such as drops, turnouts, siphons, etc.

are often left inoperative. Sediment and debris deposited on the irrigated fields interfere with irrigation; smother low, young crops; and sometimes require the releveling of the fields. The disrupted irrigation systems often cannot be readily repaired. In critical portions of the growing season, especially when it is hot and dry, partial or even complete crop losses can result from the lack of irrigation water. If a canal break occurs near the head of the system, the entire irrigated acreage below that point is endangered.

Other agricultural damage includes not only floodwater and sediment damage to farmsteads, fences, harvested crops, machinery, and livestock, but also the expense of recovering the strayed animals and the damage done by them to crops.

Flood damages to roads are usually greater on county and local roads than on the better designed state and federal highways. County bridges, as a rule, are not designed to withstand large floods. Also, due to limited funds, their repair is frequently delayed or limited. A damaged bridge is usually more vulnerable to recurring floods. Bridge damage is unusually high in areas with degrading channels. Here, floodwaters are continually deepening and widening the stream channels, thereby undermining bridge ends and supports, causing many to collapse or wash out. Damages to bridges, culverts and roadbed fills are the most frequent types of damage to railroad facilities.

Losses occur in urban areas as a result of water damage and sediment and debris damage to homes, public buildings, utilities, and commercial and industrial businesses located on the flood plain.

Because there are significant differences in the flood characteristics and in the type of remedial measures needed to reduce flood damages, a general division of flood plain areas was made based on size of contributing drainage areas. Flood plain areas lying in drainage areas of 400 square miles or less have been designated as "watersheds", while for drainage areas greater than 400 square miles the flood plain areas are designated "main stem." Minor deviations from the drainage area criteria were made when necessary to more adequately describe the flood problem.

Investigation and Analysis of Flood Damages

The flood damage evaluations made by the Soil Conservation Service and the Corps of Engineers are based on estimates of the primary tangible losses that can be expected from future flood occurrences. The amount of flood damage to be expected in a given area varies not only with magnitude of the floods experienced but with the frequency and season of flooding, and with the peculiar susceptibility of different properties to flood damage. Accordingly, average annual flood damages resulting from floods throughout the full range of potential magnitude were estimated. Flood damages experienced as a result of historic flood occurrences provided a basis for estimating damages from future floods. Estimates of flood damages were adjusted to reflect the effects of existing projects

(1968) as well as other completed works that will influence future levels of flood damage.

In addition to the tangible damages which are subject to evaluation, the threat of intangible damages exists wherever there is a flood hazard. As cities expand in population and area in the future, the potential for intangible losses will be magnified as additional flood plain areas are developed, particularly along the smaller streams with high potentials for flash flooding and with no improvements to protect against such floods. Such effects, obviously, cannot be interpreted in terms of dollar values, and it was not within the scope of this study to attempt to evaluate intangible damages in any terms. However, in some circumstances, these losses may be of commanding importance, and they must be given due consideration in project planning, formulation, and programming.

Three general classifications of damage were used: (1) crop and pasture damages, (2) other rural damages, and (3) urban damages. Detailed information was available for many areas, while for other areas little or no data existed. For areas where adequate data did not exist, flood damages were estimated by means of comparisons of generalized hydrologic, hydraulic, areal, economic, and land use and development characteristics with areas for which average annual damages were available. In some cases, particularly for smaller drainage areas, little or no information existed for making suitable comparisons. For such areas, damage data were obtained for comparison by field reconnaissance surveys of these areas within each land resource area. Estimates of the extent of flooding and average annual damages were based on judgment using relationships and guidelines from previously completed investigations. Data thus obtained were then expanded to provide damage estimates within each land resource area.

Existing Improvements for Flood Prevention and Control

The Federal Government, through the Corps of Engineers and the Soil Conservation Service, has been active in assisting with the installation of protective measures to reduce flood losses. For the purposes of this study projects providing flood control which were under construction or funded for construction as of 1968, and whose completion was assured in the immediate future, are included as existing. There are reservoirs in the State that provide incidental reduction in flood damages even though they do not reserve storage exclusively for flood control. The effect of these reservoirs was recognized in estimating the magnitude of flood and related damages, although estimates of benefits are not available.

The numerous locally-constructed levees and channel improvements are not included since accurate delineation and identification of these features was not practical. Also, upstream reservoirs on the Missouri, North Platte, and Republican Rivers provide a high degree of protection to mainstem flood plains in Nebraska. Several reservoirs on the South Platte River lower the peaks of floods not fully regulated by local reservoirs which are caused by storms occurring along the Rocky Mountain foothills.

Included as principle improvements for flood control are 411 floodwater retarding structures, 421 grade stabilization structures, 188 miles of channel improvement, and 70 miles of levees. These improvements prevent ten million dollars of tangible damages annually.

A statewide summary of existing flood control improvements and average annual benefits is provided in Table 26. The improvements are shown on Map 4.

Flood Protection Needs and Opportunities

The severity of flood damage varies widely, depending upon the width and topography of the flood plain, the amount of development in the flood plain, and the condition of the stream channel. Differences in land use, soil, and topography have a greater effect on the flooding problem than climate and precipitation.

Watershed Areas. The average annual flood losses on the tributaries are estimated at over $15,000,000. This is almost 75 percent of average annual losses in the State. It occurs on about 1,670,000 acres of land subject to flooding, an average of just over $9 per acre. These losses vary from practically nothing to over $20 per acre. Most of the significant losses occur in the eastern third of the State.

To evaluate flood prevention needs on the tributary areas, watersheds were grouped according to the severity of the damage and opportunity for installation of protective measures, as follows:

Group	Definitions
A	Watersheds with flood plains usually exceeding five percent of the total area, generally devoted to cultivated crops, and subject to frequent or occasional overflows causing high rates of damage.
B	Watersheds similar to the above, but with either lower rates of damage to present uses or lower percentages of flood plains.
C	Watersheds with a very low percentage of flood plain lands, usually under three percent, or very low rates of damage to present uses.
D	Watersheds with project measures installed or funded for installation as of 1968.

TABLE 26

SUMMARY OF EXISTING PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES (1968)

River Basin	No. of Floodwater Retarding Structures	No. of Grade Stab. Structures	Channels & Chan. Improv. (Miles)	Levees (Miles)	Average Annual Benefits ($1,000)
White River - Hat Creek	0	0	0.0	0.0	0
Niobrara	3	0	0.0	0.0	17
Missouri Tribs.	0	0	6.5 a/	15.9 a/	841 a/
North Platte	12	24	41.0	34.0	909
South Platte	2	0	1.7	0.0	12
Middle Platte	12	1	37.0	0.0	210
Loup	0	0	0.0	0.0	15 b/
Elkhorn	1	0	10.1 a/	14.3	338
Lower Platte	87	79	38.0 a/	N.A.	2,114
Republican	23	9	4.8 a/	1.2	4,100
Little Blue	20	0	19.8	2.8	122
Big Blue	160	92	28.6	1.5	764
Nemaha	91	216	0.0 a/	0.0 a/	568 a/
STATE TOTAL	411	421	187.5	69.7	10,010

a/ Complete information not available
b/ Benefits from structures in Sargent and Farwell Irrigation Units

Source: The Missouri River Basin Comprehensive Framework Study, 1967, (including later revisions)

Flood damage data for the three groups without existing project measures are shown by river basins in Tables 27, 28, and 29. The watersheds are listed by groups in Attachment 4 and are shown on Map 5.

Forty-three watersheds are listed in Group A. These watersheds have total estimated average annual damages of $4,006,600 which is about $13 annually for each acre subject to flooding by the 100-year runoff event. Sites for floodwater retarding structures exist near the areas of high damage. The installation of such structures would materially reduce the peak discharge of major flood events.

Eighty-nine watersheds with a total estimated average annual flood damage of $7,710,000 are in Group B. The average annual losses for each acre subject to flooding by the 100-year runoff event is almost $10. Reservoir sites are generally less favorable than those in the watersheds of Group A. In the Big and Little Blue River Basins, most of the Group B watersheds require major channel improvements to convey floodwaters from flat lands.

One hundred ninety-two watersheds are listed in Group C. The estimated average annual damage in these watersheds amounts to about $2,889,000, or $6.50 annually for each acre subject to flooding by the 100-year event. This group of watersheds generally does not have adequate sites for waterflow control measures.

Mainstem Areas. About 1,490,000 acres of flood plain lands on mainstem stream reaches are subject to flooding by the 100-year runoff event. Flood damages average almost five and one-half million dollars annually, about $4 per acre for each acre subject to flooding. This amount varies from about $1, or less, per acre in the White River-Hat Creek, Niobrara, Missouri Tributaries, and Middle Platte River Basins to over $20 per acre in the Big Blue River Basin. The average annual damage in other basins varies from about $3 to $6 per acre.

The opportunities for installing single-purpose waterflow control structures on mainstems in rural areas are limited by costs. Usually the installation of waterflow control structures in upstream and tributary watersheds provide at best only a low level of flood protection for mainstem damage areas. The best opportunity of providing flood protection is to combine waterflow control measures with the needs of other beneficial purposes into a multipurpose structure. Stream reaches which should be considered for protection through multipurpose developments are as follows (See Figure 8):

Stream	Reach
Loup River	St. Paul to Mouth
Elkhorn River	North Fork above Norfolk
	O'Neill to Mouth
Logan Creek	Wakefield to Mouth
Salt Creek	Lincoln to Mouth
Wahoo Creek	Wahoo to Mouth
Beaver Creek (Republican)	State Line to Mouth
Little Blue River	DeWeese to State Line

TABLE 27

FLOOD DAMAGE IN WATERSHEDS OF GROUP A

River Basin	Number of Watersheds	Area Subject To Flooding (1,000 Acres)	Average Annual Flood Damage ($1,000)[a/]			
			Crop & Pasture	Other Rural	Urban	Total
White River-Hat Creek	0					
Niobrara	0					
Missouri Tributaries	7	58.1	434.4	127.7	316.0	878.1
North Platte	3	26.6	268.4	66.1	48.0	382.5
South Platte	1	0.4	3.7	1.3	0	5.0
Middle Platte	1	5.0	46.2	6.1	0	52.3
Loup	2	22.5	85.3	15.2	6.0	106.5
Elkhorn	6	58.5	745.5	164.0	34.3	943.8
Lower Platte	6	39.5	308.7	62.1	58.0	428.8
Republican	5	13.0	171.2	50.8	1.2	223.2
Little Blue	2	15.2	115.9	34.6	3.0	153.5
Big Blue	5	20.0	180.7	41.2	0	221.9
Nemaha	5	44.2	454.1	152.3	4.6	611.0
STATE TOTAL	43	303.0	2,814.1	721.4	471.1	4,006.6

a/ Generally based on 1963 to 1965 level of land use and development and 1960 price levels

Source: The Missouri River Basin Comprehensive Framework Study, 1967, (Including revisions after publication)

TABLE 28

FLOOD DAMAGE IN WATERSHEDS OF GROUP B

River Basin	Number of Watersheds	Area Subject To Flooding (1,000 Acres)	Average Annual Flood Damage ($1,000)[a/]			
			Crop & Pasture	Other Rural	Urban	Total
White River-Hat Creek	3	8.2	19.0	20.0	1.0	40.0
Niobrara	0					
Missouri Tributaries	6	41.5	416.1	126.5	38.3	580.9
North Platte	10	72.1	579.5	117.8	6.0	703.3
South Platte	5	20.9	123.9	20.4	4.0	148.3
Middle Platte	10	138.6	665.1	236.6	45.0	946.7
Loup	8	41.5	268.2	66.5	8.2	342.9
Elkhorn	10	101.0	942.0	229.5	33.0	1,204.5
Lower Platte	10	74.5	553.7	208.1	20.0	781.8
Republican	4	22.9	166.9	51.1	2.4	220.4
Little Blue	4	51.8	432.7	74.8	1.0	508.5
Big Blue	12	167.3	1,341.1	154.7	31.2	1,527.0
Nemaha	7	49.0	473.1	201.5	31.3	705.9
STATE TOTAL	89	789.3	5,981.3	1,507.5	221.4	7,710.2

a/ Generally based on 1963 to 1965 level of land use and development and 1960 price levels

Source: The Missouri River Basin Comprehensive Framework Study, 1967, (Including revisions after publication)

TABLE 29

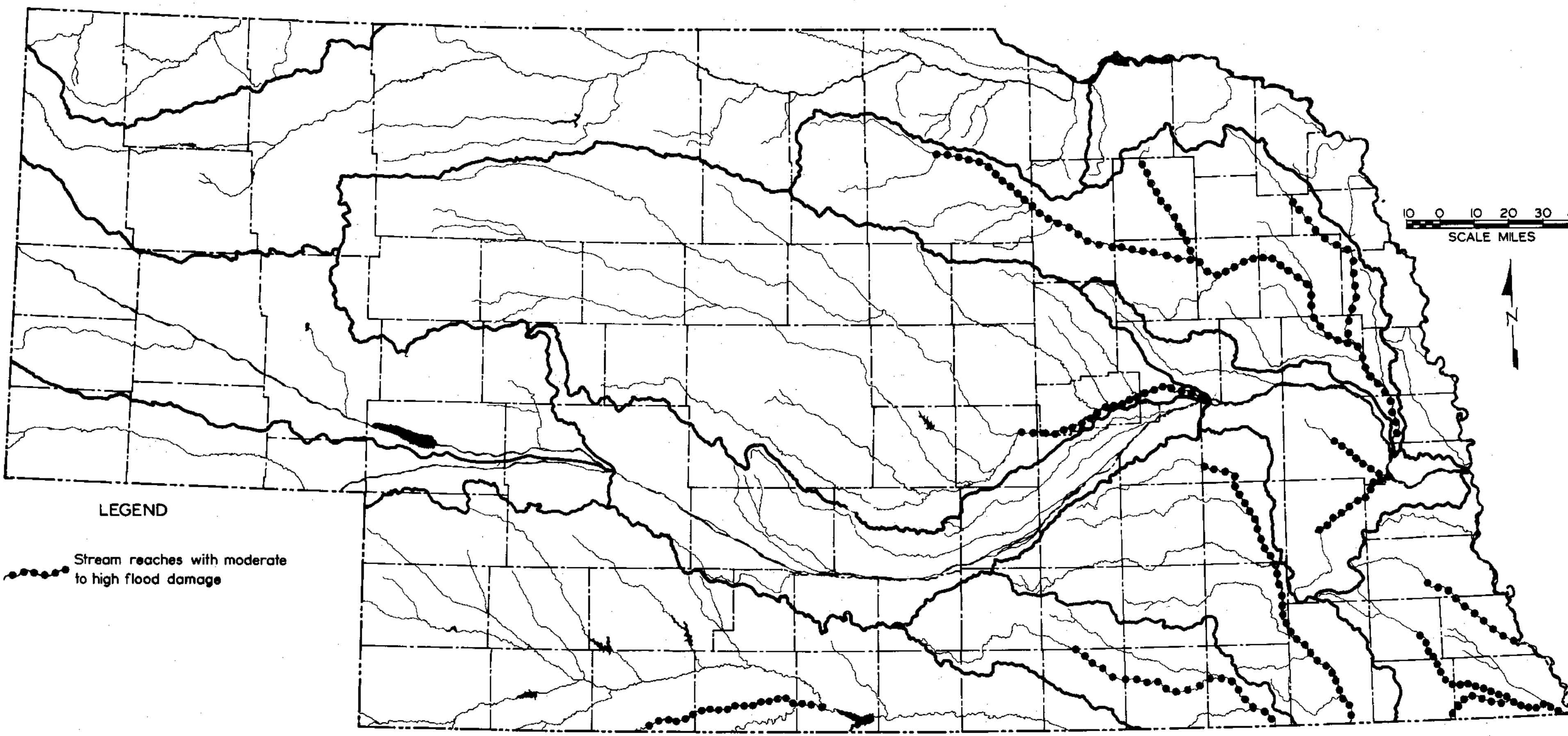
FLOOD DAMAGE IN WATERSHEDS OF GROUP C

River Basin	Number of Watersheds	Area Subject To Flooding (1,000 Acres)	Average Annual Flood Damage ($1,000)[a/]			
			Crop & Pasture	Other Rural	Urban	Total
White River-Hat Creek	14	27.8	48.1	21.2	0	69.3
Niobrara	35	71.9	175.7	114.4	13.4	303.5
Missouri Tributaries	8	29.3	163.9	59.6	3.8	227.3
North Platte	7	18.9	75.8	30.3	4.0	110.1
South Platte	9	30.2	188.6	68.5	2.2	259.3
Middle Platte	7	21.4	64.8	11.9	0	76.7
Loup	23	41.3	149.0	82.6	64.1	295.7
Elkhorn	19	64.1	286.8	111.6	26.0	424.4
Lower Platte	4	10.6	62.1	13.3	1.0	76.4
Republican	48	91.3	548.3	224.8	4.6	777.7
Little Blue	6	11.7	61.3	26.7	0	88.0
Big Blue	5	13.4	76.1	12.6	1.8	90.5
Nemaha	7	8.1	53.1	34.9	2.0	90.0
STATE TOTAL	192	440.0	1,953.6	812.4	122.9	2,888.9

a/ Generally based on 1963 to 1965 level of land use and development and 1960 price levels

Source: The Missouri River Basin Comprehensive Framework Study, 1967, (including revisions after publication)

STREAM REACHES WITH MODERATE TO HIGH FLOOD DAMAGE



SOURCE: Missouri River Basin Comprehensive Framework Study

Fig. 8

Big Blue River	West Line of Butler County to State Line
Little Nemaha River	South Fork to Mouth
Big Nemaha River	South Fork to Mouth
	North Fork-Tecumseh to Mouth
	South Fork - State Line to Mouth

Flood damage information for these mainstem stream reaches is provided in Table 30.

Flood Plain Regulation. Regulation of the use of flood plain lands can be used in all areas of the State to minimize the property and economic losses in both rural and urban areas due to floods. It would also serve to protect human life and health from dangers inherent in occupation of the flood plain.

Nebraska's Flood Plain Regulation Act, enacted by the Legislature in 1967, seeks to prevent locating homes and businesses on lands subject to flooding, to encourage flood proofing of existing installations on the flood plain, and to urge the judicious development of flood plain areas consistent with the flood hazards involved.

Description of Flood Damage by River Basins

White River-Hat Creek Basin. A few large floods have been recorded in this Basin but damages are usually not great because the flood plains are not highly developed. About 36,000 acres of bottom land are subject to flooding by the 100-year frequency storm event. The estimated average annual damage (1960 yields and prices) is about $109,000 annually, an average of $3 per acre flooded. The only urban damage reported is to the Chadron State Park which averages $1,000 annually. About $67,000 of the annual damage occurs to crops and pasture and the balance of $41,000 is largely damage to other farm property and to roads and bridges. No major waterflow control improvements have been installed to date.

Niobrara River Basin. The Niobrara River has not produced great floods in the past. There are few improvements or high value croplands in the flood plain subject to flooding. About 120,000 acres of land are subject to overflow by floods. This is less than 2 percent of the area of the Basin and is the lowest percentage of any basin in the State. Likewise, damage amounts are low with an estimated average annual loss of $363,000, about $3 per acre. Over 95 percent of the damage occurs in rural areas. Annual crop and pasture damages are estimated at $210,000 with other rural damages at $137,000 and urban damages at $16,000. About 85 percent of the monetary flood damage occurs in the tributary watersheds. One watershed project and two irrigation water storage reservoirs provide flood protection.

Missouri Tributaries River Basin. The construction of mainstem reservoirs, channel stabilization works, and levees has modified the flood hazard on the Missouri River. The present average annual damage for the 262,000 acres on the Missouri River flood plain is estimated at $219,500, considerably less than $1 per acre. Most of this results

TABLE 30

MAINSTEM STREAM REACHES WITH MODERATE TO HIGH FLOOD DAMAGE

River Basin & Stream	Area Subject To Flooding (1,000 Acres)	Average Annual Flood Damage ($1,000)[a]			
		Crop and Pasture	Other Rural	Urban	Total
Loup River Basin					
Mainstem - North Loup R. to Mouth	49.0	104.0	70.0	104.0	278.0
Elkhorn River Basin					
Mainstem - O'Neill to Mouth	115.3	185.0	122.0	85.0	392.0
North Fork Elkhorn River - Osmond to Mouth	26.0	148.0	22.0	8.0	178.0
Logan Creek - Wakefield to Mouth	44.2	124.0	84.0	22.0	230.0
Lower Platte River Basin					
Salt Creek	50.7	19.0	140.0	80.0	239.0
Wahoo Creek	25.0	271.0	226.0	23.0	520.0
Republican River Basin					
Beaver Creek	18.3	105.0	42.0	0	147.0
Little Blue River Basin					
Mainstem - Deweese to State Line	26.0	106.0	44.0	9.0	159.0
Big Blue River Basin					
Mainstem - Butler Co. to State Line	20.0	171.0	104.0	141.0	416.0
Nemaha River Basin					
Little Nemaha R. - South Fork to Mouth	26.2	93.0	52.0	0	145.0
Big Nemaha R. - Tecumseh and State Line to Mouth	55.4	551.0	188.0	0	739.0

a/ Generally based on 1963 to 1965 level of land use and development and 1960 price levels

Source: The Missouri River Basin Comprehensive Framework Study, 1967, (Including revisions after publication)

from tributary flood flows. About 128,900 acres of the Basin area subject to flooding are in tributary watersheds. The losses average about $1,686,000 annually or about $13 per acre. This area is among the most severely damaged in the State. In the Papillion Creek Watershed annual losses are estimated at $484,000 of which over $300,000 are to urban property. The Corps of Engineers has approved plans to install 21 flood control structures which will reduce the flood damages materially. These will be supplemented by 52 grade stabilization structures to be installed under the Small Watershed Act (PL 566) administered by the Soil Conservation Service.

North Platte River Basin. The North Platte River mainstem has not suffered a highly destructive flood during the period of record due to the absence of major storms and the installation of six major reservoirs above Nebraska. Also, Lake McConaughy provides some flood protection to lower mainstem reaches. Streams tributary to the North Platte River have experienced some extreme floods. About 184,000 acres of bottom and terrace lands in this Basin are subject to overflow by the runoff from a 100-year frequency event. This is only 4 percent of the Basin area. Average annual flood damage is estimated at $1,299,000. Although floods are infrequent and are usually localized, flood damage is high because most of the lands flooded are utilized for growing high-value irrigated crops and contain irrigation structures subject to damage. Crop and pasture damage is estimated at $962,000, 74 percent of the total; other rural property at $273,000, 21 percent of the total; and urban damage at $64,000, 5 percent of the total. Waterflow control measures installed in the Gering Valley and Wildhorse Watersheds provide a high degree of flood protection in these areas.

South Platte River Basin. Flood-producing storms occur frequently in the South Platte River Basin along the foothills of the Rocky Mountains. However, existing water supply and detention reservoirs upstream in Colorado provide good flood protection against all except high flood flows. The 1965 event, one of the largest storms of record, did considerable damage downstream nearly to North Platte. Considerable damage also results from intense rainfall on the short, steep canyon slopes of tributaries producing high discharges of very short duration. Damages often are high but are confined to local areas. Sidney, Brule, and Ogallala have experienced such events in the past. About 142,000 acres in this Basin are subject to flooding by the 100-year frequency storm. This is about 7 percent of the Basin area. The average annual loss is estimated at $770,700. Crop and pasture damage is $442,300, other rural damage $213,200 and urban damage $115,200. Most of the urban damage and the majority of the rural non-farm property damage occurs from floods on the South Platte River while on-farm damage results primarily from floods generated in tributary watersheds. Two small watershed projects, Cure and Brule, have been installed in the Basin.

Middle Platte River Basin. Floods along the Platte River mainstem in central Nebraska have not caused significant flood damages. The channel through this section is wide and can accommodate flood flows with relatively moderate increases in stage. The Wood River, a major tributary, has experienced occasional flood flows. A flood in 1967 caused about $3,000,000 damage in the Grand Island vicinity. Floods occur frequently in local areas the entire length of the valley resulting from intense rainfall in the adjacent hills. Spring Creek (Dawson) Watershed is an example. The flood discharges collected by canyons in the rough, steep grazing lands of this watershed must travel about 30 miles in low gradient channels through the valley before discharging into the Platte River. The main creek channel has filled with sediment and debris resulting in increased overflows. The flood flows wander over the flat valley lands, eventually finding their way to the river. Over 11 percent of the land area, 368,000 acres, of this Basin are bottom and terrace lands subject to overflow by the 100-year frequency storm. Because the flood plains are broad and nearly flat, large areas are covered at shallow depths. Major damage to crops results from delayed planting and tillage operations, resulting in weedy fields and immature grain at harvest time. Total flood damage in the Basin is estimated at $1,164,000 annually. Nearly 72 percent is to crops and pasture, 24 percent to other rural property, and 4 percent to property in urban communities. Flood control and irrigation water supply reservoirs upstream in Colorado, Wyoming, and western Nebraska provide waterflow control on the mainstem. Two watershed projects, Spring Creek (Dawson) and Jones Creek, have been approved for installation.

Loup River Basin. The Loup River drains a large area of central Nebraska in which the rainfall is moderate and infiltration rates are high. Floods in the Loup River drainage are typically moderate, but extreme floods have caused high damages in areas of urban flood plain encroachment. The most damaging flood occurred in August, 1966, when damages were estimated at over $9,000,000. Moderate to severe flooding occurred along the North Loup, Cedar and Loup Rivers, Beaver Creek, and many smaller tributaries. Approximately $5,000,000 of the damage was to agricultural properties, $2,000,000 to urban areas, $1,500,000 to transportation facilities, and $600,000 to utilities in rural areas. Columbus, in particular, was hit hard. Six hundred thirty-four homes and 34 businesses incurred severe damage. In some houses the water was six feet over the first floor. In St. Edward, 42 homes suffered first floor damage and 71 more had basement flooding. In Fullerton, the water and sewer lines were damaged severely and the municipal reservoir was emptied when the main supply line over the Cedar River was ruptured. Flood damage also occurred in Cedar Rapids, Scotia and Albion. Nearly 215,000 acres of bottom lands in the Loup River Basin are flooded by the 100-year storm event. This is just over 2 percent of the total area. Average annual flood damage is estimated at $1,152,000. Nearly $206,000 is damage to urban properties in 19 locations, crop and pasture damage is estimated at $664,000, and other rural damage at $282,000. A water supply reservoir, detention dams, and drains constructed as a part of the Sargent and Farwell Irrigation Units provide flood protection to portions of the Loup River Basin.

Elkhorn River Basin. Damaging floods occur somewhere in the Elkhorn River drainage almost every year. Frequently the extent of flooding is aggravated by ice jams. The most damaging general flood in recent times occurred in 1944 when 125,000 acres of land were flooded, many miles of railroad bed and roads were destroyed, and 17 cities and towns were seriously damaged. Total damages caused by the flood amounted to $6,820,000. A major snowmelt flood in 1960 inundated 96,300 acres of flood plain and damaged 11 towns. Estimated damages were $2,098,000. There are 411,000 acres of land in the Elkhorn River Basin subject to overflow by a flood event expected to occur once in a hundred years. This is over 9 percent of the land area of the Basin. The estimated average annual damage is $3,374,000. This is over $8 for each acre of flood plain. About 94 percent of the total damage occurs in rural areas. Crop and pasture damage is estimated at $2,432,000 and other rural losses at $734,000. The balance, $208,000, is damage to properties in 38 urban communities. Seven local protection projects and one watershed project have been installed. Another local protection project is under construction.

Lower Platte River Basin. Extensive flooding was experienced along the mainstem of the Platte River in this Basin in 1944, 1948 and 1960 when damages of $672,000, $210,000 and $2,465,000, respectively, were recorded. This is due to the ability of the lower Loup and Elkhorn drainages to generate large flood flows. Damaging floods have occurred almost annually in the Salt-Wahoo drainage. The maximum flood of record on Salt Creek occurred in 1908. Most of the urban area of Lincoln was flooded to depths of several feet and the valley from Roca to the mouth was flooded to a width varying from one-half to one mile. Recent and damaging floods occurred in 1942, 1950, 1951, and 1963. Damages caused by the 1963 flood on Wahoo Creek were estimated at $1,500,000. During this record flood the towns of Ashland, Memphis, Ithaca, Wahoo, Weston, Malmo, Prague, and the Ashland National Guard Camp were damaged. About 332,000 acres of land in the Lower Platte River Basin are subject to overflow by a 100-year frequency flood event. This is nearly 17 percent of the total area of the Basin. Average annual losses from flooding, with authorized flood control measures installed, are estimated at about $2,176,000. Of this, 91 percent, $1,972,700, occurs in rural areas, with $1,288,700 annual damage to crops and pasture and $684,000 damage to other rural property including roads, railroads, farmsteads and miscellaneous property. Annual damage to urban property is estimated at $203,000. A complex of flood control and prevention measures has been installed in the Salt Creek Watershed under federal assistance programs since 1951. These are providing almost $2,000,000 average annual flood benefits and include flood control reservoirs and channel improvements installed by the Corps of Engineers, and floodwater retarding and grade stabilization structures installed by the Soil Conservation Service. Three watershed protection projects and one local protection project have been installed in other parts of the Lower Platte River Basin.

Republican River Basin. Major floods occurred on the Republican River in 1935, 1944, 1947, 1951, and 1957. The 1935 flood was the most severe, flooding 25 cities and towns and taking 110 lives, most of them in Nebraska. Erosion and sediment damages from this storm are still in evidence. Floods occur on the tributaries more frequently. On Medicine Creek seven floods occurred in the fifteen years between 1947 and 1962. The storm of June, 1947 caused nearly $2,000,000 of damage and the loss of 13 lives. The damage to transportation facilities was severe with an estimated damage of $1,400,000; about half of which was destruction of railroad equipment and eight miles of track, and the rest was damage to roads and bridges. Frenchman Creek is another tributary which has suffered severe losses from floods. Two recent floods, in June, 1956 and July, 1962, each resulted in over a quarter million dollars damage. The town of Wauneta was severely flooded both times with 30 and 20 residences, respectively, being damaged. Floods occur in the smaller tributaries about once every two or three years with a flood usually occurring some place in the Basin every year. About 320,000 acres of land in the Republican River Basin are subject to overflow by a storm of 100-year frequency. This is over 5 percent of the Basin area. Total damage is estimated to average $2,327,500 annually. Crop and pasture damage is estimated at over $1,700,000 annually or 73 percent of the total. Urban damage is only about 1 percent of the total due primarily to the nine multipurpose reservoirs which have been constructed in the Republican River Basin since the 1935 flood, five in Nebraska, one in Colorado, and three in Kansas. These have about 1,000,000 acre-feet of storage capacity for flood control purposes. In addition, waterflow control measures have been installed at Bartley and Indianola, and in Dry Creek South, Dry Creek, and Stamford Watersheds.

Little Blue River Basin. Flood damages in the Little Blue River Basin occur from the overbank flow of streams and from water ponding in the depressions on uplands. The most frequent losses occur on the flat lands because water from intense rains collects in the broad, low areas drowning crops and preventing timely field operations. About 34,000 acres of land in the Basin have this characteristic and have flood losses estimated at $15 per acre. About 75,000 acres on the flood plains are subject to overbank flow with average annual losses estimated at $6 per acre. The total estimated average annual damage under present conditions is $964,000, over $950,000 of which occurs in rural areas. Crop and pasture damage is estimated at $740,000 annually. Waterflow control measures are being installed in three watersheds. One local protection project at Fairbury has been completed.

Big Blue River Basin. The most damaging flood in this Basin occurred in 1951, although the maximum stage of record on the mainstem in the upper reaches occurred in 1967. The Big Blue River was a major contributor to the Kansas River floods of 1903, 1941, 1945, 1947, and 1951. Tributary watersheds experience floods frequently, occasionally several floods may occur during one year. Residents in Plum Creek Watershed report that the main channel has overflowed as many as seven times in one year. Clogged channels contribute to the frequency of overbank flows. Lack of an adequate channel system on the flat lands to remove the waters from intense rainfall can cause severe crop losses. Some areas report losses occurring on the average of four years in ten. Nearly 268,000 acres, 9 percent of land in the Basin, is subject to flooding. This includes flat lands in the uplands. The average annual loss by flooding, including residual damage in authorized projects, is estimated at nearly $2,500,000 or over $9 per acre of land subject to flooding. Over 93 percent of this is in rural areas. Damage to crops and pasture is estimated at $1,930,600 or 78 percent of the total damage. Other rural damage is estimated at $371,700, and urban damage at $178,400. This is the most active area of the State in the installation of flood control and prevention measures. As of 1968 nine watersheds had been approved for operation and one local protection project had been completed.

Nemaha River Basin. One of the largest storms of record occurred on May 8-9, 1950, when rainfall varying between two and eleven inches covered all but the southern portion of the Basin. Damage inventories made by the local soil conservation districts showed agricultural damages of $1,250,000, road and bridge damage of $2,500,000, and land damage of $23,000,000. In addition the Corps of Engineers reported $350,000 damage to 16 towns and communities. Many smaller floods localized on tributary drainages have occurred since 1950. Fifteen percent of the total area of the Basin is subject to flooding by the 100-year storm event. The average annual damage is estimated at about $2,540,000 or nearly $10 for each acre flooded. Over 98 percent, about $2,496,000, occurs in the rural areas. Crop and pasture damage is estimated at $1,797,400 or 71 percent of the total. Other rural damage is estimated at $698,500 or 27 percent of the total damage. Sixteen cities and communities have a combined flood damage estimated at $44,000 annually. Waterflow control measures are being installed in six watershed projects. One watershed protection project has been completed.

Water Erosion Problem

Soil erosion by water occurs in all parts of the State. It is most severe in the eastern part where the rainfall is greater and more rolling land is intensively cultivated. Losses occur from reduced productivity on the land being eroded, and deposition of sediment on flood plains which smothers crops and pasture and in streams which reduces channel capacities.

Sheet Erosion

Sheet and rill erosion gradually removes the thin cap of highly productive top soil, exposing much less productive underlying soil materials. Soil losses have permanently reduced the productivity of large areas of soils in the glacial till areas of southeastern Nebraska. Increased fertilizer applications are required in the loess hills of central and northeastern Nebraska to overcome the loss of fertile top soil by sheet erosion. Some areas have been damaged so severely that they cannot be profitably cultivated. No estimate was made of the monetary loss.

The reduction of sheet and rill erosion requires the application of land treatment measures and proper conservation management by individual land owners.

Gully Erosion

Gully erosion and channel degrading is the process by which channels deepen and widen progressively headward in established watercourses. As the channel deepens, tributary drains likewise deepen. Damage occurs from loss of land to the channel, the extra time and care needed to perform cropping operations in gullied fields, and the extra cost of installing conservation practices. Frequently the channel enlargement destroys the footings and approaches of highway bridges. In irrigated fields, gullies are usually associated with and accentuated by irrigation water return flows.

Small gullies can usually be controlled by individual land operators with the application of land treatment measures. These have not been inventoried for this study.

Large gullies requiring project-type action were inventoried by the Soil Conservation Service for the 1967 Watershed Project Inventory. The study showed that 16 percent of the gully erosion problem areas have high rates of soil loss from productive lands. An additional 23 percent have moderate rates of soil loss, or affected lands with lower productivity. The remaining 61 percent have low rates of soil loss affecting lands of moderate to low productivity. The locations of watersheds according to rates of land loss are shown on Map 6. A summary of gully erosion damage by river basins is provided in Table 31, and is described in the narrative which follows.

White River-Hat Creek Basin. There are no known gullies in this Basin which require project action.

Niobrara River Basin. The gullies requiring project action are all in the Ponca Creek drainage. Average annual losses are low, averaging about $1 per acre for the drainage area above gullies.

Missouri Tributaries River Basin. Gully erosion is moderately severe throughout the Basin. The damage from gully erosion is estimated at over $500,000 annually, about $2.35 per acre for the drainage area above gullies. In over 48 percent of the area, gully losses average $3.50 per acre. Recently, authorization was received to install 52 grade stabilization structures in Papillion Creek Watershed providing grade stabilization for 26,000 acres.

North Platte River Basin. Gully erosion losses are very low.

South Platte River Basin. Gully erosion losses are very low.

Middle Platte River Basin. There are no known gully erosion problems requiring project action.

Loup River Basin. Gully erosion problems are found in three watersheds in the lower portion of the Basin. The average annual damage by gullies is slightly less than $1 per acre for the drainage area above gullies.

TABLE 31

SUMMARY OF GULLY EROSION DAMAGES REQUIRING PROJECT-TYPE ACTION
(INCLUDING RESIDUAL DAMAGE IN APPROVED WATERSHED PROJECTS)
(1967)

River Basin	Area Requiring Project-Type Action a/ (acres)	Area Subject To Damage: 50-Yr. Period (acres)	Area Subject To Damage: Ave. Ann. (acres)	Ave. Ann. Gully Erosion Damages: Crop & Pasture (thousand dollars)	Ave. Ann. Gully Erosion Damages: Other Rural (thousand dollars)	Ave. Ann. Gully Erosion Damages: Urban (thousand dollars)	Ave. Ann. Gully Erosion Damages: Total (thousand dollars)
White River - Hat Creek	None Reported						
Niobrara	9,000	2,400	48	8.4	1.1		9.5
Missouri Tribs.	215,100	91,850	1,837	440.0	66.0		506.0
North Platte	10,000	300	6	.9	.1		1.0
South Platte	4,000	400	8	1.4	.2		1.6
Middle Platte	None Reported						
Loup	29,600	4,800	96	24.8	3.6		28.4
Elkhorn	106,000	25,050	501	128.8	17.2		146.0
Lower Platte	122,500	45,120	902	218.0	35.0		253.0
Republican	224,000	63,350	1,267	146.0	48.0		194.0
Little Blue	27,300	6,960	139	26.5	3.0		29.5
Big Blue	87,500	31,350	627	158.1	18.9		177.0
Nemaha	311,300	140,900	2,818	640.7	89.8		730.5
STATE TOTAL	1,146,300	412,480	8,250	1,793.6	282.9	0	2,076.5

a/ Drainage area above gullies

Source of Data: 1967 Watershed Project Inventory, Nebraska Conservation Needs Inventory, 1969

Elkhorn River Basin. Gully erosion is limited to the loess hills area below Norfolk. The average annual damage by gullies is less than $1.50 per acre for the drainage area above gullies. On about 7 percent of this area the losses average about $3 per acre annually.

Lower Platte River Basin. Gully erosion is moderate in the area south of the Platte River. Little damage is experienced north of the Platte River. Average annual losses are estimated at slightly more than $2 per acre for the drainage area above gullies. Nineteen percent of the area requiring project action has average annual losses of $3 per acre.

Republican River Basin. Gully erosion is moderate in the breaks along the north side of the Republican River and its tributaries. Losses are low, averaging less than $1 per acre for the drainage area above gullies. About 12 percent of the area has damages averaging nearly $1.40 per acre.

Little Blue River Basin. Significant gully erosion damage is confined to the lower portion of this Basin. The losses by gullies requiring project action average about $1 per acre for the drainage area above gullies. The tributaries near Fairbury have the most severe damage with an average loss of $2.20 per acre annually for the area requiring project action.

Big Blue River Basin. Most of the gully erosion is in the southern portion of the Basin. The average annual losses are about $2 per acre for the drainage area above gullies. About 75 percent of the area having gully erosion problems is in watershed conservancy districts. At the time of watershed work plan preparation, these problem areas did not have benefits in excess of costs and were eliminated from the construction authorization. Of the remaining 25 percent, about half have losses of $2.25 per acre for the drainage area above gullies.

Nemaha River Basin. This Basin has the most severe gully erosion problems with losses averaging nearly three-quarters of a million dollars annually. This is about $2.35 per acre for the drainage area above gullies. About 20 percent of the area requiring project action has losses averaging $3.30 per acre annually.

Streambank Erosion

Erosion of streambanks is closely related to floods. High flows frequently destroy the vegetation along streambanks making them vulnerable to erosion even by low flows. In addition, debris is deposited in stream channels which directs the current against the banks accelerating the erosion process.

Streambank erosion occurs in local areas along major streams throughout the State, but the rates of erosion are generally moderate to mild. The nature of the hazard varies depending upon streamflow and channel characteristics and the development in the vulnerable areas. No physical estimates were made of the losses by streambank erosion, but the following narrative describes the problems by basins.

White River-Hat Creek Basin. Streambank erosion damage in this Basin is very low. The problem is considered to be minor and not in need of solution at this time.

Niobrara River Basin. Streambank erosion damages are low except along some tributaries in the lower part of the Basin.

Missouri Tributaries River Basin. Streambank erosion is severe in the tributaries adjacent to the Missouri River flood plain, particularly in the areas of loess deposits. The Missouri River mainstem channel has been stabilized by channel improvements upstream as far as Ponca State Park. These bank stabilization improvements, if properly maintained, should prevent further serious damage. The streambanks of the stretch of the Missouri from Ponca State Park to Yankton, South Dakota, have not been stabilized and have experienced increased bank erosion in recent years due to higher releases from Gavins Point Dam.

North Platte River Basin. The mainstem of the North Platte River has relatively low streambank erosion damages, but many short tributaries have had spectacular losses which damage bridges, irrigation facilities, and destroy high-valued land. Low streambank erosion rates on the mainstem particularly below Kingsley Dam, are partially the result of low flows because of upstream reservoir regulation. This has allowed vegetation to become established adding stability to the channel.

South Platte River Basin. Streambank erosion is minor in this Basin. Since construction of upstream reservoirs, vegetation has added stability to the channel.

Middle Platte River Basin. The braided channel of the Platte River is about a mile wide. With the normal flow pattern, almost no streambank erosion occurs. Low flows because of upstream reservoir regulation have allowed vegetation to become established adding stability to the channel.

Loup River Basin. The lower reaches of the Loup River have serious and continuing streambank erosion problems.

Elkhorn River Basin. Streambank erosion is a serious and continuing problem along the Elkhorn River below Neligh and along several of the tributaries, e.g. Union and Logan Creeks. The problem has been aggravated by local attempts at channel straightening. The straightening of Logan and Union Creeks started an erosion process that has destroyed many bridges and considerable adjacent farm lands.

Lower Platte River Basin. Streambank erosion is a serious and increasing problem on the Platte River in this Basin and on the mainstem of Salt Creek.

Republican River Basin. The 1935 flood caused severe erosion of the Republican River banks and left an unstable stream channel. Low streamflows have predominated since the construction of the irrigation water supply and flood control reservoirs. This has allowed willows, cottonwoods, and other vegetation to become established, providing a measure of stability to the main stream beds but decreasing their water-flow capacity. The use of Frenchman Creek to carry irrigation water is causing erosion problems in this stream. The USBR is now stabilizing the channel with erosion abatement works.

Little Blue River Basin. About 10 percent of the bank along the Little Blue River is subject to slow rates of erosion due in part to the loss of vegetation in the 1951 flood.

Big Blue River Basin. Streambank erosion is negligible in this Basin and is not considered to require action at this time.

Nemaha River Basin. Severe streambank erosion has occurred along the Little and Big Nemaha Rivers. Man's interference through straightening has caused the channels to enlarge out of proportion to their respective drainage areas. This enlargement, along with channel improvements and partial rectification measures installed by local interests, has at least partially stabilized the channels. However, a sustained period of high flows could result in additional severe erosion losses.

Stabilization of the channel has effectively controlled erosion on the Missouri River mainstem and no serious problems are anticipated if the channel improvements are maintained to design standards.

CHAPTER 8. NAVIGATION[1/]

Introduction

The Missouri River is the only "in fact" navigable stream affecting Nebraska. Shortly after Lewis and Clark blazed a trail up the Missouri in 1804, steamboats began utilizing the river from St. Louis, Missouri, to Fort Benton, Montana. The river served the pioneers as a natural route of communication and principal artery of travel until the faster, more flexible railroads with dependable schedules brought about a decline in steamboat river traffic.

Channel improvement began in 1824 when federal funds were provided to remove snags. In the later part of the nineteenth century, the Federal Government began experimental work to stabilize banks and provide more adequate channels at selected locations. A concentrated and continuous program of channel improvement and bank stabilization was started in the early 1930's. The construction for development of the authorized navigable channel of nine feet depth with a minimum width of 300 feet from Sioux City to the mouth is nearing completion.

In addition, six multipurpose dams and reservoirs have been constructed by the Corps of Engineers on the Missouri River above Sioux City. One of the functions of these dams is to regulate the streamflow to benefit navigation. Since 1962, releases for navigation from the system of reservoirs have made navigation operations from Nebraska ports possible for about eight months annually, usually April through November.

Present Situation

Barge service on the Missouri River is being provided by three common carrier companies. Connective service is available to all parts of the federal waterway system, by interline arrangements where necessary. In addition to the common carrier operators, an undetermined amount of contract and private barging takes place.

The annual tonnage moved by commercial navigation on the Missouri River increased from less than 400,000 tons before 1955 to a peak of nearly 2,600,000 tons by 1967. Over 2,000,000 tons of commodities have been moved annually since 1962. For the Sioux City to Kansas City reach, the commercial tonnage has increased gradually from about 130,000 tons in 1955 to over 1,380,000 tons in 1969. During this period, the proportion of total Missouri River commercial tonnage moving into and out of the Sioux City to Kansas City reach increased from around 1/3 to practically 2/3. In 1969 over 50 percent of the Missouri River commercial tonnage was moved into or out of the ports in the Sioux City to Rulo reach.

1/ Summarized from the navigation section of the Missouri River Basin Comprehensive Framework Plan (1969) and unpublished data furnished by the Corps of Engineers.

For the 1966-69 period, grain, including soybeans, made up about 55 percent of the total commercial tonnage on the Missouri River system. It was about 90 percent of the downstream shipments (Table 32). For the Sioux City to Kansas City reach, grains made up nearly 40 percent of the total tonnage and about 80 percent of the freight moving downstream. Food and kindred products made up nearly all the balance of downstream freight in this reach. Upstream shipments in the Sioux City to Kansas City reach included chemicals, 35 percent; food and kindred products, 24 percent; stone and clay products, 19 percent; non-metallic minerals, 15 percent; and smaller quantities of metal, fibers, and paper products.

Harbor facilities accessible to Nebraska shippers are located in or near Sioux City, Blair, Omaha, Council Bluffs, Bellevue, Plattsmouth, Nebraska City, Brownville, and Rulo (Figure 9). The type of facilities available at each location is shown on Table 33. Most of these facilities have connections with railroads and all are accessible to improved highways. There are ten facilities available for handling grain; one for sand and gravel; four terminal, including steel handling; seven for general bulk commodities; and one for cement.

Navigation is competitive with other modes of transport in the movement of low cost bulk-type commodities, particularly those originating from or destined to foreign ports. Corn, wheat, grain sorghum, and soybeans make up most of the outgoing shipments from Nebraska that are in this category. Incoming shipments consist mostly of chemicals, animal feeds, molasses, fertilizers, and building materials.

Most freight commodities do not lend themselves to water transport because they are in less than bulk-type lots or have relatively short travel time requirements and must be transported more rapidly. Another factor which limits use of commercial navigation is the lack of grain storage facilities to hold the peak fall harvest deliveries until barge shipment opens in the spring.

Future Needs

Nebraska shippers are expected to move about the same commodities by water transport in the future as at present. This means that corn, wheat, sorghums, and soybeans will make up the bulk of the outgoing loadings, and chemicals, building materials, animal feeds, and fertilizers the major incoming commodities. There is expected to be some increase in the quantities moved by commercial navigation but the increase will be somewhat less than the gross increase in crop production and demands for bulk-type goods. This is due to the anticipated increase in utilization and processing of farm crops near sources of production and the utilization of bulk unit railroad and truck transport.

The main needs to improve navigation transport are grain storage facilities at ports and the development of standardized shipping containers which can be readily transferred between railroad cars, trucks and barges.

TABLE 32

COMMERCIAL TONNAGE - MISSOURI RIVER ANNUAL AVERAGE - 1966-69 PERIOD
(Thousand Tons)

	Sioux City to Mouth		Sioux City to Kansas City	
	Up	Down	Up	Down
Farm Products (grains, etc.)	12	1,285	0	516
Non-Metallic Minerals	148	*	105	*
Food and Kindred Products	167	139	166	138
Basic Textiles	1	0	1	0
Pulp Paper and Allied Products	9	0	9	0
Chemicals and Related Products	310	6	238	6
Petroleum Products	73	9	0	0
Stone, Clay, and Glass Products	134	0	129	0
Metal Products	79	2	37	*
Miscellaneous	1	*	*	*
TOTAL	934	1,441	685	660

* Less than 500 tons

Source of Data: U. S. Army, Corps of Engineers

TABLE 33

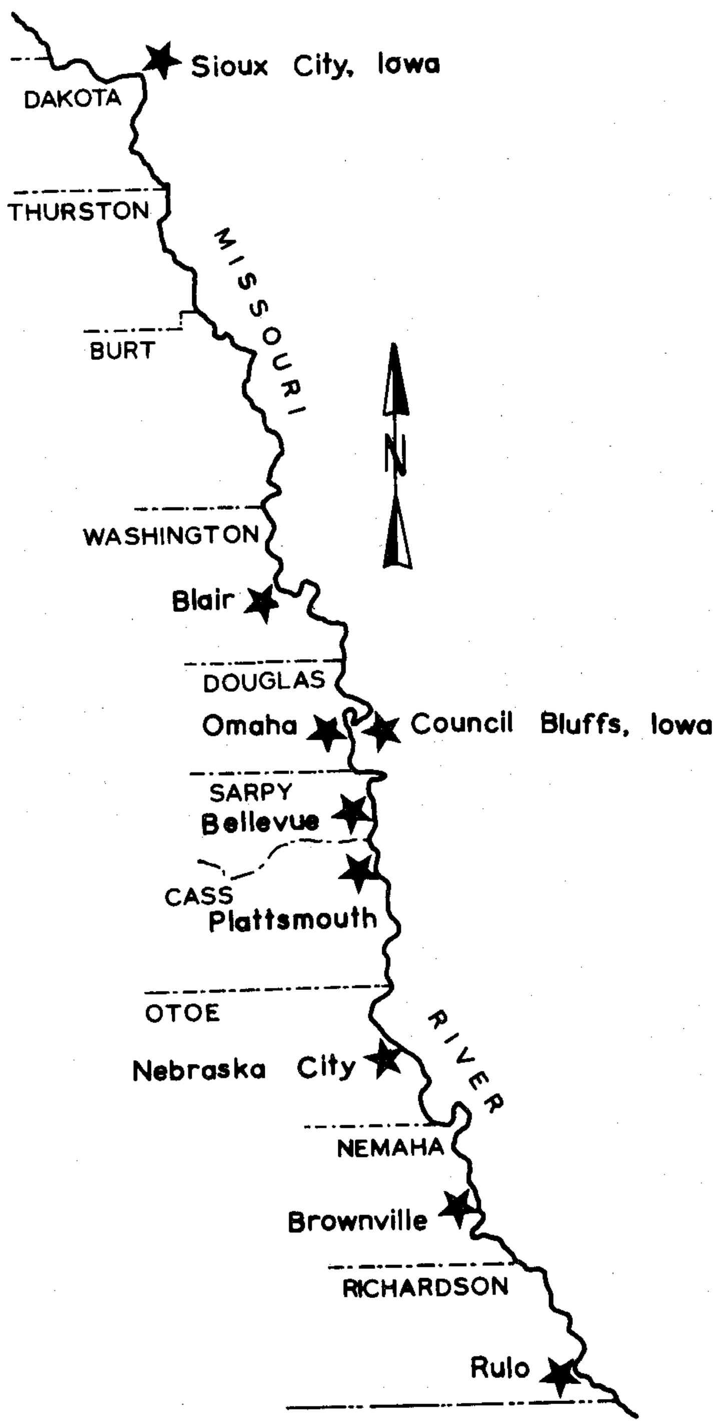
CARGO AND SERVICE FACILITES AVAILABLE TO NEBRASKA SHIPPERS

Harbor Location	Grain	Sand & Gravel	Terminal Incl. Steel Handling	General Bulk Commodities	Cement
Sioux City		1	1	1	
Blair				1	
Omaha	3			3	1
Council Bluffs				1	
Bellevue			1		
Plattsmouth	1				
Nebraska City	3		2	1	
Brownville	2				
Rulo	1				
TOTAL	10	1	4	7	1

Source of Data: Missouri River Basin Comprehensive Framework Study (1969)

FIG. 9

LOCATION OF HARBOR FACILITIES ACCESSIBLE TO NEBRASKA SHIPPERS



Source: Missouri River Basin Comprehensive Framework Study, 1967

CHAPTER 9. ELECTRIC POWER

Introduction

The electric power industry has been one of the fastest growing industries in the State. It has expanded at a rate almost twice that of the overall economy, roughly doubling every ten years.

At the beginning of the century electrical energy was provided by small capacity generators serving individual communities. Since then it has changed into a complicated system of large generation plants interconnected with high voltage transmission lines supplying power to homes, farms, businesses, and industrial plants in all areas of the State.

The power industry of the State consists entirely of publicly-owned utilities. This chapter is based largely upon a study of the state's power needs made by the Nebraska Power Industry Committee (NPIC). The State was divided into three geographical areas for the power study--Eastern, Central, and Western. The areas served largely by the Omaha Public Power District and the municipal systems in eastern Nebraska comprise the Eastern area. The Western area consists of the western one-third of the State, generally the area west of North Platte and Cody. The Central area consists of the remainder of the State.

The NPIC study was confined to an analysis of the water usage and consumption requirements of thermal electric generation plants (steam plants). It is recognized that hydroelectric plants in the State do require large amounts of water. However, the water used for this purpose is usually not degraded in quality and very little is consumed. Water is also required to cool internal combustion engines used to power some generators. The water requirements of these small generating plants are so small that they have not been estimated.

Criteria

Water requirements and usages are based on data contained in a comprehensive framework study of water requirements for thermal electric generation in the Missouri River Basin conducted under the auspices of the Missouri Basin Inter-Agency Committee in January, 1967. The Nebraska Power Industry Committee made projections of: (1) present and future power requirements, (2) types and capacities of generation facilities, and (3) types of condenser cooling units to be used.

The terms used in the discussion of water requirements for electrical power generation are defined as follows:

(1) Capacity is the load for which a machine or plant is rated.

(2) Capability is the amount of power that a generating plant can supply to a load.

(3) Capacity factor is the ratio of the average output of a generating plant for a given period of time to the capacity of the generating plant.

(4) Peak load is the maximum load for a one hour duration occurring over a given period of time.

(5) Load factor is the ratio of the average load for a given period of time to the peak load for the same given period of time.

(6) Energy production is the amount of electrical energy generated in a given period of time.

(7) Heat rate is the measure of thermal efficiency of a generation plant. It is measured in British Thermal Units (BTU).

(8) Cooling water requirement is the amount of water needed to pass through the condensing unit in order to condense the steam to water. It is independent of the type of cooling.

(9) Cooling water consumption is the cooling water lost, primarily by evaporation. The amount is dependent upon the type of cooling employed; flow-thru, cooling tower, or cooling pond.

(10) Cooling water diversion is water withdrawn from a supply source for cooling purposes. The amount is dependent upon the type of cooling used.

(11) A flow-thru cooling unit withdraws water from a supply source continuously for a single pass through the condenser unit. The amount of water needed is the same as the cooling water requirement.

(12) A cooling tower (or pond) contains water in storage for recirculation through the condensing unit. Water is withdrawn from a supply source to make up the losses by evaporation. This quantity is equivalent to the amount consumed.

The power and water requirements are based upon the following assumptions:

(1) A cooling water temperature rise of 18°F for all plants (1970 thru 2020),

(2) A load factor of 50% (1990 thru 2020),

(3) Heat rates used were 10,000 BTU/KWH for nuclear fueled plants and 9,000 BTU/KWH for fossil fueled plants (1990 thru 2020),

(4) Future generation facilities (1990 thru 2020) to be 65 percent nuclear fueled and 35 percent fossil fueled,

(5) All unit cooling after 1990 to be by wet-type towers, and

(6) All projected future (1990 thru 2020) power requirements to be generated within the respective areas of the State.

Present Situation

The Omaha Public Power District (OPPD) and the Nebraska Public Power District (NPPD) provide almost 75 percent of the generation capacity of the State. They serve both wholesale and retail customers. The Central Nebraska Public Power and Irrigation District (CNPP&ID) and the Loup River Public Power District provide another 12 percent of the state's generation capacity, the majority of this in the Canaday thermal electric plant. The balance of the generation capacity is provided by municipalities. Table 34 contains a list of the plants with net capabilities generally in excess of 10 MW. Fourteen small hydroelectric plants with a combined capacity of less than 14 MW and small capacity municipal plants are not included. Their output will have little significance in supplying the state's future power requirements.

The generating capacity of power plants within the State is presently not sufficient to supply all of Nebraska's power needs, particularly peaking power. Presently about one-fourth of the peak load is imported, mostly from the Missouri Basin Power System to which the hydroelectric plant at Gavins Point Dam is intertied.

The estimated water requirements for the present thermal generating plants listed in Table 34 are based upon capacity factors determined in the NPIC studies. The factors were based upon historical data or information used in the 1969 Nebraska Power Industry Committee System Planning Study. Information on the water requirements for the Alliance plant was not included.

The estimated peak load and energy requirements for 1970 are shown in Table 35. The amount provided by thermal generation is shown by areas, and the amount generated by hydroelectric power plants and purchased from outside the State are combined. About two-thirds of the estimated 1970 power and energy requirements are now supplied by thermal generation in the State.

Table 35 shows that in 1970 855,300 acre-feet of water were required to cool the condensers of the thermal units which provided about 7,561,700 MWH of electrical energy. This requires a diversion, including ground water withdrawals, of 622,100 acre-feet of water--555,700 acre-feet from surface water and 66,400 acre-feet from ground water. About 465,500 acre-feet of water are diverted from the Missouri River for power plants in the vicinity of Omaha; 83,000 acre-feet of water from the Central Nebraska Public Power and Irrigation District irrigation supply canal near Lexington; and 7,200 acre-feet of water from the Little Blue River and ground water at Fairbury. About 62,800 acre-feet of ground water withdrawals are from wells in and near Grand Island and Scottsbluff. These plants have flow-thru cooling units. The balance, or 3,600 acre-feet, is withdrawn from wells to make up the consumption losses of generating plants located near South Omaha, Fremont, Lincoln, Hallam, Ogallala, and Hastings. These plants have cooling tower units.

TABLE 34
PRESENT ELECTRIC POWER GENERATION CAPACITY
1970

Ownership	Location	Name	Net Capability MW	Type	Cooling	Source of Water
Omaha Public Power District						
	Omaha	Jones Street	180	Steam	Flow Thru	Missouri River
		North Omaha	647	Steam	Flow Thru	Missouri River
		South Omaha	23	Steam	Tower	Ground Water
Subtotal			(850)			
Loup River Public Power District						
	Monroe	Monroe	8	Hydro	---	Loup River
	Columbus	Columbus	40	Hydro	---	Loup River
Subtotal			(48)			
Nebraska Public Power District						
	Hallam	Sheldon	225	Steam	Tower	Ground Water
	Lincoln	K Street	30	Steam	Tower	Ground Water
	North Platte	North Platte	26	Hydro	---	North & South Platte Rivers
	Ogallala	Ogallala	9	Steam	Tower	Ground Water
	Omaha	Kramer	113	Steam	Flow Thru	Missouri River
	Scottsbluff	Scottsbluff	44	Steam	Flow Thru	Ground Water
Subtotal			(447)			
Central Nebraska Public Power and Irrigation District						
	Brady	Jeffrey	18	Hydro	---	Platte River
	Lexington	Canaday	108	Steam	Flow Thru	Platte River
		Johnson #1	18	Hydro	---	Platte River
		Johnson #2	18	Hydro	---	Platte River
Subtotal			(162)			
Municipalities (Plants 10 MW capacity and larger)						
	Alliance	Alliance	16	Steam	Tower	Ground Water
	Grand Island	Burdick, C.W.	42	Steam	Flow Thru	Ground Water
		Pine Street	18	Steam	Flow Thru	Ground Water
	Fairbury	Fairbury	21	Steam	Flow Thru	Little Blue R.a/
	Falls City	Falls City	10	I.C.b/	Closed	Ground Water
	Fremont	No. 1	44	Steam	Tower	Ground Water
		No. 2	21	Steam	Tower	Ground Water
	Hastings	Hastings	59	Steam	Tower	Ground Water
	Nebraska City	Nebraska City	10	I.C.b/	Closed	Ground Water
Subtotal			(241)			
STATE TOTAL			1,748			

a/ Partially from ground water
b/ Internal combustion

Source: Nebraska Power Industry Committee System Planning Study, (1969), and Missouri River Basin Comprehensive Framework Study (1967)

TABLE 35

PRESENT COOLING WATER REQUIREMENTS AND USAGES
FOR THERMAL ELECTRIC GENERATION
(1970)

Areas	Annual Power Requirements		Annual Cooling Water Requirement	Annual Cooling Water Usage	
	Peak Load MW	Energy Production MWH	AF/Yr.	Diversion[a/] AF/Yr.	Consumption AF/Yr.
Eastern	923	4,005,777	418,900	374,900	4,200
Central	610	3,377,593	404,200	219,300	4,770
Western	53	178,310	32,200	27,900	330
Purchases and Hydro Generation	787	2,832,060	---	---	---
STATE TOTAL	2,373	10,393,740	855,300	622,100	9,300

a/ Including ground water withdrawals

Source: Nebraska Power Industry Committee

Projection of Future Power and Water Requirements

The demand for electric power in 1980 is expected to be about double the amount required in 1970. The rate of increase in demand is expected to decrease slightly between 1980 and 1990 and then stabilize at a growth rate of 75 percent per decade up to the year 2020.

It is assumed that Fremont, Grand Island, Hastings, and Fairbury will supply generating capacity for their loads through 1972 and thereafter will purchase their load growth requirements from large units within the State. Up to 1980, the additional statewide power and energy requirements can be met by generating facilities already under construction or planned. Two nuclear-fueled generating stations, Ft. Calhoun by the OPPD and Cooper at Brownville by NPPD, are nearing completion. These stations will have generation capacities of 475 MW and 778 MW respectively. The OPPD plans to add 200 MW capacity to the North Omaha station, and NPPD plans to construct generation stations at Grand Island and North Platte with a combined capacity of 900 MW. These additional generation stations will use fossil fuels. The North Platte plant will have a flow-thru cooling unit.

The projected future power and energy requirements and water usages for 1980, 2000, and 2020 are shown in Table 36. Projected water diversion requirements are shown on Figure 10.

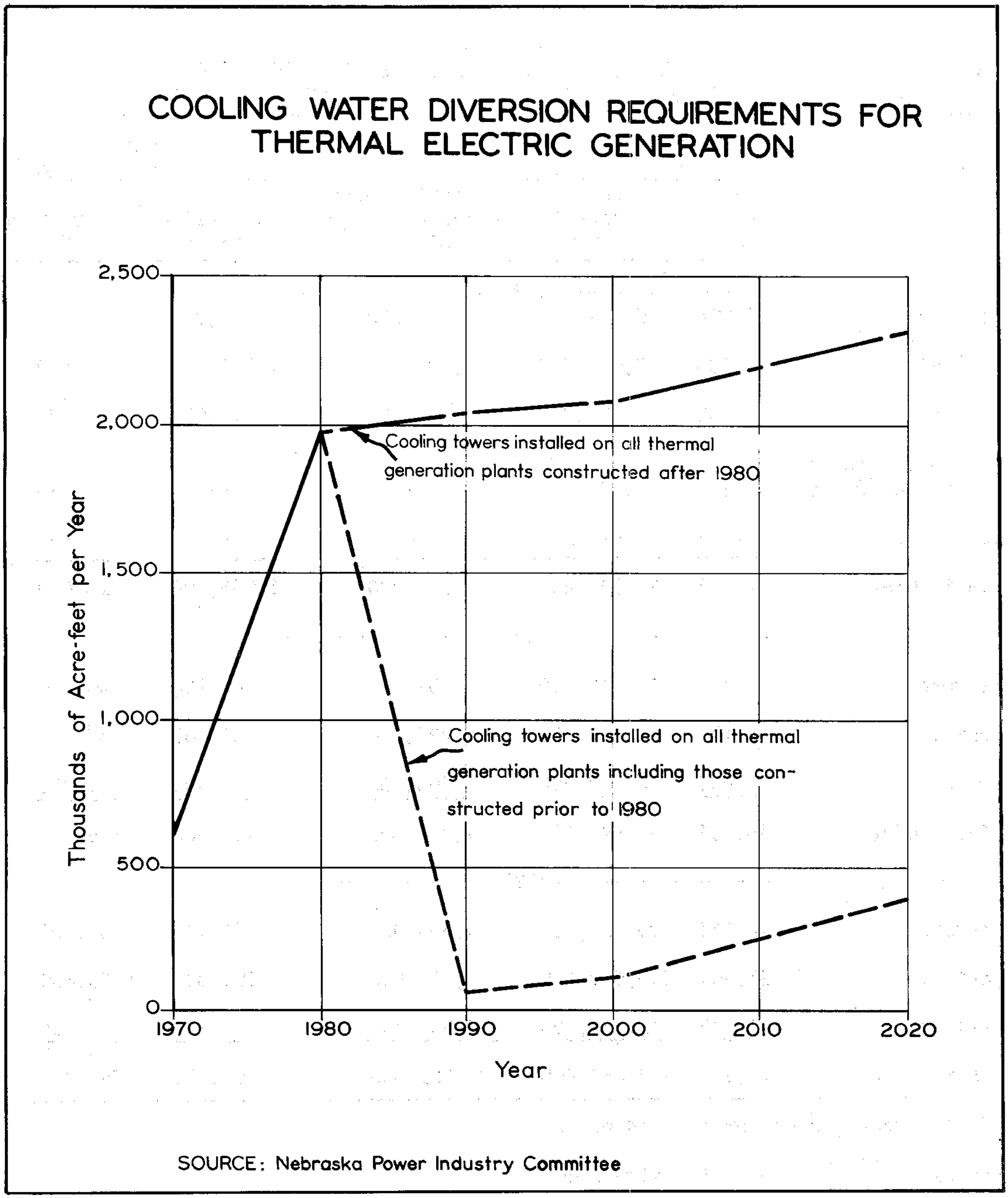
TABLE 36
COOLING WATER REQUIREMENTS AND USAGES FOR PROJECTED FUTURE THERMAL ELECTRIC GENERATION

Areas	Annual Power Requirements: Peak Load MW	Annual Power Requirements: Energy Production MWH	Annual Cooling Water Requirement AF/Yr.	Annual Cooling Water Usage: Diversion[a/] AF/Yr.	Annual Cooling Water Usage: Consumption AF/Yr.
	1980				
Eastern	1,598	6,861,700	780,900	772,000	7,260
Central	2,288	13,623,750	1,508,100	1,201,300	15,600
Western	53	79,250	14,400	13,000	140
Purchases and Hydro Generation	1,197	3,663,200	---	---	---
Less Sales	(389)	(2,896,500)	---	---	---
STATE TOTAL	4,747	21,331,400	2,303,400	1,986,300	23,000
	2000				
Eastern	6,192	27,118,700	3,137,600	46,200	46,200
Central	8,477	37,123,100	4,295,100	63,300	63,300
Western	992	4,352,300	503,600	7,400	7,400
STATE TOTAL	15,661	68,594,100	7,936,300	116,900	116,900
	2020				
Eastern	18,961	83,050,900	9,609,000	141,500	141,500
Central	25,961	113,689,600	13,153,900	193,800	193,800
Western	3,039	13,328,900	1,542,100	22,700	22,700
STATE TOTAL	47,961	210,069,400	24,305,000	358,000	358,000

a/ Includes ground water withdrawals

Source: Nebraska Power Industry Committee

Fig. 10



COOLING WATER DIVERSION REQUIREMENTS FOR THERMAL ELECTRIC GENERATION
2,500
2,000
1,500
1,000
500
0
Thousands of Acre-feet per Year
1970
1980
1990
2000
2010
2020
Year
Cooling towers installed on all thermal generation plants constructed after 1980
Cooling towers installed on all thermal generation plants including those constructed prior to 1980
SOURCE: Nebraska Power Industry Committee

The gross water diversions, including ground water withdrawals, in 1980 for cooling condensers to generate 20,564,700 MWH of energy are estimated at 1,986,300 acre-feet. Almost 1,584,100 acre-feet of water will be diverted from the Missouri River to supply the needs of the power plants in the vicinity of Omaha and Brownville; 40,200 acre-feet of water will be withdrawn from the irrigation canal operated by the Central Nebraska Public Power and Irrigation District; less than 1,000 acre-feet of water will be diverted from the Little Blue River at Fairbury; and almost 338,800 acre-feet of water will be diverted from the Platte River to supply the needs of the power plant to be constructed near North Platte. About 17,600 acre-feet of ground water withdrawals will be from wells in and near Grand Island and Scottsbluff for flow-thru plants in these areas and about 4,700 acre-feet will be required to make up consumption losses of plants with cooling towers.

The diversion, including ground water withdrawals, required for 2000 and 2020 power and energy requirements will depend upon the type of cooling utilized. If all thermal generation is in plants with cooling towers (one of the assumptions) the diversion requirements, including ground water withdrawals, would decrease to 116,900 acre-feet by 2000 and then increase gradually to 358,000 acre-feet by 2020 (Table 36 and Figure 10, lower line).

This situation is not likely to exist. It appears that some flow-thru cooling units will remain in operation through 2020. If all present and future systems to 1980 operate through the projection period with their present or planned types of cooling and if the growth requirements beyond 1980 are supplied by plants with cooling tower-type units, the amount of diversion required will be about 2,080,000 acre-feet by 2000 and 2,321,000 acre-feet by 2020 (Figure 10, upper line). The actual diversion is expected to fall between 116,900 and 2,080,000 acre-feet by 2000 and between 358,000 and 2,321,000 by 2020, with the most likely amounts nearer the larger quantities.

As demands for water approach the available quantities and more stringent water quality standards are enacted, more cooling units with lower diversion requirements will be installed. The possibilities include dry-type cooling towers and new methods of generation which would eliminate the conventional heat cycle, thus doing away with the need for cooling water.

CHAPTER 10. FISH AND WILDLIFE

The purpose of fish and wildlife management is to perpetuate and enhance fish and wildlife resources for recreational, aesthetic, and scientific uses--both consumptive and non-consumptive. This chapter summarizes information contained in Outdoor Recreation - A Comprehensive Plan (1968) prepared by the Nebraska Game and Parks Commission and supplementary unpublished material also furnished by that agency. The need for additional hunting and fishing opportunities is discussed in Chapter 11, Outdoor Recreation.

Water Habitat

Bodies of water larger than 40 acres and streams over 1/8 mile wide provide about 705 square miles of water surface area within the State.1/ However, not all of this area may be of value to fish and wildlife. Major reservoirs are located in the Republican River Basin in the southwest, along the Platte River in the westcentral, in the Niobrara River Basin in the northwest, and on the Missouri River in the northeast. Almost all of the natural lakes are located in the Sandhills area. Major rivers in the State are the Missouri, Niobrara, Elkhorn, the Loup system, Platte, Republican, and the Big Blue. There are also many smaller rivers and streams, particularly in the eastern and southern portions of the State.

Fishery

The five major types of water that contribute to sport fishery are reservoirs, natural lakes, streams, farm ponds and grade stabilization structures, and gravel pits.

Reservoirs furnish fair to excellent fisheries of walleye, white bass, channel catfish, crappie, largemouth bass, bluegill, and yellow perch. Selected reservoirs provide fishing for trout, coho salmon, striped bass, and smallmouth bass. Nearly all reservoirs contain high populations of rough fish including carp, carpsucker, and gizzard shad. The primary management problems involve fluctuation of the water levels.

Natural lakes which have sufficient depth and chemical characteristics are highly productive and can support excellent populations of northern pike, largemouth bass, bluegill, yellow perch, bullhead, and carp. Major problems stem from the shallow nature of the lakes plus heavy vegetative growth. The high productivity of these lakes has resulted in some summer and periodic winter kill.

Streams primarily support warm water fisheries. Trout fishing is a popular activity, but highly restricted in potential. Cold water fisheries for rainbow, brown, and brook trout are limited and confined

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1/ Area Measurement Reports, Bureau of the Census, June, 1967.

primarily to the northern and western portion of the State. Warm-water streams support mainly channel catfish, carp, and bullhead fisheries with a few stream reaches supporting walleye, sauger, white bass, northern pike, and largemouth bass. Factors which affect production are sediment and other pollutants, channelization, direct diversions, irrigation return flows, and storage in and releases from reservoirs.

Most farm ponds primarily produce largemouth bass, bluegill and channel catfish. However, lack of proper management has caused many ponds to become overpopulated with carp and bullheads.

Most gravel pits are being managed for production of either largemouth bass, bluegill, and channel catfish; or smallmouth bass, rock bass, and channel catfish. Other pits contain mixed populations of game and rough fish. The major factor limiting production is stratification. Lack of circulation of the water in deep pits prevents replenishment of oxygen as it is used up.

The fishing capacity of the waters of the State were inventoried by the Nebraska Game and Parks Commission in 1966. Fishing capacity is a measure of both the quality, or productivity, and the quantity of the fishery resource. The distribution of existing fishing capacity as well as fishing use of Nebraska waters are shown by river basins in Attachment 5.

Migratory Waterfowl

Waterfowl resources with the exception of the Sandhills area are handicapped by the lack of sufficient natural wetlands or developed facilities. The acreage of wetlands in Nebraska by type as based upon the standards Classification of Wetlands in the U.S., 1953, are shown in Table 37.

TABLE 37

ACREAGE OF WETLANDS IN NEBRASKA

Type	Approximate Acreage
1 Seasonally flooded basins	a/
2 Fresh meadows	32,450
3 Shallow fresh marshes	37,000
4 Deep fresh marshes	56,540
5 Open fresh waters	60,180

a/ Acreage not available

Source: Nebraska Game and Parks Commission, 1970

Data collected by the Nebraska Game and Parks Commission during the past several years show that approximately one-fourth of the original statewide wetland acreage has been lost. More than one-half of the losses have occurred in the rainwater basin area. More important than the acreage of wetlands lost in this region is the 87% reduction in the number of wetlands. The production value of scattered small wetlands cannot be over-emphasized. They provide for greater dispersion of nesting and maintain essential isolation between breeding pairs.

These wetlands reach their greatest importance as production habitat and resting areas during migration. During the fall migration, prior to freezeup, most of the recreational waterfowl hunting occurs on natural wetlands. In the spring, due to Nebraska's position in the flyway, these provide the first major staging grounds enroute to the northern breeding areas. The importance of the spring stopover is enhanced by the abundance of high quality feed left in the fields from the previous fall's grain harvest. The birds enter the breeding season in good physical condition, an important factor in reproductive success. Production habitat is the most limited duck habitat in the flyway. Nebraska's wetlands accommodate over 200,000 breeding ducks on an average annual basis. General areas of the State containing habitat that is of high value to ducks are shown in Figure 11.

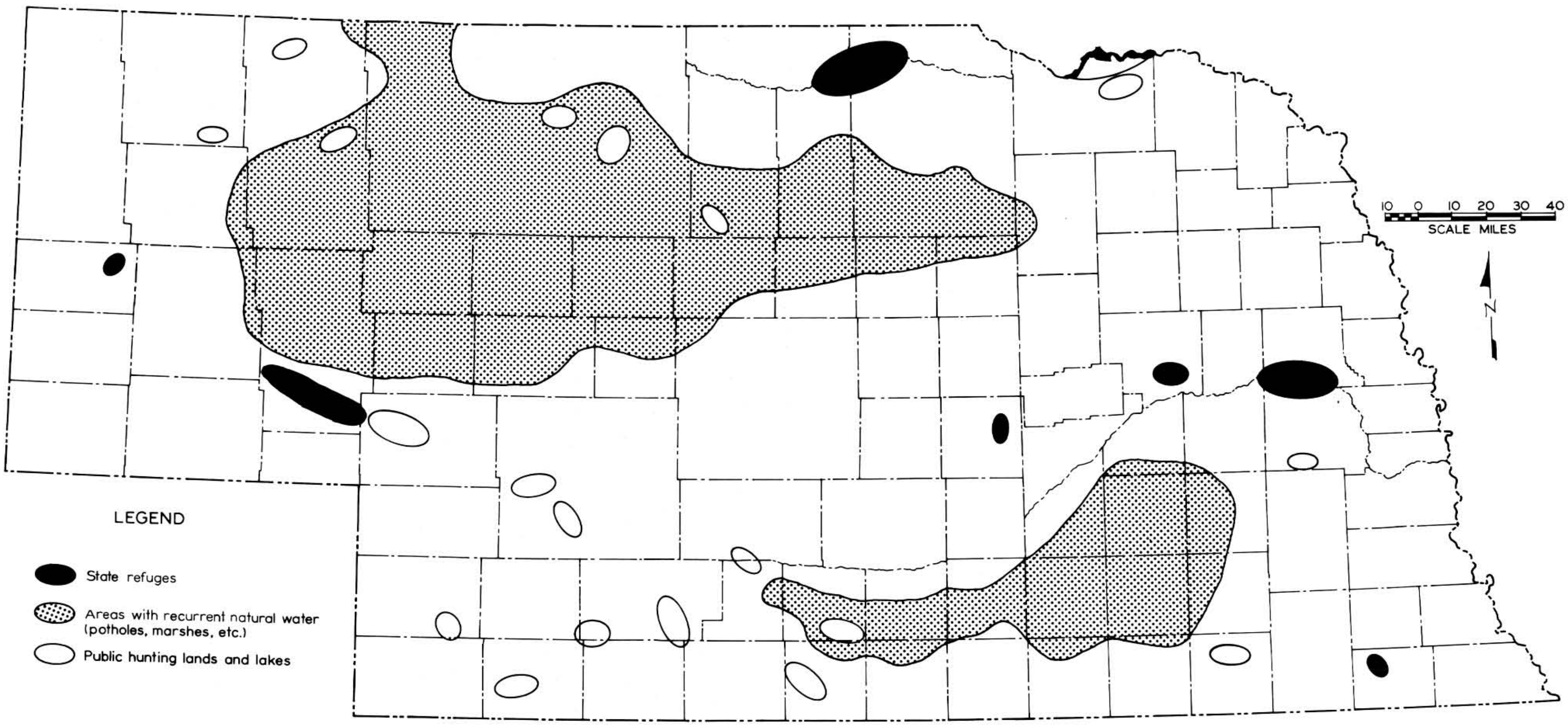
Sixty-two publicly owned areas in the State containing about 160,000 acres are managed primarily for waterfowl purposes. Of these, 21 areas containing 18,227 acres are managed by the Nebraska Game and Parks Commission and four areas containing about 128,000 acres are wildlife refuges managed by the U. S. Bureau of Sport Fisheries and Wildlife. The remaining 37 areas totalling 12,274 acres were recently acquired by the Bureau of Sport Fisheries and Wildlife in the rainwater basin area of southcentral Nebraska. These areas were obtained as a part of a program to purchase and manage selective waterfowl production areas.

The unique Sandhills area is extremely valuable for waterfowl, especially ducks. During normal years when the water table is high and most depressions are full, duck production is high. Although periodic drying up of the water areas reduces use, it also creates and maintains desirable habitat through initiation of new plant successions and invertebrate interruptions.

Other important wetland complexes are located along the Platte and Missouri Rivers, and in the rainwater basin area of southcentral Nebraska. The accelerated stockpond construction and watershed development during the last 20 years has improved the waterfowl habitat in areas without natural wetland areas.

A large variety of migratory waterfowl pass through the State each spring and fall. The most prominent are mallards, pintails, blue-winged teal, and snow, blue, Canada, and white-fronted geese. The Platte Rivers and adjacent fields from Lewellen to Grand Island historically constitute the most important staging area in the Midwest, and perhaps the country, for Sandhill cranes during their spring migration. Recent populations in this area have reached 240,000 birds with the greatest concentrations occurring between Kearney and Lexington.

PRIMARY WATERFOWL HABITAT



SOURCE: Outdoor Recreation-A Comprehensive Plan
Nebraska Game and Parks Commission

Fig. 11

Wintering waterfowl are mostly mallards and Canada geese, and nesting waterfowl are primarily teal and mallards. An estimate of migratory waterfowl wintering and breeding in the State is shown in Table 38.

Furbearing Animals

Beaver, muskrat, and mink together with several other species of furbearers occupy all suitable water areas in the State. These species constitute an important resource for the 18,000 to 20,000 trappers who annually harvest between 100,000 and 200,000 pelts. In addition to being of interest to trappers, furbearing animals contribute significantly to the general outdoor scene for the hiker, photographer and all others who enjoy the outdoors.

Shorebirds

Snipe, rail, and a great variety of other shorebirds depend upon the state's water areas for their sustenance. These species, although not of major importance for hunting, are an integral part of the ecology of each wetland area.

Upland Game and Big Game

Pheasants and deer, both highly prized wildlife species, rely on the marsh cover associated with wetlands. This type of habitat provides a variety of cover needs for game bird roosting, loafing, nesting, and brooding chicks.

Data from a five-year study near Clay Center on the life history and ecology of the ring-necked pheasant shows the importance of this habitat type to pheasants. Vegetation associated with wetlands occurred on an average of 14.6 percent of the study area. Approximately 10 percent (about 70 percent of the wetland area) was used for pasture and hay while the remainder was not used for agricultural production. During the study 7 to 37 percent of all nests initiated were located in the wetland cover type with a five-year mean of 25 percent. Chick production from vegetation associated with wetlands constituted 25 percent of the total pheasant production on the study area.

Water Quality

The water quality in most streams, lakes, and reservoirs under normal conditions is adequate for the production of fish and wildlife. Pollution, however, is an increasing problem adversely affecting these resources. Pollutants may result from municipal and industrial wastes or from agricultural practices producing pesticides, agricultural chemicals, and wastes from livestock feeding operations. Sediment is considered the most widespread pollutant adversely affecting fish production, especially outside the Sandhills where cropland occupies a high percentage of the total land area.

TABLE 38

ESTIMATED NUMBER OF WINTERING AND BREEDING
WATERFOWL IN THE STATE

	Wintering	Breeding
Canada Geese	9,000	*
Mallards	258,000	49,000
Pintails	*	9,000
Teal	*	65,000
Shovelers	*	12,000
Gadwalls	*	12,000
Others	37,000	7,000
STATE TOTAL	304,000	154,000

* Very few, included with "Others"

Source: Nebraska Game and Parks Commission, 1970

Future Needs

Fisheries

The demand for fishing activity is expected to increase almost 70 percent over present demand by 2000 (Chapter 11, Outdoor Recreation). Most of the increase will come in the Omaha and Lincoln areas with about 120 and 90 percent increases expected respectively. These areas also have the greatest deficiencies under present conditions. Most of the remaining areas of the State are expected to exhibit small to moderate increases in demand.

Streams and natural lakes are not subject to large increases in fish production under present water policies of the State. Reduction of pollution and regulation of streamflow and developments to improve habitat will be required to maintain the present rate of production. The primary potential for increasing fish production lies in construction of multipurpose reservoirs and farm ponds.

Wildlife

The well-being and relative abundance of all wildlife species are affected in varying degrees by land use changes. While most of these changes result from individual actions stemming from economic factors, some result either directly or indirectly from assistance provided by the state or federal governments. The principal effect resulting from land use changes is normally a reduction in essential interspersion of habitat types. A partial list of these and the primary wildlife they may affect includes:

1. Woodland-shrub associations interspersed with cropland - bobwhite quail.

2. Riparian woodlands - forest game, including deer and squirrels.

3. Grass-forb associations interspersed with cropland - farm game including pheasants and rabbits.

4. Wetlands, primarily types 3, 4 and 5 - waterfowl, shorebirds, pheasants, deer, and furbearing animals.

Protection of Rivers

A few rivers or portions of rivers in the State still retain to a large degree their historic flow and natural shoreline characteristics. They are now of particular value to fish and wildlife, largely because there are so few remaining quasi natural stream reaches that have escaped many of the effects of man's developments, e.g. channelization, irrigation and power diversions, and water quality degradation. These stream reaches are also valuable for the unique recreational, scientific, cultural, environmental, and aesthetic values they possess.

Rivers possessing particularly valuable natural characteristics should be preserved in their existing free flowing, natural condition in order to preserve these values. Some may meet minimum federal standards as wild or scenic rivers. But whether or not they measure up to these standards, they should be given consideration for protection in a system of state scenic and recreation rivers, possibly through the use of flood plain zoning or easements to preserve the existing riparian lands. The following rivers or reaches of rivers of especially high significance should be investigated for possible protection.

1. Niobrara River - from its confluence with Antelope Creek downstream to the headwaters of the proposed Norden Reservoir, including the lower 8 miles of the Snake River tributary.

2. Snake River - from its headwaters to the headwaters of Merritt Reservoir.

3. North Loup River - from its headwaters to 18 miles west of the Taylor Diversion Dam.

4. Middle Loup River - from its headwaters to the Milburn Diversion Dam.

5. Dismal River - from its headwaters to its mouth.

6. Missouri River - from Lewis and Clark Reservoir west and north along the Nebraska border.

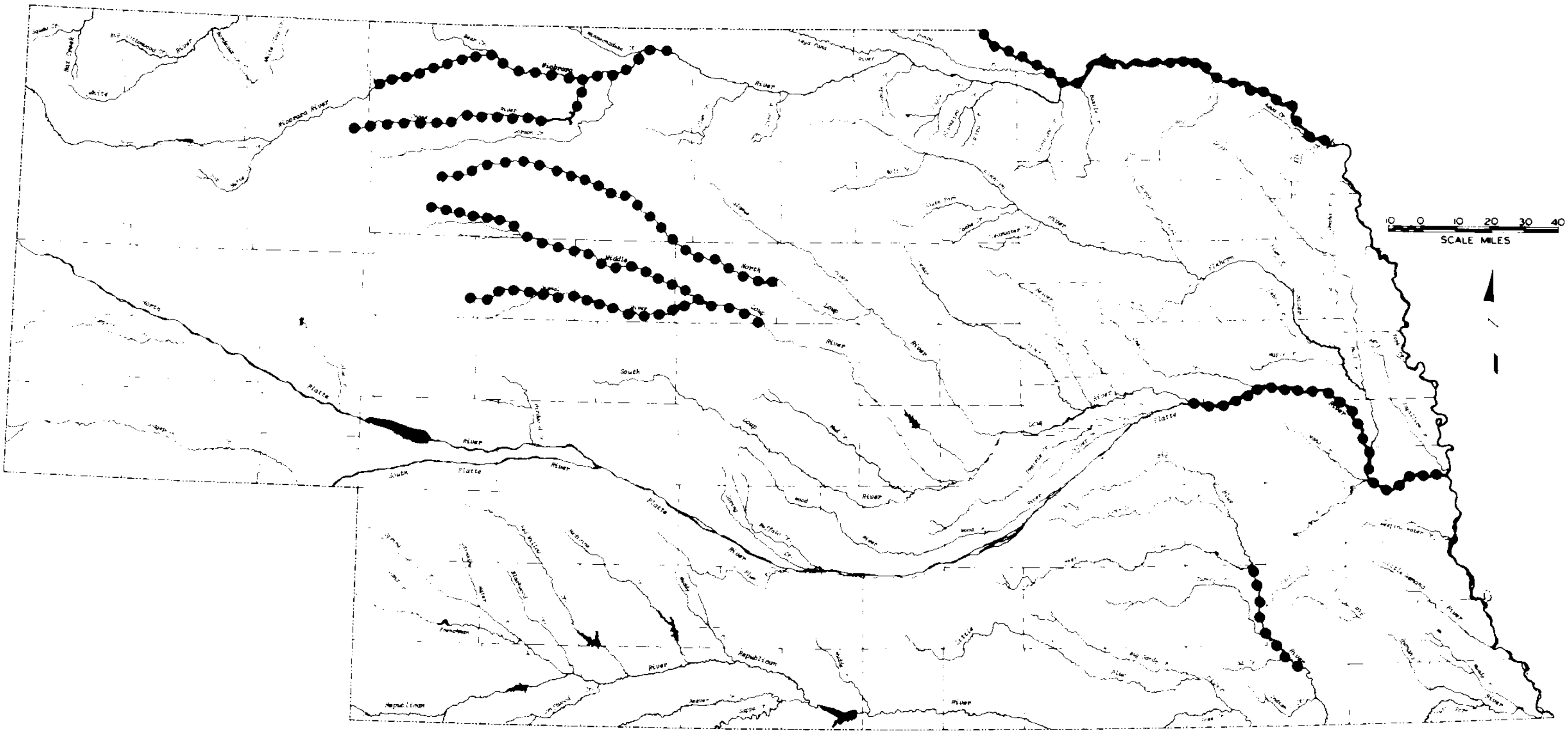
7. Missouri River - from Yankton to South Sioux City.

8. Platte River - from the mouth of the Loup River to the confluence of the Missouri River.

9. Big Blue River - from Crete to Beatrice.

These stream reaches are delineated in Figure 12. The reach of the Niobrara and lower Snake Rivers shown is presently being considered for preservation as a wild river by the Federal Government under the Wild and Scenic Rivers Act of 1968.

STREAM REACHES WITH POTENTIAL FOR DESIGNATION AS WILD, SCENIC OR RECREATION RIVERS



Source: Nebraska Game and Parks Commission

Fig.12

CHAPTER 11. OUTDOOR RECREATION

This section is limited to an appraisal of the problems pertaining to and the needs for water-oriented outdoor recreation facilities. The needs for swimming pools in urban areas, the development of which depends upon restricted local demand, is not included.

The report, Outdoor Recreation-A Comprehensive Plan, published by the Nebraska Game and Parks Commission in 1968 provides nearly all the information contained in this discussion. Much of this section is quoted directly from the Game and Parks Commission report.

Present Use

Demand for Outdoor Recreation

Participation in outdoor recreation has been increasing rapidly in the past few years. According to the Outdoor Recreation Resources Review Commission (ORRRC), demand is expected to triple before the turn of the century. The major factors responsible for this steady and rapid rise in the demand for outdoor recreation facilities are:

(1) growing population,

(2) increasing urban concentration of population,

(3) increasing family income,

(4) increasing leisure time,

(5) increasing mobility of the population, and

(6) increasing recreational opportunities.

In estimating recreation demand a population analysis was made on a statewide scale and also by hypothetical "socio-economic areas" as shown in Table 39. The population projections used were current at the time the outdoor recreation report was prepared but may vary slightly with later projections used in this appendix. The various factors affecting per capita recreation demand such as economic growth, leisure time, mobility, and people's interests were treated on a statewide basis.

The concept of "socio-economic areas" (SEA's) is based on the idea that there are various regions in the State which include a central city and a large enough natural economic area surrounding it to support an acceptable level of facilities, goods and services.1/ Fourteen areas were delineated as shown in Figure 13 and projections made for each area.

1/ Land and People in the Northern Plains Transition Area; Ottoson, Howard W., Eleanor Birch, and Philip A. Henderson; University of Nebraska Press, 1965.

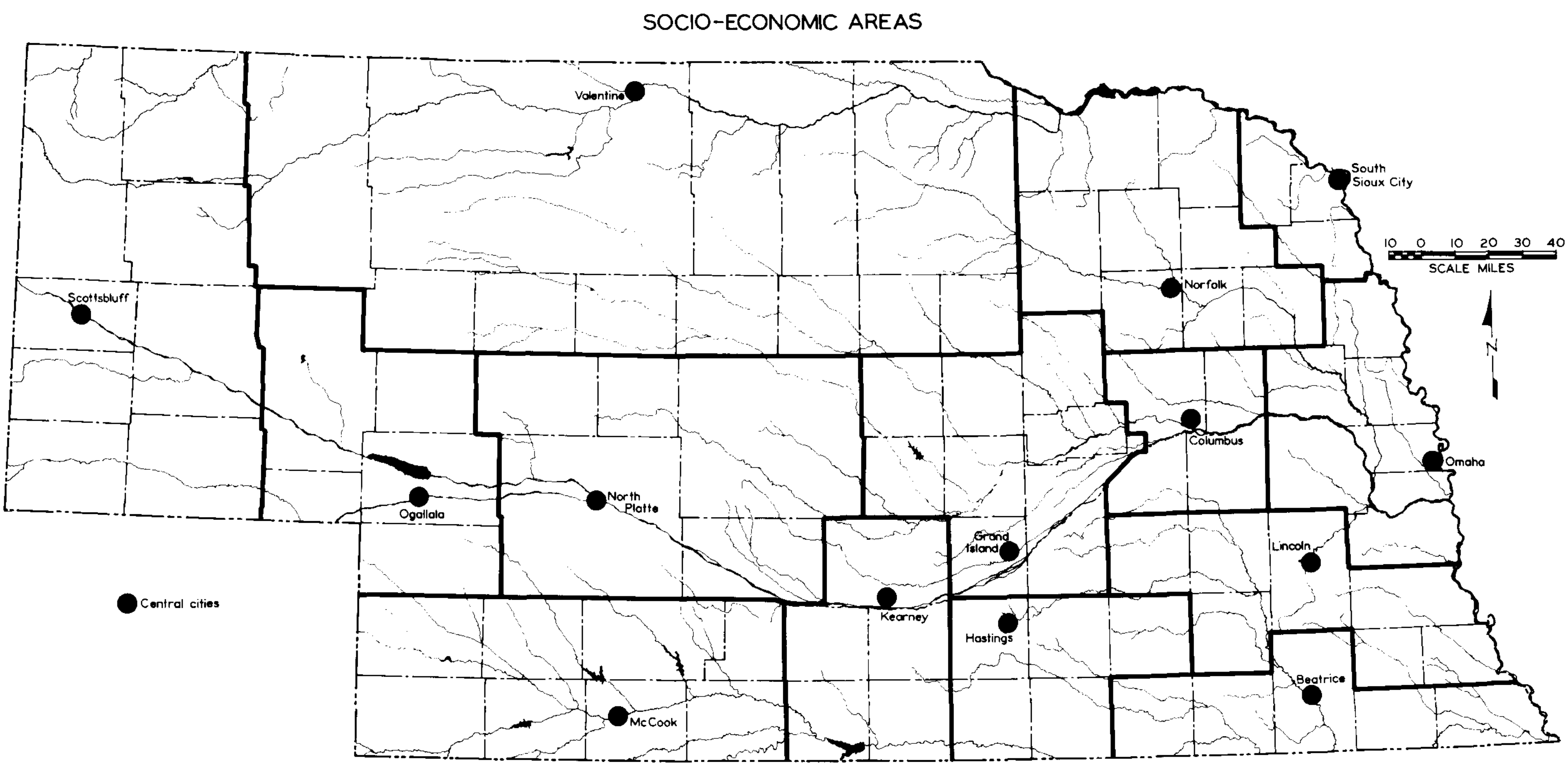
TABLE 39

CHARACTERISTICS OF SOCIO-ECONOMIC AREAS OF NEBRASKA -- PRESENT AND PROJECTED

Central City	No. of Counties	Area[a/] (Sq. Miles)	% of Total Area	Population 1966 Total[b/]	Population 1966 %	Population 1985 Total	Population 1985 %	% Change
South Sioux City	3	1,123	1.46	28,056	1.85	29,345	1.5	+ 4.6
Omaha	7	3,279	4.28	548,225	36.16	829,727	43.3	+ 51.3
Lincoln	7	3,962	5.17	247,308	16.31	343,897	17.9	+ 39.1
Beatrice	5	2,993	3.91	63,296	4.18	48,525	2.5	- 23.3
Norfolk	8	5,291	6.91	101,158	6.67	105,490	5.5	+ 4.3
Columbus	4	2,092	2.73	53,286	3.51	60,800	3.2	+ 14.1
Grand Island	9	4,945	6.45	93,325	6.16	101,078	5.3	+ 8.3
Hastings	5	2,863	3.74	62,631	4.13	67,897	3.5	+ 8.4
Kearney	5	3,141	4.10	53,800	3.55	60,225	3.1	+ 11.9
McCook	8	6,103	7.97	40,284	2.66	38,360	2.0	- 4.8
North Platte	5	7,489	9.78	66,636	4.40	72,309	3.8	+ 8.5
Ogallala	5	4,783	6.24	18,861	1.24	17,262	0.9	- 8.5
Valentine	14	19,024	24.83	51,399	3.39	40,278	2.1	- 21.6
Scottsbluff	8	9,524	12.43	87,809	5.79	103,380	5.4	+ 17.7
STATE TOTAL	93	76,612	100.00	1,516,074	100.00	1,918,573	100.0	+ 26.5

a/ Source: The World Almanac 1967, Newspaper Enterprise Assn., Inc., 1966, page 371 (large water areas not included)

b/ Source: Business in Nebraska, Bureau of Business Research, University of Nebraska, April, 1967



SOURCE: Land and People in the Northern Plains Transition Area
Ottoson, Birch, and Henderson, 1965

Fig. 13

The state's population distribution is extremely irregular. As of the 1960 census, the fourteen counties included in the Lincoln and Omaha SEA's had about one-half the state's population but occupied less than ten percent of the state's land area. In contrast, the 14-county Sandhills area (Valentine SEA) contains less than four percent of the state's population on approximately one-fourth of the total land area. To a certain extent, population concentrations follow major river courses. Large rivers can be easily delineated by observing the groupings of cities and towns. A large portion of Nebraska's population is concentrated in the eastern one-third of the State and within the Platte Valley. High density in the Omaha region is especially apparent.

Nebraska has experienced a relatively slow rate of growth in comparison to the national rate. Only three regions, Omaha, Lincoln, and Scottsbluff SEA's, have shown a total increase in population for the period 1920 to 1960. A decrease in rural populations as opposed to an increase in urban numbers was generally exhibited. Although most of the socio-economic areas decreased or remained stable in population, individual cities and towns within various regions often increased. Certain rural communities have also shown a modest increase.

A greater rate of growth is expected during the period of 1966 to 2000 than previously experienced. It is estimated that Nebraska's population will increase by 26.5 percent from 1966 to 1985. If past trends continue, approximately 73 percent of the 1985 Nebraska population will be urban (including urban fringe areas) as compared to 54 percent in 1960. The Omaha, Lincoln and Scottsbluff SEA's will account for most of Nebraska's net population increase for the period 1966 to 1985.

Hunting and fishing have traditionally been popular with Nebraskans. In 1966, 188,493 hunting licenses and 198,606 fishing licenses were sold to residents. It is estimated that over 35 percent of the male population over age 16 purchased hunting and/or fishing licenses that year.

Boating activities are expanding rapidly. The number of registered motor boats has increased by 51 percent from 1960 to 1966.

In 1967, 4,869 parties representing about 16,000 people visiting twelve selected reservoirs were interviewed to determine their participation in selected activities. The results are shown in Table 40.

Water Supply and Capacities for Recreational Use

About 705 square miles of surface water area are provided within the State by bodies of water larger than 40 acres and streams over 1/8 mile wide.2/

2/ Area Measurement Reports, Bureau of the Census, June, 1967.

TABLE 40

PARTICIPATION IN SELECTED ACTIVITIES BY PARTIES INTERVIEWED AT TWELVE SELECTED NEBRASKA RESERVOIRS SURVEYED DURING THE SUMMER OF 1967

Outdoor Recreation Activities	Percent of Respondents Indicating Each as Primary Activity	Percent of Respondents Indicating Each as Secondary Activity	Percent of Respondents Indicating Each as Primary and/or Secondary Activity
Fishing	29.1	8.4	37.5
Sightseeing	28.8	7.4	36.2
Swimming	11.7	11.6	23.3
Boating	8.1	12.6	20.7
Camping	6.7	9.0	15.7
Picnicking	6.5	10.4	16.9
Water-skiing	4.4	5.7	10.1
Hiking	0.3	1.0	1.3
Nature Study	0.1	0.3	0.4
Horseback Riding	0.0	*	*
Other	4.3	1.6	5.9

* Less than 0.1 percent

Source: <u>Outdoor Recreation - A Comprehensive Plan</u>, Nebraska Game and Parks Commission, 1968 (Corrected)

Major watercourses include the Missouri, Niobrara, Elkhorn, the Loup system, Platte, Republican, and Big Blue Rivers. Size and depth of water limit recreation activities on all but the Missouri River. Here, opportunity for pleasure boating with powered crafts is substantial and limited only by access and facilities. Opportunity for non-power boating on other streams is largely limited to portions of the Niobrara, Elkhorn and Loup Rivers because of inadequate stream depth.

Although pleasure boating on streams is limited mostly to the Missouri River, development of an extensive reservoir system for flood control, power, and irrigation, particularly in the southwest, has opened a mecca for pleasure boating and other water-oriented activities requiring relatively large bodies of water.

The supply of surface water is shown in Table 41. Stream classes for recreational purposes are defined as follows:

Class 1 - Streams with national as well as statewide value

2 - Streams with statewide value

3 - Streams of value to large districts of the State

4 - Streams of value to smaller districts such as counties

5 - Streams of restricted local value

Fishing

The five major types of water that contribute to the sport fishing in Nebraska are reservoirs, natural lakes, streams, farm ponds and grade stabilization structures, and gravel pits. Nearly all reservoirs, about half the natural lakes, and a small percent of the gravel pits are open to public fishing. The great majority of streams, farm ponds, and grade stabilization structures are private.

Fishery resources were inventoried in 1966 by socio-economic area. The inventory does not include gravel pits and reservoirs created under the P.L. 566 watershed program. Streams and standing waters were classified for fishing on the basis of present conditions concerning aesthetics, use, availability, and productivity. On the basis of these factors, several classes for streams and lakes were developed and assigned appropriate capacities in angler trips.

Fishing capacity of various waters as shown in Table 42 is an estimate of the angler use in fisherman trips that the water could sustain and still provide a quality fishery under a reasonable level of management. Capacity of a particular body of water in man days of fishing is a relative measure and is dependent upon how much success or lack of success the average fisherman will or should be expected to tolerate. Lowered productivity, and thus lowered capacity, occurs on stream systems which are subject to siltation, diverted for irrigation and power production, polluted, and channelized. Productivity of some standing waters

TABLE 41

EXISTING SUPPLY OF SURFACE WATERS
(1967)

Socio-Economic Area	Stream Mileage by Class					Surface Acreage of Standing Water[a]			
						Reservoirs			
	1	2	3	4	5	Over 1,000 Acres	Under 1,000 Acres	Farm Ponds	Natural Lakes
South Sioux City		36	39	233			500	421	
Omaha			198	509	43		724	1,306	
Lincoln				693		1,800	2,586	2,812	
Beatrice			96	474	13		255	2,315	
Norfolk		32	130	419		7,349	60	2,329	
Columbus			18	257	2		1,114	522	
Grand Island				737		2,680	175	1,398	
Hastings			34	239			59	1,534	
Kearney				238		13,468	364	806	
McCook				807		10,085	120	313	
North Platte				397		7,661	1,752	258	
Ogallala			32	140		35,000	320		3,372
Valentine			166	1,860		2,700	370	1,913	22,775
Scottsbluff			193	808	9	3,758	1,192	636	
STATE TOTAL		68	906	7,811	67	84,501	9,591	16,563	26,147

a/ Surface area of private gravel pits and watershed (PL 566) structures not estimated

Source: Outdoor Recreation - A Comprehensive Plan, Nebraska Game and Parks Commission, 1968

TABLE 42

CAPACITY OF FISHING WATERS IN ANNUAL FISHERMAN VISITS

Streams	Capacity per mile	Standing Waters	Capacity per Surface Acre
Class 1	500	Reservoirs	
2	250	over 1,000 acres	25
3	150	under 1,000 acres	40
4	25	Private Farm Ponds	25
5	0	Natural Lakes	60

Source: Outdoor Recreation - A Comprehensive Plan, Nebraska Game and Parks Commission, 1968

is variously affected by siltation, water level fluctuation, pollution, stratification, and eutrophication.

Estimated capacity of the fishery resources by type and socio-economic area is summarized in Table 43. The state totals in this summary serve to point out the relative importance of the different types of water. Reservoirs over 1,000 acres and natural lakes are of major importance, comprising 44 percent and 33 percent of the total estimated capacity respectively. Farm ponds account for 8.6 percent of the total estimated capacity, reservoirs less than 1,000 acres for 7.6 percent, and streams for 7.2 percent.

Distribution of estimated capacity by socio-economic areas is of particular importance. Over 55 percent of the capacity occurs in the Valentine and Ogallala SEA's, accounting for 32.6 percent and 22.9 percent of the capacity, respectively. Approximately 80 percent of the estimated capacity in the Ogallala SEA is derived entirely from one body of water -- Lake McConaughy.

Hunting-Migratory Waterfowl

Waterfowl hunting has been a traditional outdoor recreation pursuit for large numbers of Nebraskans for many years. Recent declines in continental waterfowl populations, however, have drastically altered the status of waterfowl hunting in Nebraska.

A summary of waterfowl harvests and participation is shown in Table 44. These trends amply reflect participation and supply of waterfowl for recreational hunting during recent years. The waterfowl harvest declined from 697,054 ducks and 12,499 geese in 1957, to 151,795 ducks and 13,655 geese in 1965. During the same period, the number of active waterfowl hunters declined from 64,100 in 1957 to 18,114 in 1965. The average annual duck harvest for the three-year period from 1957 to 1959 was 482,695 as compared to 194,472 from 1964 to 1966. The average annual goose harvest during these periods also declined, but much less than the duck harvest.

TABLE 43

ESTIMATED ANNUAL CAPACITY OF FISHERY RESOURCES EXPRESSED AS FISHERMAN TRIPS (1967)

Socio-Economic Area	Streams	Reservoirs over 1,000 Acres	Reservoirs and Public Pits Under 1,000 Acres	Private Farm Ponds	Natural Lakes	Total[1/]
South Sioux City	20,625	None	20,000	10,525	None	51,150
Omaha	43,375	None	28,960	32,650	None	104,985
Lincoln	17,325	45,000	103,440	70,300	None	236,065
Beatrice	26,250	None	10,200	57,875	None	94,325
Norfolk	37,975	183,725	2,400	58,225	None	282,325
Columbus	9,125	None	44,560	13,050	None	66,735
Grand Island	18,425	67,000	6,960	34,950	None	127,335
Hastings	10,975	None	2,320	38,350	None	51,645
Kearney	5,950	336,700	14,560	20,150	None	377,360
McCook	20,175	257,000	4,800	7,825	None	289,800
North Platte	10,800	191,525	53,800	6,450	None	262,575
Ogallala	8,300	875,000	12,800	1,650	202,320	1,100,070
Valentine	71,400	67,500	14,800	47,825	1,366,500	1,568,025
Scottsbluff	44,325	84,500	47,680	15,900	None	192,405
STATE TOTAL	345,025	2,107,950	367,280	415,725	1,568,820	4,804,800

1/ Private gravel pits and watershed (PL 566) structures not included

Source: Outdoor Recreation - A Comprehensive Plan, Nebraska Game and Parks Commission, 1968 (Revised after publication)

TABLE 44

HUNTERS AND WATERFOWL HARVESTS FOR THREE HIGH YEARS AND THREE LOW YEARS

	High Years			3-Year	Low Years			3-Year
	1957	1958	1959	Average	1964	1965	1966	Average
Hunters	64,100	56,200	41,100	53,800	25,349	18,114	28,453	23,972
			------ Waterfowl Harvested ------					
Ducks	697,054	445,172	305,860	482,695	176,683	151,795	254,939	194,472
Geese	12,499	22,343	15,900	16,914	13,617	13,655	15,505	14,259
Snipe	2,500	3,654	5,084	3,746	3,448	1,823	2,278	2,516

Source: Outdoor Recreation - A Comprehensive Plan, Nebraska Game and Parks Commission, 1968 (Revised after publication)

The basic cause of the sharp decline of hunters and annual waterfowl harvest was the reduced flyway population of ducks due to continued drouth on the breeding grounds. This in turn was reflected in unattractive restrictive seasons and reduced hunting opportunity. Some of these factors are temporary, and participation should increase as the waterfowl population recovers and seasons become more attractive.

Distribution of hunting activity and hunting success by regions is shown in Table 45. Nineteen-sixty data was used since it is more representative than that from the temporarily restrictive seasons of recent years.

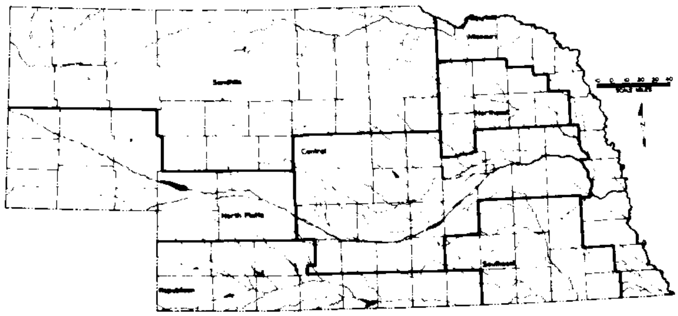
Waterfowl hunting opportunity, as well as production, is dependent on available water and wetland areas. Streams and rivers, potholes of southcentral Nebraska, reservoirs, natural lakes of the Sandhills, and farm ponds provide the available water area for waterfowl hunting in Nebraska. Distribution of the primary harvest areas was shown in Figure 11.

Not all of the shaded areas shown in Figure 11 are important waterfowl harvest areas. The shaded sandhills region in the northcentral part of the State has large sections void of lakes and wetlands. A large part of the Sandhills is not accessible to hunters due to lack of roads. Other portions are closed to public hunting by the landowners. Because of the large number of lakes and wetlands, however, this expansive area provides excellent early season hunting and is an important harvest area.

The rainwater basin area in southcentral Nebraska is an important harvest area during years of normal or above normal rainfall. The number of potholes was once far more numerous than today. About 85 to 90 percent of the original potholes have been lost to drainage, land

TABLE 45

DUCK HARVEST DATA BY REGION - 1960 SEASON



	Region						
	Sandhills	North Platte	Republican	Central	North-east	South-east	Missouri
% of Hunters	14.7	17.7	5.7	27.7	2.7	16.4	15.2
% of Days	9.8	19.2	4.6	30.3	3.4	15.1	17.5
% of Ducks	15.8	23.4	4.6	22.5	1.9	19.0	12.7
Ave. Season Bag	7.9	9.7	6.0	6.0	5.3	8.6	6.2
Ducks/day	1.64	1.24	1.02	0.75	0.57	1.28	0.74

Source: Outdoor Recreation - A Comprehensive Plan, Nebraska Game and Parks Commission, 1968

leveling and siltation. Most potholes are highly accessible, but few private potholes are available for public waterfowl hunting.

The primary stream harvest areas are the Missouri River, particularly in the northeast and immediately north of Omaha (especially for geese); the Platte River system, especially adjacent to the Dodge-Saunders Counties Refuge, in the Kearney-Lexington area along the North and South Platte Rivers near North Platte, and along the North Platte River from Lake McConaughy west to the Wyoming state line; and the lower reaches of the Loup River in Howard and Nance Counties.

Most of the better waterfowl areas are leased by individuals or groups and are not available for public hunting. This is especially true along the Platte and Missouri Rivers and in parts of the rainwater basin area of southcentral Nebraska. The Sandhills still contain a number of waterfowl areas which are open to public hunting with permission. The principal problem areas for access are in the eastern one-third of the State.

Boating and Water-Skiing

Boating and water-skiing are considered together since facilities developed for boating will normally service water-skiers. Many of the facilities which service boaters on large reservoirs will also meet some of the needs for development of the fishing potential.

Boating has grown by leaps and bounds in Nebraska. In 1960, the first year for which data became available, 14,800 motorboats were registered in the State. By 1966, the number of motorboats registered had grown to 22,400, an increase of 51 percent in six years. Counties near reservoirs have more boat owners per capita than other counties, illustrating the interaction of opportunity and demand expressed as participation. Lancaster and Gage Counties registered the greatest increase in boat owners during 1964 as a direct result of the increased boating opportunity offered by the Salt Valley Reservoirs completed at that time.

Twenty-one percent of the visitors interviewed by the Nebraska Game and Parks Commission at twelve reservoirs during the summer of 1967 indicated that they participated in boating (Table 40). Ten percent of those interviewed listed water-skiing as an activity in which they participated. Almost thirteen percent of the total interviewed indicated that either boating or water-skiing was the primary purpose of their visit to these reservoirs.

Present public facilities for boating (including water-skiing) are shown in Table 46. Some existing reservoirs and the Missouri River do not have sufficient access facilities to fully utilize the present resources.

Outdoor Swimming

Over 23 percent of those interviewed at the twelve reservoirs participated in outdoor swimming and nearly 12 percent listed this activity as the primary reason for their visit. High participation in swimming at reservoirs occurred in spite of the fact that very little development of swimming facilities has been made on these areas. Participation would undoubtedly be even higher if these areas were more fully developed. Public swimming beach facilities by socio-economic areas are shown in Table 46. Presently, there are only 48 sites developed for swimming.

Ice Skating

Ice skating is the most popular outdoor winter sport. Most of the present ice skating activity takes place in municipal areas although a

TABLE 46

SUMMARY OF PUBLIC BOATING AND SWIMMING FACILITIES
(1967)

Socio-Economic Area	Water Surface Area Acres	Boat Access		Swimming Beaches	
		Sites	Acres	Sites	Acres
South Sioux City	30	2	2	1	1
Omaha	1,945	12	15	6	13
Lincoln	4,513	10	29	3	8
Beatrice	285	2	2	0	0
Norfolk	7,450	6	7	3	2
Columbus	946	1	2	1	15
Grand Island	3,083	5	17	5	5
Hastings	102	1	1	0	0
Kearney	13,188	2	2	4	4
McCook	12,255	15	57	4	9
North Platte	7,416	4	4	6	7
Ogallala	36,620	4	5	5	73
Valentine	14,914	18	15	4	7
Scottsbluff	3,898	5	6	6	29
STATE TOTAL	106,645	87	164	48	173

Source: Outdoor Recreation - A Comprehensive Plan, Nebraska Game and Parks Commission, 1968 (Corrected) few non-urban areas are of importance. Verifiable figures on the present supply of public ice skating facilities are not available in the outdoor recreation plan of the Nebraska Game and Parks Commission.

Private Recreation Resources

Recreation facilities developed by private clubs and individuals contribute to the state's total recreation resources and complement the public facilities developed by political subdivisions and public agencies.

According to information provided by the Nebraska Conservation Needs Inventory, almost 400,000 acres of private lands and water are being used for outdoor recreation purposes. About 88,000 acres are water. Fee fishing is the primary enterprise on 28,600 acres of water, fee hunting on 5,500 acres, and other water sports on almost 28,000 acres. About 22,000 acres of water are contained in camping areas, and almost 3,900 acres in sites for vacation cabins, cottages, homes, and miscellaneous developments. The private waters have an estimated capacity of 8,900 swimmers, 4,300 fishermen, 780 water-skiers, and 270 boats. However, because these areas are not usually available to satisfy the recreation needs of the general public, these capacities were not used in the analysis of future water surface area needs in the remainder of this chapter except where they possibly are included in the inventoried fishing waters.

Water Quality

The quality of nearly all surface waters is adequate for water-based recreational activities. Pollution of streams and lakes is, however, an ever-increasing problem.

Water-Based Outdoor Recreation Needs

Needs for water-based outdoor recreation were estimated using standards, based upon the load design concept, established by the Nebraska Game and Parks Commission. These standards, except for fishing and ice skating, relate to peak season participation. The base figures on participation were derived from the ORRRC Study,[3/] Report 19, for the North Central Region of the United States. The population projections used to estimate recreation demands are shown in Attachment 6, Table 1. The standards for each activity are discussed in detail in the outdoor recreation report prepared by the Nebraska Game and Parks Commission and are summarized in Attachment 6, Table 2.

3/ Participation in Outdoor Recreation: Factors Affecting Demand Among American Adults, Outdoor Recreation Resources Review Commission, U. S. Government Printing Office, Washington, D. C., Report Nos. 19 and 20, 1962.

This study pertains to the water surface area requirements and does not consider all the land needed to make the water usable for the water-oriented recreation activities. It is recognized that the feasibility of many developments will depend upon the recreational quality of adjacent land which could or should become a part of a multiple use development. Facilities for land-oriented activities such as camping, picnicking and sightseeing complement and often greatly enhance water-oriented developments.

The needs are expressed in gross requirements and deficiencies in each of the water-oriented activities except for ice skating. No attempt is made to account for multiple use of the areas, even though it is recognized that this will take place.

Fishing

The total available fishing capacity of public and private waters in the State is 4,804,800 fisherman days. When compared to present gross demand, computed at 5,080,000 fisherman days, this indicates an almost balanced situation. The problem, however, is in the location of the supply (Attachment 6, Table 3). The eastern Nebraska socio-economic areas have big deficiencies, while central and western Nebraska socio-economic areas have large excesses in fishing capacity. The total need, demand less capacity, under present conditions is over 3,000,000 fisherman days. More than half the deficiency is in the Omaha SEA. It is recognized that some of these needs are being met in western areas, but because of the time-distance concepts, this amount will remain low. The deficiency would more than double by 2000 if the capacity remains constant.

Between about 75 and 120 thousand acres of additional fishing waters are needed to meet the present demand (1967). By 2000, approximately 165 to 265 thousand acres will be needed under present systems of water management. The deficiencies in fishing waters are summarized for 1972, 1980, and 2000 in Tables 47, 48, and 49.

Capacity of streams and natural lakes cannot be expected to increase appreciably in the future. It is apparent that the only substantial potential for significant increased fishing capacity lies in future construction of reservoirs and farm ponds.

The most significant opportunity to meet needs for additional fishing waters is the construction of multiple purpose reservoirs for which consideration is given to recreational development and public access. Participation in these projects should be related to the needs as shown in Tables 47, 48, and 49.

Reservoirs in southwestern Nebraska and natural lakes of north-central Nebraska are largely under-harvested. This is due primarily to distance from population centers. Improved roads and camping facilities are needed to encourage greater utilization of these areas.

TABLE 47

PROJECTED DEFICIENCIES IN WATER-BASED
OUTDOOR RECREATION FACILITIES IN 1972
(Acres of Surface Water)

Socio-Economic Area	Fishing[a/]	Boating	Water-Skiing	Swimming Beaches
South Sioux City	1,300 - 2,100	1,100	300	-
Omaha	43,900 - 70,300	30,600	20,800	18
Lincoln	15,800 - 25,300	9,800	5,000	6
Beatrice	3,300 - 5,200	2,100	500	2
Norfolk	1,800 - 2,900	-	-	2
Columbus	3,300 - 5,300	1,100	-	-
Grand Island	5,500 - 8,800	600	-	-
Hastings	4,900 - 7,800	2,600	800	3
Kearney	-	-	-	-
McCook	-	-	-	-
North Platte	-	-	-	-
Ogallala	-	-	-	-
Valentine	-	-	-	-
Scottsbluff	3,700 - 6,000	200	-	-
STATE TOTAL	83,500 - 133,700	48,100	27,400	31

a/ The smaller acreage will be needed if all future impoundments are less than 1,000 surface acres (estimated on the basis of a capacity of 40 fisherman days per acre annually) and the larger acreage is applicable if all future impoundments are greater than 1,000 surface acres (25 fisherman days per acre annually).

Source: Outdoor Recreation - A Comprehensive Plan, Nebraska Game and Parks Commission, 1968

TABLE 48

PROJECTED DEFICIENCIES IN WATER-BASED
OUTDOOR RECREATION FACILITIES IN 1980
(Acres of Surface Water)

Socio-Economic Area	Fishing[a/]	Boating	Water-Skiing	Swimming Beaches
South Sioux City	1,500 - 2,400	1,300	400	-
Omaha	54,400 - 87,000	42,000	31,700	29
Lincoln	19,500 - 31,200	14,100	9,200	10
Beatrice	2,900 - 4,600	2,200	600	2
Norfolk	2,400 - 3,800	-	-	2
Columbus	3,800 - 6,100	1,700	-	-
Grand Island	6,300 - 10,000	1,400	-	-
Hastings	5,400 - 8,700	3,200	1,000	3
Kearney	-	-	-	-
McCook	-	-	-	-
North Platte	400 - 700	-	-	-
Ogallala	-	-	-	-
Valentine	-	-	-	-
Scottsbluff	4,800 - 7,600	1,100	-	-
STATE TOTAL	101,400 - 162,100	67,000	42,900	46

a/ See footnote, Table 47

Source: Outdoor Recreation - A Comprehensive Plan, Nebraska Game and Parks Commission, 1968 (Revised after publication)

TABLE 49

PROJECTED DEFICIENCIES IN WATER-BASED OUTDOOR RECREATION FACILITIES IN 2000
(Acres of Surface Water)

Socio-Economic Area	Fishing[a/]	Boating	Water-Skiing	Swimming Beaches
South Sioux City	2,000 - 3,200	2,000	1,100	1
Omaha	93,200 - 149,200	93,800	83,200	79
Lincoln	33,300 - 53,200	33,500	28,800	29
Beatrice	800 - 1,300	1,600	700	2
Norfolk	4,000 - 6,400	-	-	4
Columbus	5,600 - 8,900	3,700	1,400	-
Grand Island	8,400 - 13,500	4,300	700	1
Hastings	7,100 - 11,300	5,400	2,800	5
Kearney	-	-	-	1
McCook	-	-	-	-
North Platte	2,200 - 3,500	-	-	-
Ogallala	-	-	-	-
Valentine	-	-	-	-
Scottsbluff	8,700 - 14,000	5,700	900	-
STATE TOTAL	165,300 - 264,500	150,000	119,600	122

a/ See footnote, Table 47

Source: Outdoor Recreation - A Comprehensive Plan, Nebraska Game and Parks Commission, 1968 (Corrected)

Improved management of small reservoirs, farm ponds and natural lakes, particularly those under private ownership, offer a good opportunity to increase the fishery resources.

Hunting

Hunting needs are related to the pattern of land ownership in the State. Presently, private lands provide most of the hunting opportunities.

Most of the waterfowl hunting sites are leased to groups or individuals. The lack of adequate sites is most critical along the Platte Valley and in eastern Nebraska, where the potential hunting demand is highest.

Public waterfowl management units are needed in eastern Nebraska. It is impossible to forecast the amount of land which would be required to meet the demand. However, the waterfowl hunting opportunity could be increased significantly by the addition of three management units with a minimum of 2,000 acres each. These units should be located in areas easily accessible to people living in the metropolitan areas and managed intensively to produce the maximum hunting opportunity.

Additional public hunting opportunities could be provided by obtaining easements along streams and marshes which have significant waterfowl hunting potential.

Boating and Water-Skiing

The boating and water-skiing demand-supply relationship is similar to that for fishing. Central and western Nebraska have excess capacity and eastern Nebraska is deficient. The deficiencies are not quite as severe though. The gross needs, capacities and deficiencies for boating and water-skiing by socio-economic areas are shown in Tables 4 and 5, Attachment 6, respectively.

Boating and water-skiing are rapidly gaining in popularity and participation in these activities is expected to increase greatly over the next few years. Water-skiing demand, on a percentage basis, is estimated to increase faster than the demand for any other outdoor activity. An increase of 60 percent is expected by 1972, 130 percent by 1980, and 460 percent by 2000. The estimated deficiencies by socio-economic areas are shown in Tables 47, 48, and 49.

Multipurpose reservoirs provide the best opportunity for additional boating and water-skiing opportunities. Improved access facilities are needed to some existing reservoirs and the Missouri River to utilize the present potential.

Swimming Beaches

Nearly one-fourth of the visitors interviewed at twelve reservoirs (Table 40) participated in outdoor swimming. With improved facilities, such as changing and shower facilities and cleaner beaches, the demand should increase materially.

The swimming beach demand was calculated on the assumption that 15 percent of the total swimming demand occurs at beaches. The gross demand and deficiencies are shown in Attachment 6, Table 6. The areas comprising the water surface acreage shown under present supply have facilities in various stages of development. Swimming facilities generally are meager, thus the future needs are somewhat understated.

The deficiencies for 1972, 1980, and 2000 are summarized in Tables 47, 48, and 49.

Ice Skating

Ice skating is the most popular outdoor winter sport in the State. According to estimates, the 1967 peak season demand for ice skating was over one million activity days. This demand is expected to increase by almost 45 percent by 1972, 90 percent by 1980, and nearly 300 percent before the turn of the century.

Gross needs for developed ice skating areas in each socio-economic area, shown in Attachment 6, Table 7, are based upon a standard of one acre of developed land per 2,500 population 12 years of age and over. This data indicates that the area of primary need for ice skating facilities is in the eastern part of the State, particularly in the Omaha and Lincoln SEA's. Since ice skating is primarily a day-use activity, the needs originating in one socio-economic area should be satisfied in that area, preferably within or near municipalities. The deficiencies for ice skating areas are not quantified because verifiable figures on the existing supply of facilities were not available.

Summary of Future Needs

The greatest deficiency in water-based outdoor recreational opportunities is for fishing. The need for additional fishing waters is estimated at nearly 135,000 acres by 1972 and 265,000 acres by 2000. Boating and water-skiing follow closely with estimates for 1972 of 48,100 and 27,400 acres respectively and for 2000 of 150,000 and 120,000 acres respectively. The deficiencies by activities are not necessarily accumulative since the same waters can provide opportunities for several purposes.

The greatest need for additional water-based recreational opportunities is in the eastern portion of the State with the Omaha and Lincoln areas having severe opportunity limitations as shown in Figure 14. The Scottsbluff area has a moderate deficiency while the central portion has a surplus.

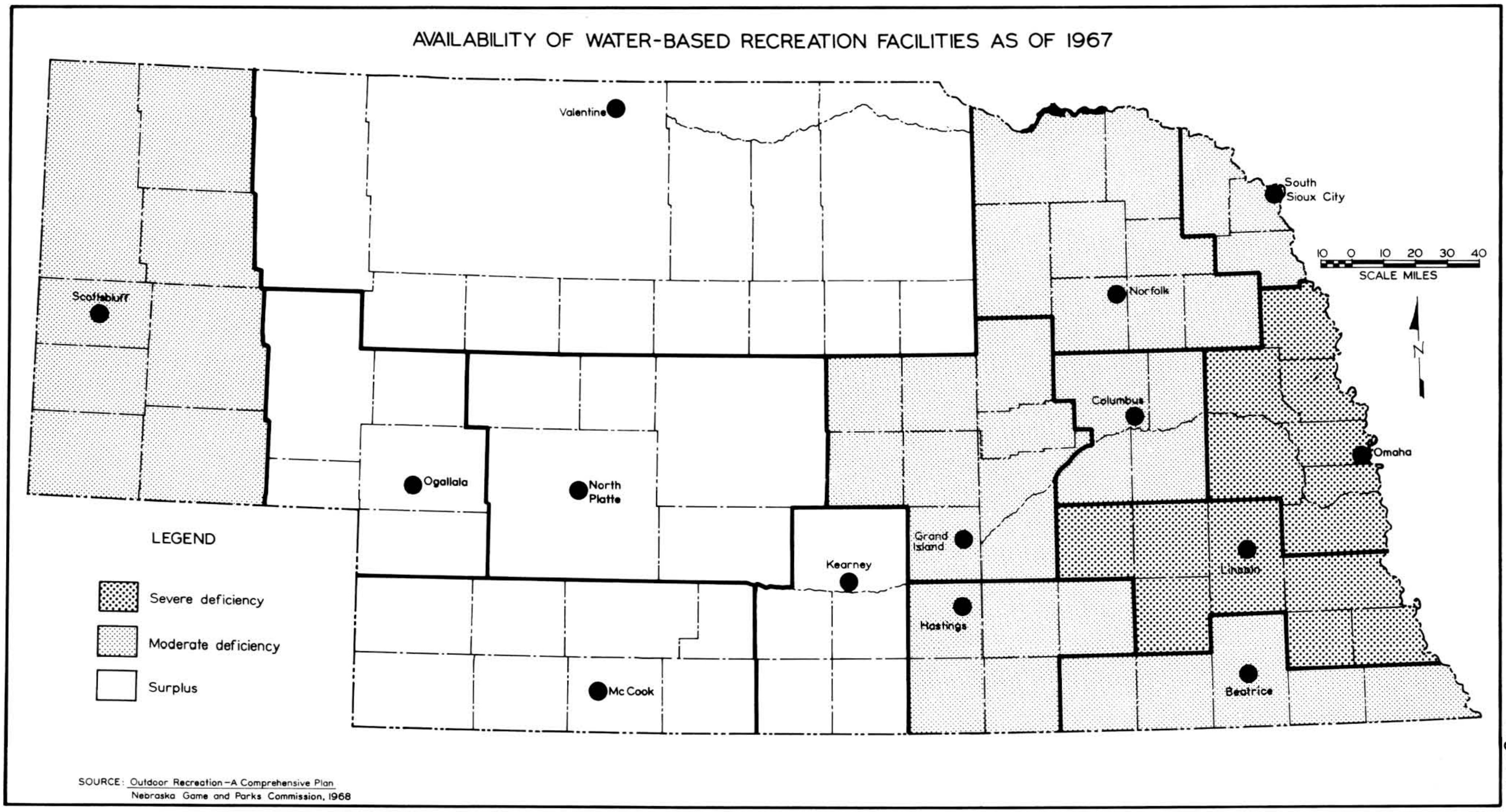

AVAILABILITY OF WATER-BASED RECREATION FACILITIES AS OF 1967
Valentine
South Sioux City
Scottsbluff
Norfolk
Columbus
Omaha
Ogallala
North Platte
Grand Island
Kearney
Hastings
Lincoln
Beatrice
McCook
10 0 10 20 30 40
SCALE MILES
N
LEGEND
Severe deficiency
Moderate deficiency
Surplus
SOURCE: Outdoor Recreation—A Comprehensive Plan
Nebraska Game and Parks Commission, 1968

Fig. 14

Additional water-based outdoor recreational opportunities must come from construction of water storage reservoirs, since not enough can be done to increase the recreation capacities of streams and natural lakes. All proposals for flood control dams and water supply reservoirs for municipal, industrial and irrigation purposes should be analyzed for their recreational potential. This is particularly true in the eastern third of the State. Increased utilization of the Missouri River would provide additional water-based recreational opportunities in this area.

The waterfowl hunting activity can be enhanced by incorporating waterfowl habitat in land and water developments and dedicating lagoons and potholes that contain water most of the time to wildlife use.

CHAPTER 12. WATERSHED PROTECTION

Introduction

Watershed protection can be described as proper use and management of the land to control erosion, maintain fertility, and improve the water infiltration rate and water holding capacity of the soil. The statement "use every acre within its capability and treat it according to its needs" expresses the goal of the soil conservationist. The proper use and management of Nebraska's land will reduce storm water runoff and the amount of sediment contributed to water courses.

This chapter is based upon the Nebraska Conservation Needs Inventory (1969) published by the Nebraska Conservation Needs Committee. It contains an inventory of the soil and water conservation needs on agricultural lands (except federal non-cropland) as of December, 1967, and is an updating of the inventory made in 1958. County data on major agricultural land uses, types of crops grown, and conservation treatment needs are shown by land capability classes and subclasses in the publication.

The major land uses are (1) cropland, (2) pasture, (3) range, (4) forest, and (5) other, which includes farmsteads, farm roads, feedlots, ditch banks, fence and hedge rows, and miscellaneous areas.

Land capability classes and subclasses are defined in the Nebraska Conservation Needs Inventory as follows:

> "The capability classification is the grouping of soils in a general way to show their suitability for most kinds of agricultural use. The arable soils are grouped according to their potentialities and limitations for sustained production of the common cultivated crops. Nonarable soils (soils unsuitable for longtime sustained use for cultivated crops) are grouped according to their potentialities and limitations for the production of permanent vegetation such as grass or trees and according to their risks of soil damage if mismanaged.
>
> "The broadest category in the capability classification places all soils in eight capability classes. The risks of soil damage or limitations in use become progressively greater from class one to class eight. In general, the first four land capability classes are for classifying "arable" soils capable of producing crops without deterioration over a long period if under proper treatment. They may also be used for pasture, range, forest and woodland. Soils in land capability classes five, six and seven are primarily "nonarable" soils suited mainly for use of grasses or trees.
>
> "Soils in land capability class eight are not suited for crops, grass or trees. In Nebraska, class eight soils include rock outcrops, marshes, canyons, bluffs, and riverwash land.

"The eight capability land classes are briefly defined as follows:

Class I - Soils have few limitations that restrict their use.

Class II - Soils have some limitations that reduce the choice of plants or require moderate conservation practices.

Class III - Soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV - Soils have very severe limitations that restrict the choice of plants, require very careful management, or both.

Class V - Soils have little or no erosion but have other limitations which are impractical to remove that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Class VI - Soils with severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture, range, woodland or wildlife food and cover.

Class VII - Soils with very severe limitations that make them unsuitable for cultivation and that restrict their use largely to grazing, woodland or wildlife.

Class VIII - Soils and landforms with limitations that preclude their use for commercial plant production without major reclamation and that restrict their use to recreation, wildlife, water supply, or to aesthetic purposes."

The capability subclass which denotes the type of problem or limitation is shown by letter after the land capability class. These letters stand for the principal kind of problem or limitation applicable to the land class. These limitations or problems are: E for erosion, wind and water; W for wetness, including flooding; S for soil limitations such as stony, saline, shallow, or droughty soils; and C is used where climate is the chief limitation for the production of crops.

"For capability class I, there is no subclass as it includes only those soils with few or no limitations. Capability subclass C is used primarily in central and western Nebraska on soils with no other limitations except inadequate rainfall. This is generally the area with less than 24 inches of annual rainfall. Under irrigation the C subclass is not used in Nebraska since the moisture limitation is not a problem for crop production.

"The soil limitations or hazards used to classify land into capability classes and subclasses may include singly, or in combination, the effects of many soil properties or conditions. These include slope of the land, severity of erosion, soil depth limiting the root zone, texture, salinity, alkalinity, stoniness, claypans, low moisture holding capacity, low fertility, poor drainage, high water table and overflow."

Present Land Use

About 95 percent of the surface area of the State is in agricultural uses and covered by the 1967 conservation needs inventory.

The major land uses by soil capability classes and subclasses are shown in Table 50. About 26,412,000 acres, 56 percent of the inventoried acreage, are in land capability classes one through four. These are considered arable lands (suitable for crop production). About 72 percent of these arable lands are now used as cropland; 24 percent as pasture and range; 1 percent as forest and woodland; and 3 percent in other agricultural uses.

The remaining 20,757,000 acres inventoried are in capability classes five through eight. These classes of soils are not normally considered suitable for crop production. Almost 5 percent are presently used as cropland, about 91 percent as pasture and range, slightly over 3 percent as forest and woodland, and about 1 percent is used for other agricultural purposes.

About 20,014,000 acres of all capability classes inventoried are cropland of which about 95 percent is on arable soils. The remaining 967,000 acres are nonarable soils and are made up mostly of narrow fringe-like tracts bordering or running through much larger cropland areas on arable soils. Nearly three-fourths of this acreage is steeply sloping and land use should be changed to permanent vegetation--grass or trees.

About 3,270,000 acres of the cropland are irrigated. Less than 1 percent, 24,000 acres, is on nonarable soils, but an additional 185,000 acres are on soils requiring very intensive water and land management.

Over 25,000,000 acres of land are in grass and are utilized for grazing purposes. About 25 percent (6,413,000 acres) is on arable soils which could be converted to cropland. However, most of this land, about 4,750,000 acres, would need careful soil and water management if converted to cropland uses. About 16,000,000 acres of the total now used for grazing have severe to very severe wind and water

TABLE 30

LAND USE BY CAPABILITY CLASS AND SUBCLASS
(Thousand Acres)
(1967)

Land Capability Class and Subclass	Cropland		Pasture and Range		Forest		Other Land	Total Inventory
	Total	Irri-gated	Total	Irri-gated	Total	Grazed	Total	
I	2,427	1,405	134	0	20	6	63	2,643
II E	4,864	725	719	a/	45	19	172	5,801
III E	5,560	284	1,928	1	71	32	196	7,755
IV E	2,631	150	2,274	1	51	23	93	5,049
VI E	713	11	13,525	0	160	99	76	14,474
VII E	1	0	2,764	0	55	35	4	2,825
II W	821	173	623	0	71	43	43	1,558
III W	424	44	315	0	19	10	15	774
IV W	29	4	75	0	4	3	1	108
V W	33	0	457	0	21	13	11	522
VI W	54	a/	531	0	161	90	24	771
VIII W	0	0	0	0	4	2	40	44
II S	775	383	36	0	3	a/	13	827
III S	143	47	40	0	0	0	4	187
IV S	79	31	111	0	8	3	3	200
VI S	160	13	1,107	0	58	41	9	1,334
VII S	6	0	546	0	221	150	1	773
VIII S	0	0	0	0	a/	a/	15	15
II C	1,181	0	140	0	4	1	51	1,376
III C	113	0	18	0	0	0	2	133
STATE TOTAL	20,014	3,270	25,343	2	976	570	836	47,169
Arable Lands (Classes I thru IV)	19,047		6,413		296		656	26,412
Non-arable Lands (Classes V thru VIII)	967		18,930		680		180	20,757

a/ Less than 500 acres

Source: Nebraska Conservation Needs Inventory (1969)

Note: "Total Inventory" may not check across due to rounding erosion limitations. These lands should remain in permanent vegetation and be managed to maintain a good vegetative cover.

About 976,000 acres are in forest and woodland of which about 60 percent is being grazed. Other land, including many miscellaneous uses, occupies about 836,000 acres. These uses are distributed on soils of all the land capability classes.

Present Conservation Treatment Needs

The conservation treatment needs for agricultural land, as determined during the 1967 conservation needs inventory, are shown in Table 51. More detailed information for the State and individual counties can be obtained from the Nebraska Conservation Needs Inventory (1969) which is available in most county offices of agencies of the United States Department of Agriculture.

Non-Irrigated Cropland

About 16,744,000 acres are now used for non-irrigated crop production, including about 1,600 acres in orchards and 26,500 acres of open land formerly cropped but not yet converted to another use. About 30 percent, 5,070,000 acres, is now adequately treated. This is the land used within its capability on which the conservation practices and planned improvements that are essential to its protection have been applied.

About 2,310,000 acres of land need the application of simple conservation practices such as crop residue management, annual cover crops, sod crops in the rotation program, and contour farming. Of this acreage, incorporation of crop residues and the growing of annual cover crops to maintain proper soil, water, and air relationships and to prevent erosion are needed on 1,634,000 acres; sod crops, such as perennial grasses or biennial or perennial legumes with or without perennial grasses, are needed in the crop rotation on 514,000 acres to maintain proper soil tilth and permeability; and contour planting and cultivating of row crops are needed on 162,000 acres to control soil erosion and conserve moisture.

Strip cropping, terraces and diversions, either singly or in combination, are needed to protect 7,756,000 acres of land from wind and water erosion. This is 46 percent of the non-irrigated cropland. Strip cropping is the growing of crops in a systematic arrangement of strips or bands. The crops are arranged so that a strip of grass or close-growing crop is alternated with a strip of clean-tilled crop or fallow. Strips on land with a water erosion problem are laid out on a contour. On land with a wind erosion problem the strips run across the direction of the prevailing wind. Terraces are earth embankments or ridges constructed across the slope to intercept surface runoff and either hold it for infiltration into the soil or carry it to stable outlets at a non-erosive velocity. Diversions are similar to but usually larger than terraces and are installed to prevent damage to lower lying land by storm runoff

TABLE 51

NEBRASKA CONSERVATION TREATMENT NEEDS
FOR AGRICULTURAL LANDS
(1967)

MAJOR LAND USE Conservation Treatment Needs	Acres (Thousands)	
CROPLAND		
Non-Irrigated		
Land adequately treated		5,070
Treatment needs:		
Crop residues or annual cover crops	1,634	
Sod in rotation	514	
Contouring only	162	
Strip cropping, terraces, and diversions	7,756	
Change in land use	1,022	
Drainage	586	
Total Needing Conservation Treatment		(11,674)
Subtotal Non-Irrigated Cropland		16,744
Irrigated		
Land adequately treated		1,239
Treatment needs:		
Cultural or management measures only	257	
Improved irrigation systems	1,026	
Proper irrigation water management	748	
Total Needing Conservation Treatment		(2,031)
Subtotal Irrigated Cropland		3,270
Total Cropland		20,014
PASTURE AND RANGE		
Land adequately treated		9,227
Treatment not feasible		262
Treatment needs:		
Protection from overgrazing	8,455	
Improvement in plant cover	5,775	
Brush control and improvement	367	
Reestablishment	1,257	
Total Needing Conservation Treatment		(15,854)
Total Pasture and Range		25,343
FOREST LAND		
Land adequately treated		209
Treatment needs:		
Establishment or reinforcement	178	
Timber stand improvement	589	
Improve forage	210 [a]	
Reduce or eliminate grazing	250 [a]	
Total Needing Conservation Treatment		(767)
Total Forest Land		976

TABLE 51

NEBRASKA CONSERVATION TREATMENT NEEDS
FOR AGRICULTURAL LANDS (CON'T.)

MAJOR LAND USE Conservation Treatment Needs		Acres (Thousands)
OTHER LAND		
Land adequately treated		447
Total Needing Conservation Treatment		(389)
Total Other Land		836
TOTAL AREA INVENTORIED		47,169
NON-INVENTORIED LAND AREA		1,852
Federal non-cropland	657	
Urban and built-up	1,069	
Water areas	126	
STATE TOTAL - LAND AREA b/		49,021

a/ These are duplicated acres as they are included in the first two treatment needs. These treatment needs apply only if continued use and management is for grazing and forest production.

b/ Does not include inland water, about 476,000 acres

Source: Nebraska Conservation Needs Inventory, (1969), and Census, Inland Water Areas, 1960, (unpublished)

from land at higher elevations. Other measures such as crop residue management, sod in rotation, and field windbreaks are usually needed to supplement these practices.

A change in use is needed on 1,022,000 acres of non-irrigated cropland. This land has very severe limitations for crop production and should be maintained in permanent vegetation--grass or trees. The land could then be utilized for grazing or production of forest products.

Drainage measures are needed on 586,000 acres to remove excess surface or internal water.

Irrigated Cropland

According to the Nebraska Conservation Needs Inventory, about 3,270,000 acres of cropland were under irrigation in 1967. About 1,239,000 acres, 38 percent of the area irrigated, are being adequately treated. An additional 257,000 acres need the application of only cultural or soil and management measures to maintain proper soil, moisture, and fertility conditions.

About 24,000 acres of the 257,000 acres of irrigated land are on soils with severe limitations for crop production. These acreages should be planted and maintained in permanent vegetation.

Improved irrigation systems are needed on 1,026,000 acres for the proper application of irrigation water and to prevent soil erosion. Included in this practice are one or more of the following: reorganization of existing systems, land leveling, ditch lining, erosion control structures, and drainage measures.

Improved irrigation water management is needed on 748,000 acres to control erosion, prevent excess water losses, and to time water application to crop needs. This practice requires that the quantity of water used be determined by the moisture-holding capacity of the soil and the need of the crop. The water is to be applied in stream sizes adjusted and controlled to prevent erosion, and in lengths of "sets" to reduce water losses.

Pasture and Range

This land use includes all grassland utilized for grazing. Pasture consists primarily of land seeded to introduced grasses such as bromegrass, intermediate wheatgrass, and reed canarygrass. Range includes all natural grazing lands (except grazed forest) and lands that have been seeded to mixtures of adapted native grasses for permanent use as grazing land. Wild hay, native hay, and rangeland meadows are included as range.

About 25,343,000 acres of the inventoried lands are utilized as pasture and range. Over 36 percent, 9,227,000 acres, is now receiving adequate conservation treatment. This includes about 8,940,000 acres of range in good to excellent condition that is being managed to maintain high plant vigor. The remainder, 287,000 acres, is in pasture. It has good plant composition and is being adequately fertilized and grazed at rates needed to maintain good stands. Conservation treatment is needed but is not feasible on about 262,000 acres because of the small size and location of the areas being grazed or because economic returns after needed treatment would not justify the treatment cost.

About 15,854,000 acres of pasture and range need conservation treatment. Over half, 8,455,000 acres, is being over utilized. It needs protection from overgrazing which can be corrected by:

(1) Limiting the number of livestock to the carrying capacity of the pasture or range,

(2) Periodically deferring grazing for a growth period during the year, and/or

(3) Installing livestock watering facilities, fences, and salting locations to encourage better grazing distribution.

About 5,775,000 acres of pasture and range need improvement in plant composition. On the 310,000 acres of pasture with this problem, the forage can be restored by controlling perennial weeds and scattered woody plants, fertilizing, and/or partial reseeding to grasses or legumes. The 5,465,000 acres of range with this problem are in fair condition. These ranges require one or more of the following more intensive range management practices:

(1) Limiting livestock numbers to less than present stocking rates,

(2) Grazing under a system where areas are rested for planned intervals throughout the growing season of key plants, and generally changing the areas deferred to different plant growth periods on successive years,

(3) Partial seeding of native grasses to speed up plant succession, and/or

(4) Installing livestock watering facilities, fences, and salting locations to encourage better distribution of grazing.

About 367,000 acres of grassland, almost entirely range, has been invaded by shrubs or shrub-like types of vegetation such as sagebrush, red cedar, osage orange, honey locust, sumac, dogwood, and buckbrush. These grasslands may be improved by mowing or applying herbicides, and limiting grazing to the carrying capacity of the range.

About 1,257,000 acres of grasslands are in poor condition and need complete reestablishment of the adapted high producing forage types. About 20 percent of the pastures, 291,000 acres, and 4 percent of the range, 966,000 acres, are in this condition. The pastures require a complete treatment of seed bed preparation, seeding to adapted perennial grasses, application of fertilizers, and protection from grazing until the grass stands become established. The operations needed on the range areas are land preparation, planting of cover crops (sorghum or small grain), and drilling seed mixtures of adapted native climax grasses into the cover crop stubble. It is necessary that the seeded areas be protected from grazing until the grass stands are established. It may be necessary to interseed the grass seed mixtures directly into the vegetation on the soils that have critical wind erosion problems.

Forest

Only slightly more than 20 percent of the 976,000 acres in forest and woodland use is receiving adequate conservation treatment for the production of forest products. About 589,000 acres need timber stand improvement which consists of thinning stands to increase tree growth and/or improve the quality of timber remaining. An additional 178,000 acres need increased timber density and nearly all of these timbered tracts, or about 174,000 acres, are producing below their potential because of inadequate stocking. The stocking can be improved by planting or seeding (natural or artificial) with or without site preparation. Additional trees should be planted on the remaining 4,000 acres of forest and woodland to improve the areas for wildlife, erosion control, beautification, and recreation.

Grazing of livestock is practiced on about 570,000 acres of forest and woodland. Conservation treatment is adequate on 110,000 acres. Improved forage is needed on 210,000 acres. This consists of protection from overgrazing, improved cover or brush control, and/or the reestablishment of forage plants. Grazing should be reduced or eliminated on 250,000 acres to protect the land from further erosion or deterioration, and to provide improved cover.

Other Land

Of the 836,000 acres classified as "other" agricultural land, about 447,000 acres are receiving adequate treatment. The conservation treatment needs for the remaining 389,000 acres were not specifically determined.

Present Conservation Treatment Needs by River Basins

The estimated conservation treatment needs on agricultural lands by river basins are shown in Table 52. These estimates were derived by expanding original unadjusted sample data gathered for the conservation treatment needs inventory and adjusting the basin acreages to the state totals published in the Nebraska Conservation Needs Inventory (1969).

The percentage of cropland being adequately treated varies between a high of 51 percent in the Nemaha River Basin and a low of 16 percent in the South Platte River Basin. Only about 20 percent of the cropland in the White River-Hat Creek, Missouri Tributaries, North Platte, and Elkhorn River Basins is adequately treated. Planting row crops and clean fallow on moderately to steeply sloping soils are the major problems. Strip cropping, terraces, and diversions are needed in addition to crop residue management, annual cover crops, sod crops in the rotation, and contour planting. The major need on irrigated land is improving the irrigation systems. This conservation treatment need varies between 74 percent of the irrigated cropland in the White River-Hat Creek Basin and 22 percent of the irrigated cropland in the Big Blue River Basin.

The amount of pasture and range adequately treated varies between 46 percent in the Niobrara River Basin and 11 percent in the Missouri Tributaries River Basin. Others with only 12 to 16 percent adequately treated are the Little Blue, Big Blue, Nemaha, and South Platte River Basins. Most of these are pastures or rangeland in small tracts lying adjacent to farmsteads on which livestock graze all year. The major need in the White River-Hat Creek and Little Blue River Basins is strict regulation of grazing in order to improve plant composition. In the other river basins, the major need is protection from over-grazing so present stands will be maintained.

TABLE 52

CONSERVATION TREATMENT NEEDS FOR AGRICULTURAL LANDS[a/]
(Thousand Acres)

MAJOR LAND USE Conservation Treatment Needs	River Basins White River-Hat Creek	Nio-brara	Missouri Tribs.	North Platte	South Platte	Middle Platte	Loup	Elkhorn	Lower Platte	Repub-lican	Little Blue	Big Blue	Nemaha
CROPLAND													
Non-Irrigated[b/]													
Land adequately treated	47	417	233	66	202	238	464	438	441	789	408	704	623
Treatment needs:													
Crop residues or annual cover crops	3	60	51	68	334	96	53	72	79	500	109	198	11
Sod in rotation	0	19	42	1	1	21	104	109	47	26	33	58	53
Contouring only	0	0	19	1	2	3	18	85	12	4	11	4	3
Strip cropping, terraces, and diversions	129	668	614	299	627	163	794	1,349	629	1,136	321	576	451
Change in land use	17	79	76	46	101	87	155	28	28	265	59	59	22
Drainage	0	7	103	0	0	59	47	131	89	15	12	65	58
Total Needing Treatment	(149)	(833)	(905)	(415)	(1,065)	(429)	(1,171)	(1,774)	(884)	(1,946)	(545)	(960)	(598)
Subtotal Non-Irrigated Cropland	196	1,250	1,138	481	1,267	667	1,635	2,212	1,325	2,735	953	1,664	1,221
Irrigated													
Land adequately treated	0	36	4	118	18	296	142	39	36	108	154	283	5
Treatment needs:													
Cultural or management measures only	0	12	1	29	3	68	15	10	1	30	16	72	0
Improved irrigation sys.	20	77	6	182	31	215	104	37	36	92	73	147	6
Proper irrig. water mgt.	7	14	7	51	25	256	84	18	21	81	33	151	0
Total Needing Treatment	(27)	(103)	(14)	(262)	(59)	(539)	(203)	(65)	(58)	(203)	(122)	(370)	(6)
Subtotal Irrigated Cropland	27	139	18	380	77	835	345	104	94	311	276	653	11
Total Cropland	223	1,389	1,156	861	1,344	1,502	1,980	2,316	1,419	3,046	1,229	2,317	1,232
PASTURE AND RANGE													
Land adequately treated	255	2,624	45	1,359	90	394	2,736	579	66	948	37	51	43
Treatment not feasible	3	22	3	25	24	48	30	10	13	61	8	12	3
Treatment needs:													
Protection from overgrazing	67	1,543	255	1,058	337	526	2,524	738	135	875	60	188	149
Improvement in plant cover	410	1,161	39	736	108	332	1,637	240	40	720	189	100	63
Brush control and improvement	3	51	27	121	1	7	33	16	15	64	4	12	13
Reestablishment	10	266	40	80	5	89	459	93	24	92	17	53	29
Total Needing Treatment	(490)	(3,021)	(361)	(1,995)	(451)	(954)	(4,653)	(1,087)	(214)	(1,751)	(270)	(353)	(254)
Total Pasture and Range	748	5,667	409	3,379	565	1,396	7,419	1,676	293	2,760	315	416	300
FOREST LAND													
Land adequately treated	53	18	9	17	5	19	20	24	13	14	2	7	8
Treatment needs:													
Establishment or reinforcement	34	27	18	8	3	9	11	19	9	12	4	7	17
Timber stand improvement	78	101	70	30	7	34	34	57	31	41	12	28	66
Improve forage	(47)	(25)	(15)	(11)	(3)	(15)	(13)	(34)	(9)	(11)	(5)	(7)	(15)
Reduce or eliminate grazing	(43)	(42)	(28)	(11)	(3)	(16)	(13)	(18)	(11)	(16)	(8)	(13)	(28)
Total Needing Treatment[c/]	(112)	(128)	(88)	(38)	(10)	(43)	(45)	(76)	(40)	(53)	(16)	(35)	(83)
Total Forest Land	165	146	97	55	15	62	65	100	53	67	18	42	91
OTHER LAND													
Land adequately treated	12	25	35	33	18	30	65	78	45	46	13	23	24
Total Needing Treatment	7	23	33	22	8	25	49	80	36	31	10	32	33
Total Other Land	19	48	68	55	26	55	114	158	81	77	23	55	57
TOTAL LAND INVENTORIED[a/]	1,155	7,250	1,730	4,350	1,950	3,015	9,578	4,250	1,846	5,950	1,585	2,830	1,680
TOTAL NOT INVENTORIED[d/]	205	345	160	220	65	270	172	230	144	225	110	95	90
BASIN TOTALS	1,360	7,595	1,890	4,570	2,015	3,285	9,750	4,480	1,990	6,175	1,695	2,925	1,770

a/ Does not include federal non-cropland (657,000 acres)
b/ Includes orchards and open cropland
c/ Forest measures only
d/ Federal non-cropland, urban, and water areas

Source: Nebraska Conservation Needs Inventory (1969)

The amount of forest and woodland receiving adequate conservation treatment is very low. For timber production it varies between a high of 33 percent in the South Platte River Basin to a low of 9 percent in the Nemaha and Missouri Tributaries River Basins. Thinning of stands to improve timber is the major need. About 570,000 acres of forests and woodlands are grazed. Adequate conservation treatment of grazed forests and woodland varies from a high of 42 percent in the White River-Hat Creek Basin to a low of 2 percent in the Missouri Tributaries River Basin. In none of the other river basins are more than 20 percent of the grazed forests being adequately treated. In the Niobrara, Missouri Tributaries, Republican, Little Blue, Big Blue, and Nemaha River Basins grazing should be drastically reduced or eliminated on 50 percent or more of the forest or woodland areas now being grazed.

The proportion of other agricultural land receiving adequate conservation treatment varies between a high of 69 percent in the South Platte River Basin to a low of 42 percent in the Big Blue and Nemaha River Basins. All of the other basins have 49 or more percent of "other" land being adequately treated.

It should be noted that many acres of land have had one or more of the needed conservation measures applied. Information was not available to indicate the amount of land which has received partial treatment.

Table 53 contains a summary of the conservation treatment needs for adequate agricultural land protection by relative ease of application of measures needed. The three types of conservation treatment measures (simple, moderate, and intensive) referred to in the table are defined as follows:

- Simple-type measures
  - Cropland
    - Crop residues or annual cover crops
    - Sod in rotation
    - Contouring only
    - Cultural or management measures only (Irrigated)
  - Pasture and Range
    - Protection from overgrazing
  - Forest
    - None
  - Other
    - None

- Moderate-type measures
  - Cropland
    - Strip cropping, terraces, and diversions
    - Improved irrigation systems (Irrigated)
    - Proper irrigation water management (Irrigated)
  - Pasture and Range
    - Improvement in plant cover
    - Brush control and improvement

TABLE 53

SUMMARY OF CONSERVATION TREATMENT NEEDS FOR AGRICULTURAL LANDS
(1967)

River Basins	Agricultural Land Adequately Protected		Conservation Treatment Measures Needed: Simple-Type Measures		Moderate-Type Measures		Intensive-Type Measures	
	1,000 Acres	Percent of Basin Total	1,000 Acres	Percent of Total Agr. Land	1,000 Acres	Percent of Total Agr. Land	1,000 Acres	Percent of Total Agr. Land
White River-Hat Creek	367	32	70	6	647	56	71	6
Niobrara	3,120	43	1,634	23	2,072	28	424	6
Missouri Tributaries	326	19	368	21	763	44	273	16
North Platte	1,593	36	1,157	27	1,419	33	181	4
South Platte	333	17	677	35	799	41	141	7
Middle Platte	977	32	714	24	1,007	33	317	11
Loup	3,427	36	2,714	28	2,686	28	751	8
Elkhorn	1,158	27	1,014	24	1,717	40	361	9
Lower Platte	601	32	274	15	772	42	199	11
Republican	1,905	32	1,435	24	2,134	36	476	8
Little Blue	614	39	229	14	632	40	110	7
Big Blue	1,068	38	520	18	1,014	36	228	8
Nemaha	703	42	216	13	599	36	162	9
STATE TOTAL	16,192	34	11,022	23	16,261	35	3,694	8

Source: Nebraska Conservation Needs Inventory (1969)

Forest
- Timber stand improvement

Other
- None

Intensive-type measures

Cropland
- Change in land use
- Drainage

Pasture and Range
- Treatment not feasible
- Reestablishment

Forest
- Establishment or reinforcement

Other
- Needing treatment

About 40 percent of the agricultural land in the Niobrara, Nemaha, and Little and Big Blue River Basins is now receiving adequate conservation treatment. About 80 percent of the agricultural land in the Niobrara River Basin is used for grazing while 73 to 82 percent of the agricultural land in the latter three river basins is cropland. The Sandhills rancher found out early that his success was largely dependent upon proper use of his ranges. Also, the rapid loss of productivity on the thin top soils of southeastern Nebraska due to water erosion caused farmers to apply conservation treatment measures to save the land resource. The upper portions of the Big and Little Blue River Basins are relatively level and require only good cultural and management practices to be adequately treated. Residents of this area were among the first to organize soil and water conservation districts and develop small watershed projects.

The South Platte, Missouri Tributaries, and Elkhorn River Basins have 17,19, and 27 percent, respectively, of their agricultural land under adequate conservation treatment. A high percentage of croplands in these river basins is on soils that are moderately to steeply sloping. Although soil erosion has been moderately severe in the Missouri Tributaries and Elkhorn River Basins the loss in productivity has not been drastic because of the deep loess soils and widespread use of commercial fertilizers. In the South Platte River Basin, cropland, pastures and ranges, and forests and woodlands all show low amounts of adequate conservation treatment.

Future Conservation Treatment Needs

Future conservation treatment needs on agricultural lands will tend to decrease as land treatment measures and improved management practices are applied, and tend to increase as farmers and ranchers intensify their operations and cut corners to counteract the cost-price squeeze. The direction and amount of change will depend upon the severity of the cost-price squeeze, the continuation of policies by the Federal Government to provide cost-sharing assistance for the application of land treatment measures and management practices (including conversion of marginal land to less intensive uses), and the adoption of additional policies to encourage marginal agricultural producers into other occupations.

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ATTACHMENT 1

This section shows the present municipal and industrial water usage by stream reaches or planning areas. The data for these tables was obtained largely from the Problems and Needs Appendix of the Comprehensive Framework Study of the Missouri River Basin. Minor revisions were made by the Nebraska Department of Health to bring the information up to date as of July 1, 1969.

The municipal system usage includes reported quantities from approximately 270 cities and towns and estimates for the others based upon per capita use rates established for planning purposes and the number of people served. Municipal system usage also includes some water supplied for industrial purposes, including cooling water used in generation of electrical energy.

Industrial system usage includes the water supplied by private systems. Quantities for most of the private systems were estimated using a liberal rate of water requirement per unit of production. Also included are the present boiler and condenser cooling water requirements for generation of electrical energy.

PRESENT MUNICIPAL AND INDUSTRIAL WATER USAGE BY RIVER BASINS

RIVER BASIN Planning Reach or Subbasin	Municipal Systems People Served	 MGD	 AF/Yr.	Private Industrial Systems[a/] AF/Yr.
WHITE RIVER-HAT CREEK BASIN				
White River				
Crawford to State Line	6,670	1.41	1,580	0
Total	6,670	1.41	1,580	0
NIOBRARA RIVER BASIN				
Niobrara River				
State Line to Gordon	11,225	2.15	2,405	60
Gordon to Sparks	5,955	.91	1,020	0
Sparks to Spencer	2,845	.38	425	0
Spencer to Mouth	1,288	.19	210	0
Ponca Creek				
State Line to Mouth	1,950	.25	280	0
Total	23,263	3.88	4,340	60
MISSOURI TRIBUTARIES RIVER BASIN				
Bazile Creek	3,240	.44	490	0
Bow Valley Creek	2,525	.23	260	0
Aowa Creek	1,620	.20	220	0
Omaha Creek	1,960	.20	210	0
Missouri River				
Niobrara River to Douglas County Line	19,520	2.07	2,320	2,600
Omaha Metropolitan Area	325,715	61.69	69,130	287,030
Total	354,580	64.83	72,630	289,630
NORTH PLATTE RIVER BASIN				
North Platte River				
State Line to Lisco	26,885	4.84	5,420	43,190
Lisco to Lewellen	1,775	.29	320	0
Lewellen to Mouth	18,500	3.26	3,650	490
Total	47,160	8.39	9,390	43,680

a/ Includes cooling water used in generation of electrical energy

PRESENT MUNICIPAL AND INDUSTRIAL WATER USAGE BY RIVER BASINS (Con't)

RIVER BASIN Planning Reach or Subbasin	Municipal Systems People Served	 MGD	 AF/Yr.	Private Industrial Systems[a/] AF/Yr.
SOUTH PLATTE RIVER BASIN				
Lodgepole Creek				
State Line to Mouth	17,220	2.67	2,990	7,100
South Platte River				
State Line to Mouth	7,345	.83	930	3,580
Total	24,565	3.50	3,920	10,680
MIDDLE PLATTE RIVER BASIN				
Platte River				
North Platte to Overton	7,220	.76	845	800
Overton to Duncan	56,086	10.98	12,335	67,740
Duncan to Loup River	300	.02	20	0
Total	63,606	11.76	13,200	68,540
LOUP RIVER BASIN				
North Loup River				
Burwell to Mouth	4,890	.44	490	0
Middle Loup River				
Above Dunning	1,580	.21	230	0
Dunning to Arcadia	1,535	.14	160	0
Arcadia to St. Paul	2,685	.39	440	0
South Loup River	8,480	1.27	1,420	120
Loup River				
St. Paul to Genoa	4,600	.52	580	0
Cedar River	1,740	.18	200	0
Genoa to Mouth	17,290	2.11	2,370	290
Total	42,800	5.26	5,890	410
ELKHORN RIVER BASIN				
Elkhorn River				
Above Ewing	6,725	.83	930	0
Ewing to Norfolk	5,885	.89	995	0
North Fork Elkhorn	19,535	2.63	2,970	1,260
Logan Creek				
Above Pender	9,770	1.23	1,380	120
Below Pender	3,435	.51	570	0
Elkhorn River				
Norfolk to Mouth	37,627	5.42	6,070	5,190
Total	82,977	11.51	12,915	6,570

a/ Includes cooling water used in generation of electrical energy

PRESENT MUNICIPAL AND INDUSTRIAL WATER USAGE BY RIVER BASINS (Con't)

RIVER BASIN Planning Reach or Subbasin	Municipal Systems People Served	 MGD	 AF/Yr.	Private Industrial Systems[a/] AF/Yr.
LOWER PLATTE RIVER BASIN				
Platte River				
Loup River to North Bend	6,590	.59	660	1,300
No. Bend to So. Bend except Lincoln SMSA	10,380	1.52	1,720	27,550
Lincoln Metropolitan Area	141,212	21.59	24,190	0
South Bend to Mouth	2,040	.24	240	1,250
Total	160,222	23.94	26,810	30,100
REPUBLICAN RIVER BASIN				
Republican River				
State Line to Stratton	1,630	.31	350	0
Frenchman River				
State Line to Mouth	4,270	.65	730	0
Republican River				
Stratton to Orleans	18,485	3.52	3,950	0
Orleans to State Line	14,465	2.45	2,740	220
Beaver & Sappa Creeks	1,595	.20	220	0
Total	40,445	7.13	7,990	220
LITTLE BLUE RIVER BASIN				
Little Blue River				
Above DeWeese	7,554	.80	880	1,300
DeWeese to Fairbury	14,005	1.96	2,200	110
Fairbury to State Line	705	.14	160	0
Total	22,264	2.90	3,240	1,410
BIG BLUE RIVER BASIN				
Big Blue River				
Above Seward	14,880	1.64	1,840	100
Seward to Crete	40,540	9.01	10,100	2,200
Crete to Barneston	25,590	3.35	3,740	2,000
Barneston to State Line	none			
Total	81,010	14.00	15,680	4,300

a/ Includes cooling water used in generation of electrical energy

PRESENT MUNICIPAL AND INDUSTRIAL WATER USAGE BY RIVER BASINS (Con't)

RIVER BASIN Planning Reach or Subbasin	Municipal Systems People Served	 MGD	 AF/Yr.	Private Industrial Systems[a/] AF/Yr.
NEMAHA RIVER BASIN				
Weeping Water Creek	2,338	.18	200	0
Little Nemaha River	7,170	.70	790	0
Big Nemaha River				
Above Humboldt	5,046	.82	920	0
Humboldt to Falls City	7,810	.97	1,090	0
Falls City to Mouth	700	.05	60	0
Missouri River				
Plattsmouth to Rulo	15,300	2.21	2,480	0
Total	38,364	4.93	5,540	0
STATE TOTAL	987,926	163.44	183,125	455,600

a/ Includes cooling water used in generation of electrical energy. State total includes 366,810 acre-feet used by electric power plants and 88,790 acre-feet by other industries.

ATTACHMENT 2

This attachment includes a projection of the municipal and industrial water requirements for 1980, 2000 and 2020 by stream reaches or planning areas.

The municipal requirements were based upon the present per capita water usage rates, or the projected rate established for planning purposes, whichever is the greater. Eighty gallons per capita per day was added to each system as a reserve for industrial purposes.

Private industrial requirements were estimated using present usage and the additional water needed to support the expected increase in agricultural production and process the products thereof. The increases in industrial requirements were placed in communities near the areas with the greatest increases in agricultural production. Included in these tabulations are the present usage of boiler and condenser cooling water for presently operated electric power plants.

LIST OF TABLES

TABLE 1

PROJECTED MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

White River-Hat Creek Basin

Planning Reach or Subbasin	Municipal Systems			Private Industrial Systems[a/]
	People Served	MGD	AF/Yr.	AF/Yr.
-----------1980-----------				
White River				
Crawford to State Line	7,900	2.2	2,500	None
--Total--	7,900	2.2	2,500	None
-----------2000-----------				
White River				
Crawford to State Line	9,200	2.5	2,700	None
--Total--	9,200	2.5	2,700	None
-----------2020-----------				
White River				
Crawford to State Line	10,500	2.7	3,100	None
--Total--	10,500	2.7	3,100	None

a/ Includes cooling water used in presently operated electric power plants

TABLE 2

PROJECTED MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

Niobrara River Basin

Planning Reach or Subbasin	Municipal Systems			Private Industrial Systems[a/]
	People Served	MGD	AF/Yr.	AF/Yr.
--------1980--------				
Niobrara River				
State Line to Gordon	11,100	2.9	3,300	90
Gordon to Sparks	5,850	1.4	1,500	
Sparks to Spencer	2,800	.6	700	
Spencer to Mouth	1,630	.4	400	
Ponca Creek				
State Line to Mouth	1,840	.3	300	
--Total--	23,220	5.6	6,200	90
--------2000--------				
Niobrara River				
State Line to Gordon	11,150	3.1	3,500	150
Gordon to Sparks	6,080	1.5	1,600	
Sparks to Spencer	2,460	.5	600	
Spencer to Mouth	1,400	.2	250	
Ponca Creek				
State Line to Mouth	1,480	.3	350	
--Total--	22,570	5.6	6,300	150
--------2020--------				
Niobrara River				
State Line to Gordon	11,370	3.1	3,500	200
Gordon to Sparks	6,220	1.5	1,700	
Sparks to Spencer	2,320	.5	600	
Spencer to Mouth	1,140	.2	200	
Ponca Creek				
State Line to Mouth	1,150	.3	300	
--Total--	22,200	5.6	6,300	200

a/ Includes cooling water used in presently operated electric power plants

TABLE 3

PROJECTED MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

Missouri Tributaries River Basin

Planning Reach or Subbasin	Municipal Systems People Served	Municipal Systems MGD	Municipal Systems AF/Yr.	Private Industrial Systems[a/] AF/Yr.
-----------1980-----------				
Bazile Creek	3,000	.6	700	
Bow Valley Creek	2,490	.5	500	
Aowa Creek	1,470	.3	330	
Omaha Creek	1,890	.3	370	
Missouri River				
Niobrara River to Douglas County Line	23,640	6.2	6,900	2,800
Omaha Metropolitan Area	535,000	149.8	168,000	291,370
--Total--	567,490	157.7	176,800	294,170
-----------2000-----------				
Bazile Creek	2,650	.6	600	
Bow Valley Creek	2,200	.5	500	
Aowa Creek	1,220	.2	300	
Omaha Creek	1,830	.3	400	
Missouri River				
Niobrara River to Douglas County Line	28,820	7.6	8,500	3,000
Omaha Metropolitan Area	690,000	193.2	216,500	296,270
--Total--	726,720	202.4	226,800	299,270
-----------2020-----------				
Bazile Creek	2,210	.5	500	
Bow Valley Creek	1,880	.4	400	
Aowa Creek	1,080	.2	250	
Omaha Creek	1,910	.3	400	
Missouri River				
Niobrara River to Douglas County Line	34,740	9.3	10,350	3,000
Omaha Metropolitan Area	850,000	238.0	266,700	297,470
--Total--	891,820	248.7	278,600	300,470

a/ Includes cooling water used in presently operated electric power plants

TABLE 4

PROJECTED MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

North Platte River Basin

Planning Reach or Subbasin	Municipal Systems			Private Industrial Systems[a/]
	People Served	MGD	AF/Yr.	AF/Yr.
-----------1980-----------				
North Platte River				
State Line to Lisco	32,330	8.8	10,000	43,320
Lisco to Lewellen	1,540	.4	400	
Lewellen to Mouth	18,000	5.1	5,600	640
--Total--	51,870	14.3	16,000	43,960
-----------2000-----------				
North Platte River				
State Line to Lisco	37,940	10.6	12,000	45,830
Lisco to Lewellen	1,300	.3	400	
Lewellen to Mouth	20,000	5.6	6,300	760
--Total--	59,240	16.5	18,700	46,590
-----------2020-----------				
North Platte River				
State Line to Lisco	41,980	11.9	13,300	50,550
Lisco to Lewellen	1,010	.3	300	
Lewellen to Mouth	22,000	6.2	6,900	950
--Total--	64,990	18.4	20,500	51,500

a/ Includes cooling water used in presently operated electric power plants

TABLE 5

PROJECTED MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

South Platte River Basin

Planning Reach or Subbasin	Municipal Systems			Private Industrial Systems[a/]
	People Served	MGD	AF/Yr.	AF/Yr.
-----------1980-----------				
Lodgepole Creek				
State Line to Mouth	13,150	3.3	3,700	7,220
South Platte River				
State Line to Mouth	7,080	1.6	1,800	3,720
--Total--	20,230	4.9	5,500	10,940
-----------2000-----------				
Lodgepole Creek				
State Line to Mouth	12,730	3.1	3,600	7,440
South Platte River				
State Line to Mouth	7,250	1.6	1,800	3,830
--Total--	19,980	4.7	5,400	11,270
-----------2020-----------				
Lodgepole Creek				
State Line to Mouth	12,270	3.1	3,500	7,600
South Platte River				
State Line to Mouth	7,360	1.6	1,800	3,970
--Total--	19,630	4.7	5,300	11,570

a/ Includes cooling water used in presently operated electric power plants

TABLE 6

PROJECTED MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

Middle Platte River Basin

Planning Reach or Subbasin	Municipal Systems			Private Industrial Systems[a/]
	People Served	MGD	AF/Yr.	AF/Yr.
-----------1980-----------				
Platte River				
No. Platte to Overton	14,760	4.16	4,660	900
Overton to Duncan	67,550	20.30	22,900	68,300
Duncan to Loup River	240	.04	40	
--Total--	82,550	24.50	27,600	69,200
-----------2000-----------				
Platte River				
No. Platte to Overton	16,860	4.82	5,400	1,000
Overton to Duncan	79,870	24.44	27,370	75,600
Duncan to Loup River	180	.03	30	
--Total--	96,910	29.29	32,800	76,600
-----------2020-----------				
Platte River				
No. Platte to Overton	19,220	5.58	6,300	1,200
Overton to Duncan	92,140	28.55	31,980	78,000
Duncan to Loup River	120	.02	20	
--Total--	111,480	34.15	38,300	79,200

a/ Includes cooling water used in presently operated electric power plants

TABLE 7

PROJECTED MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

Loup River Basin

Planning Reach or Subbasin	Municipal Systems			Private Industrial Systems[a/]
	People Served	MGD	AF/Yr.	AF/Yr.
-----------1980-----------				
North Loup River				
Burwell to Mouth	4,840	1.00	1,100	
Middle Loup River				
Above Dunning	1,250	.30	340	
Dunning to Arcadia	1,390	.28	310	
Arcadia to St. Paul	2,410	.58	650	
South Loup River	8,990	2.20	2,500	200
Loup River				
St. Paul to Genoa	4,320	.84	960	
Cedar River	1,645	.30	340	
Genoa to Mouth	22,170	3.70	4,100	400
--Total--	47,015	9.20	10,300	600
-----------2000-----------				
North Loup River				
Burwell to Mouth	4,190	.85	950	
Middle Loup River				
Above Dunning	1,100	.27	300	
Dunning to Arcadia	1,160	.26	300	
Arcadia to St. Paul	1,990	.48	540	
South Loup River	9,080	2.25	2,500	400
Loup River				
St. Paul to Genoa	3,740	.74	830	
Cedar River	1,405	.25	280	
Genoa to Mouth	25,660	4.20	4,700	2,700
--Total--	48,325	9.30	10,400	3,100
-----------2020-----------				
North Loup River				
Burwell to Mouth	3,550	.70	800	
Middle Loup River				
Above Dunning	1,000	.27	300	
Dunning to Arcadia	890	.18	200	
Arcadia to St. Paul	1,530	.36	400	
South Loup River	9,190	2.30	2,600	600
Loup River				
St. Paul to Genoa	3,170	.63	700	
Cedar River	1,165	.26	300	
Genoa to Mouth	29,100	4.70	5,300	3,000
--Total--	49,595	9.40	10,600	3,600

a/ Includes cooling water used in presently operated electric power plants

TABLE 8

PROJECTED MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

Elkhorn River Basin

Planning Reach or Subbasin	Municipal Systems			Private Industrial Systems[a/]
	People Served	MGD	AF/Yr.	AF/Yr.
1980				
Elkhorn River				
Above Ewing	7,230	1.70	1,900	
Ewing to Norfolk	5,850	1.30	1,400	
North Fork Elkhorn	22,200	6.00	6,700	1,780
Logan Creek				
Above Pender	10,820	2.30	2,550	200
Pender to Mouth	3,080	.70	750	
Elkhorn River				
Norfolk to Mouth	46,640	11.70	13,100	6,570
--Total--	95,820	23.70	26,400	8,550
2000				
Elkhorn River				
Above Ewing	7,950	1.90	2,100	
Ewing to Norfolk	5,050	1.10	1,200	
North Fork Elkhorn	24,710	6.70	7,500	2,830
Logan Creek				
Above Pender	11,370	2.40	2,640	300
Pender to Mouth	2,630	.60	660	
Elkhorn River				
Norfolk to Mouth	54,590	14.30	16,000	10,070
--Total--	106,300	27.00	30,100	13,200
2020				
Elkhorn River				
Above Ewing	8,370	2.00	2,200	
Ewing to Norfolk	4,160	.90	1,000	
North Fork Elkhorn	27,080	7.40	8,300	3,430
Logan Creek				
Above Pender	12,410	2.60	2,900	400
Pender to Mouth	2,100	.50	600	
Elkhorn River				
Norfolk to Mouth	64,730	17.10	19,200	11,170
--Total--	118,850	30.50	34,200	15,000

a/ Includes cooling water used in presently operated electric power plants

TABLE 9

PROJECTED MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

Lower Platte River Basin

Planning Reach or Subbasin	Municipal Systems			Private Industrial Systems[a/]
	People Served	MGD	AF/Yr.	AF/Yr.
-----------1980-----------				
Platte River				
Loup River to North Bend	6,530	1.2	1,400	1,800
No. Bend to So. Bend except Lincoln SMSA[b/]	10,140	2.3	2,600	2,000
Lincoln Metropolitan Area	170,000	47.6	53,300	26,750
South Bend to Mouth	1,770	.3	300	1,500
--Total--	188,440	51.4	57,600	32,050
-----------2000-----------				
Platte River				
Loup River to North Bend	6,550	1.2	1,400	2,400
North Bend to South Bend except Lincoln SMSA[b/]	11,020	2.5	2,800	2,500
Lincoln Metropolitan Area	230,000	64.4	72,000	26,750
South Bend to Mouth	2,070	.3	400	2,000
--Total--	249,640	68.4	76,600	33,650
-----------2020-----------				
Platte River				
Loup River to North Bend	6,400	1.3	1,400	3,000
North Bend to South Bend except Lincoln SMSA[b/]	12,480	3.0	3,300	4,000
Lincoln Metropolitan Area	300,000	84.0	94,000	26,750
South Bend to Mouth	2,450	.4	500	2,500
--Total--	321,330	88.7	99,200	36,250

a/ Includes cooling water used in presently operated electric power plants
b/ SMSA population less people served by private systems (farm, etc.) 1980-20,000; 2000-30,000; and 2020-45,000

TABLE 10

PROJECTED MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

Republican River Basin

Planning Reach or Subbasin	Municipal Systems			Private Industrial Systems[a/]
	People Served	MGD	AF/Yr.	AF/Yr.
1980				
Republican River				
State Line to Stratton	1,510	.4	500	
Frenchman River				
State Line to Mouth	4,050	.9	1,000	
Republican River				
Stratton to Orleans	19,150	5.3	5,800	200
Orleans to State Line	16,170	4.2	4,700	340
Beaver & Sappa Creeks	1,430	.3	300	
--Total--	42,310	11.1	12,300	540
2000				
Republican River				
State Line to Stratton	1,320	.3	400	
Frenchman River				
State Line to Mouth	3,560	.8	900	
Republican River				
Stratton to Orleans	19,660	5.6	6,200	400
Orleans to State Line	16,890	4.5	5,100	670
Beaver & Sappa Creeks	1,180	.3	300	
--Total--	42,610	11.5	12,900	1,070
2020				
Republican River				
State Line to Stratton	1,090	.3	300	
Frenchman River				
State Line to Mouth	2,960	.7	750	
Republican River				
Stratton to Orleans	20,100	5.8	6,550	500
Orleans to State Line	18,040	5.0	5,600	1,000
Beaver & Sappa Creeks	910	.2	200	
--Total--	43,100	12.0	13,400	1,500

a/ Includes cooling water used in presently operated electric power plants

TABLE 11

PROJECTED MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

Little Blue River Basin

Planning Reach or Subbasin	Municipal Systems			Private Industrial Systems[a/]
	People Served	MGD	AF/Yr.	AF/Yr.
----------1980----------				
Little Blue River				
Above DeWeese	5,860	1.2	1,300	2,000
DeWeese to Fairbury	12,840	2.8	3,200	130
Fairbury to State Line	850	.2	200	
--Total--	19,550	4.2	4,700	2,130
----------2000----------				
Little Blue River				
Above DeWeese	5,850	1.2	1,300	2,600
DeWeese to Fairbury	11,750	2.6	2,900	360
Fairbury to State Line	650	.2	200	
--Total--	18,250	4.0	4,400	2,960
----------2020----------				
Little Blue River				
Above DeWeese	5,830	1.2	1,300	3,000
DeWeese to Fairbury	10,580	2.3	2,600	400
Fairbury to State Line	490	.1	100	
--Total--	16,900	3.6	4,000	3,400

a/ Includes cooling water used in presently operated electric power plants

TABLE 12

PROJECTED MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

Big Blue River Basin

Planning Reach or Subbasin	Municipal Systems			Private Industrial Systems[a/]
	People Served	MGD	AF/Yr.	AF/Yr.
-----------1980-----------				
Big Blue River				
Above Seward	16,800	3.6	4,000	200
Seward to Crete	45,240	14.6	16,300	3,400
Crete to Barneston	23,480	5.7	6,400	2,000
Barneston to State Line	140	b/	25	
--Total--	85,660	23.9	26,725	5,600
-----------2000-----------				
Big Blue River				
Above Seward	18,310	3.8	4,400	400
Seward to Crete	50,070	15.9	17,800	5,050
Crete to Barneston	23,840	5.8	6,500	2,000
Barneston to State Line	110	b/	20	
--Total--	92,330	25.5	28,720	7,450
-----------2020-----------				
Big Blue River				
Above Seward	19,760	4.3	4,800	500
Seward to Crete	54,830	17.6	19,700	5,500
Crete to Barneston	24,460	6.0	6,700	3,000
Barneston to State Line	70	b/	10	
--Total--	99,120	27.9	31,210	9,000

a/ Includes cooling water used in presently operated electric power plants
b/ Less than .05 MGD

TABLE 13

PROJECTED MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

Nemaha River Basin

Planning Reach or Subbasin	Municipal Systems			Private Industrial Systems[a/]
	People Served	MGD	AF/Yr.	AF/Yr.
-----------1980-----------				
Weeping Water Creek	1,970	.3	400	
Little Nemaha River	8,440	1.6	1,800	
Big Nemaha River				
Above Humboldt	4,600	1.2	1,300	
Humboldt to Falls City	6,940	1.4	1,600	
Falls City to Mouth	600	.1	100	
Missouri River				
Plattsmouth to Rulo	17,690	4.3	4,800	
--Total--	40,240	8.9	10,000	None
-----------2000-----------				
Weeping Water Creek	1,630	.3	300	
Little Nemaha River	10,420	2.0	2,200	
Big Nemaha River				
Above Humboldt	3,970	1.1	1,200	
Humboldt to Falls City	6,630	1.4	1,500	
Falls City to Mouth	460	.1	100	
Missouri River				
Plattsmouth to Rulo	20,210	4.9	5,500	
--Total--	43,320	9.8	10,800	None
-----------2020-----------				
Weeping Water Creek	1,230	.2	200	
Little Nemaha River	13,170	2.5	2,800	
Big Nemaha River				
Above Humboldt	3,320	.9	1,000	
Humboldt to Falls City	6,290	1.3	1,500	
Falls City to Mouth	300	.1	100	
Missouri River				
Plattsmouth to Rulo	23,410	5.7	6,400	
--Total--	47,720	10.7	12,000	None

a/ Includes cooling water used in presently operated electric power plants

ATTACHMENT 3

This attachment includes a summary of drainage needs by watershed areas within each river basin. These tables are summaries of 1967 data collected for the Watershed Projects Inventory of the 1969 Nebraska Conservation Needs Inventory.

Locations of watersheds included in Tables 1 through 13 are shown on Map 2 and the accompanying key.

LIST OF TABLES

TABLE 1

DISTRIBUTION OF DRAINAGE PROBLEMS

White River-Hat Creek Basin

Watershed Identification		Area With Drainage Problem (Acres)	
Map 2 Location Number	Name	Total	Requiring Project Action
9	Whitney-Big Cottonwood	2,500	0
16	Wolfe-Wounded Knee	100	0
17	Little White	1,000	0
	TOTAL	3,600	0

TABLE 2

DISTRIBUTION OF DRAINAGE PROBLEMS

Niobrara River Basin

Watershed Identification		Area With Drainage Problem (Acres)	
Map 2 Location Number	Name	Total	Requiring Project Action
5	Niobrara-Marsland	1,000	0
6	Sand Creek	500	0
7	Dunlap Tribs.	1,000	0
8	Mirage Flats	1,500	0
9	Box Butte	2,200	0
10	Snake Creek (Upper)	500	0
11	Point of Rocks Creek	2,500	0
12	Berea-Hemingford Creeks	4,500	3,000[a/]
13	Snake Creek (Lower)	6,000	4,000[a/]
14	Rush Creek	1,000	0
15	Niobrara Tribs. - Sheridan	300	0
16	Antelope Creek	2,000	0
18	Minnechaduza Creek	1,000	0
21	Plum Creek (Lower)	2,000	2,000
22	Bone Creek	6,000	6,000
23	Long Pine Creek	2,500	1,500
24	Riverview Tribs.	300	0
25	Mariaville Tribs.	2,000	0
26	Keya Paha Creek	1,400	0
27	Big Sandy	500	0
28	Turkey Creek, Etc.	100	0
29	Eagle Creek	4,000	4,000
30	Redbird Creek	3,000	2,000
32	North Branch Verdigre Creek	2,500	1,500
33	Verdigre Creek (Lower)	200	0
34	Niobrara River (Lower)	2,700	2,000
35	Ponca	4,700	3,000
	TOTAL	55,900	29,000
			(7,000[a/])

a/ Problem areas, 1,000 acres or more, in cropland use

TABLE 3

DISTRIBUTION OF DRAINAGE PROBLEMS

Missouri Tributaries River Basin

Watershed Identification		Area With Drainage Problem (Acres)	
Map 2 Location Number	Name	Total	Requiring Project Action
1	Bazile Creek (Upper)	3,300	2,500[a/]
2	Little Bazile Creek	500	0
3	Bazile Creek (Lower)	1,000	0
5	Antelope-Beaver	1,000	800
6	Sunny Side Tribs.	500	500
7	Bow Valley Creek	1,200	500
8	Bow Creek (Upper)	1,500	0
9	Bow Creek (Lower)	1,500	0
10	Cedar-Dixon Missouri Tribs.	3,200	0
11	Aowa Creek	200	0
12	South Creek	700	0
13	Elk Creek	6,000	5,000[a/]
14	Omaha Creek	7,000	5,000[a/]
15	Blackbird Creek	2,500	2,000[a/]
16	Decatur Tribs.	15,000	10,000[a/]
17	Tekamah-Mud	12,000	6,000[a/]
18	Blair-Herman Tribs.	10,000	6,000[a/]
19	Mill-Long	500	0
20	Omaha Tribs.	8,500	4,000[a/]
21	Papillion Creek	8,500	0
	TOTAL	84,600	42,300
			(39,500[b/])

a/ Problem areas, 1,000 acres or more, primarily in cropland use. In some cases, the total acreage included is not entirely in cropland use.
b/ Acreage in cropland use

TABLE 4

DISTRIBUTION OF DRAINAGE PROBLEMS

North Platte River Basin

Watershed Identification		Area With Drainage Problem (Acres)	
Map 2 Location Number	Name	Total	Requiring Project Action
1	Kiowa Creek	10,000	8,000[a/]
2	Sheep Creek	3,500	0
3	Spotted Tail Creek	10,000	7,500[a/]
4	South Mitchell	5,000	4,500[a/]
5	Winters Creek	9,000	7,000[a/]
7	Nine Mile	10,000	5,000[a/]
8	Chimney Rock	11,000	11,000[a/]
9	Triple	3,000	2,000[a/]
11	North Port Tribs.	12,000	7,000[a/]
16	Broadwater Tribs.	600	0
17	Deep Holes, Cedar, Etc.	2,300	0
18	Rush Creek	6,200	0
19	Lost Creek	4,500	0
20	Ash Hollow	2,100	0
22	Ash-Plum	1,500	1,000[a/]
	TOTAL	90,700	53,000[a/]

a/ Problem areas, 1,000 acres or more, in cropland use

TABLE 5

DISTRIBUTION OF DRAINAGE PROBLEMS

South Platte River Basin

Watershed Identification		Area With Drainage Problem (Acres)	
Map 2 Location Number	Name	Total	Requiring Project Action
2	Bushnell Tribs.	500	0
3	Kimball Tribs.	1,000	0
4	Potter Tribs.	4,200	0
5	Southwest Kimball	1,000	0
6	Sidney Draw	600	0
7	Sioux Ordnance Depot Tribs.	5,100	0
8	Cow Creek, Etc.	3,000	0
9	Lodgepole Creek (Lower)	1,000	0
10	Western Canal Tribs.	7,300	2,800[a/]
11	O'Neill Draw	100	0
12	Big Springs Tribs.	2,600	1,900[a/]
14	Ogallala-Sutherland Tribs.	18,000	1,000[a/]
16	Roscoe Draw, Etc.	24,500	12,500[a/]
17	Sutherland Res., Lake Mahoney	32,000	10,000[a/]
	TOTAL	100,900	28,200[a/]

a/ Problem areas, 1,000 acres or more, in cropland use

TABLE 6

DISTRIBUTION OF DRAINAGE PROBLEMS

Middle Platte River Basin

Watershed Identification		Area With Drainage Problem (Acres)	
Map 2 Location Number	Name	Total	Requiring Project Action
3	Bignall Tribs.	16,000	0
4	Gothenburg Tribs.	10,000	5,000[a]
5	Tri County Tribs.	40,000	0
6	Spring Creek (Dawson Co.)	21,000	5,000[a]
7	Plum Creek	6,100	1,000[a]
8	Buffalo Creek	23,200	16,000[a]
9	Platte Tribs. (Phelps Co.)	12,000	8,000[a]
10	Hall-Buffalo Bottom	60,000	40,000[a]
11	Twin, Lost & Dry	32,500	26,000[a]
12	Wood River	3,000	0
13	Wood River (Lower)	8,500	0
14	Box Elder	1,500	0
15	Warm Slough-Silver Creek	61,100	49,100[a]
16	Platte Tribs. (Hamilton)	5,200	0
17	Prairie Creek (Upper)	26,000	10,000[a]
18	Prairie Creek (Lower)	72,000	59,000[a]
19	Jones Creek	900	0
20	Clear Creek	8,000	6,500[a]
	TOTAL	407,000	225,600[a]

a/ Problem areas, 1,000 acres or more, in cropland use

TABLE 7

DISTRIBUTION OF DRAINAGE PROBLEMS

Loup River Basin

Watershed Identification		Area With Drainage Problem (Acres)	
Map 2 Location Number	Name	Total	Requiring Project Action
1	South Loup Sandhills	3,000	0
2	Callaway Tribs.	2,000	0
3	Ash, Deer, Box Elder, Oak Creek	800	0
4	Cat, Elk & Dry Creeks	2,600	0
5	Otter & Death Creeks	2,200	0
6	Clear Creek	3,300	0
7	Mud Creek	14,300	5,000 a/
8	Cedar-Sweet-Cherry Creeks	3,100	0
9	Middle Loup Sandhills	33,000	0
10	Anselmo Area	8,000	3,000 a/
11	Lillian-Spring Creeks	3,000	0
12	Sargent Tribs.	16,000	10,000 a/
13	Loup City Tribs. (West)	13,300	2,000 a/
14	Hawthorne Creek	400	0
15	Loup City Tribs. (East)	10,100	2,000 a/
16	Farwell	3,100	1,500 a/
17	Loup Bottom (Upper)	27,500	17,000 a/
18	North Loup Sandhills	34,500	0
19	Calamus River	15,200	0
20	Taylor-Ord Canal Tribs.	5,400	0
21	Burwell-Sumter Canal Tribs.	1,700	0
22	Haskell Creek	100	0
23	North Loup Tribs. (Lower)	7,500	0
24	Miry-Davis-Munson Creeks	6,700	0
25	Spring Creek (Howard County)	4,300	0
26	Cedar Creek (Sandhills)	12,400	0
27	Cedar Creek (Middle)	7,500	0
29	Cedar Creek (Lower)	3,500	0
30	Plum Creek (Boone)	2,500	0
31	Beaver Creek (Sandhills)	13,000	0
32	Beaver Creek (Lower)	9,000	0
33	Lookingglass Creek	8,000	3,000 a/
34	Loup Bottom (Lower)	7,000	2,500 a/
	TOTAL	284,000	46,000 a/

a/ Problem areas, 1,000 acres or more, in cropland use

TABLE 8

DISTRIBUTION OF DRAINAGE PROBLEMS

Elkhorn River Basin

Watershed Identification		Area With Drainage Problem (Acres)	
Map 2 Location Number	Name	Total	Requiring Project Action
1	Elkhorn River (Upper)	13,500	13,500
2	Stuart-Atkinson Tribs.	10,000	10,000
3	Holt Creek	10,000	10,000
4	Dry Creek (Sandhills)	20,000	20,000
5	South Fork Elkhorn River	30,000	30,000
6	O'Neill Tribs.	2,000	0
7	Cache-Clearwater Creeks	21,500	20,000
8	Antelope-Cedar	4,000	0
9	Neligh-Norfolk Tribs.	4,000	2,500[a]
10	Tilden-Battle Creek Tribs.	15,000	11,000[a]
12	North Fork (Upper)	6,100	4,500[a]
13	Dry Creek	10,400	10,400
14	Willow Creek	14,000	14,000
15	Yankton Slough	2,000	0
16	North Fork (Lower)	2,800	0
17	Stanton Tribs.	2,000	0
18	Union Creek	4,000	0
19	Butterfly-Leisy	3,500	0
20	Humbug Creek	200	0
21	Pilger	500	0
22	Sand Creek	3,000	2,000[a]
23	Rock Creek	1,000	0
24	Fischer Creek	4,500	2,000[a]
25	Plum Creek	6,000	1,500[a]
26	Cuming Creek	7,000	3,000[a]
27	Pebble Creek	8,700	6,000[a]
28	Logan Creek (Upper)	5,800	3,000[a]
29	South Logan Creek	3,200	0
30	Logan Creek (Middle)	8,400	5,900[a]
31	Logan Creek (Lower)	14,500	3,500[a]
32	East Fork Maple	1,500	0
33	Maple-Dry Creek	1,200	0
34	Maple Creek (Lower)	6,000	2,600[a]
35	Bell Creek	7,200	2,500[a]
36	Rawhide Creek	36,500	30,000[a]
	TOTAL	290,000	207,900
			(80,000[a])

a/ Problem areas, 1,000 acres or more, in cropland use

TABLE 9

DISTRIBUTION OF DRAINAGE PROBLEMS

Lower Platte River Basin

Watershed Identification		Area With Drainage Problem (Acres)	
Map 2 Location Number	Name	Total	Requiring Project Action
1	Bellwood	8,000	0
2	Lost Creek	27,000	17,000[a/]
3	Bone Creek	7,000	5,000[a/]
4	Shell Creek	15,800	0
5	Loseke-Taylor	2,500	0
6	Skull Creek	2,500	0
7	North Bend Drains, Etc.	54,000	8,000[a/]
8	Platte Tribs. (Saunders Co.)	12,000	5,000[a/]
9	Upper Salt	1,000	0
10	Lincoln Tribs.	600	0
11	Stevens-Camp	1,500	1,000[a/]
12	Oak-Middle	2,200	0
13	Little Salt-Jordan Creeks	1,200	0
14	Rock Creek	3,800	0
15	Salt Creek (Lower)	2,500	0
16	Wahoo Creek (Upper)	2,200	0
17	Cottonwood Creek	1,000	0
18	Sand Creek	3,000	0
20	Silver Creek	4,000	4,000[a/]
21	Clear Creek	15,000	0
22	Wahoo Creek (Lower)	9,000	3,000[a/]
23	Platte Tribs. (Sarpy Co.)	6,000	3,000[a/]
25	Northeast Cass	500	0
	TOTAL	182,300	46,000[a/]

a/ Problem areas, 1,000 acres or more, in cropland use

TABLE 10

DISTRIBUTION OF DRAINAGE PROBLEMS

Republican River Basin

Watershed Identification		Area With Drainage Problem (Acres)	
Map 2 Location Number	Name	Total	Requiring Project Action
1	North Fork Republican River	200	0
2	Arikaree River	500	0
3	Buffalo Creek	3,000	0
4	Rock-Spring Creeks	2,500	0
5	Hey Canyon, Etc. Tribs.	600	0
6	South Fork Republican River	500	0
7	Chase-Dundy Sandhills	1,100	0
8	Indian Creek	1,100	0
9	Burntwood Creek	700	0
10	Muddy Creek (Dundy Co.)	900	0
11	Culbertson to Stratton Tribs. (No.)	1,600	0
12	Culbertson to Stratton Tribs. (So.)	300	0
13	Sand Creek	2,500	0
14	Frenchman Creek (Enders Res.)	2,000	1,500 a/
15	Frenchman Creek (Wauneta Trib.)	1,700	300
16	Venango Tribs.	1,700	0
17	Spring Creek (Upper)	3,000	1,500 a/
18	Grant Tribs.	5,000	2,300 a/
19	Stinking Water Creek (Upper)	5,500	2,000 a/
20	Spring-Stinking Water Creeks	800	500
21	Frenchman River (Lower)	1,700	0
22	Blackwood Creek (Upper)	300	0
23	Blackwood Creek (Lower)	100	0
24	Driftwood Creek	500	0
25	Dry Creek South	50	50
26	McCook Tribs.	500	500
28	Red Willow (Upper)	3,600	1,000
29	Red Willow (Lower)	1,000	0
31	Dry Creek (Pilot)	400	0
35	Medicine Creek (Upper)	2,500	0
36	Medicine Creek (Middle)	1,000	0
38	Republican So. Tribs. (Furnas Co.)	4,200	1,800 a/
39	Deer Creek	500	0
41	Elk, Turkey, Etc. Creeks	4,100	500
42	Orleans Tribs.	13,400	7,400 a/
47	Sappa Creek (Lower)	1,400	200
49	Prairie Dog Creek (Lower)	1,500	0
50	Turkey Creek	1,100	0
51	Lost Creek Tribs.	500	0
52	Sacramento Tribs.	5,500	4,500 a/
53	Center Tribs.	2,000	0
54	Thompson Creek	7,800	6,900 a/
55	Lohffy-Oak Creeks	2,000	0
56	Farmers-Indian Creeks	1,700	0
57	Red Cloud Tribs.	1,500	0
59	Courtland Tribs.	1,400	0
60	Superior Tribs.	1,900	800 a/
	TOTAL	97,350	31,750 (23,800 b/)

a/ Problem areas, 1,000 acres or more, primarily in cropland use. In some cases the total acreage included is not entirely in cropland use.

b/ Acreage in cropland use

TABLE 11

DISTRIBUTION OF DRAINAGE PROBLEMS

Little Blue River Basin

Watershed Identification		Area With Drainage Problem (Acres)	
Map 2 Location Number	Name	Total	Requiring Project Action
1	Little Blue (Upper)	5,800	4,000[a]
2	Cottonwood-Scott Creeks	1,400	1,000[a]
3	Thirty-Two Mile Creek	200	0
4	Pawnee Creek	1,000	1,000[a]
5	ACNW Tribs.	1,500	1,000[a]
6	Angus-Hebron Tribs.	500	0
7	Spring Creek	200	0
8	Dry Creek (Thayer Co.)	1,500	0
9	Big Sandy	24,800	15,500[a]
10	Little Sandy	3,200	3,000[a]
11	Bowman-Spring Branch	200	0
13	Rose Creek	400	0
14	Fairbury Tribs.	1,000	0
	TOTAL	41,700	25,500[a]

a/ Problem areas, 1,000 acres or more, in cropland use

TABLE 12

DISTRIBUTION OF DRAINAGE PROBLEMS

Big Blue River Basin

Watershed Identification		Area With Drainage Problem (Acres)	
Map 2 Location Number	Name	Total	Requiring Project Action
1	North Fork	7,000	7,000[a]
2	Kezar Creek	2,000	2,000[a]
3	North Branch (Upper)	7,200	7,200[a]
4	North Branch (Lower)	5,300	3,000[a]
5	Lincoln Creek (Upper)	1,150	1,150[a]
6	Lincoln Creek (Lower)	7,200	7,200[a]
7	Plum Creek (Seward)	1,000	0
8	Seward-Milford Tribs.	6,000	1,500[a]
9	West Fork (Upper)	9,500	8,500[a]
10	School Creek	3,200	3,000[a]
11	West Fork (Middle)	14,900	12,900[a]
12	Beaver Creek	15,000	12,000[a]
13	West Fork (Lower)	11,000	8,500[a]
14	Dorchester	200	0
15	Crete-Wilber-Dewitt Tribs.	4,700	3,500[a]
16	Upper Turkey Creek	10,500	8,500[a]
17	Lower Turkey Creek	3,500	3,500[a]
18	Swan-Dry Creeks	600	0
19	Clatonia	200	0
20	Soap Creek	300	0
21	Plymouth	2,100	0
22	Cub Creek	1,300	0
24	Bear-Pierce-Cedar	200	0
25	Mud Creek	100	0
26	Beatrice Tribs.	1,500	0
27	Big Indian Creek	1,500	0
28	Wolf-Wildcat	400	0
29	Plum Creek	400	0
	TOTAL	117,950	89,450[a]

a/ Problem areas, 1,000 acres or more, in cropland use

TABLE 13

DISTRIBUTION OF DRAINAGE PROBLEMS

Nemaha River Basin

Watershed Identification		Area With Drainage Problem (Acres)	
Map 2 Location Number	Name	Total	Requiring Project Action
3	Weeping Water Creek	3,500	0
4	Nebraska City-Peru Tribs.	3,500	2,000[a/]
Little Nemaha			
5	Little Nemaha (Upper)	2,000	0
6	Brownell Creek	500	0
7	Ziegler Creek	400	0
8	South Branch Little Nemaha	2,000	0
9	Wilson Creek	1,200	0
10	Spring Creek (Johnson County)	600	0
11	Brock Tribs.	200	0
12	Rock Creek (Nemaha & Otoe Co's.)	1,500	0
13	Auburn Tribs.	1,000	0
14	Beadow-Deroin	500	0
15	Winnebago-Bean	200	0
Big Nemaha			
16	Upper Big Nemaha	1,300	0
17	Middle Big Nemaha	1,500	0
18	Lower Big Nemaha	3,700	0
19	Long Branch	400	0
20	Turkey Creek	1,800	0
22	South Fork (West)	500	0
23	South Fork (Lower)	2,300	0
24	Pony Creek	2,500	0
25	Walnut Creek	300	0
26	Muddy Creek	5,100	0
27	Nemaha-Missouri Bottom	5,000	4,000[a/]
	TOTAL	41,500	6,000[a/]

a/ Problem areas, 1,000 acres or more, in cropland use

ATTACHMENT 4

This section contains detailed tables by river basins showing:

Part a—Principal improvements for flood control and related purposes considered to be existing as of 1968,

Part b—Distribution of flood damages by main stream reaches and watershed groups, and

Part c—Distribution of urban flood damages.

Projects funded for construction are considered as operational. Degree of flood control is expressed in recurrence interval in years of the design runoff capacity of the principal works of improvement, or as floodwater storage capacity provided expressed in inches of runoff from the controlled drainage area. Benefits for multipurpose structures are for reduction in flood damages only. Flood damages are based on 1960 price levels and generally on 1963 to 1965 levels of land use and development.

Source: Missouri River Basin Comprehensive Framework Study, 1967 (including later revisions)

LIST OF TABLES

TABLE 1a

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES
CONSIDERED TO BE EXISTING IN THE WHITE RIVER-HAT CREEK BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
None							

TABLE 1b

DISTRIBUTION OF FLOOD DAMAGES IN THE WHITE RIVER-HAT CREEK BASIN
(1960 PRICE LEVELS) (UNIT AMOUNTS IN THOUSANDS)

Stream Reach or Watershed	Area Subject to Flooding (Acres)	Average Annual Flood Damage: Crop and Pasture (Dollars)	Other Rural (Dollars)	Urban (Dollars)	Total (Dollars)
Mainstem:					
None Inventoried	-	-	-	-	-
Watersheds:a/					
A None	0	0	0	0	0
B Ash-Chadron, Bordeaux Cr., and White Clay Cr.	8.2	19.0	20.0	1.0	40.0
C Indian Cr. (Upper & Lower), Hat Cr. (Upper & Lower), Hat Tribs., Horsehead Cr., White River (Upper), Crawford Tribs., Whitney-Cottonwood, Lone Tree Cr., Beaver Cr., Lime Kiln Cr., Wolf-Wounded Knee Crs., Little White (Upper)	27.8	48.1	21.2	0	69.3
D None	0	0	0	0	0
RIVER BASIN TOTAL	36.0	67.1	41.2	1.0	109.3

a/ Classification of watersheds by severity of flood damage (see text, Chapter 7)

TABLE 1c

DISTRIBUTION OF URBAN FLOOD DAMAGES IN THE
WHITE RIVER-HAT CREEK BASIN (1960 PRICE LEVELS)

Community	1960 Population	Stream	Current Urban Flood Area (Acres)	Recurrence Interval of Flooding (Years)	Average Annual Flood Damage (Thousand Dollars)
Chadron State Park	--	Ash-Chadron, etc.	50	NA	1

TABLE 2a

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES CONSIDERED TO BE EXISTING IN THE NIOBRARA RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Box Butte Reservoir	BR	1946	Niobrara River	Multiple-purpose dam and reservoir, Mirage Flats Project, total capacity 31,100 acre-feet. No storage reserved exclusively for flood control. Drainage area 1,266 sq. mi.	NA	NA	Incidental
Antelope Creek Watershed	SCS	1964	Niobrara River	3 floodwater-retarding structures; capacity 4,842 acre-feet.	500	100	17
Merritt Reservoir	BR	1963	Snake River	Multiple-purpose dam and reservoir, Ainsworth Unit, total capacity 74,500 acre-feet. No storage reserved exclusively for flood control. Drainage area 83 sq. mi.	NA	NA	Incidental
				--TOTAL--	500	--	17

TABLE 2b

DISTRIBUTION OF FLOOD DAMAGES IN THE NIOBRARA RIVER BASIN
(1960 PRICE LEVELS) (UNIT AMOUNTS IN THOUSANDS)

Stream Reach or Watershed	Area Subject to Flooding (Acres)	Average Annual Flood Damage: Crop and Pasture (Dollars)	Average Annual Flood Damage: Other Rural (Dollars)	Average Annual Flood Damage: Urban (Dollars)	Average Annual Flood Damage: Total (Dollars)
Mainstem					
Niobrara River - Box Butte Reservoir to Mouth	44.0	34.0	22.0	0	56.0
Watersheds:a/					
A None	0	0	0	0	0
B None	0	0	0	0	0
C Vantassell, Niobrara (Harrison and Agate), Whistle Cr., Niobrara-Marsland, Sand Cr., Dunlap Tribs., Mirage Flats, Box Butte Cr., Snake Creek (Upper & Lower), Point of Rocks, Berea-Hemingford Crs., Rush Cr., Sheridan Tribs. (Niobrara), Niobrara Sandhills, Minnechaduza Cr., Niobrara Tribs.-Cherry-Keya Paha, Plum Cr. (Upper & Lower), Bone Cr., Long Pine Cr., Riverview Cr., Mariaville Tribs., Keya Paha Cr., Big Sandy-Brush Crs., Turkey Cr., Eagle Cr., Redbird Cr., Verdigre (Upper, Lower, and North Branch), Niobrara (Lower), Ponca, Boyd-Missouri Tribs.	71.9	175.7	114.4	13.4	303.5
D Antelope Creek	2.3	0.2	0.3	3.0	3.5
Subtotal-Watersheds	74.2	175.9	114.7	16.4	307.0
RIVER BASIN TOTAL	118.2	209.9	136.7	16.4	363.0

a/ Classification of watersheds by severity of flood damage (see text, Chapter 7)

TABLE 2c

DISTRIBUTION OF URBAN FLOOD DAMAGES IN THE NIOBRARA RIVER BASIN
(1960 PRICE LEVELS)

Community	1960 Population	Stream	Current Urban Flood Area (Acres)	Recurrence Interval of Flooding (Years)	Average Annual Flood Damage (Thousand Dollars)
Ainsworth	1,982	Bone Creek	40	15	a/
Alliance	7,845	Lower Snake Creek	50	15	1
Gordon	2,223	Antelope Creek	100	50	3
Hay Springs	823	Rush Creek	50	10	2
Merriman	285	Niobrara Sandhills	200	5	1
Niobrara	736	Niobrara River	0	--	0
Verdigre	584	Lower Verdigre Creek	100	10	7

a/ Less than $1,000

TABLE 3a

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES
CONSIDERED TO BE EXISTING IN THE MISSOURI TRIBUTARIES RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Missouri River Bank Stabilization	CE	UC	Missouri R.	Dikes, revetments, channel cutoffs for navigation and bank stabilization.	Not Available	--	Not Available
Missouri River Levees	CE	UC	Missouri R.	Mainstem and tributary tie-back to protect Missouri River flood plain from Missouri River and tributary floods.	Not Available	100	Not Available
Blackbird Creek Local Protection Macy, Nebraska	CE	UC	Blackbird Creek	2.5 miles of levee and some channel cleanout near mouth of Blackbird Creek.	2,700	50	7
Omaha Local Protection	CE	1949	Missouri R.	12.3 mi. of levees, 1.1 mi. of floodwall and appurtenant works for protection of metropolitan Omaha from Missouri River floods.	5,760	1,000	600
Little Papillion Cr., Nebraska	CE	UC	L. Papillion Creek	6.5 mi. channel enlargement and straightening through metropolitan area of Omaha, Nebraska.	1,060	33	234
				--TOTAL--	9,520	--	841

TABLE 3b

DISTRIBUTION OF FLOOD DAMAGES IN THE MISSOURI TRIBUTARIES RIVER BASIN
(1960 PRICE LEVELS) (UNIT AMOUNTS IN THOUSANDS)

Stream Reach or Watershed	Area Subject to Flooding (Acres)	Average Annual Flood Damage: Crop and Pasture (Dollars)	Other Rural (Dollars)	Urban (Dollars)	Total (Dollars)
Mainstem: Missouri River - Niobrara River to Omaha	262.0	124.0	82.5	13.0	219.5
Watersheds:[a]					
A Cedar-Dixon-Mo. Tribs., Aowa Cr., Decatur Tribs., Tekamah-Mud, Blair-Herman Tribs., Omaha Tribs., Papillion Cr.	58.1	434.4	127.7	316.0	878.1
B Little Bazile Cr., Antelope-Beaver, Bow Valley Cr., Bow Cr. (Upper & Lower), Omaha Cr.	41.5	416.1	126.5	38.3	580.9
C Bazile Cr. (Upper & Lower), Lewis and Clark (Lower), Sunny Side Tribs., South Creek, Elk Creek, Blackbird Cr., Mill-Long	29.3	163.9	59.6	3.8	227.3
D None	0	0	0	0	0
Subtotal-Watersheds	128.9	1,014.4	313.8	358.1	1,686.3
RIVER BASIN TOTAL	390.9	1,138.4	396.3	371.1	1,905.8

a/ Classification of watersheds by severity of flood damage (see text, Chapter 7)

TABLE 3c

DISTRIBUTION OF URBAN FLOOD DAMAGES IN THE MISSOURI TRIBUTARIES RIVER BASIN
(1960 PRICE LEVELS)

Community	1960 Population	Stream	Current Urban Flood Area (Acres)	Recurrence Interval of Flooding (Years)	Average Annual Flood Damage (Thousand Dollars)
Bloomfield	1,349	Little Bazile Creek	50	20	2
Center	147	Bazile Creek	50	20	a/
Creighton	1,388	Bazile Creek	50	10	1
Crofton	604	Antelope-Beaver Creeks	30	15	a/
Decatur	786	Decatur Tributaries	50	50	1
Hartington	1,648	Bow Creek (Upper)	50	5	1
Homer	370	Omaha Creek	90	5	20
Jackson	224	Elk Creek	50	50	1
Macy	50	Blackbird Creek	20	50	a/
Ponca	924	South Creek	50	50	1
Omaha Urban Area	374,773 b/	Missouri River	5,800	1,000 c/	13
		Big Papillion Creek	490	20	94
		Little Papillion Creek	1,000	33	153
		West Papillion Creek	130	10	14
		Papillion Creek	220	50	41
		Thomas Creek	10	5	2
Tekamah	1,788	Tekamah-Mud	50	5	11
Walthill	844	Omaha	100	5	5
Winnebago	682	Omaha	80	5	10

a/ Less than $1,000
b/ Douglas County and Sarpy County population (1960)
c/ Based upon Corps of Engineers standard project flood with recurrence interval beyond limits of statistical probability analysis

TABLE 4a

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES CONSIDERED TO BE EXISTING IN THE NORTH PLATTE RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Gering Valley Watershed	SCS & CE	UC	Gering Drain	10 mi. diversions; 31 mi. channel improvement; 9 floodwater-retarding structures, capacity 5,532 acre-feet, in upstream drainage. 24 concrete drop structures, 120 rock sills, 10 mi. of stabilized channel, 24 mi. of spoil bank levees, and appurtenant works on primary channels.	34,000	50	889
Wildhorse Creek Watershed	SCS	1969	North Platte River	3 floodwater-retarding structures, capacity 2,300 acre-feet.	738	100	20
Lake McConaughy	CNPP&ID	1941	North Platte River	Multiple-purpose reservoir formed by Kingsley Dam, Tri-County Project, capacity 1,948,000 acre-feet. No storage reserved exclusively for flood control. Drainage area approximately 31,500 sq. mi.	NA		NA
				--TOTAL--	34,738	--	909

TABLE 4b

DISTRIBUTION OF FLOOD DAMAGES IN THE NORTH PLATTE RIVER BASIN
(1960 PRICE LEVELS) (UNIT AMOUNTS IN THOUSANDS)

Stream Reach or Watershed	Area Subject to Flooding (Acres)	Average Annual Flood Damage: Crop and Pasture (Dollars)	Other Rural (Dollars)	Urban (Dollars)	Total (Dollars)
Mainstem:					
North Platte River-State Line to Mouth	35.0	36.0	58.0	6.0	100.0
Watersheds:a/					
A South Mitchell, Winters Cr., Chimney Rock	26.6	268.4	66.1	48.0	382.5
B Kiowa Cr., Sheep Cr., Spotted Tail Cr., Nine-Mile, Triple, North Port Tribs., Pumpkin Cr. (Middle & Lower), Broadwater Tribs., Deep Holes-Cedar Etc., Ash-Plum	72.1	579.5	117.8	6.0	703.3
C Pumpkin Cr. (Upper), Lawrence Cr., Middle Greenwood, Rush Cr., Lost Cr. Etc., Ash Hollow, North Platte Sand-hills	18.9	75.8	30.3	4.0	110.1
D Gering, Wildhorse	31.6	2.4	.4	.1	2.9
Subtotal-Watersheds	149.2	926.1	214.6	58.1	1,198.8
RIVER BASIN TOTAL	184.2	962.1	272.6	64.1	1,298.8

a/ Classification of watersheds by severity of flood damage (see text, Chapter 7)

TABLE 4c

DISTRIBUTION OF URBAN FLOOD DAMAGES IN THE NORTH PLATTE RIVER BASIN
(1960 PRICE LEVELS)

Community	1960 Population	Stream	Current Urban Flood Area (Acres)	Recurrence Interval of Flooding (Years)	Average Annual Flood Damage (Thousand Dollars)
Bayard	1,519	Wildhorse Creek	150	50	a/
Bridgeport	1,645	North Platte River	100	--	1
Melbeta	118	Creighton Drain	80	10	2
Gering	4,585	North Platte River	100	20	2
Harrisburg	150	Middle Pumpkin Creek	50	10	1
Lyman	626	Kiowa Creek	20	15	1
Morrill	884	Spotted Tail Creek	50	10	4
Mitchell	1,920	North Platte River	30	--	1
Oshkosh	1,025	Lost Creek	100	10	4
Scottsbluff	13,377	North Platte River	300	--	2
		Winters Creek	600	10	44
South Mitchell	50	Browns Canyon Drain	10	10	2

a/ Less than $1,000

TABLE 5a

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES
CONSIDERED TO BE EXISTING IN THE SOUTH PLATTE RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Brule Watershed	SCS	1969	South Platte River	1 floodwater retarding structure, capacity 1,105 acre-feet, 1.7 mi. channel improvement.	130	100	9
Cure Watershed	SCS	1967	South Platte River	1 floodwater-retarding structure, capacity 240 acre-feet.	57	100	3
				--TOTAL--	187	---	12

TABLE 5b

DISTRIBUTION OF FLOOD DAMAGES IN THE SOUTH PLATTE RIVER BASIN
(1960 PRICE LEVELS) (UNIT AMOUNTS IN THOUSANDS)

Stream Reach or Watershed	Area Subject to Flooding (Acres)	Average Annual Flood Damage: Crop and Pasture (Dollars)	Other Rural (Dollars)	Urban (Dollars)	Total (Dollars)
Mainstem:					
South Platte River-State Line to Mouth	74.7	118.0	114.0	85.0	317.0
Lodgepole Creek-Wyoming State Line to Colorado State Line	15.5	8.0	9.0	23.0	40.0
Subtotal-Mainstem	90.2	126.0	123.0	108.0	357.0
Watersheds:[a/]					
A O'Neill Draw (Colorado)	0.4	3.7	1.3		5.0
B Cottonwood Cr., Kimball Tribs., Western Canal Tribs., Ogallala-Sutherland Tribs., Roscoe Draw	20.9	123.9	20.4	4.0	148.3
C Bushnell Tribs., Potter Tribs., Southwest Kimball, Sidney Draw, Sioux Ordnance Depot, Cow Cr., Big Springs Tribs., Sutherland Reservoir-Lake Mahoney, Lodgepole Cr. (Lower)	30.2	188.6	68.5	2.2	259.3
D Brule, Cure	.5	.1	0	1.0	1.1
Subtotal-Watersheds	52.0	316.3	90.2	7.2	413.7
RIVER BASIN TOTAL	142.2	442.3	213.2	115.2	770.7

a/ Classification of watersheds by severity of flood damage (see text, Chapter 7)

TABLE 5c

DISTRIBUTION OF URBAN FLOOD DAMAGES IN THE SOUTH PLATTE RIVER BASIN
(1960 PRICE LEVELS)

Community	1960 Population	Stream	Current Urban Flood Area (Acres)	Recurrence Interval of Flooding (Years)	Average Annual Flood Damage (Thousand Dollars)
Big Springs	506	South Platte River	70	--	14
Brule	370	South Platte River	50	--	7
Hershey	504	South Platte River	100	--	20
Lodgepole	492	Lodgepole Creek Trib.	50	10	1
North Platte	17,184	South Platte River	200	20	1
Ogallala	4,250	South Platte River	200	--	18
		Cure Creek	60	50	1
Paxton	566	South Platte River	110	--	14
		South Platte Trib.	60	5	4
Sidney	8,004	Lodgepole Creek	200	5	23
		Lodgepole Creek Trib.	20	10	1
Sutherland	867	South Platte River	70	--	11

TABLE 6a

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES
CONSIDERED TO BE EXISTING IN THE MIDDLE PLATTE RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Spring Creek Watershed (Dawson)	SCS	UC	Platte River	11 floodwater-retarding structures, capacity 7,602 acre-feet, 33 mi. of channel improvement.	15,080	25 100[a]	200
Jones Creek Watershed	SCS	UC	Platte River	1 floodwater-retarding structure, 1 grade stabilization structure, 4 mi. channel improvement, capacity 230 acre-feet.	1,450	25	10
				--TOTAL--	16,530	---	210

a/ Urban area

TABLE 6b

DISTRIBUTION OF FLOOD DAMAGES IN THE MIDDLE PLATTE RIVER BASIN
(1960 PRICE LEVELS) (UNIT AMOUNTS IN THOUSANDS)

Stream Reach or Watershed	Area Subject to Flooding (Acres)	Average Annual Flood Damage: Crop and Pasture (Dollars)	Other Rural (Dollars)	Urban (Dollars)	Total (Dollars)
Mainstem:					
Platte River-North and South Platte R. confluence to Loup R.	192.0	23.0	11.0	5.0	39.0
Watersheds:[a/]					
A Box Elder	5.0	46.2	6.1	0	52.3
B Gothenburg Tribs., Plum Cr., Buffalo Cr., Platte Tribs. (Phelps), Twin, Lost, and Dry Crs., Wood River (Lower), Warm Slough-Silver Cr., Prairie Cr. (Upper & Lower), Clear Cr.	138.6	665.1	236.6	45.0	946.7
C North Platte Sandhills (part), Maxwell Sandhills & Tribs., Bignall Tribs., Tri County Tribs., Hall-Buffalo Bottom, Wood River, Platte Tribs. (Hamilton)	21.4	64.8	11.9	0	76.7
D Spring Cr. (Dawson), Jones Cr.	10.9	36.6	13.0	0	49.6
Subtotal-Watersheds	175.9	812.7	267.6	45.0	1,125.3
RIVER BASIN TOTAL	367.9	835.7	278.6	50.0	1,164.3

a/ Classification of watersheds by severity of flood damage (see text, Chapter 7)

TABLE 6c

DISTRIBUTION OF URBAN FLOOD DAMAGES IN THE MIDDLE PLATTE RIVER BASIN
(1960 PRICE LEVELS)

Community	1960 Population	Stream	Current Urban Flood Area (Acres)	Recurrence Interval of Flooding (Years)	Average Annual Flood Damage (Thousand Dollars)
Central City and Grand Island	28,148	Warm Slough-Silver Cr.	400	5	7
Elm Creek	778	Elm Creek	20	5	1
Gibbon	1,083	Wood River	50	5	6
Gothenburg	3,050	Gothenburg Tribs.	100	15	1
Grand Island	25,742	Wood River	800	5	20
Kearney	14,210	Platte River	1,200	20	2
Shelton	904	Wood River	40	10	5
Silver Creek	431	Platte River	50	10	1
Wood River	828	Wood River	50	5	5
Columbus	12,476	Platte River	400	--	2

TABLE 7a

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES
CONSIDERED TO BE EXISTING IN THE LOUP RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Sargent Unit	BR	1959	Middle Loup River	Detention dams and reservoirs and drains constructed in connection with Sargent Canal provide flood protection for flood plain areas in and near Sargent, Nebraska.	NA	NA	7
Farwell Unit	BR	1963	Middle Loup River	Sherman Dam and Reservoir, total capacity 90,800 acre-feet, on Oak Creek and Arcadia Diversion Dam and Sherman Feeder Canal on the Middle Loup River provide flood protection.	NA	NA	8
				--TOTAL--	NA	--	15

TABLE 7[illegible]

DISTRIBUTION OF FLOOD DAMAGES IN THE LOUP RIVER BASIN
(1960 PRICE LEVELS) (UNIT AMOUNTS IN THOUSANDS)

Stream Reach or Watershed	Area Subject to Flooding (Acres)	Average Annual Flood Damage: Crop and Pasture (Dollars)	Other Rural (Dollars)	Urban (Dollars)	Total (Dollars)
Mainstem:					
Loup River-North Loup R. to Mouth	49.0	104.0	70.0	104.0	278.0
So. Loup River-Arnold to Mouth	19.0	6.0	5.0	3.0	14.0
Middle Loup R.-Seneca to Mouth	23.0	33.0	25.0	9.0	67.0
North Loup R.-Goose Cr. to Mouth	13.4	15.0	16.0	3.0	34.0
Beaver Cr.-Albion to Mouth	5.0	3.0	2.0	9.0	14.0
Subtotal-Mainstem	109.4	161.0	118.0	128.0	407.0
Watersheds:[a/]					
A Hawthorne Cr., Beaver Cr. (Lower)	22.5	85.3	15.2	6.0	106.5
B Cat-Elk-Dry, Clear Cr., Anselmo Area, Loup City Tribs. (East), Farwell and Oak, Spring Cr. (Howard), Plum Cr. (Boone), Lookingglass & Cherry-Dry Crs.	41.5	268.2	66.5	8.2	342.9
C So. Loup Sandhills, Callaway Tribs., Ash-Deer-Box Elder-Oak, Otter-Death and Tribs., Mud Creek, Cedar-Sweet-Cherry, Middle Loup Sandhills, Sargent Tribs., Lillian-Spring Etc., Loup City Tribs. (West), Loup Bottom (Upper), N. Loup Sand-hills, Calamus River, Taylor-Ord Canals, Burwell-Sumter Canal, Haskell Cr., N. Loup Tribs. (Lower), Miry-Davis-Munson, Cedar Cr. Sand-hills, Cedar Cr. (Middle), Timber Cr., Cedar Cr. (Lower), Beaver Cr. Sandhills	41.3	149.0	82.6	64.1	295.7
D None	0	0	0	0	0
Subtotal-Watersheds	105.3	502.5	164.3	78.3	745.1
RIVER BASIN TOTAL	214.7	663.5	282.3	206.3	1,152.1

a/ Classification of watersheds by severity of flood damage (see text, Chapter 7)

TABLE 7c

DISTRIBUTION OF URBAN FLOOD DAMAGES IN THE LOUP RIVER BASIN
(1960 PRICE LEVELS)

Community	1960 Population	Stream	Current Urban Flood Area (Acres)	Recurrence Interval of Flooding (Years)	Average Annual Flood Damage (Thousand Dollars)
Anselmo	269	Victoria Creek	40	5	2
Arcadia	446	Middle Loup & Hawthorne Cr.	115	5	7
Boelus	180	Middle Loup River	40	10	4
Broken Bow	3,482	Mud Creek	110	3	59
Cedar Rapids	512	Cedar River	20	5	1
Columbus	12,476	Loup River	1,500	5	104
Dannebrog	277	Oak Creek	17	10	5
Dunning	210	Middle Loup River	25	10	1
Ericson	157	Cedar River	25	5	1
Loup City and Rockville	1,568	Middle Loup River & Tribs.	90	5	4
North Loup	453	North Loup River & Tribs.	100	10	2
Ord	2,413	North Loup River & Tribs.	200	20	1
Pleasanton	199	South Loup River	20	10	3
Ravenna	1,417	Mud Creek	4	5	2
St. Edward	777	Beaver Creek	20	5	7
Scotia	350	North Loup River	10	--	a/
Taylor	280	North Loup River	10	10	1
Westerville	50	Clear Creek	10	20	a/

a/ Less than $1,000

TABLE 8a

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES
CONSIDERED TO BE EXISTING IN THE ELKHORN RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Battle Creek Local Protection	CE	UC	Elkhorn R.	3 mi. of levee; 1 mi. of channel improvement.	300	100	14
Hooper Local Protection	CE	1966	Elkhorn R.	2.1 mi. of levee.	100	100	17
Pierce Local Protection	CE	1964	No. Branch Elkhorn R.	2 mi. of levee.	1,300	100	21
Madison Local Protection	CE	1966	Union & Taylor Crs.	1.6 miles of channel improvement on Union Creek and 0.5 miles of channel improvement on Taylor Cr.	700	14	20
Norfolk Local Protection	CE	1969	Elkhorn R.	1.6 miles of levees and 3.5 miles diversion channel. Improve .5 mile existing channel.	860	100	202
Pilger Watershed	SCS	1967	Elkhorn R.	1 floodwater-retarding structure, capacity 456 acre-feet, 3 mi. channel improvement.	435	50 100 a/	10
Waterloo Local Protection	CE	1967	Elkhorn R.	4.1 mi. of levees.	768	250	20
West Point Local Protection	CE	1964	Elkhorn R.	1.5 miles of levees.	300	100	20
Clarkson Local Protection	CE	1965	Maple Cr.	Channel improvement.	250	100	14
				--TOTAL--	5,013	---	338

a/ Urban area

TABLE 8b

DISTRIBUTION OF FLOOD DAMAGES IN THE ELKHORN RIVER BASIN
(1960 PRICE LEVELS) (UNIT AMOUNTS IN THOUSANDS)

Stream Reach or Watershed	Area Subject to Flooding (Acres)	Average Annual Flood Damage: Crop and Pasture (Dollars)	Other Rural (Dollars)	Urban (Dollars)	Total (Dollars)
Mainstem:					
Elkhorn River-O'Neill to Mouth	115.3	185.0	122.0	85.0	392.0
North Fork-Osmond to Mouth	26.0	148.0	22.0	8.0	178.0
Logan Cr.-Wakefield to Mouth	44.2	124.0	84.0	22.0	230.0
Subtotal-Mainstem	185.5	457.0	228.0	115.0	800.0
Watersheds:[a/]					
A Corporation Gulch, Plum Cr., Pebble Cr., East Fork Maple, Maple-Dry Cr., Maple Cr. (Lower)	58.5	745.5	164.0	34.3	943.8
B North Fork (Upper), Yankton Slough, Union Cr., Sand, Cuming Cr., Logan Cr. (Upper and Middle), South Logan Cr., Bell Cr., Rawhide Cr.	101.0	942.0	229.5	33.0	1,204.5
C Elkhorn River (Upper), Stuart-Atkinson Tribs., Holt Cr., Dry Creek Sandhills, South Fork Elkhorn, O'Neill Tribs., Cache-Clearwater Crs., Antelope-Cedar, Neligh-Norfolk Tribs., Tilden-Battle Cr. Tribs., Dry Cr., Willow Cr., North Fork (Lower), Stanton Tribs., Butterfly-Leisy, Humbug Cr., Rock Cr., Fisher Cr., Logan Cr. (Lower)	64.1	286.8	111.6	26.0	424.4
D Pilger	1.8	1.0	.5	0	1.5
Subtotal-Watersheds	225.4	1,975.3	505.6	93.3	2,574.2
RIVER BASIN TOTAL	410.9	2,432.3	733.6	208.3	3,374.2

a/ Classification of watersheds by severity of flood damage (see text, Chapter 7)

TABLE 8c

DISTRIBUTION OF URBAN FLOOD DAMAGES IN THE ELKHORN RIVER BASIN
(1960 PRICE LEVELS)

Community	1960 Population	Stream	Current Urban Flood Area (Acres)	Recurrence Interval of Flooding (Years)	Average Annual Flood Damage (Thousand Dollars)
Atkinson	1,324	Elkhorn River	50	10	1
Battle Creek, Meadow Grove and Tilden	1,934	Elkhorn River Tributaries	100	10	20
Beemer	667	Elkhorn River	20	5	2
Clarkson & Leigh	797	Maple-Dry Creek	20	10	a/
Clearwater	418	Elkhorn River	60	10	1
Craig and Arlington	1,118	Bell Creek	100	5	2
Ewing	583	Elkhorn River	160	10	1
Fremont	19,698	Rawhide Creek	300	10	8
Hooper	832	Elkhorn River	100	100	2
Hoskins and Hadar	279	North Fork Elkhorn R. and Tribs.	30	15	1
Howells	694	East Fork Maple Creek	40	10	2
Inman	192	Elkhorn River	10	10	1
		Dry Creek	50	10	1
King's Lake		Elkhorn River	300	6	19
Laurel and Randolph	1,985	Logan Creek	100	3	20
Lyons	974	Logan Creek	10	5	2
Madison	1,513	Union Creek	120	14	2
Neligh	1,776	Elkhorn River	50	10	1
Norfolk	13,111	Elkhorn River	860	100	9
		Corporation Gulch	100	5	15
Oakdale	397	Cedar Creek	30	10	2
O'Neill	3,181	Elkhorn River	40	10	1
Osmond	719	North Fork Elkhorn R.	50	10	1
Pender	1,165	Logan Creek	20	3	20
Pierce	1,216	North Fork Elkhorn R.	140	100	8
Scribner	1,021	Elkhorn River	700	5	23

a/ Less than $1,000

TABLE 8c (Page 2)

DISTRIBUTION OF URBAN FLOOD DAMAGES IN THE ELKHORN RIVER BASIN
(1960 PRICE LEVELS)

Community	1960 Population	Stream	Current Urban Flood Area (Acres)	Recurrence Interval of Flooding (Years)	Average Annual Flood Damage (Thousand Dollars)
Scribner, Dodge & Snyder	1,995	Pebble Creek	50	5	15
Stanton	1,317	Meskenthine Creek	20	15	1
Waterloo	516	Elkhorn River	770	250	2
West Point	2,921	Elkhorn River	300	100	2
West Point & Beemer	3,588	Plum Creek	20	5	2
Winslow	136	Elkhorn River	50	2	17
Wisner	1,192	Elkhorn River	80	10	3

TABLE 9a

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES CONSIDERED TO BE EXISTING IN THE LOWER PLATTE RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Bellwood Watershed	SCS	UC	Platte R.	15 floodwater-retarding structures, capacity 2,620 acre-feet, 33 mi. channel improvements.	11,600	25	90.6
Schuyler Local Protection	CE	1947	Platte R.	Bank protection.	NA	1,000	8
Turtle Creek Watershed	SCS	1962	Platte R.	Two grade stabilization structures.	92	25	3
Upper Salt Creek-Swedeburg (Pilot) Watershed	SCS	1969	Salt Creek	32 floodwater-retarding structures, capacity 7,700 acre-feet, 57 grade stabilization structures.	9,129	25	100
Oak-Middle Creeks Watershed	SCS	UC	Salt Creek	16 floodwater-retarding structures, capacity 4,100 acre-feet, 20 grade stabilization structures.	3,030	25	30
Salt Creek Reservoirs & Bank Stabilization	CE	1969	Salt Creek	Channel improvement and levees at Lincoln, Nebr., 12 dams in Salt Creek controlled drainage area.	50,700	1,000	1,829
Cottonwood Watershed	SCS	UC	Wahoo Creek	12 floodwater-retarding structures, capacity 3,020 acre-feet, 5 mi. channel improvement.	2,500	25	53.1
				--TOTAL--	77,051	---	2,113.7

TABLE 9b

DISTRIBUTION OF FLOOD DAMAGES IN THE LOWER PLATTE RIVER BASIN
(1960 PRICE LEVELS) (UNIT AMOUNTS IN THOUSANDS)

Stream Reach or Watershed	Area Subject to Flooding (Acres)	Average Annual Flood Damage: Crop and Pasture (Dollars)	Average Annual Flood Damage: Other Rural (Dollars)	Average Annual Flood Damage: Urban (Dollars)	Average Annual Flood Damage: Total (Dollars)
Mainstem:					
Platte River-Loup River to Elkhorn River	97.3	24.0	16.0	19.0	59.0
Platte River-Elkhorn River to Mouth	17.6	14.0	5.0	2.0	21.0
Salt Cr. and Tributaries	50.7	19.0	140.0	80.0	239.0
Wahoo Cr. and Tributaries	25.0	271.0	226.0	23.0	520.0
Subtotal-Mainstem	190.6	328.0	387.0	124.0	839.0
Watersheds:a/					
A Lost Cr., Bone Cr., Oak-Middle (part), Stevens-Camp, Sand Cr., Clear Cr.	39.5	308.7	62.1	58.0	428.8
B Shell Cr., Loseke-Taylor, Skull Creek, Platte Tribs. (Sarpy), Northeast Cass, Rock Cr., Salt Cr. (Lower), Wahoo Cr. (Upper), Silver Cr., Lincoln Tribs.	74.5	553.7	208.1	20.0	781.8
C North Bend Drains, Platte Tribs. (Saunders), Little Salt-Jordan Cr., Wahoo Cr. (Lower)	10.6	62.1	13.3	1.0	76.4
D Bellwood, Turtle Cr., Upper Salt, Oak Middle (part), Cottonwood, Swedeburg	16.7	36.2	13.5	0	49.7
Subtotal-Watersheds	141.3	960.7	297.0	79.0	1,336.7
RIVER BASIN TOTAL	331.9	1,288.7	684.0	203.0	2,175.7

a/ Classification of watersheds by severity of flood damage (see text, Chapter 7)

TABLE 9c

DISTRIBUTION OF URBAN FLOOD DAMAGES IN THE LOWER PLATTE RIVER BASIN
(1960 PRICE LEVELS)

Community	1960 Population	Stream	Current Urban Flood Area (Acres)	Recurrence Interval of Flooding (Years)	Average Annual Flood Damage (Thousand Dollars)
Ashland	1,989	Salt and Wahoo Creeks	50	5	26
Bellwood	361	Platte River Tributary	20	30	a/
Columbus	12,476	Platte River	400	---	2
Inglewood & Fremont	20,503	Platte River	200	5	5
Ithaca	126	Wahoo Creek	20	5	1
LaPlatte	---	Platte River	100	10	1
Leshara	103	Platte River Tributary	10	10	1
Lincoln	128,521	Salt Creek	9,300	100	18
		Middle Creek	1,490	25	1
		Oak Creek	1,000	50	1
		Antelope Creeks	680	5	44
		Tributaries	1,200	5	5
Lindsay	218	Shell Creek	30	1	3
Linwood	151	Skull Creek	30	20	3
Louisville	1,194	Platte River and Tribs.	20	5	3
Memphis	77	Wahoo Creek	120	14	2
North Bend	1,174	Platte River	50	---	1
Platte Center	402	Shell Creek	20	1	1
Prague and Malmo	507	Cottonwood Creek	40	10	a/
Roca	123	Salt Creek	0	---	a/
Schuyler	3,096	Platte River	100	5	3
Schuyler and Columbus	15,572	Lost Creek	500	10	55
Sprague	120	Olive Branch	0	---	a/
Springfield	506	Platte River Tributary	20	10	1
Valley	1,452	Platte River	300	5	10
Valparaiso	394	Oak Creek	50	15	1
Wahoo	3,610	Sand and Wahoo Creeks	80	2	10
Waverly and Lincoln	129,000	Stevens-Camp Creek	30	10	2
Weston	340	Wahoo Creek	50	20	a/

a/ Less than $1,000

TABLE 10a

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES CONSIDERED TO BE EXISTING IN THE REPUBLICAN RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Bartley Local Protection	CE	1952	Dry Creek	Levees and channel improvements.	343	NA	14.3
Dry Creek Watershed	SCS	1960	Dry Creek	10 floodwater-retarding structures, capacity 1,612 acre-feet, 9 grade stabilization structures.	1,500	25	23.9
Dry Creek South Watershed	SCS	1968	Dry Creek	6 floodwater-retarding structures, capacity 1,741 acre-feet, 1.5 mi. of floodway.	1,810	25	23.8
Enders Reservoir	BR	1951	Frenchman Creek	Multipurpose dam and reservoir, capacity 74,500 acre-feet, 30,000 acre-feet flood control.	a/	0.69 in.	192.0
Harlan County Dam and Reservoir	CE	1952	Republican River	Multipurpose dam and reservoir, capacity 850,000 acre-feet, 500,000 acre-feet flood control.	a/	1.12 in.	2,532.0
Indianola Local Protection	CE	1949	Coon Creek	Levees and channel improvments.	140	NA	7.8
Medicine Creek Dam (Harry Strunk L.)	BR	1949	Medicine Creek	Multipurpose dam and reservoir, capacity 90,900 acre-feet, 51,700 acre-feet flood control.	a/	1.47 in.	175.0
Red Willow Dam (Hugh Butler L.)	BR	1962	Red Willow Creek	Multipurpose dam and reservoir, capacity 86,600 acre-feet, 48,900 acre-feet flood control.	a/	2.76 in.	207.0

TABLE 10a (Page 2)

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES
CONSIDERED TO BE EXISTING IN THE REPUBLICAN RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Stamford Watershed	SCS	1968	Beaver Creek	2 floodwater-retarding structures, capacity 200 acre-feet, 3.3 miles channel, 1.2 miles dike.	650	50 100 b/	12.8
Trenton Dam (Swanson Lake)	BR	1953	Republican River	Multipurpose dam and reservoir, capacity 254,000 acre-feet, 134,000 acre-feet flood control.	a/	0.63 in.	911.0
				--TOTAL--	4,443	---	4,099.6

a/ CE & BR reservoirs reduce flooding on 277,400 acres, including areas in Kansas & Colorado.
b/ Urban area

TABLE 10b

DISTRIBUTION OF FLOOD DAMAGES IN THE REPUBLICAN RIVER BASIN
(1960 PRICE LEVELS) (UNIT AMOUNTS IN THOUSANDS)

Stream Reach or Watershed	Area Subject to Flooding (Acres)	Average Annual Flood Damage: Crop and Pasture (Dollars)	Other Rural (Dollars)	Urban (Dollars)	Total (Dollars)
Mainstem:					
Republican River					
-Arikaree River to Harlan Co. Dam	95.6	540.0	168.0	7.0	715.0
-Harlan County Dam to State Line	47.6	85.0	33.0	5.0	123.0
Frenchman River-Enders Dam to Mouth	11.4	11.0	2.0	3.0	16.0
Beaver Cr.-State Line to Mouth	18.3	105.0	42.0	0	147.0
Sappa Cr.-State Line to Mouth	16.1	63.0	18.0	0	81.0
Subtotal-Mainstem	189.0	804.0	263.0	15.0	1,082.0
Watersheds:[a/]					
A Blackwood (Upper and Lower), McCook Tribs., Medicine Cr. (Upper and Middle)	13.0	171.2	50.8	1.2	223.2
B Orleans Tribs., Sacramento Tribs., Thompson Cr., Superior Tribs.	22.9	166.9	51.1	2.4	220.4
C No. Fk. Republican River, Arikaree River, Buffalo Cr., Rock-Spring Creeks, Hey Canyon, So. Fk. Republican River, Chase-Dundy Sandhills, Indian Cr., Burntwood Cr., Muddy Cr. (Dundy Co.), Culbertson to Stratton Tribs. (North & South), Sand Cr., Enders Res., Wauneta Tribs., Venango Tribs., Spring Cr. (Upper), Grant Tribs., Stinking Water Cr. (Upper), Spring-Stinking Water (Lower), Frenchman River (Lower), Driftwood Cr., Sleepy Hollow-Bushy Etc., Red Willow (Upper	91.3	548.3	224.8	4.6	777.7

TABLE 10b (Page 2)

DISTRIBUTION OF FLOOD DAMAGES IN THE REPUBLICAN RIVER BASIN
(1960 PRICE LEVELS) (UNIT AMOUNTS IN THOUSANDS)

Stream Reach or Watershed	Area Subject to Flooding (Acres)	Average Annual Flood Damage: Crop and Pasture (Dollars)	Other Rural (Dollars)	Urban (Dollars)	Total (Dollars)
and Lower), Coon Cr., Cambridge to Bartley Tribs., Silver Cr., Medicine Cr. (Sandhills), Medicine Cr. (Lower), Republican River South Tribs. (Furnas Co.), Deer Cr., Muddy Cr. (Frontier & Gosper Cos.), Elk-Turkey, Beaver Cr. (Kansas), Beaver Cr. (Lebanon), Beaver Cr. (Beaver City), Sappa Cr., Sappa (Lower), Prairie Dog Cr. (Lower), Turkey Cr., Lost Cr. Etc. Tribs., Center Tribs., Lohffy-Oak Crs., Farmers-Indian Cr., Red Cloud Tribs., Minnie Cr., Courtland Tribs.					
D Dry Cr. (South), Dry Cr. (Pilot), Stamford Cr.	3.9	13.9	10.3	0	24.2
Subtotal-Watersheds	131.1	900.3	337.0	8.2	1,245.5
RIVER BASIN TOTAL	320.1	1,704.3	600.0	23.2	2,327.5

a/ Classification of watersheds by severity of flood damage (see text, Chapter 7)

TABLE 10c

DISTRIBUTION OF URBAN FLOOD DAMAGES IN THE REPUBLICAN RIVER BASIN
(1960 PRICE LEVELS)

Community	1960 Population	Stream	Current Urban Flood Area (Acres)	Recurrence Interval of Flooding (Years)	Average Annual Flood Damage (Thousand Dollars)
Arapahoe	1,084	Republican River	50	9	2
Cambridge	1,090	Republican River & Medicine Cr.	70	12	4
Danbury, Lebanon & Marion	358	Beaver Creek	100	10	2
Edison	249	Republican River	50	25	1
Holbrook	354	Republican River	50	25	1
McCook	8,301	Republican River Tribs.	70	5	1
Orleans	608	Flag Creek	20	5	a/
Oxford	1,090	Republican River	50	30	a/
Stratton	492	Muddy Creek & Hey Canyon	50	10	1
Wauneta	794	Frenchman Creek	100	10	3
Guide Rock	441	Minnie Creek	20	20	a/
Inavale	---	Republican River	20	10	1
Naponee	206	Turkey Creek	20	15	a/
Riverton	303	Republican River & Thompson Creek	30	10	1
Superior	2,935	Republican River & Lost Creek	100	10	5

a/ Less than $1,000

TABLE 11a

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES
CONSIDERED TO BE EXISTING IN THE LITTLE BLUE RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Bowman-Spring Branch Watershed	SCS	UC	Rose Cr. Tribs.	8 floodwater-retarding structures, capacity 3,130 acre-feet.	6,085	25	26.2
Buckley Cr. Watershed	SCS	UC	Buckley Cr.	6 floodwater-retarding structures, capacity 2,560 acre-feet, 19 miles channel improvement.	3,139	25	22.5
Fairbury Local Protection	CE	UC	Little Blue River	1.8 mi. levee with appurtenant structures.	180	70	21.3
32-Mile Creek Watershed	SCS	UC	32-Mile Creek	6 floodwater-retarding structures, capacity 5,756 acre-feet, 1.0 mi. dike, 0.8 miles channel diversion.	2,810	25 100 a/	52.4
				--TOTAL--	12,214	---	122.4

a/ Urban area

TABLE 11b

DISTRIBUTION OF FLOOD DAMAGES IN THE LITTLE BLUE RIVER BASIN
(1960 PRICE LEVELS) (UNIT AMOUNTS IN THOUSANDS)

Stream Reach or Watershed	Area Subject to Flooding (Acres)	Average Annual Flood Damage			
		Crop and Pasture (Dollars)	Other Rural (Dollars)	Urban (Dollars)	Total (Dollars)
Mainstem:					
Little Blue River					
Deweese to State Line	26.0	106.0	44.0	9.0	159.0
Watersheds:[a/]					
A Little Sandy, Rose Creek	15.2	115.9	34.6	3.0	153.5
B Little Blue (Upper), Cottonwood-Scott Creeks, ACNW Tribs., Big Sandy	51.8	432.7	74.8	1.0	508.5
C Pawnee Cr., Angus-Hebron Tribs., Spring Cr., Dry Cr. (Thayer), Fairbury Tribs., Little Blue (Hollenberg)	11.7	61.3	26.7	0	88.0
D Thirty-Two Mile Cr., Bowman-Spring Branch, Buckley Cr.	4.3	23.9	30.7	0	54.6
Subtotal-Watersheds	83.0	633.8	166.8	4.0	804.6
RIVER BASIN TOTAL	109.0	739.8	210.8	13.0	963.6

a/ Classification of watersheds by severity of flood damage (see text, Chapter 7)

TABLE 11c

DISTRIBUTION OF URBAN FLOOD DAMAGES IN THE LITTLE BLUE RIVER BASIN
(1960 PRICE LEVELS)

Community	1960 Population	Stream	Current Urban Flood Area (Acres)	Recurrence Interval of Flooding (Years)	Average Annual Flood Damage (Thousand Dollars)
Deshler	956	Spring Creek	50	15	a/
Deweese, Blue Hill & Crystal Lake	823	Ash Creek	210	10	1
Fairbury	5,572	Little Blue River	160	5	3
Hebron	1,920	Little Blue River	50	5	4
Reynolds	131	Rose Creek	100	10	3
Steele City	173	Little Blue River	20	5	2

a/ Less than $1,000

TABLE 12a

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES
CONSIDERED TO BE EXISTING IN THE BIG BLUE RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Bear-Pierce-Cedar Crs. Watershed	SCS	UC	Bear, Pierce, Cedar Crs.	27 floodwater-retarding structures, capacity 9,070 acre-feet, 6 grade stabilization structures.	6,505	25	119.7
Big Indian Cr. Watershed	SCS	UC	Big Indian Creek	32 floodwater-retarding structures, capacity 22,083 acre-feet, 3 grade stabilization structures.	15,800	25	196.9
Clatonia Watershed	SCS	UC	Clatonia Cr.	8 floodwater-retarding structures, capacity 3,185 acre-feet.	1,817	25	32.3
Cub Cr. Watershed	SCS	UC	Cub Creek	17 floodwater-retarding structures, capacity 10,050 acre-feet, 12 grade stabilization structures.	4,895	25	136.0
Dorchester Watershed	SCS	1969	Big Blue Trib.	4 floodwater-retarding structures, capacity 610 acre-feet, 1 grade stabilization structure, 1.6 mi. channel improvement.	800	25	24.2
Little Indian Cr. Watershed	SCS	1964	Little Indian Cr.	24 floodwater-retarding structures, capacity 4,430 acre-feet, 39 grade stabilization structures.	5,300	25	37.6

TABLE 12a (Page 2)

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES
CONSIDERED TO BE EXISTING IN THE BIG BLUE RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Mission Creek Watershed	SCS	UC	Mission Cr.	12 floodwater-retarding structures, capacity 5,200 acre-feet, 4 grade stabilization structures.	2,540	25	56.8
Mud Cr. Watershed	SCS	UC	Mud Creek	11 floodwater-retarding structures, capacity 6,640 acre-feet, 20 grade stabilization structures.	4,400	25	62.7
Plum Cr. Watershed	SCS	UC	Plum Creek	25 floodwater-retarding structures, capacity 4,040 acre-feet, 7 grade stabilization structures, 27 mi. channel improvement.	6,000	25	67.0
Seward Local Protection	CE	1964	Big Blue R.	1.5 miles of levee.	105	50	31.2
				--TOTAL--	48,162	---	764.4

TABLE 12b

DISTRIBUTION OF FLOOD DAMAGES IN THE BIG BLUE RIVER BASIN
(1960 PRICE LEVELS) (UNIT AMOUNTS IN THOUSANDS)

Stream Reach or Watershed	Area Subject to Flooding (Acres)	Average Annual Flood Damage: Crop and Pasture (Dollars)	Other Rural (Dollars)	Urban (Dollars)	Total (Dollars)
Mainstem:					
Big Blue River					
-West Line Butler County to Kansas State Line	20.0	171.0	104.0	143.0	418.0
Watersheds:[a/]					
A Kezar Cr., Plum Cr. (Seward), Swan-Dry Crs., Soap Cr., Wolf-Wildcat	20.0	180.7	41.2	0	221.9
B North Fork, North Branch (Upper & Lower), Lincoln Cr. (Lower), West Fork (Upper), School Cr., West Fork (Middle), Beaver Cr., West Fork (Lower), Crete-Wilber-DeWitt Tribs., Turkey Cr. (Upper & Lower)	167.3	1,341.1	154.7	31.2	1,527.0
C Lincoln Cr. (Upper), Seward-Milford Tribs., Plymouth, Beatrice Tribs., Horseshoe Cr.	13.4	76.1	12.6	1.8	90.5
D Dorchester, Clatonia Cr., Cub Cr., Little Indian Cr., Bear-Pierce-Cedar, Mud Cr., Big Indian Cr., Plum Cr., Mission Cr.	47.2	161.7	59.2	2.4	223.3
Subtotal-Watersheds	247.9	1,759.6	267.7	35.4	2,062.7
RIVER BASIN TOTAL	267.9	1,930.6	371.7	178.4	2,480.7

a/ Classification of watersheds by severity of flood damage (see text, Chapter 7)

TABLE 12c

DISTRIBUTION OF URBAN FLOOD DAMAGES IN THE BIG BLUE RIVER BASIN
(1960 PRICE LEVELS)

Community	1960 Population	Stream	Current Urban Flood Area (Acres)	Recurrence Interval of Flooding (Years)	Average Annual Flood Damage (Thousand Dollars)
Aurora	2,576	Lincoln Creek	60	25	1
Beatrice	12,132	Big Blue River & L. Indian Creek	400	8	45
Beaver Crossing	439	West Fork Big Blue River	30	5	5
Blue Springs	509	Big Blue River	10	8	a/
Crete	3,546	Big Blue River & Walnut Creek	100	1	51
DeWitt	504	Big Blue River	30	1	41
Diller, Odell	644	Big Indian Creek	40	5	a/
Holmesville	---	Big Blue River	10	8	a/
McCool Junction	246	West Fork Big Blue River	20	5	1
Milford	1,462	Big Blue River	20	8	a/
Osceola	1,013	Davis Creek	50	5	1
Seward	4,208	Big Blue River	105	4	2
Stromsburg	1,244	Prairie Creek	40	15	1
Sutton	1,252	School Creek	100	15	a/
Wilber	1,358	Big Blue River	100	3	1
Wymore	1,975	Big Blue River	50	8	5
York	6,173	Beaver Creek	80	8	22

a/ Less than $1,000

TABLE 13a

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES CONSIDERED TO BE EXISTING IN THE NEMAHA RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Missouri River Bank Stabilization	CE	UC	Missouri R.	Dikes, revetments, channel cutoffs for navigation and bank stabilization.	Not Available	---	Not Available
Missouri River Levees	CE	UC	Missouri R.	Mainstem and tributary tie-back to protect Missouri River flood plain from Missouri River and tributary floods.	Not Available	100	Not Available
Plattsmouth Watershed	SCS	UC	Missouri R.	10 floodwater-retarding structures, capacity 360 acre-feet, 1 grade stabilization structure.	167	100	75
Ziegler Creek	SCS	UC	Little Nemaha R.	15 grade stabilization structures, capacity 1,708 acre-feet.	2,262	50	20
Wilson Creek Watershed	SCS	UC	Little Nemaha R.	22 floodwater-retarding structures, capacity 8,068 acre-feet, 46 grade stabilization structures.	10,998	25	140
Upper Big Nemaha Watershed	SCS	UC	Big Nemaha River	38 floodwater-retarding structures, capacity 16,285 acre-feet, 59 grade stabilization structures.	16,800	25	230

TABLE 13a (Page 2)

PRINCIPAL IMPROVEMENTS FOR FLOOD CONTROL AND RELATED PURPOSES
CONSIDERED TO BE EXISTING IN THE NEMAHA RIVER BASIN (1968)

Project	Agency	Date Completed or Operational	Stream	Description	Area Protected in Acres	Degree of Control	Annual Benefits in $1,000
Brownell Creek Watershed	SCS	1962	Little Nemaha R.	9 combination stabilization and floodwater-retarding structures, capacity 734 acre-feet, 62 grade stabilization structures.	421	50	31
Rock Creek (Pawnee) Watershed	SCS	UC	Turkey Cr.	5 floodwater-retarding structures, capacity 1,136 acre-feet, 12 grade stabilization structures.	2,158	25	21
Spring Creek (Johnson) Watershed	SCS	UC	Little Nemaha R.	7 floodwater-retarding structures, capacity 2,276 acre-feet, 21 grade stabilization structures.	3,060	25	51
				--TOTAL--	35,866	---	568

TABLE 13b

DISTRIBUTION OF FLOOD DAMAGES IN THE NEMAHA RIVER BASIN
(1960 PRICE LEVELS) (UNIT AMOUNTS IN THOUSANDS)

Stream Reach or Watershed	Area Subject to Flooding (Acres)	Average Annual Flood Damage: Crop and Pasture (Dollars)	Other Rural (Dollars)	Urban (Dollars)	Total (Dollars)
Mainstem:					
Missouri River-Platte River to Rulo	63.0	37.0	13.5	2.0	52.5
Little Nemaha R.-South Fork to Mouth	26.2	93.0	52.0	0	145.0
Big Nemaha R.-South Fork to Mouth	18.0	237.0	85.0	0	322.0
North Fork-Tecumseh to Mouth	23.5	180.0	59.0	0	239.0
South Fork, State Line to Mouth	13.9	134.0	44.0	0	178.0
Subtotal-Mainstems	144.6	681.0	253.5	2.0	936.5
Watersheds:[a/]					
A Nebraska City-Peru Tribs., Little Nemaha (Upper), South Branch Little Nemaha, Turkey Cr., Nemaha-Missouri Bottom	44.2	454.1	152.3	4.6	611.0
B Weeping Water Cr., Rock Cr. (Nemaha & Otoe Co's.), Middle Big Nemaha, Long Branch, Pony Cr., Muddy Cr., South Fork (Lower)	49.0	473.1	201.5	31.3	705.9
C Murray Tribs., Brock Tribs., Auburn Tribs., Beadow-Deroin Tribs., Winnebago-Bean, Lower Big Nemaha, South Fork (West)	8.1	53.1	34.9	2.0	90.0
D Plattsmouth, Brownell Cr., Ziegler Cr., Wilson Cr., Spring Cr. (Johnson), Upper Big Nemaha, Rock Cr. (Pawnee), Walnut Cr.	19.6	136.1	56.3	4.0	196.4
Subtotal-Watersheds	120.9	1,116.4	445.0	41.9	1,603.3
RIVER BASIN TOTAL	265.5	1,797.4	698.5	43.9	2,539.8

a/ Classification of watersheds by severity of flood damage (see text, Chapter 7)

TABLE 13c

DISTRIBUTION OF URBAN FLOOD DAMAGES IN THE NEMAHA RIVER BASIN
(1960 PRICE LEVELS)

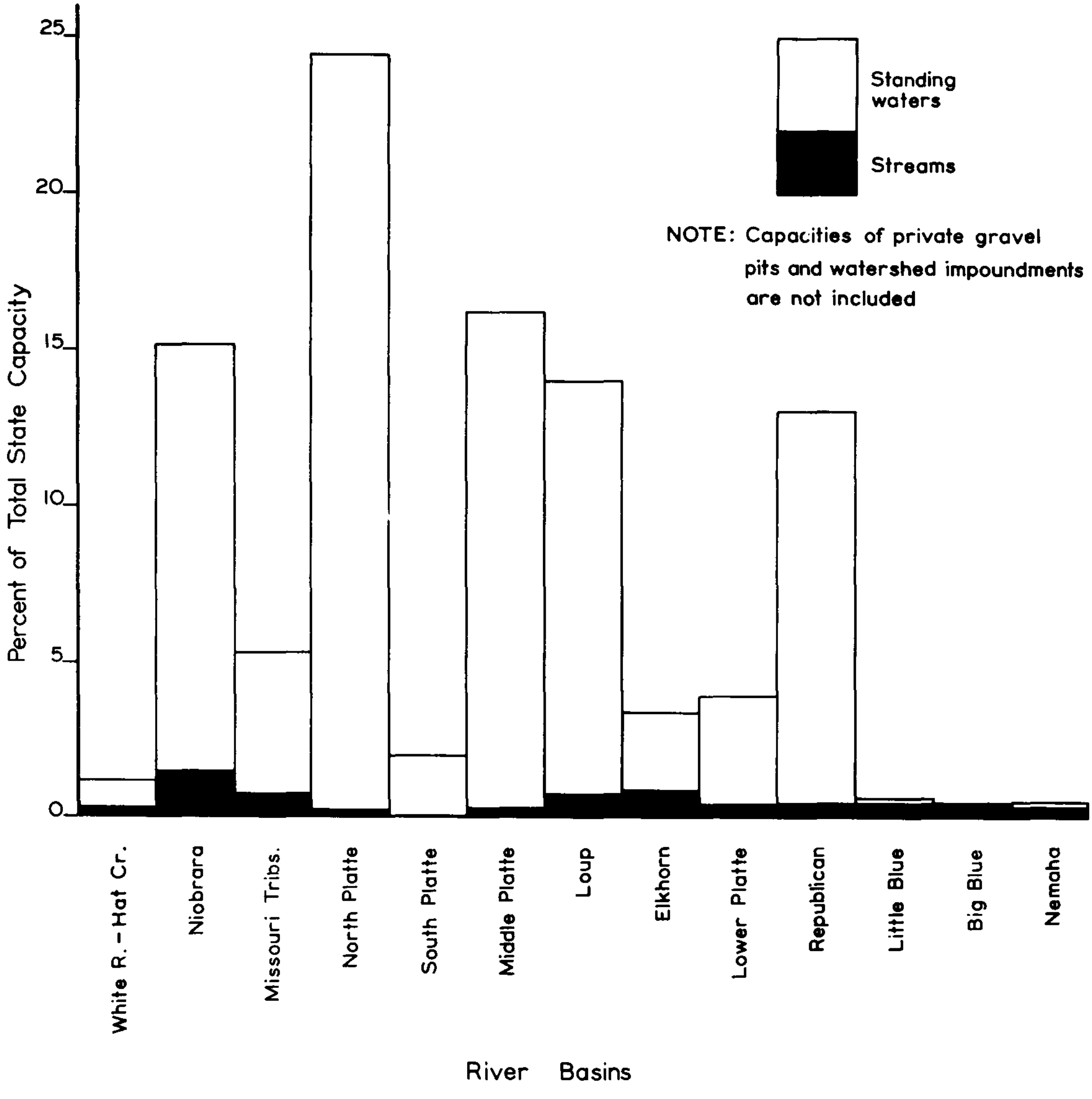
Community	1960 Population	Stream	Current Urban Flood Area (Acres)	Recurrence Interval of Flooding (Years)	Average Annual Flood Damage (Thousand Dollars)
Adams	387	Big Nemaha River	40	15	a/
Avoca	218	Weeping Water Creek	20	25	1
Brock	213	Brock Creek	50	20	2
Crab Orchard	103	Yankee Creek	30	10	a/
Dunbar	232	Wilson Creek	20	50	a/
Humboldt	1,322	Long Branch Creek	40	25	1
Nebraska City	7,252	Missouri River	20	100 b/	1
		Missouri River Tribs.	100	20	1
Nehawka	262	Weeping Water Creek	30	10	5
Otoe	225	Wilson Creek	10	50	a/
Peru	1,151	Missouri River Tribs.	20	15	1
Plattsmouth	6,244	Missouri River	20	100 b/	1
		Plattsmouth Watershed	150	100 b/	1
Steinauer	124	Turkey Creek	10	10	a/
Sterling	471	Big Nemaha River	30	15	1
Syracuse	1,261	Little Nemaha River	50	25	2
Union	303	Weeping Water Creek	20	10	3
Weeping Water	1,048	Weeping Water Creek	330	5	21

a/ Less than $1,000
b/ Approximate protection level provided by existing Missouri River agricultural levee units

ATTACHMENT 5

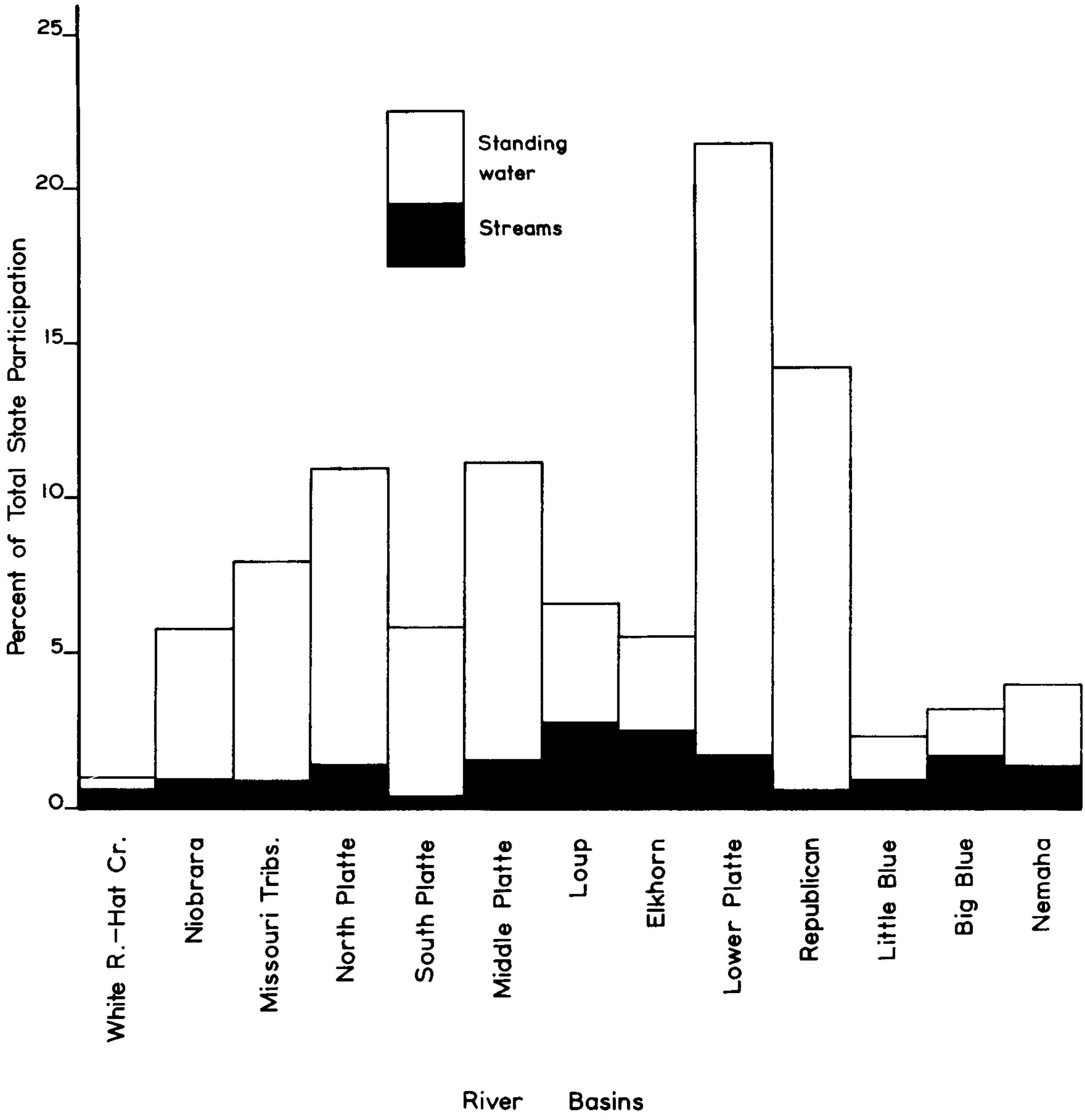
This attachment contains 2 graphs which show fishing capacity and fishing participation by river basin. Data collected by the Nebraska Game and Parks Commission in 1966 and 1967 was used to prepare these graphs.

FISHING CAPACITY BY BASIN



SOURCE: Nebraska Game and Parks Commission

FISHING PARTICIPATION BY BASIN



SOURCE: Nebraska Game and Parks Commission

ATTACHMENT 6

This attachment contains data used in determining the needs for water-based outdoor recreational opportunities. For a full discussion of the demands for outdoor recreational opportunities see Outdoor Recreation - A Comprehensive Plan, Volumes I, II and III, published by the Nebraska Game and Parks Commission in 1968. Recreational activity participation rates and other quantitative information used in estimating recreation demand are found on pages A-5, 6, 7, 8 and 9 of Volume III.

LIST OF TABLES

TABLE 1

POPULATION PROJECTIONS - PERSONS 12 YEARS OLD AND OLDER

Socio-Economic Area	Estimated Population 1972	1980	2000
South Sioux City	21,317	21,867	24,294
Omaha	454,985	553,022	941,861
Lincoln	208,202	241,927	380,371
Beatrice	46,220	41,891	24,147
Norfolk	76,463	78,980	88,309
Columbus	41,131	44,079	55,857
Grand Island	71,255	74,783	88,195
Hastings	48,675	51,058	60,540
Kearney	42,414	45,025	55,828
McCook	29,443	29,683	24,784
North Platte	50,192	52,667	62,870
Ogallala	13,418	12,948	11,235
Valentine	35,660	32,547	19,978
Scottsbluff	66,470	73,110	97,361
STATE TOTAL	1,205,845	1,353,587	1,935,630

Source of Data: Nebraska Bureau of Business Research (1965)

TABLE 2

STANDARDS FOR ESTIMATING WATER-BASED RECREATIONAL OPPORTUNITY NEEDS

The estimated need for additional fishing waters is based upon the annual fishing demand while the estimated needs for additional boating, water-skiing, and non-urban swimming waters are based upon the peak season demand. The need for additional ice skating area is based upon an area requirement per unit of population 12 years and older. The demand for each recreation activity was translated from activity occasions to water surface area need using the following load factors.

Fishing

Forty (40) fisherman days annually per surface acre of water for reservoirs less than 1,000 acres in size; 25 fisherman days annually per surface acre of water for reservoirs larger than 1,000 acres.

Boating

Fifty-five percent of boating occurs on peak days; 2 acres of surface area are needed per boat; there are 14 peak days per season; the turnover rate is 1.25 per day; and the average is three persons per boat.

Water-Skiing

Sixty percent of water-skiing occurs on peak days; 5 acres of surface area are needed per boat; there are 14 peak days per season; the turnover rate is 2.0 per day; and the average is three persons per boat.

Swimming Beaches

Fifteen percent of swimming occasions are on beaches; 60 percent occur on peak days; 150 square feet is needed per swimmer (287 swimmers per acre); there are 12 peak days per season; and the turnover rate is 3.0 per day.

Ice Skating

One surface acre per 2,500 persons 12 years and older.

TABLE 3

NEED FOR ADDITIONAL FISHING CAPACITY IN THOUSANDS OF FISHERMAN DAYS BY SOCIO-ECONOMIC AREA IN NEBRASKA

Socio-Economic Area	Annual Demand				Present Capacity	Estimated Deficiencies			
	1967	1972	1980	2000	1967	1967	1972	1980	2000
South Sioux City	103.3	104.8	111.5	131.3	51.2	52.1	53.6	60.3	80.1
Omaha	1,643.3	1,861.4	2,281.1	3,834.6	105.0	1,538.3	1,756.4	2,176.1	3,729.6
Lincoln	797.2	868.1	1,016.1	1,567.1	236.1	561.1	632.0	780.0	1,331.0
Beatrice	242.3	225.6	209.5	125.9	94.3	148.0	131.3	115.2	31.6
Norfolk	351.2	355.0	378.6	443.4	282.3	68.9	72.7	96.3	161.1
Columbus	192.2	198.4	219.2	289.7	66.7	125.5	131.7	152.5	223.0
Grand Island	339.7	347.4	376.5	464.8	127.3	212.4	220.1	249.2	337.4
Hastings	242.2	247.5	268.2	333.8	51.6	190.6	195.9	216.6	282.1
Kearney	207.3	214.0	235.0	306.6	377.4	-	-	-	-
McCook	143.8	138.3	143.1	123.4	289.8	-	-	-	-
North Platte	253.2	258.8	280.2	349.8	262.6	-	-	17.6	87.2
Ogallala	65.5	63.0	62.4	56.1	1,100.1	-	-	-	-
Valentine	169.8	92.6	147.8	93.1	1,568.0	-	-	-	-
Scottsbluff	328.7	342.0	383.0	542.0	192.4	136.3	149.6	190.6	349.6
STATE TOTAL	5,079.7	5,316.9	6,112.2	8,661.6	4,804.8	3,033.2	3,343.3	4,054.4	6,612.7

Source of Data: Outdoor Recreation-A Comprehensive Plan, Nebraska Game and Parks Commission, 1968. (revised after publication)

TABLE 4

NEED FOR ADDITIONAL BOATING WATERS BY SOCIO-ECONOMIC AREA

Socio-Economic Area	Peak Season Demand (Activity Occasions)			Estimated Needs (Acres)			Present Supply (Acres)	Estimated Deficiencies (Acres)		
	1972	1980	2000	1972	1980	2000	1967	1972	1980	2000
South Sioux City	51,451	61,956	99,148	1,078	1,298	2,077	30	1,048	1,268	2,047
Omaha	1,554,610	2,099,689	4,568,189	32,572	43,993	95,713	1,945	30,627	42,048	93,768
Lincoln	682,911	888,108	1,813,085	14,308	18,608	37,988	4,513	9,795	14,095	33,475
Beatrice	113,912	117,358	91,104	2,387	2,459	1,907	285	2,102	2,174	1,622
Norfolk	162,118	194,454	306,609	3,397	4,074	6,424	7,450	-	-	-
Columbus	99,715	123,833	220,360	2,089	2,595	4,617	946	1,143	1,649	3,671
Grand Island	174,663	213,126	354,109	3,660	4,465	7,419	3,083	577	1,382	4,336
Hastings	130,475	158,206	262,105	2,734	3,315	5,492	102	2,632	3,213	5,390
Kearney	111,359	137,330	240,238	2,333	2,877	5,033	13,188	-	-	-
McCook	60,888	70,395	80,758	1,276	1,475	1,692	12,255	-	-	-
North Platte	147,230	177,494	291,853	3,085	3,719	6,115	7,416	-	-	-
Ogallala	28,686	31,659	37,919	601	663	794	36,620	-	-	-
Valentine	63,463	66,469	55,947	1,330	1,393	1,172	14,914	-	-	-
Scottsbluff	194,856	240,351	459,417	4,083	5,036	9,626	3,898	185	1,138	5,728
STATE TOTAL	3,576,337	4,580,428	8,880,841	74,933	95,970	186,069	106,645	48,109	66,967	150,037

Source of Data: Outdoor Recreation - A Comprehensive Plan, Nebraska Game and Parks Commission, 1968 (revised after publication)

TABLE 5

NEED FOR ADDITIONAL WATER-SKIING WATERS BY SOCIO-ECONOMIC AREA

Socio-Economic Area	Peak Season Demand (Activity Occasions)			Estimated Needs (Acres)			Present Supply (Acres)	Estimated Deficiencies (Acres)		
	1972	1980	2000	1972	1980	2000	1967	1972	1980	2000
So. Sioux City	10,250	13,169	31,234	366	470	1,116	30	336	440	1,086
Omaha	636,422	942,173	2,385,296	22,729	33,649	85,189	1,945	20,784	31,704	83,244
Lincoln	266,854	383,006	931,639	9,531	13,679	33,273	4,513	5,018	9,166	28,760
Beatrice	21,363	23,633	27,437	763	844	980	285	478	559	695
Norfolk	32,148	41,348	93,687	1,148	1,477	3,346	7,450	-	-	-
Columbus	18,393	24,294	64,914	657	868	2,318	946	-	-	1,372
Grand Island	32,940	42,800	106,694	1,176	1,529	3,811	3,083	-	-	728
Hastings	24,751	32,199	81,752	884	1,150	2,920	102	782	1,048	2,818
Kearney	21,250	28,027	74,698	759	1,001	2,668	13,188	-	-	-
McCook	13,143	16,243	25,629	469	580	915	12,255	-	-	-
North Platte	25,183	32,697	87,099	899	1,168	3,111	7,416	-	-	-
Ogallala	5,871	6,939	11,720	210	248	419	36,620	-	-	-
Valentine	13,912	15,477	16,952	497	553	605	14,914	-	-	-
Scottsbluff	33,136	43,728	135,223	1,183	1,562	4,829	3,898	-	-	931
STATE TOTAL	1,155,616	1,645,733	4,073,974	41,271	58,778	145,500	106,645	27,398	42,917	119,634

Source of Data: Outdoor Recreation - A Comprehensive Plan, Nebraska Game and Parks Commission, 1968 (Corrected)

TABLE 6

NEED FOR ADDITIONAL SWIMMING BEACHES IN ACRES OF WATER BY SOCIO-ECONOMIC AREA

Socio-Economic Area	Peak Season Demand (Activity Occasions)			Estimated Needs (Acres)			Present Supply (Acres)	Estimated Deficiencies (Acres)		
	1972	1980	2000	1972	1980	2000	1967	1972	1980	2000
So. Sioux City	126,287	148,967	225,608	1	1	2	1	0	0	1
Omaha	3,541,243	4,829,199	10,540,835	31	42	92	13	18	29	79
Lincoln	1,564,673	2,052,253	4,195,747	14	18	37	8	6	10	29
Beatrice	267,205	273,850	207,306	2	2	2	0	2	2	2
Norfolk	416,634	492,174	741,170	4	4	6	2	2	2	4
Columbus	232,973	284,030	478,965	2	2	4	15	-	-	-
Grand Island	411,953	493,400	778,742	4	4	6	5	-	-	1
Hastings	299,113	358,791	572,890	3	3	5	0	3	3	5
Kearney	258,127	313,671	525,102	2	3	5	4	-	-	1
McCook	166,303	189,935	209,245	1	2	2	9	-	-	-
North Platte	306,121	366,922	588,474	3	3	5	7	-	-	-
Ogallala	74,897	81,835	94,113	1	1	1	73	-	-	-
Valentine	185,627	191,045	152,933	2	2	2	7	-	-	-
Scottsbluff	403,739	497,163	905,422	4	4	8	29	-	-	-
STATE TOTAL	8,254,895	10,573,235	20,216,552	74	91	177	173	31	46	122

Source of Data: Outdoor Recreation - A Comprehensive Plan, Nebraska Game and Parks Commission, 1968 (Corrected)

TABLE 7

GROSS NEEDS FOR ICE SKATING OPPORTUNITY

Socio-Economic Area	Gross Needs (Surface Acres) 1972	1980	2000
South Sioux City	9	9	10
Omaha	182	221	377
Lincoln	83	97	152
Beatrice	18	17	10
Norfolk	31	32	35
Columbus	16	18	22
Grand Island	29	30	35
Hastings	19	20	24
Kearney	17	18	22
McCook	12	12	10
North Platte	20	21	25
Ogallala	5	5	5
Valentine	14	13	8
Scottsbluff	27	29	39
STATE TOTAL	482	542	774

Source of Data: Outdoor Recreation - A Comprehensive Plan, Nebraska Game and Parks Commission, 1968 (Corrected)

ATTACHMENT 7

This attachment includes:

1. An inventory current as of July 1, 1969 of towns in the State showing the types of sewage treatment provided and treatment facility needs,

2. Feedlot registrations by counties as of June 15, 1969, including the population equivalent (P.E.) based upon total capacities, and

3. Raw water quality criteria used for planning purposes.

Source of Data: Nebraska Department of Health (1969)

LIST OF TABLES

LIST OF TABLES (Con't.)

TABLE 1

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

White River-Hat Creek Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Type of Treatment: Primary Only	Type of Treatment: Primary and Secondary	Need Improved Facilities
Crawford	1,588				X	X
Whitney	98	X				
Chadron	5,079				X	
TOTAL	6,765	1	0	0	2	1

TABLE 2

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

Niobrara River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Type of Treatment: Primary Only	Type of Treatment: Primary and Secondary	Need Improved Facilities
Harrison	448				X	
Hemingtord	904				X	X
Alliance	7,845				X	
Rushville	1,228				X	X
Hay Springs	823			X		X
Gordon	2,223				X	X
Merriman	285	X				
Cody	230	X				
Kilgore	157	X				
Crookston	139	X				
Valentine	2,875			X		X
Wood Lake	197	X				
Long Pine	497			X		X
Ainsworth	1,982				X	
Springview	281				X	
Orchard	421				X	
Royal	93	X				
Verdigre	584			X		X
Naper	198	X				
Anoka	32	X				
Butte	526				X	
Spencer	671				X	
Bristow	153	X				
Lynch	409				X	
Monowi	40	X				
Verdel	123	X				
TOTAL	23,364	11	0	4	11	7

TABLE 3

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

Missouri Tributaries River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment			Need Improved Facilities
			None	Primary Only	Primary and Secondary	
Niobrara	736				X	
Winnetoon	85	X				
Brunswick	254	X				
Creighton	1,388				X	
Bloomfield	1,349				X	
Center	147				X	
Crofton	604				X	X
Coleridge	604			X		X
Hartington	1,648				X	
Wynot	209	X				
Fordyce	143	X				
Obert	42	X				
Maskell	54	X				
Newcastle	357				X	
Ponca	924		X			X
Allen	350	X				
South Sioux City	7,200		Connected to Sioux City Sewerage System			
Dakota City	706			X		X
Hubbard	138				X	
Walthill	844				X	
Winnebago	682				X	
Homer	370		X			X
Winnebago Indian Reser.	100				X	
Macy	203				X	
Decatur	786				X	
Tekamah	1,788				X	
Herman	335				X	
Blair	4,931			X		X
Fort Calhoun	458				X	
Omaha	301,598			X		X
Kennard	331				X	
Bennington	341				X	
Ralston	2,977		Connected to Omaha Sewerage System			
Elkhorn	749				X	
Millard	1,014				X	
Boystown	997				X	
Gretna	745				X	X
Papillion	2,235				X	
Bellevue	8,831			X		X
TOTAL	347,253	7	2	5	23	9

TABLE 4

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

North Platte River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Type of Treatment: Primary Only	Type of Treatment: Primary and Secondary	Need Improved Facilities
Henry	138				X	
Lyman	626				X	
Morrill	884				X	
Mitchell	1,920				X	
Terrytown	164				X	
Scottsbluff	13,377				X	
Gering	4,585				X	
Minatare	894				X	
Melbeta	188				X	X
Bayard	1,519				X	
Bridgeport	1,645				X	
Dalton	503				X	
Broadwater	235				X	
Gurley	329				X	
Oshkosh	1,025				X	
Lewellen	410				X	
North Platte	17,184				X	
TOTAL	45,626	0	0	0	17	1

TABLE 5

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

South Platte River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Type of Treatment: Primary Only	Type of Treatment: Primary and Secondary	Need Improved Facilities
Bushnell	266				X	
Kimball	4,384				X	
Dix	420				X	X
Potter	554				X	
Sidney	8,004				X	
Lodgepole	492				X	
Chappell	1,280				X	X
Big Springs	506				X	X
Brule	370				X	
Ogallala	4,250				X	
Paxton	566				X	
Sutherland	867				X	
Hershey	504				X	
TOTAL	22,463	0	0	0	13	3

TABLE 6

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

Middle Platte River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Type of Treatment: Primary Only	Type of Treatment: Primary and Secondary	Need Improved Facilities
Maxwell	324				X	
Brady	275				X	
Gothenburg	3,050				X	
Cozad	3,184				X	
Farnam	285				X	
Eustis	386				X	
Lexington	5,572				X	
Smithfield	85	X				
Loomis	299				X	
Overton	523				X	
Elm Creek	778			X		X
Funk	141				X	
Kearney (2 facilities)	14,210			X	X a/	X
State Boys' Home	200				X	
Oconto	219				X	
Miller	137				X	
Amherst	220				X	
Riverdale	144				X	
Gibbon	1,083				X	
Shelton	904				X	
Wood River	828				X	
Alda	229				X	
Cairo	503				X	
Grand Island	25,742				X	
Doniphan	390				X	
Central City	2,406				X	
Chapman	303				X	
Silver Creek	431				X	
Clarks	439				X	
Duncan	294				X	
TOTAL	63,584	1	0	2	28	2

a/ Approximately 25 percent of population served by secondary treatment facility, remainder served by primary facility

TABLE 7

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

Loup River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Type of Treatment: Primary Only	Type of Treatment: Primary and Secondary	Need Improved Facilities
Hyannis	373				X	X
Mullen	811				X	
Thedford	303				X	
Dunning	210	X				
Anselmo	269	X				
Merna	349				X	
Sargent	876				X	
Comstock	235				X	
Arcadia	446				X	
Loup City	1,415				X	
Boelus	181				X	
Stapleton	359				X	
Arnold	844				X	
Callaway	603			X		X
Pleasanton	199				X	
Broken Bow	3,482				X	
Ansley	714				X	
Mason City	277	X				
Litchfield	264				X	
Ravenna	1,417				X	
Ashton	320				X	
Dannebrog	277				X	
Farwell	137				X	
St. Paul	1,714				X	
Taylor	280			X		X
Burwell	1,425			X		X
Ord	2,413				X	
North Loup	453				X	
Scotia	350				X	X
Cotesfield	81	X				
Elba	184				X	
Greeley	656				X	
Wolbach	382				X	
Palmer	418				X	
Ericson	157	X				
Bartlett	125	X				
Spalding	683			X		X
Primrose	117	X				
Cedar Rapids	512				X	
Belgrade	224	X				
Fullerton	1,475				X	
Petersburg	400				X	
Albion	1,982			X		X
St. Edward	777				X	
Genoa	1,009				X	
Monroe	261				X	
Columbus	12,476				X	X
TOTAL	42,915	8	0	5	34	8

TABLE 8

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

Elkhorn River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Type of Treatment: Primary Only	Type of Treatment: Primary and Secondary	Need Improved Facilities
Bassett	1,023				X	
Newport	162	X				
Stuart	794				X	X
Atkinson	1,324			X		X
O'Neill	3,181				X	
Page	230				X	
Chambers	396				X	
Ewing	583			X		X
Clearwater	418				X	
Neligh	1,776				X	
Elgin	881				X	
Oakdale	397				X	
Tilden	917			X		X
Meadow Grove	430			X		X
Battle Creek	587				X	
Wausa	724				X	
Osmond	719				X	
Plainview	1,467				X	
Magnet	116	X				
McLean	73	X				
Pierce	1,216			X		X
Hadar	100				X	
Hoskins	179				X	
Norfolk	13,640			X		X
Norfolk State Hospital	1,210				X	
Creston	177	X				
Humphrey	801				X	
Madison	1,513				X	
Stanton	1,317			X		X
Pilger	491		X			X
Wisner	1,192				X	
Beemer	667				X	
West Point	2,921			X		X
Scribner	1,021			X		X
Dodge	649				X	X
Snyder	325				X	
Hooper	832			X		X
Winslow	136				X	
Randolph	1,063				X	
Belden	157				X	X
Laurel	922				X	
Concord	150				X	
Dixon	139	X				
Winside	416				X	
Carroll	220	X				
Wayne	4,217				X	
Sholes	26	X				

TABLE 8 (Con't.)

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

Elkhorn River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Type of Treatment: Primary Only	Type of Treatment: Primary and Secondary	Need Improved Facilities
Wakefield	1,068				X	X
Pender	1,165				X	
Thurston	140	X				
Bancroft	496				X	
Rosalie	182				X	
Lyons	974				X	
Oakland	1,429				X	
Uehling	231			X		X
Leigh	502				X	
Clarkson	797				X	
Howells	694				X	
Nickerson	168				X	
Arlington	740				X	X
Craig	378	X				
Fremont	19,698			X		X
Valley	1,452				X	
Waterloo	516			X		X
TOTAL	82,525	9	1	13	41	19

TABLE 9

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

Lower Platte River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Type of Treatment: Primary Only	Type of Treatment: Primary and Secondary	Need Improved Facilities
Bellwood	361				X	
Schuyler	3,096				X	
Newman Grove	880				X	
Lindsay	218			X		X
Platte Center	402				X	
Rogers	162	X				
Bruno	155				X	
Abie	117	X				
Morse Bluff	119	X				
Dwight	209				X	
North Bend	1,174				X	
Valparaiso	394				X	
Malcolm	116				X	
Raymond	223				X	
Waverly	511				X	
Ceresco	429				X	
Davey	121				X	
Eagle	302				X	
Alvo	159	X				
Ashland	1,989			X		X
Greenwood	403				X	
Weston	340				X	
Prague	372				X	
Malmo	135				X	
Wahoo	3,610				X	
Colon	110	X				
Cedar Bluffs	585				X	
Yutan	335				X	
Mead	428				X	
Sprague	120				X	
Denton	94				X	
Hickman	288				X	
Hallam	264				X	
Roca	123				X	
Holland	100				X	
Garland	198				X	
Pleasant Dale	190				X	
Lincoln - Including Huskerville & West Lincoln	129,578				X	X
Murdock	247				X	
Louisville	1,194				X	
Springfield	506				X	X
LaVista	193				X	
TOTAL	150,550	5	0	2	35	4

TABLE 10

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

Republican River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Primary Only	Primary and Secondary	Need Improved Facilities
Haigler	268	X				
Benkelman	1,400				X	
Stratton	492				X	X
Trenton	914			X		X
Imperial	1,423				X	
Wauneta	794				X	
Madrid	271				X	
Venango	227				X	
Grant	1,166				X	
Palisade	544				X	
Elsie	198	X				
Hayes Center	283	X				
Culbertson	803				X	
McCook	8,301				X	
Wallace	293	X				
Indianola	754			X		X
Bartley	309	X				
Maywood	337	X				
Curtis	868			X		X
Moorefield	55	X				
Stockville	91	X				
Cambridge	1,090				X	
Holbrook	354				X	X
Arapahoe	1,084			X		X
Elwood	581				X	X
Edison	249				X	
Oxford	1,090				X	X
Bertrand	691				X	
Danbury	185	X				
Lebanon	143	X				
Wilsonville	289	X				
Beaver City	818				X	
Stamford	220	X				
Orleans	608				X	
Alma	1,342				X	
Republican City	189				X	
Atlanta	107	X				
Holdrege	5,226				X	
Ragan	90	X				
Naponee	206	X				
Bloomington	176	X				
Franklin	1,194				X	
Wilcox	260				X	

TABLE 10 (Con't.)

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

Republican River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Type of Treatment: Primary Only	Type of Treatment: Primary and Secondary	Need Improved Facilities
Hildreth	305				X	
Upland	237				X	
Riverton	303	X				
Red Cloud	1,525			X		X
Guide Rock	441			X		X
Superior	2,935				X	
Hardy	285				X	
TOTAL	42,014	17	0	6	27	10

TABLE 11

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

Little Blue River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Primary Only	Primary and Secondary	Need Improved Facilities
Axtell	447				X	
Campbell	424			X		X
Minden	2,383				X	
Norman	57	X				
Holstein	205				X	
Roseland	163				X	
Ayr	111				X	
Bladen	332				X	
Blue Hill	723				X	
Juniata	422				X	
Kenesaw	546				X	
Hastings		(Effluent to Big Blue River)				
Ingleside St. Hospital	1,350				X	
Lawrence	338				X	X
Nelson	695				X	
Hebron	1,920			X		X
Deshler	956				X	
Ruskin	203				X	
Byron	147				X	
Glenville	323				X	
Fairfield	495				X	
Edgar	730				X	
Davenport	416				X	X
Clay Center	792				X	
Carleton	207	X				
Belvidere	185	X				
Shickley	371				X	
Bruning	289				X	
Alexandria	257				X	
Ohiowa	195	X				
Milligan	323				X	
Fairbury	5,572			X		X
Chester	480				X	X
Hubbell	126				X	
Reynolds	131	X				
Endicott	166	X				
TOTAL	22,480	6	0	3	26	6

TABLE 12

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

Big Blue River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Type of Treatment: Primary Only	Type of Treatment: Primary and Secondary	Need Improved Facilities
Hordville	128				X	
Marquette	210				X	
Polk	435				X	
Stromsburg	1,244				X	
Osceola	1,013				X	
Shelby	613				X	
Rising City	308				X	
David City	2,304				X	
Ulysses	357				X	
Staplehurst	240			X		X
Phillips	192	X				
Aurora	2,576				X	
Benedict	170				X	
Gresham	239				X	
Seward	4,208				X	
Brainard	300				X	
Bee	149				X	
Milford	1,462			X		X
Goehner	106				X	
Hastings	21,412				X	
Trumbull	173				X	
Harvard	1,261				X	
Sutton	1,252				X	
Grafton	171				X	
Henderson	730				X	
McCool Junction	246				X	
Giltner	293				X	
Hampton	331				X	
Bradshaw	306				X	
York	6,173				X	
Waco	166				X	
Utica	564				X	
Fairmont	829				X	
Beaver Crossing	439				X	
Exeter	745				X	X
Cordova	152				X	
Friend	1,069				X	
Crete	3,546				X	X
Dorchester	460				X	X
Wilber	1,358				X	
Clatonia	203				X	
Geneva	2,352				X	
Tobias	202	X				
Daykin	144				X	
Western	351				X	

TABLE 12 (Con't.)

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

Big Blue River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Type of Treatment: Primary Only	Type of Treatment: Primary and Secondary	Need Improved Facilities
Swanton	190				X	
DeWitt	504				X	
Plymouth	372				X	
Cortland	285				X	
Pickrell	130				X	
Beatrice	12,132				X	
Beatrice State Home	2,185				X	
Filley	149				X	
Blue Springs	509				X	
Wymore	1,975				X	X
Jansen	204				X	
Harbine	58	X				
Diller	286				X	
Odell	358				X	X
Burchard	132				X	
Liberty	174	X				
Barneston	177				X	
TOTAL	81,000	4	0	2	56	7

TABLE 13

INVENTORY OF PUBLIC SEWAGE TREATMENT FACILITIES AND NEEDS (1969)

Nemaha River Basin

Community	1960 Pop.	No Sewer System	Type of Treatment: None	Type of Treatment: Primary Only	Type of Treatment: Primary and Secondary	Need Improved Facilities
Plattsmouth	6,244			X		X
Murray	279				X	
Elmwood	481				X	
Weeping Water	1,048				X	X
Nehawka	262				X	
Avoca	218				X	
Union	303				X	
Nebraska City	7,252			X		X
Peru	1,151				X	
Brownville	243	X				
Bennet	381				X	
Palmyra	377				X	
Unadilla	254				X	
Syracuse	1,261				X	
Douglas	197				X	
Burr	81				X	
Cook	313				X	
Otoe	225	X				
Dunbar	232	X				
Talmage	361				X	
Brock	213				X	
Auburn	3,229				X	
Shubert	231	X				
Panama	155				X	
Firth	277				X	
Adams	387				X	
Sterling	471			X		X
Tecumseh	1,887				X	
Elk Creek	170	X				
Table Rock	422				X	
Humboldt	1,322			X		X
Dawson	263	X				
Salem	261	X				
Steinauer	124	X				
Pawnee City	1,343				X	
DuBois	218	X				
Falls City	5,598				X	
Johnson	304				X	
Stella	262				X	
Verdon	267				X	
TOTAL	38,567	9	0	4	27	5

TABLE 14

SUMMARY OF FEEDLOT REGISTRATIONS

		Feeder Cattle		Beef & Dairy Cows		Swine		
County	Number of Regis-trations	Total No. Animals	No. of Lots With 300 or More Animals	Total No. Animals	No. of Lots With 100 or More Animals	Total No. Animals	No. of Lots With 500 or More Animals	Waste[a/] Potential (Pop. Equiv. in Thousands)
Adams	10	11,925	6	130	1	1,600	1	207
Antelope	10	5,770	5	355	2	500		101
Arthur	4	1,350	3	45		10		23
Boone	7	3,775	3	115	1			64
Box Butte	7	3,100	5	150	1			53
Boyd	2	550	1					9
Brown	12	7,050	9	631	2	700	1	127
Buffalo	72	24,920	24	1,352	6	7,293	4	448
Burt	67	27,617	36	685	3	13,460	9	495
Butler	25	15,540	12	275	1	1,950	1	267
Cass	36	12,015	10	229		3,870	3	211
Cedar	12	4,025	6			2,425	1	71
Chase	6	8,950	5			150		147
Cheyenne	14	14,700	9	151	1	800	1	246
Clay	30	14,775	18	320	1	4,240	4	256
Colfax	21	25,730	13	51		1,120		460
Cuming	235	111,067	123	1,195	3	34,115	14	1,910
Custer	26	6,405	10	1,382	5	1,675		131
Dakota	12	8,900	5	235	2	1,450	1	153
Dawes	1			100	1			2
Dawson	134	90,396	74	2,792	16	18,335	15	1,577
Deuel	7	3,950	5	80				66
Dixon	16	15,931	2	189	1	2,765	1	270
Dodge	23	16,940	13	102	1	2,400	1	290
Douglas	33	45,770	20	235	1	1,675	1	768

a/ Includes capacities of confined feeding operations for sheep and poultry

TABLE 14

SUMMARY OF FEEDLOT REGISTRATIONS

County	Number of Regis- trations	Feeder Cattle		Beef & Dairy Cows		Swine		Waste[a/] Potential (Pop. Equiv. in Thousands)
		Total No. Animals	No. of Lots With 300 or More Animals	Total No. Animals	No. of Lots With 100 or More Animals	Total No. Animals	No. of Lots With 500 or More Animals	
Dundy	4	3,450	3	303	1	400		62
Fillmore	36	17,370	25	1,123	5	8,170	5	317
Franklin	14	3,760	6	145		2,320	2	73
Frontier	1							
Furnas	49	16,672	19	782	4	2,710	2	295
Gage	19	19,575	11	300	2	3,150	3	332
Garfield	8	1,148	2	231	1	1,525	1	26
Gosper	4	1,375	2	50		200		24
Greeley	9	2,115	2	137	1	1,730	2	40
Hall	47	41,325	33	365	1	1,780	1	687
Hamilton	28	14,175	20	470	3	2,300	2	251
Harlan	12	2,212	2	115		900		41
Hayes	3	1,100	2			850	1	20
Hitchcock	11	5,300	8	318	2	1,590	1	96
Holt	12	18,780	5	1,165	1	685		329
Hooker	1	500	1	300	1			13
Howard	10	4,135	7	130	1	1,200		72
Jefferson	4	7,150	2			1,000	1	119
Johnson	6	1,115	1			830		20
Kearney	42	23,800	20	760	3	4,060	2	430
Keith	6	24,350	6			200		400
Kimball	6	2,600	5					43
Knox	25	8,915	10	240	1	2,700	1	155
Lancaster	26	6,415	12	110		1,850		163
Lincoln	20	8,620	11	400	3	5,630	4	161

a/ Includes capacities of confined feeding operations for sheep and poultry

TABLE 14

SUMMARY OF FEEDLOT REGISTRATIONS

County	Number of Regis- trations	Feeder Cattle Total No. Animals	Feeder Cattle No. of Lots With 300 or More Animals	Beef & Dairy Cows Total No. Animals	Beef & Dairy Cows No. of Lots With 100 or More Animals	Swine Total No. Animals	Swine No. of Lots With 500 or More Animals	Waste[a/] Potential (Pop. Equiv. in Thousands)
Loup	1	250				250		4
Madison	17	3,535	6	398	2	1,950	2	76
Merrick	29	17,145	14	694	4	2,250	3	298
Morrill	3	1,100	3	205	1	800	1	23
Nance	4	2,000	4	100	1	350		36
Nemaha	23	4,959	7	32		1,850	1	85
Nuckolls	12	4,200	5			775	1	70
Otoe	21	10,590	8	122		2,230	1	182
Pawnee	2	380	1	12		300		13
Phelps	30	21,140	26	180	1	1,950	2	353
Pierce	19	3,627	6	250	1	4,150	2	73
Platte	41	23,590	24	520	1	4,725	5	405
Polk	32	45,290	27			3,225	2	749
Red Willow	17	5,430	9	130	1	1,510	1	94
Richardson	50	13,304	12	970	2	6,604	4	247
Rock	3	3,250	3					53
Saline	10	5,180	7	166	1	400		88
Sarpy	44	45,475	22	511	2	8,800	5	789
Saunders	29	18,625	18	125		2,550	1	312
Scotts Bluff	43	65,850	30	790	4	6,400	1	1,219
Seward	25	13,874	11	275	1	1,475	1	235
Sherman	4	675	1			1,150		13
Sioux	6	7,300	6			1,200		122
Stanton	50	46,689	34	112		8,487	2	784
Thayer	7	2,000	4	150	1	2,200	2	39

a/ Includes capacities of confined feeding operations for sheep and poultry

TABLE 14

SUMMARY OF FEEDLOT REGISTRATIONS

County	Number of Regis-trations	Feeder Cattle		Beef & Dairy Cows		Swine		Waste[a/] Potential (Pop. Equiv. in Thousands)
		Total No. Animals	No. of Lots With 300 or More Animals	Total No. Animals	No. of Lots With 100 or More Animals	Total No. Animals	No. of Lots With 500 or More Animals	
Thurston	23	11,615	15	174		3,340	4	200
Valley	14	4,935	11	595	2	825		92
Washington	30	8,607	8	708	3	2,415	2	159
Wayne	41	14,615	22	180		4,910	5	253
Webster	9	2,842	5	230	1			50
Wheeler	1	50						1
York	31	12,715	20	501	1	2,800	1	223

a/ Includes capacities of confined feeding operations for sheep and poultry

TABLE 15

WATER QUALITY CRITERIA FOR PLANNING PURPOSES

	Degree of Acceptability	
	Desirable	Usable
1. Raw Water for Domestic and Food Processing Purposes		
Organisms of the Fecal Coliform Group (monthly average)	MPN 50/100 ml (chlorinations required on all supplies)	MPN 5000/100 ml[a]
Floating or Settleable Solids	None identifiable of sewage or industrial waste origin	
Total Dissolved Solids (average)	Ave. 500 mg/l	Ave. 1500 mg/l[a]
pH	7.0 - 8.5	6.0 - 9.5[a]
Color	None	$<$100 units[a]
Dissolved Oxygen (DO)	Aerobic	Aerobic[a]
Chlorides	$<$250 mg/l	$<$400 mg/l
Sulfates	$<$250 mg/l	$<$500 mg/l
Phenolics	None	$<$.005 mg/l[a]
Toxic Materials and/or Oil	None	None in injurious concentrations
Nitrates	$<$10.0 mg/l	$<$ 45.0 mg/l
Sodium	$<$10 mg/l	$<$ 100 mg/l
Fluorides	1.0 mg/l	$<$2.5 mg/l
Iron and Manganese Combined	$<$0.3 mg/l	$<$ 0.3 mg/l[a]
2. Raw Water for Industrial Purposes		
Total Dissolved Solids	$<$500 mg/l	$<$ 1000 mg/l
pH	7.0 - 8.5	6.0 - 9.5
Chlorides	$<$ 200 mg/l	$<$250 mg/l
Sulfates	$<$250 mg/l	$<$ 250 mg/l

a/ In municipal water supplies concentrations in excess of these limits can usually be corrected by normal treatment processes.

TABLE 15 (Con't.)

WATER QUALITY CRITERIA FOR PLANNING PURPOSES

	Degree of Acceptability	
	Desirable	Usable
3. Raw Water for Irrigation Purposes		
Organisms of Fecal Coliform Group b/ (monthly average)	MPN < 10/100 ml	MPN < 25/100 ml
Conductivity c/ (micromhos/cm)	< 1500	< 3000
Sodium Adsorption Ratio	< 5	< 8
Toxic Material	Toxicity concentration varies with "toxic" substance and crop	
Chlorides d/	< 175 mg/l	< 175 mg/l

b/ Truck garden and dairy cow pasture irrigation

c/ Local problems may lower this limit, i.e. water with conductivity of 750 to 2250 micromhos/cm cannot be used on soils with restricted drainage.

d/ Chloride concentrations may be limited for irrigation suitability at any point between 70 and 570 mg/l, depending primarily on percent sodium and electrical conductivity. Generally no problems will arise if chloride concentrations are less than 175 mg/l, and special studies will generally be required if concentrations exceed 350 mg/l.

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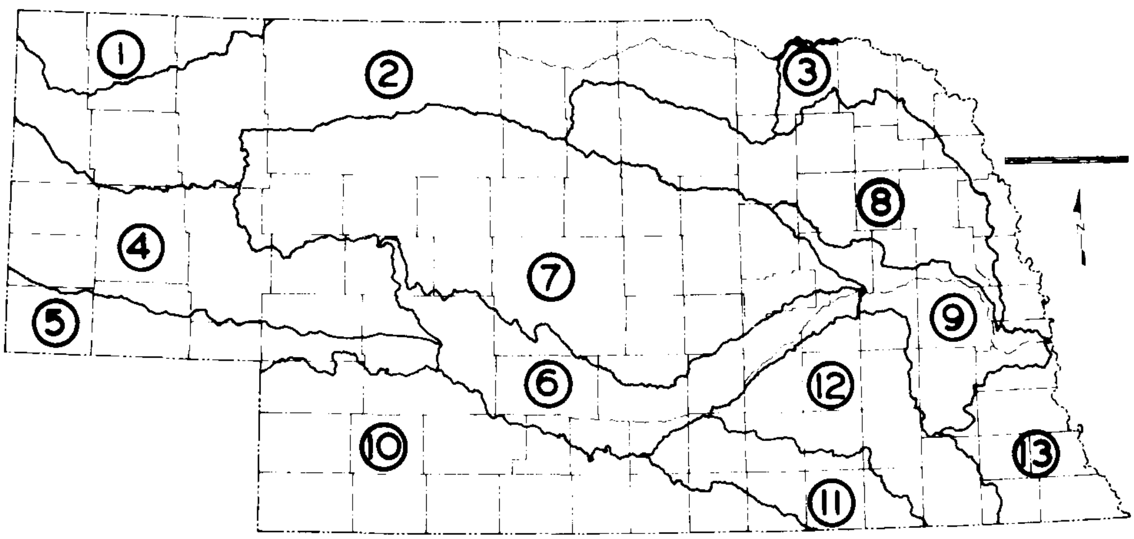
MAP SECTION

KEY TO IDENTIFICATION OF RIVER BASINS



1. White River–Hat Creek
2. Niobrara
3. Missouri Tribs
4. North Platte
5. South Platte
6. Middle Platte
7. Loup
8. Elkhorn
9. Lower Platte
10. Republican
11. Little Blue
12. Big Blue
13. Nemaha

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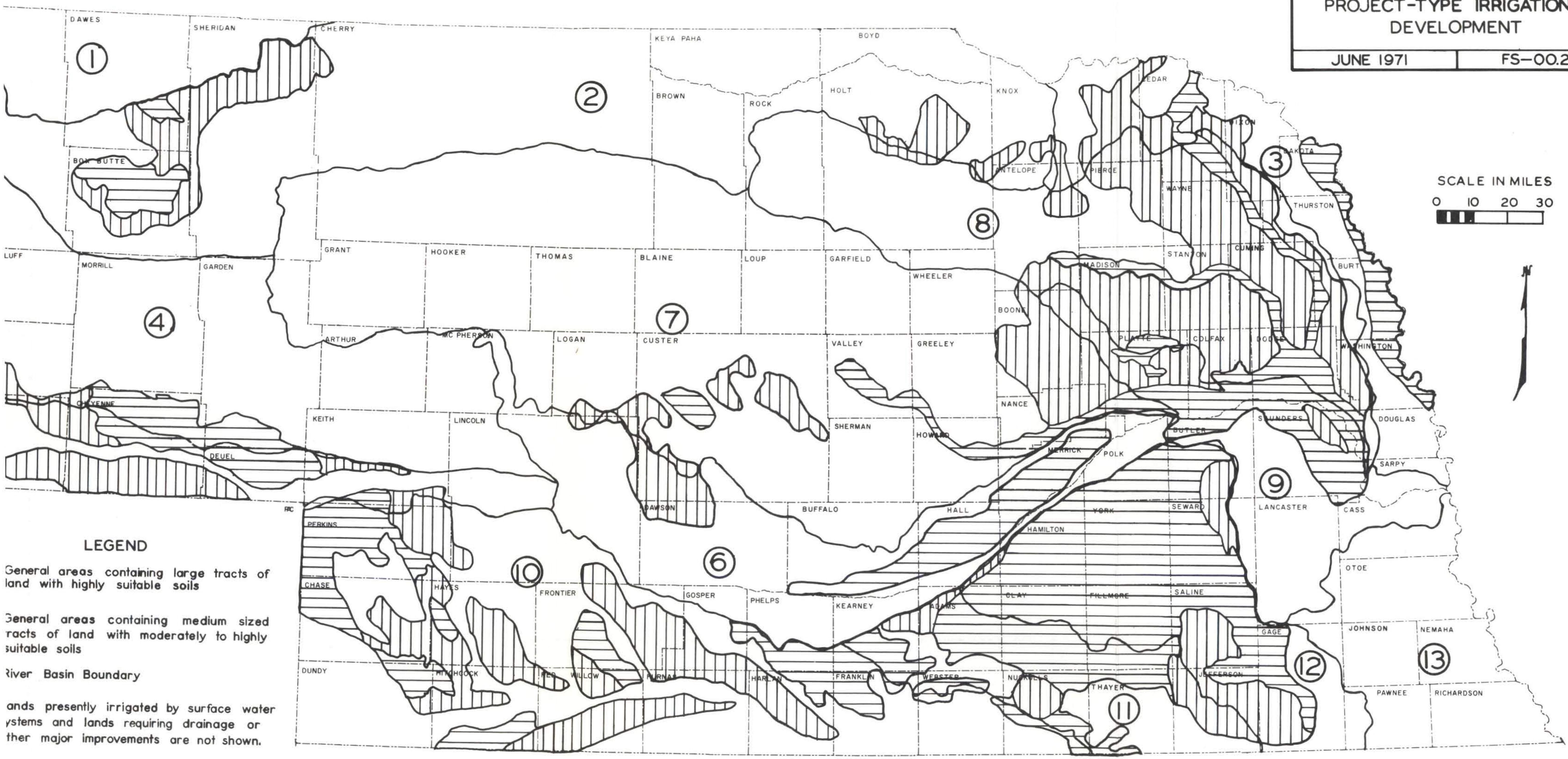
MAP 1

State of Nebraska
SOIL & WATER CONSERVATION COMMISSION
Planning Division

LANDS SUITABLE FOR PROJECT-TYPE IRRIGATION DEVELOPMENT

JUNE 1971 | FS–00.23



LEGEND

General areas containing large tracts of land with highly suitable soils

General areas containing medium sized racts of land with moderately to highly suitable soils

River Basin Boundary

ands presently irrigated by surface water ystems and lands requiring drainage or ther major improvements are not shown.

WATERSHED IDENTIFICATION KEY

(1) WHITE RIVER-HAT CREEK BASIN

1. Indian Creek (Upper)
2. Hat Creek (Lower)
3. Hat Creek (Upper)
4. Indian Creek (Lower)
5. Hat Tribs (East)
6. Horsehead Creek
7. White River (Upper)
8. Crawford Tribs
9. Whitney - Big Cottonwood
10. Ash - Chadron, etc.
11. Lone Tree Creek, etc.
12. Bordeaux Creek
13. Beaver Creek
14. Lime Kiln Creek
15. White Clay Creek
16. Wolf - Wounded Knee Creeks
17. Little White (Upper)

(2) NIOBRARA RIVER BASIN

1. Vantassell Creek
2. Niobrara - Harrison
3. Niobrara - Agate
4. Whistle Creek
5. Niobrara - Marsland
6. Sand Creek
7. Dunlap Tribs
8. Mirage Flats
9. Box Butte Creek
10. Snake Creek (Upper)
11. Point of Rocks Creek
12. Berea - Hemingford Creeks
13. Snake Creek (Lower)
14. Rush Creek
15. Niobrara - Sheridan Tribs
16. Antelope Creek
17. Niobrara Sandhills
18. Minnechaduza Creek
19. Niobrara Tribs-Cherry-Keya Paha
20. Plum Creek (Upper)
21. Plum Creek (Lower)
22. Bone Creek
23. Long Pine Creek
24. Riverview Tribs
25. Mariaville Tribs
26. Keya Paha Creek
27. Big Sandy - Brush Creek
28. Turkey Creek, etc. Tribs
29. Eagle Creek
30. Redbird Creek
31. Verdigre Creek (Upper)
32. North Branch Verdigre Creek
33. Verdigre Creek (Lower)
34. Niobrara River (Lower)
35. Ponca Creek
36. Boyd - Missouri Tribs

(3) MISSOURI RIVER TRIBUTARIES BASIN

1. Bazile Creek (Upper)
2. Little Bazile Creek
3. Bazile Creek (Lower)
4. Lewis & Clark (Lower)
5. Antelope - Beaver
6. Sunny Side Tribs
7. Bow Valley Creek
8. Bow Creek (Upper)
9. Bow Creek (Lower)
10. Cedar - Dixon - Missouri Tribs

(Missouri R. Tributaries Basin-Con't.)

11. Aowa Creek
12. South Creek
13. Elk Creek
14. Omaha Creek
15. Blackbird Creek
16. Decatur Tribs
17. Tekamah - Mud
18. Blair - Herman Tribs
19. Mill - Long
20. Omaha Tribs
21. Papillion Creek

(4) NORTH PLATTE RIVER BASIN

1. Kiowa Creek
2. Sheep Creek
3. Spotted Tail Creek
4. South Mitchell
5. Winters Creek
6. Gering Valley
7. Nine-Mile Creek
8. Chimney Rock Creek
9. Triple
10. Wildhorse
11. North Port Tribs
12. Pumpkin Creek (Upper)
13. Pumpkin Creek (Middle & Lower)
14. Lawrence Creek
15. Middle - Greenwood
16. Broadwater Tribs
17. Deep Holes - Cedar, Etc.
18. Rush Creek
19. Lost Creek, etc.
20. Ash Hollow
21. North Platte Sandhills
22. Ash-Plum

(5) SOUTH PLATTE RIVER BASIN

1. Cottonwood Creek, etc.
2. Bushnell Tribs
3. Kimball Tribs
4. Potter Tribs
5. Southwest Kimball
6. Sidney Draw
7. Sioux Ordnance Depot Tribs
8. Cow Creek, etc.
9. Lodgepole Creek (Lower)
10. Western Canal Tribs
11. O'Neil Draw
12. Big Springs Tribs
13. Brule
14. Ogallala - Sutherland Tribs
15. Cure
16. Roscoe Draw, etc.
17. Sutherland Reservoir-Lake Mahoney

(6) MIDDLE PLATTE RIVER BASIN

1. North Platte Sandhills (part)
2. Maxwell Sandhills & Tribs
3. Bignall Tribs
4. Gothenburg Tribs
5. Tri-County Tribs
6. Spring Creek (Dawson)
7. Plum Creek
8. Buffalo Creek
9. Platte Tribs (Phelps)
10. Hall - Buffalo Bottom

(Middle Platte R. Basin-Con't.)

11. Twin, Lost and Dry Creeks
12. Wood River
13. Wood River (Lower)
14. Box Elder
15. Warm Slough - Silver Creek
16. Platte Tribs (Hamilton)
17. Prairie Creek (Upper)
18. Prairie Creek (Lower) pt.
19. Jones Creek
20. Clear Creek

(7) LOUP RIVER BASIN

1. South Loup Sandhills
2. Callaway Tribs
3. Ash-Deer-Box Elder-Oak Creeks
4. Cat-Elk-Dry Creeks
5. Otter-Death Creeks & Tribs
6. Clear Creek
7. Mud Creek
8. Cedar-Sweet-Cherry Creeks
9. Middle Loup Sandhills
10. Anselmo Area
11. Lillian - Spring Creek, etc.
12. Sargent Tribs
13. Loup City Tribs (West)
14. Hawthorne Creek
15. Loup City Tribs (East)
16. Farwell and Oak
17. Loup Bottom (Upper)
18. North Loup Sandhills
19. Calamus River
20. Taylor-Ord Canal Tribs
21. Burwell-Sumter Canal Tribs
22. Haskell Creek
23. North Loup Tribs (Lower)
24. Miry-Davis-Munson Creeks
25. Spring Creek (Howard)
26. Cedar Creek Sandhills
27. Cedar Creek (Middle)
28. Timber Creek
29. Cedar Creek (Lower)
30. Plum Creek (Boone)
31. Beaver Creek Sandhills
32. Beaver Creek (Lower)
33. Lookingglass Creek
34. Loup Bottom (Lower)

(8) ELKHORN RIVER BASIN

1. Elkhorn River (Upper)
2. Stuart - Atkinson Tribs
3. Holt Creek
4. Dry Creek Sandhills
5. South Fork Elkhorn River
6. O'Neill Tribs
7. Cache - Clearwater Creeks
8. Antelope - Cedar
9. Neligh - Norfolk Tribs
10. Tilden - Battle Creek Tribs
11. Corporation Gulch
12. North Fork (Upper)
13. Dry Creek
14. Willow Creek
15. Yankton Slough
16. North Fork (Lower)
17. Stanton Tribs
18. Union Creek

WATERSHED IDENTIFICATION KEY (Con't.)

(Elkhorn River Basin-Con't.)

19. Butterfly - Leisy
20. Humbug Creek
21. Pilger
22. Sand Creek
23. Rock Creek
24. Fisher Creek
25. Plum Creek
26. Cuming Creek
27. Pebble Creek
28. Logan Creek (Upper)
29. South Logan Creek
30. Logan Creek (Middle)
31. Logan Creek (Lower)
32. East Fork Maple Creek
33. Maple - Dry Creek
34. Maple Creek (Lower)
35. Bell Creek,
36. Rawhide Creek, etc.

(9) LOWER PLATTE RIVER BASIN

1. Bellwood
2. Lost Creek
3. Bone Creek
4. Shell Creek
5. Loseke-Taylor
6. Skull Creek
7. North Bend Drains, etc.
8. Platte Tribs (Saunders)
9. Upper Salt Creek
10. Lincoln Tribs
11. Stevens - Camp
12. Oak - Middle
13. Little Salt-Jordan Creek
14. Rock Creek
15. Salt Creek (Lower)
16. Wahoo Creek (Upper)
17. Cottonwood Creek
18. Sand Creek
19. Swedeburg
20. Silver Creek
21. Clear Creek
22. Wahoo Creek (Lower)
23. Platte Tribs (Sarpy)
24. Turtle Creek
25. NE Cass

(10) REPUBLICAN RIVER BASIN

1. North Fork Republican River
2. Arikaree River
3. Buffalo Creek
4. Rock-Spring Creeks
5. Hey Canyon - etc. Tribs
6. South Fork Republican River
7. Chase-Dundy Sandhills
8. Indian Creek
9. Burntwood Creek
10. Muddy Creek (Dundy Co.)
11. Culbertson to Stratton Tribs (No.)
12. Culbertson to Stratton Tribs (So.)
13. Sand Creek
14. Frenchman River (Enders Reservoir)
15. Frenchman River (Wauneta Tribs)
16. Venango Tribs
17. Spring Creek (Upper)
18. Grant Tribs
19. Stinking Water Creek (Upper)
20. Spring-Stinking Water Creeks (Lower)
21. Frenchman River (Lower)

(Republican River Basin-Con't.)

22. Blackwood Creek (Upper)
23. Blackwood Creek (Lower)
24. Driftwood Creek
25. Dry Creek (South)
26. McCook Tribs
27. Sleepy Hollow-Bushy, etc. Creeks
28. Red Willow Creek (Upper)
29. Red Willow Creek (Lower)
30. Coon Creek
31. Dry Creek (Pilot)
32. Cambridge to Bartley Tribs
33. Silver Creek
34. Medicine Creek (Sandhills)
35. Medicine Creek (Upper)
36. Medicine Creek (Middle)
37. Medicine Creek (Lower)
38. Republican R. So. Tribs (Furnas Co.)
39. Deer Creek
40. Muddy Creek (Frontier & Gosper Co.)
41. Elk-Turkey, etc. Creeks
42. Orleans Tribs
43. Beaver Creek
44. Beaver Creek (Lebanon)
45. Beaver Creek (Beaver City)
46. Sappa Creek
47. Sappa Creek (Lower)
48. Stamford Creek
49. Prairie Dog Creek (Lower)
50. Turkey Creek
51. Lost Creek, etc. Tribs
52. Sacramento Tribs
53. Center, etc. Tribs
54. Thompson Creek
55. Lohffy-Oak - etc. Creeks
56. Farmers-Indian, etc. Creeks
57. Red Cloud Tribs
58. Minnie Creek
59. Courtland Tribs
60. Superior Tribs

(11) LITTLE BLUE RIVER BASIN

1. Little Blue (Upper)
2. Cottonwood - Scott Creeks
3. Thirty-Two Mile Creek
4. Pawnee Creek
5. ACNW Tribs
6. Angus - Hebron Tribs
7. Spring Creek
8. Dry (Thayer)
9. Big Sandy
10. Little Sandy
11. Bowman - Spring Branch
12. Buckley Creek
13. Rose Creek
14. Fairbury Tribs
15. Little Blue (Hollenberg)

(12) BIG BLUE RIVER BASIN

1. North Fork
2. Kezar Creek
3. North Branch (Upper)
4. North Branch (Lower)
5. Lincoln Creek (Upper)
6. Lincoln Creek (Lower)
7. Plum Creek (Seward)
8. Seward - Milford Tribs
9. West Fork (Upper)
10. School Creek

(Big Blue River Basin-Con't.)

11. West Fork (Middle)
12. Beaver Creek
13. West Fork (Lower)
14. Dorchester
15. Crete-Wilber-DeWitt Tribs
16. Upper Turkey Creek
17. Lower Turkey Creek
18. Swan-Dry
19. Clatonia
20. Soap Creek
21. Plymouth
22. Cub Creek
23. Little Indian Creek
24. Bear-Pierce-Cedar Creeks
25. Mud Creek
26. Beatrice
27. Big Indian Creek
28. Wolf-Wildcat Creek
29. Plum Creek
30. Mission Creek
31. Horseshoe Creek

(13) NEMAHA RIVER BASIN

1. Plattsmouth
2. Murray Tribs
3. Weeping Water Creek
4. Nebraska City - Peru Tribs
5. Little Nemaha (Upper)
6. Brownell Creek
7. Ziegler
8. South Branch Little Nemaha
9. Wilson Creek
10. Spring (Johnson)
11. Brock
12. Rock (Nemaha - Otoe)
13. Auburn Tribs
14. Beadow - Deroin, etc.
15. Winnebago - Bean
16. Upper Big Nemaha
17. Middle Big Nemaha
18. Lower Big Nemaha
19. Long Branch
20. Turkey Creek
21. Rock (Pawnee)
22. South Fork (West)
23. South Fork (Lower)
24. Pony Creek
25. Walnut Creek
26. Muddy Creek
27. Nemaha-Missouri Bottom

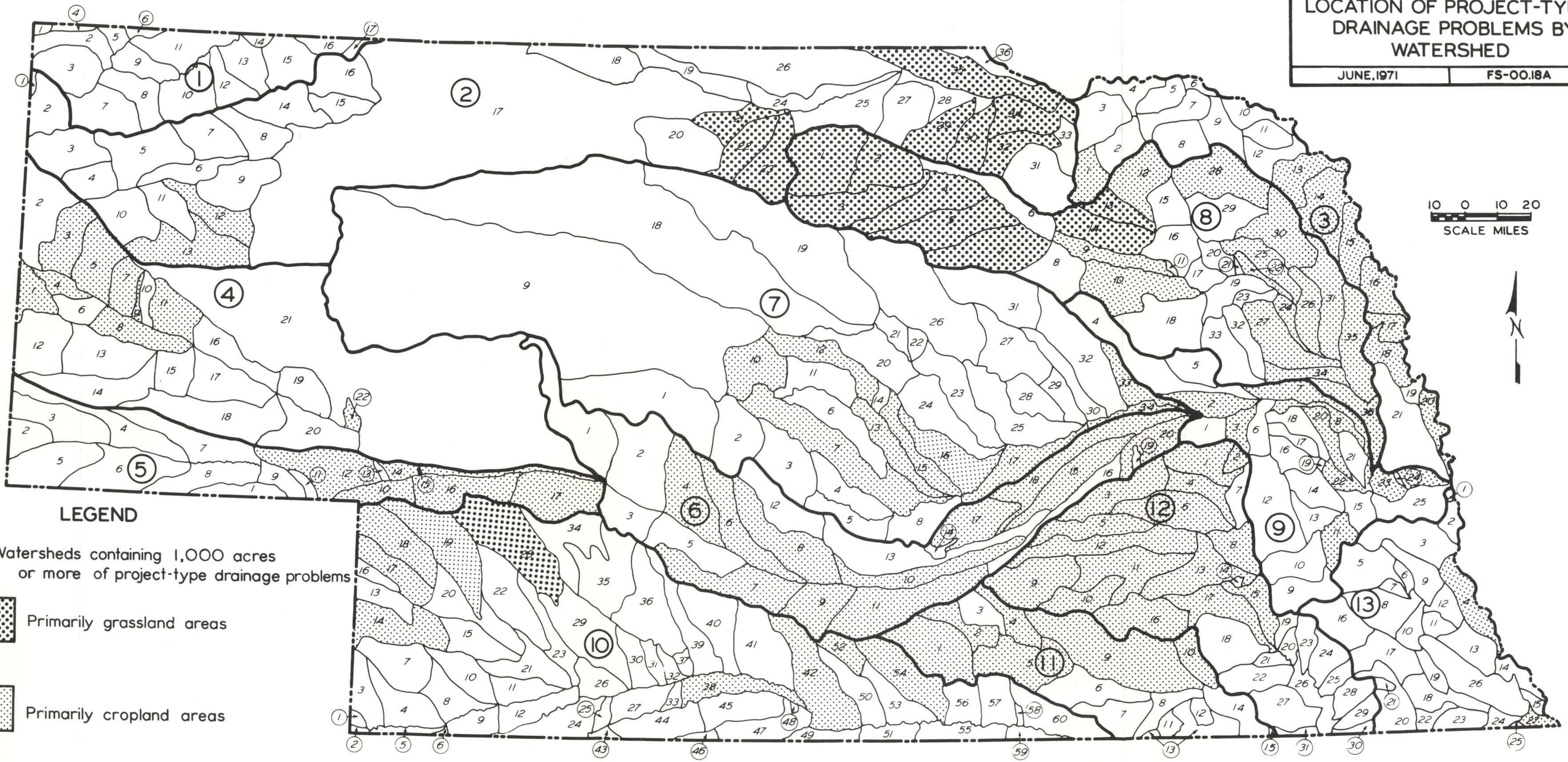
Source: Conservation Needs Inventory, USDA

MAP 2

State of Nebraska
SOIL & WATER CONSERVATION COMMISSION
Planning Division

LOCATION OF PROJECT-TYPE DRAINAGE PROBLEMS BY WATERSHED

JUNE, 1971 | FS-00.18A



LEGEND

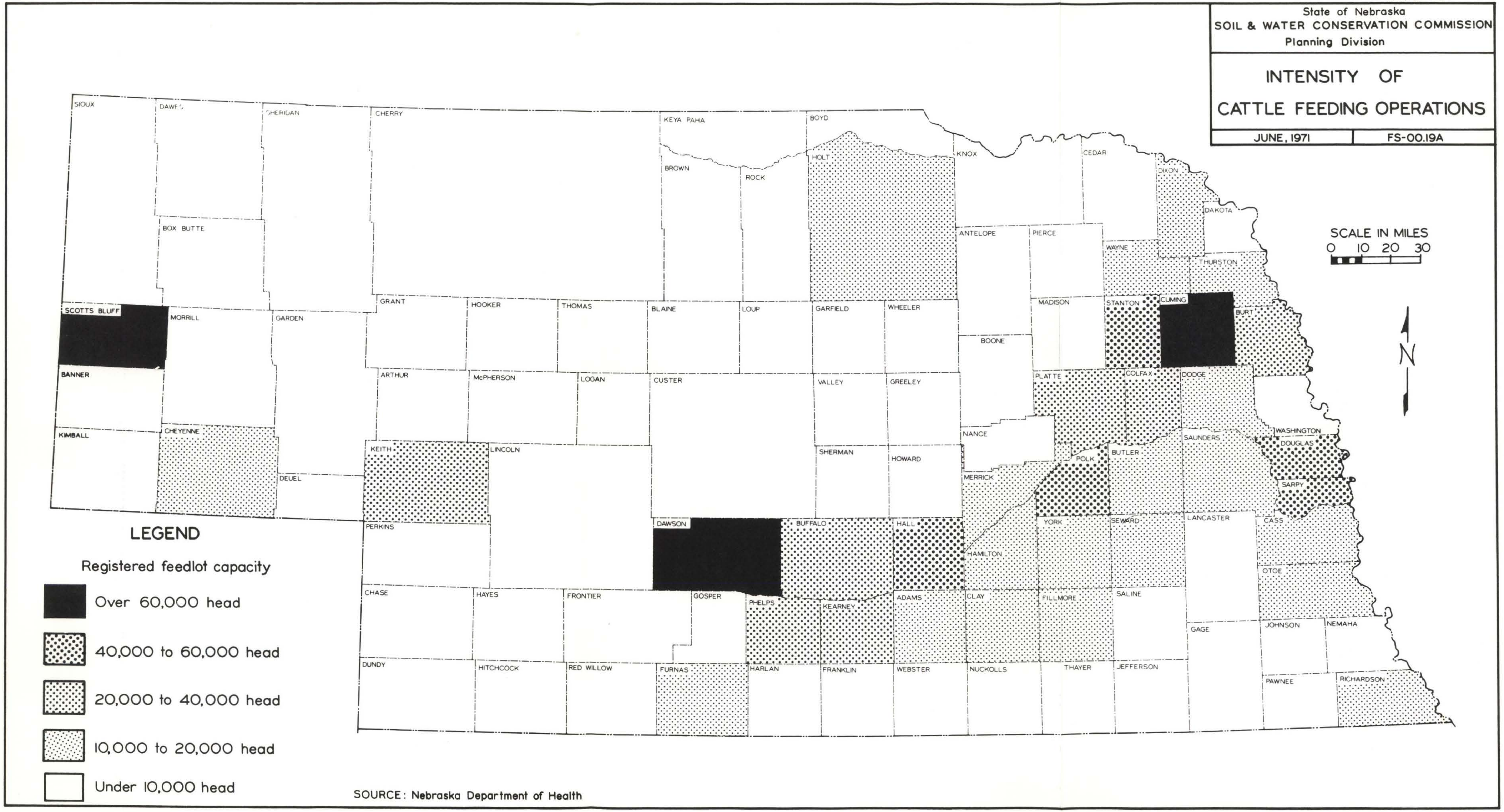
Watersheds containing 1,000 acres or more of project-type drainage problems

- Primarily grassland areas
- Primarily cropland areas

SOURCE: Missouri Basin Inter-agency Committee: Conservation Needs Inventory, SCS, USDA

NOTE: To identify watersheds, see key preceding this map.

MAP 3



SOURCE: Nebraska Department of Health

IDENTIFICATION OF EXISTING AND AUTHORIZED WORKS
OF IMPROVEMENT FOR FLOOD CONTROL AND RELATED PURPOSES

Project or Structure

1. Box Butte Dam and Reservoir
2. Antelope Creek Watershed
3. Merritt Dam and Reservoir
4. Gavins Point Dam (Lewis and Clark Lake)
5. Bank Stabilization (All along Missouri River)
6. Blackbird Creek Local Protection
7. Omaha Local Protection
8. Little Papillion Creek
9. Missouri River Levees
10. Gering Valley Watershed
11. Wildhorse Creek Watershed
12. Lake McConaughy
13. Cure Watershed
14. Brule Watershed
15. Spring Creek (Dawson) Watershed
16. Jones Creek Watershed
17. Sargent Unit (Irrigation)
18. Sherman Dam and Reservoir
19. Battle Creek Local Protection
20. Pierce Local Protection
21. Norfolk Local Protection
22. Madison Local Protection
23. Pilger Watershed
24. West Point Local Protection
25. Hooper Local Protection
26. Clarkson Local Protection
27. Waterloo Local Protection
28. Bellwood Watershed
29. Schuyler Local Protection
30. Cottonwood Watershed
31. Oak Middle Creeks Watershed
32. Salt Creek Reservoirs (10)
33. Upper Salt Creek-Swedeburg (Pilot) Watershed
34. Salt Creek Bank Stabilization
35. Turtle Creek Watershed
36. Enders Dam and Reservoir
37. Trenton Dam (Swanson Lake)
38. Dry Creek South Watershed
39. Red Willow Dam (Hugh Butler Lake)
40. Indianola Local Protection
41. Dry Creek Watershed
42. Bartley Local Protection
43. Medicine Creek Dam (Harry Strunk Lake)
44. Stamford Watershed
45. Harlan County Dam and Reservoir
46. 32-Mile Creek Watershed
47. Bowman-Spring Branch Watershed
48. Buckley Creek Watershed
49. Fairbury Local Protection
50. Seward Local Protection
51. Dorchester Watershed
52. Clatonia Watershed
53. Little Indian Creek Watershed
54. Bear-Pierce-Cedar Watershed
55. Mud Creek Watershed
56. Cub Creek Watershed
57. Big Indian Creek Watershed
58. Plum Creek Watershed
59. Mission Creek Watershed
60. Plattsmouth Watershed
61. Wilson Creek Watershed
62. Brownell Creek Watershed
63. Ziegler Creek Watershed
64. Spring Creek (Johnson) Watershed
65. Upper Big Nemaha Watershed
66. Rock Creek (Pawnee) Watershed
67. Walnut Creek Watershed

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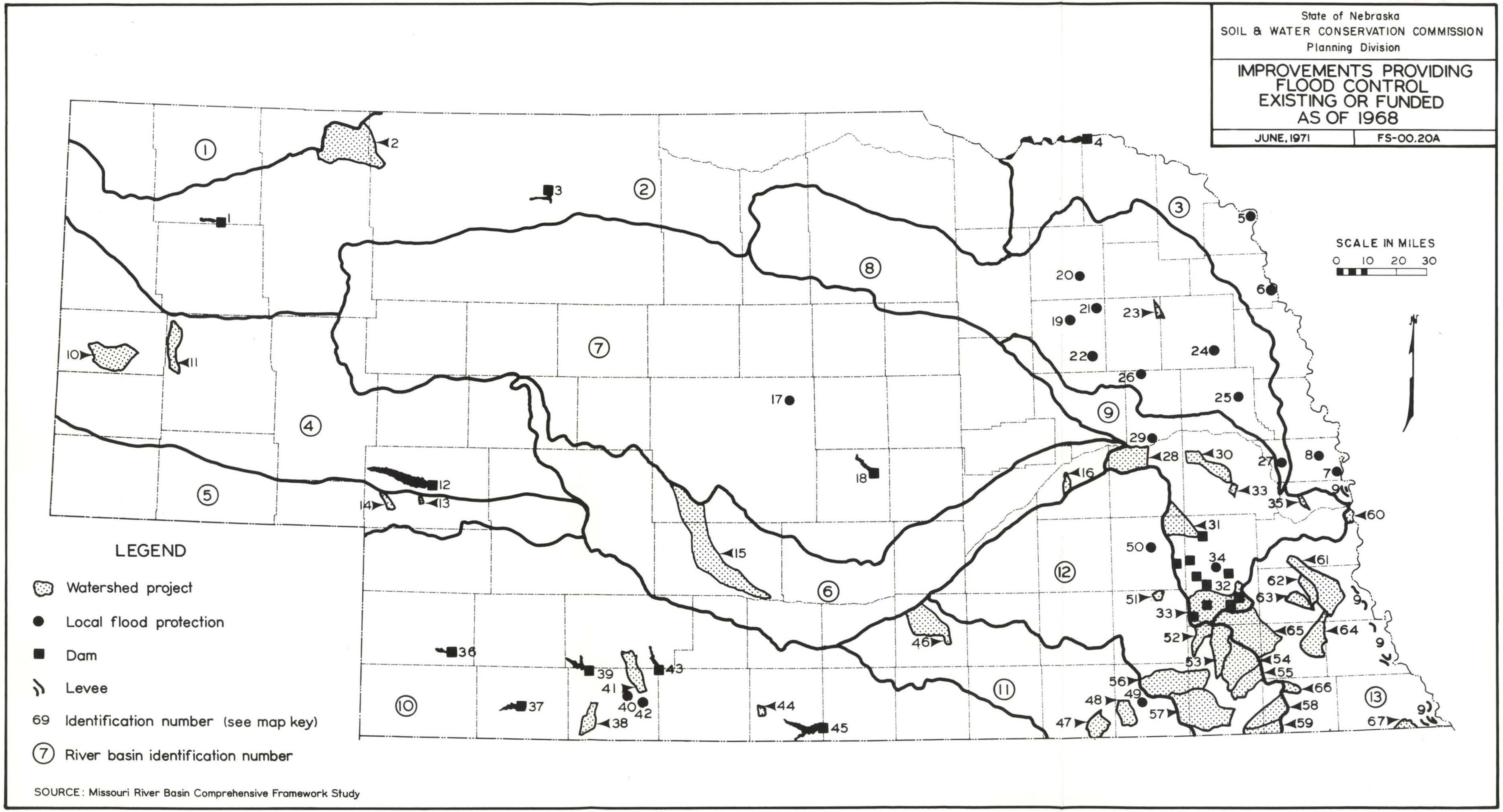
MAP 4

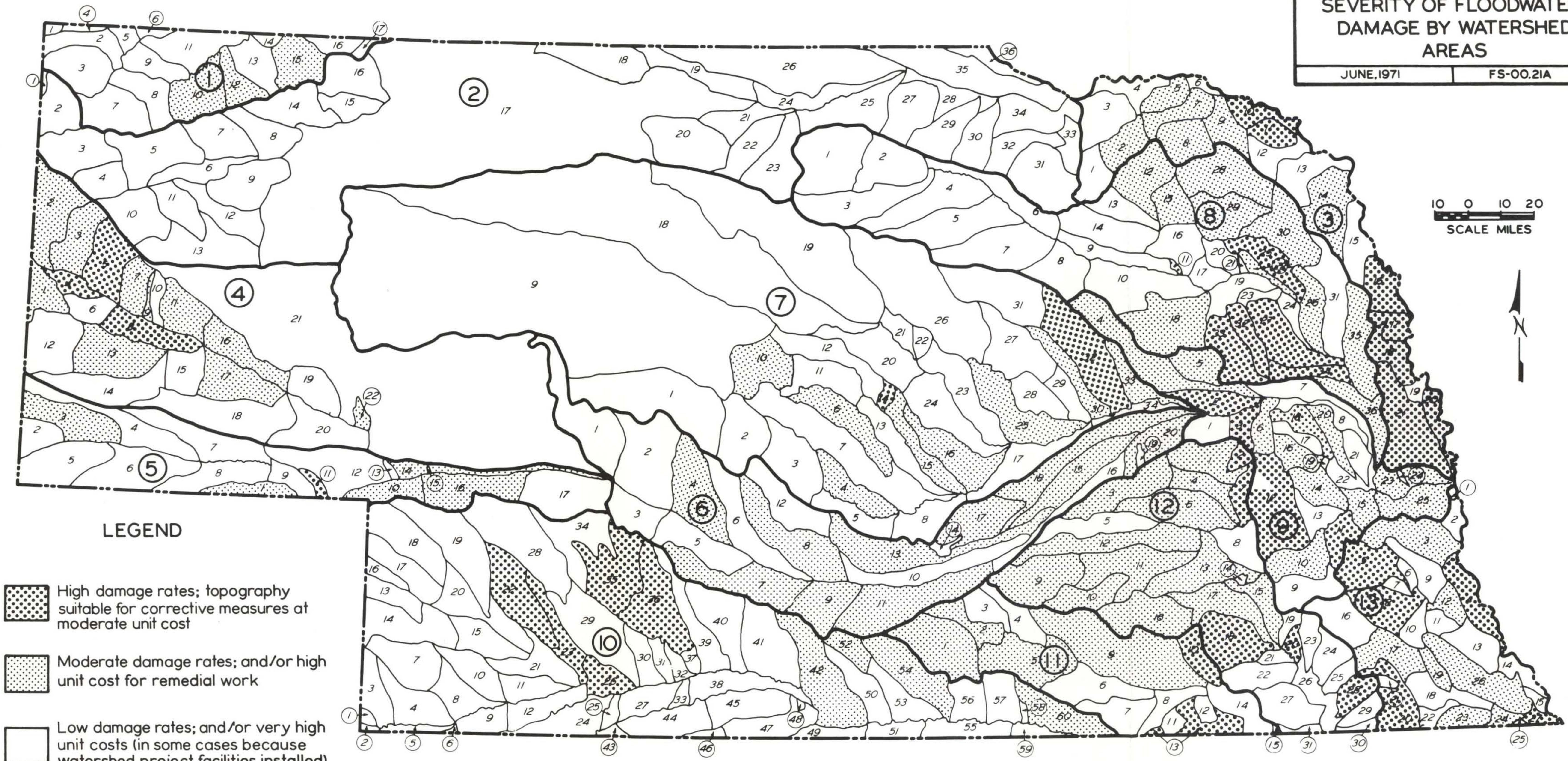

State of Nebraska
SOIL & WATER CONSERVATION COMMISSION
Planning Division
IMPROVEMENTS PROVIDING FLOOD CONTROL EXISTING OR FUNDED AS OF 1968
JUNE, 1971
FS-00.20A
SCALE IN MILES
0 10 20 30
LEGEND
Watershed project
Local flood protection
Dam
Levee
69 Identification number (see map key)
7 River basin identification number
SOURCE: Missouri River Basin Comprehensive Framework Study

MAP 5

State of Nebraska
SOIL & WATER CONSERVATION COMMISSION
Planning Division

SEVERITY OF FLOODWATER DAMAGE BY WATERSHED AREAS

JUNE, 1971 | FS-00.21A



LEGEND

- High damage rates; topography suitable for corrective measures at moderate unit cost
- Moderate damage rates; and/or high unit cost for remedial work
- Low damage rates; and/or very high unit costs (in some cases because watershed project facilities installed)

SOURCE: Missouri River Basin Comprehensive Framework Study

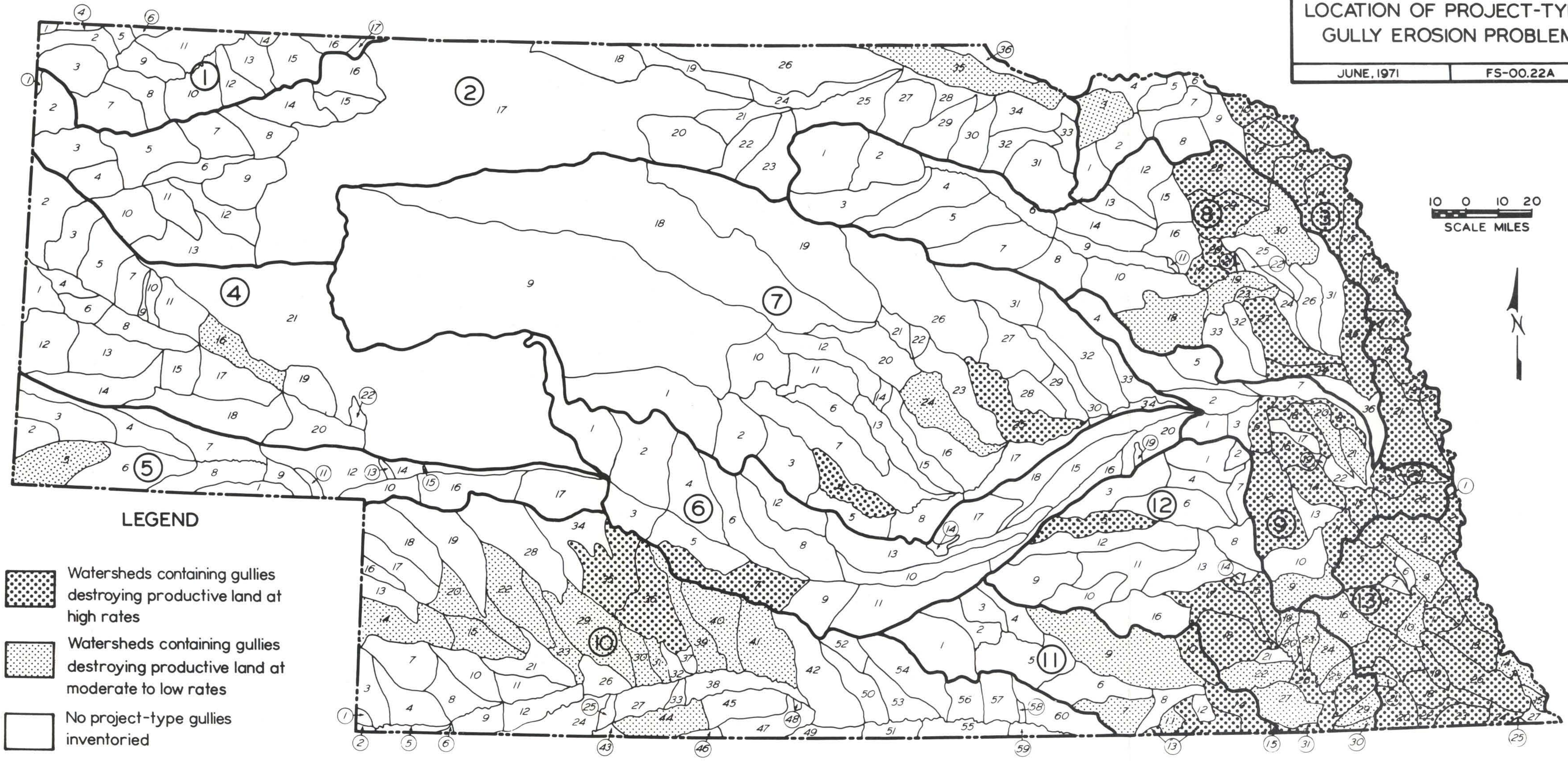
NOTE: To identify watersheds, see key preceding MAP 2

MAP 6

State of Nebraska
SOIL & WATER CONSERVATION COMMISSION
Planning Division

LOCATION OF PROJECT-TYPE GULLY EROSION PROBLEMS

JUNE, 1971 | FS-00.22A



LEGEND

- Watersheds containing gullies destroying productive land at high rates
- Watersheds containing gullies destroying productive land at moderate to low rates
- No project-type gullies inventoried

SOURCE: Missouri Basin Inter-agency Committee: Conservation Needs Inventory, SCS, USDA

NOTE: To identify watersheds, see key preceding MAP 2