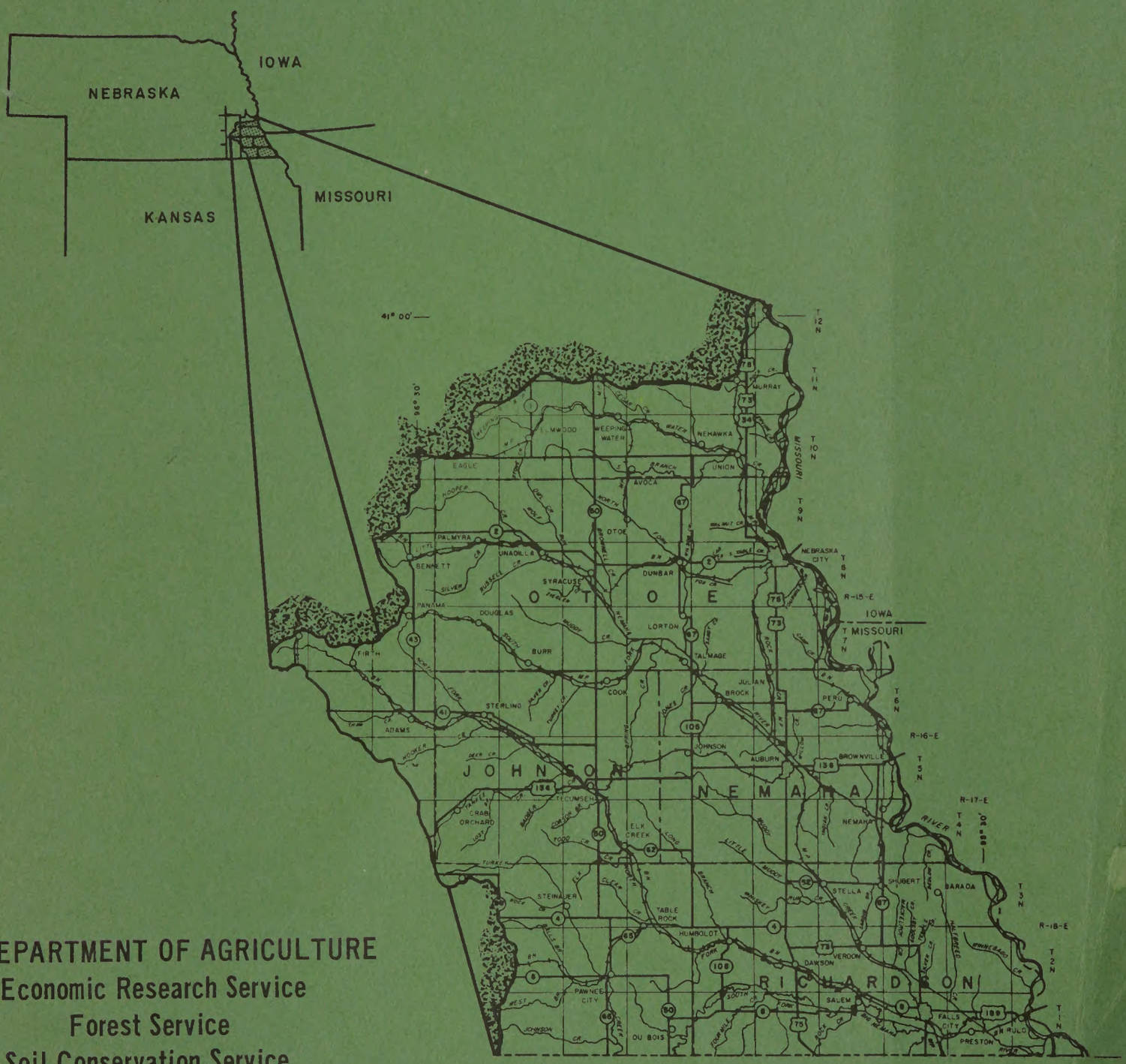
NEMAHA RIVER BASIN
Nebraska
WATER AND RELATED LAND RESOURCES



U.S. DEPARTMENT OF AGRICULTURE
Economic Research Service
Forest Service
Soil Conservation Service

1975

USDA-SCS-LINCOLN, NEBR. 1975

"We come and go but the land is always here",
by Willa Cather, O Pioneers!

NEMAHA RIVER BASIN

NEBRASKA

WATER AND RELATED LAND RESOURCES

Prepared by

UNITED STATES DEPARTMENT OF AGRICULTURE

U.S. SOIL CONSERVATION SERVICE

ECONOMIC RESEARCH SERVICE

FOREST SERVICE

In Cooperation with

NEMAHA NATURAL RESOURCES DISTRICT

LOWER PLATTE SOUTH NATURAL RESOURCES DISTRICT

NEBRASKA NATURAL RESOURCES COMMISSION

1975

ACKNOWLEDGMENT

Assistance and useful information was provided the U.S. Department of Agriculture planning staff by the following local, state and federal organizations:

United States Department of Agriculture

- Agricultural Research Service
- Agricultural Stabilization and Conservation Service
- Farmers Home Administration
- Statistical Reporting Service

United States Department of Defense

- Corps of Engineers

United States Department of Commerce

- National Weather Service

United States Department of Interior

- Bureau of Reclamation
- Fish and Wildlife Service
- Geological Survey, Water Resources Division

State of Nebraska

- Department of Environmental Control
- Department of Water Resources
- Game and Parks Commission
- University of Nebraska
  - Agricultural Experiment Station
  - Agricultural Extension Service
  - Conservation and Survey Division

Natural Resources Districts

- Lower Platte South
- Nemaha

PHOTOGRAPHS

All photographs used in this report are from Soil Conservation Service unless otherwise noted.

PROGRAMS:

SOIL & WATER CONSERVATION
WATERSHED PROTECTION
COMPREHENSIVE PLANNING
FLOOD PLAIN MANAGEMENT
DATA BANK
WATER QUALITY PLANNING
DEVELOPMENT FUND

STATE OF NEBRASKA

NATURAL RESOURCES COMMISSION

Seventh Floor
Terminal Building
Lincoln, Nebraska 68508

May 27, 1975

Mr. W. J. Parker
State Conservationist
Soil Conservation Service
134 South 12th Street
Lincoln, Nebraska 68508

Dear Bill:

The drafts of the Water and Related Land Resources Plan for the Nemaha River Basin have been reviewed by several state agencies including the Natural Resources Commission. As the coordinating agency for this review, the Commission has submitted all comments which have been incorporated into the study to the SCS River Basin Survey Staff.

The writers have done an excellent job of inventory and problem delineation and citing potential development. The economic impact statements are generalized for the area and the public gives an overall view of the region. All of this information will provide basic supporting data for future specific project area water and related land resources management considerations. It is understood there will be changes in detailed planning in which case any projects should be reexamined for feasibility.

On May 22, 1975, the Nebraska Natural Resources Commission approved the Nemaha River Basin Study with general endorsement as a selected plan. The Commission wishes to assist the Natural Resources Districts in any projects developing under the plan.

Very truly yours,

Dayle E. Williamson
Executive Secretary

DEW:GHL:cd

nemaha
NATURAL RESOURCES DISTRICT

TECUMSEH, NEBRASKA 68450
SCS OFFICES
AUBURN, FALLS CITY, PAWNEE CITY, SYRACUSE, TECUMSEH

April 18, 1975

Wilson J. Parker
State Conservationist
U.S. Soil Conservation Service
134 S 12th, Room 604
Lincoln, Nebraska

Re:Nemaha River Basin Study

Dear Mr. Parker:

The Board of Directors, Nemaha Natural Resources District, have completed a final review of the USDA Nemaha River Basin Study Report. Our remarks and endorsement are related only to the area of study within the Nemaha Natural Resources District.

In general, the main objectives as enumerated in the summary, have been extensively explored, characterized and evaluated for presentation. All of this information will provide basic supporting data for future specific project area soil, water and related resource management considerations. The study along with other land and water resources related inventories, will be immensely helpful and worthwhile to our district as we establish our broad conservation programs for the future. We realize also that the study is general in nature and that future detailed studies of specific areas may reveal other needs. In this regard it is suggested, that should planning criteria change significantly at some future date, the South Fork Nemaha Tributaries watershed be reexamined for feasibility.

Accordingly then the Board of Directors of the Nemaha Natural Resources District at an official meeting on April 17, 1975 entered into their official minutes a resolution indicating approval of the Nemaha River Basin study with general endorsement as a selected plan for that area lying within the Nemaha Natural Resources District.

We acknowledge and compliment all agencies and organizations for their contribution to this study.

Respectfully yours,

Ernest Bredemeier

Ernest Bredemeier, Chairman
Nemaha Natural Resources District

cc:Dayle Williamson
Norman Doehring
James McDowell
Lower Platte South NRD

Lower Platte South Natural Resources District

401 Lincoln Benefit Life Building
134 South 13th Street
Lincoln, Nebraska 68508

Phone 432-0751
432-2253

April 23, 1975

Mr. W. J. Parker
State Conservationist
Soil Conservation Service
134 South 12th Street
Lincoln, Nebraska 68508

Dear Mr. Parker:

Your letter of November 20, 1974 supplied this NRD, as well as the Nemaha NRD, with a copy of the review draft, dated October, 1974, of the Water and Related Land Resources Report, Nemaha River Basin.

We were given the opportunity of reviewing an earlier draft of the document, and most of our suggestions have been incorporated in the current version.

Your staff has requested that this NRD, and the other cooperating local organizations, after reviewing the draft, indicate the level of endorsement of the study. Only a comparatively small portion of the entire Nemaha Basin is within this NRD, principally the Weeping Water Creek drainage and the Missouri River tributaries upstream to Plattsmouth.

We consider the specific provisions of the study pertaining to that area, as well as those sections applying to the entire basin without reference to a specific watershed, to be generally compatible with the objectives and programs of this NRD.

Accordingly, it is our recommendation that this survey report be designated "selected", in that it has the endorsement of this NRD.

It is recognized that, as more detailed study, and planning is made, such as the preparation of a Watershed Workplan, that this NRD will have opportunity for further review, and comment.

Much of the information in the report will be helpful in planning our District operations, and we wish to express our appreciation for this assistance.

Sincerely yours,
LOWER PLATTE SOUTH NRD

Hal L. Schroeder, General Manager

HS:ok

CONTENTS

CONTENTS (Cont'd)

CONTENTS (Cont'd)

TABLES

TABLES (Cont'd)

TABLES (Cont'd)

FIGURES

PLATES

U.S. DEPARTMENT OF AGRICULTURE
NEMAHA RIVER BASIN, NEBRASKA

SUMMARY

GENERAL

The Nemaha Rivers and other direct tributaries along the westside of the Missouri River between the Platte River and the Kansas State Line drain about 3,377 square miles or some 2,161,500 acres. Approximately 2,771 square miles or some 1,773,800 acres are in eight southeastern Nebraska counties which are defined as the Nemaha River Basin in this report. This survey report, prepared by the Economic Research Service, Forest Service and Soil Conservation Service of the U.S. Department of Agriculture (USDA), is for the purpose of promoting the conservation, utilization, and development of the water and related land resources in the Nebraska portion of the Nemaha River Basin. The report is based on a study of upstream watershed needs and opportunities for flood prevention; watershed protection; agricultural, municipal, and industrial water supply; fish and wildlife habitat; recreation facilities; water quality control; and environmental quality.

The main objectives of this cooperative study are to: (1) inventory the natural resources of the basin; (2) analyze the basin's economy relative to present conditions, historic trends, and projections; (3) determine the cause, extent, and frequency of the basin's resource problems; (4) determine the present and future need for development based on resource problems and projected economic activity; (5) describe the pertinent existing water and related land resource projects and programs; (6) describe the physical potential or capability of the basin to supply water and related land resources for development to meet identifiable needs; and (7) describe the opportunities for development through USDA projects and programs and determine their impacts upon the basin.

The U.S. Army Corps of Engineers has studied major flood control projects in the Nemaha River Basin. The results will be contained in agency reports. Also, the Nebraska Game and Parks Commission is planning the development of fish and wildlife and recreational resources in the basin.

PROBLEMS AND NEEDS

The principal water and related land resource problems and needs for the basin are:

1. Sheet, rill, and gully erosion are problems on most sloping land. Not only does erosion remove valuable topsoil, but the resulting sediment smothers crops, reduces channel capacities, degrades water quality and disrupts irrigation. In the basin, 965,600 acres are subject to erosion damage. Of this total, about 752,300 acres have a gully erosion problem, with over 196,600 acres needing project action.

The current average annual monetary damage for the area needing project action is estimated to be $1,107,030.

2. Floodwater and sediment damage are serious problems on the floodplains. It is estimated that 213,300 acres are damaged. The current average annual damage for the floodplain areas is estimated at about $3,101,210.

3. Excess water is a serious problem on 42,500 acres with 6,000 acres needing project action for alleviation.

4. The variability in the amount and the seasonal distribution of precipitation often results in periods of drought and a greater tendency for wind erosion. The resulting moisture shortages have a detrimental effect on agricultural crops grown in this area. Additional irrigation development is needed to assure a stable agricultural economy. Periodic water shortages also adversely affect the basin's fish and wildlife population and habitat. There is need for supplemental water supply for fish and wildlife during drought periods.

5. Major forest and range problems are caused by severe overgrazing by livestock, inadequate management of natural tree resources, fires during drought periods, and death of many trees caused by Dutch elm disease. These problems also cause increased runoff, erosion and sediment damages; loss of cover needed for wildlife; degradation of the natural beauty of the area; and loss of potential income to landowners.

6. Municipal, industrial, and agricultural wastes contribute to the pollution of many basin streams. Additional treatment is needed to reduce municipal and industrial wastes. More land treatment and management measures are needed to control erosion and to reduce runoff, erosion, and sediment. Control of wastes from, and the proper location of, livestock feedlots is needed; and proper management and use of herbicides, pesticides, and commercial fertilizers is required to effectively reduce the pollution of surface and ground water.

7. In order to satisfy the 1980 need for water-based recreational development, 32,900 acres of surface water, 1,240 acres of developed land, and 12,400 acres of undeveloped land will be required. Present water areas and facilities are inadequate to meet the existing demands of basin residents for waterskiing, sail boating, motor boating, and swimming. Fishing is generally confined to small farm ponds and to limited reaches of the Nemaha River. Hunting is partially restricted by limited access to private lands. Projected recreational demands are expected to nearly double by the year 2020, increasing the need for additional recreational land and facilities.

8. Livestock water requirements will increase from a current average annual use of 6,320 acre feet to 16,410 acre feet by 2020. Ground water will continue to be the major source of supply, with surface sources supplying an estimated 30 percent.

9. Municipal, industrial, and rural domestic water requirements will increase from an estimated current average annual requirement of 8,210 acre feet to 10,980 acre feet by 2020. Ground water has been used exclusively to supply municipal and rural domestic needs and is expected to supply all future needs.

FINDINGS AND CONCLUSIONS

The decline in basin population is expected to continue through the year 2020. Farm population is also expected to continue declining. About 60 percent of today's farm units are expected to disappear, causing the average farm size of 311 acres in 1969 to increase to over 750 acres by 2020.

The gross annual value of the total agricultural output is projected to increase about 96 percent over the current value by 2020. This will be accomplished by: changes in land use; increased yields due to improved technology, management, irrigation; and accelerated installation of conservation land treatment measures.

Irrigation is projected to increase from a current normal use of 11,000 acres to approximately 16,000 acres by 2020. This is expected to result from continued development of individual irrigation wells and does not include major project development.

Enhancement of the natural beauty of the basin will result from the development of water impoundments and the wooded and grassed areas adjacent to them. Many existing woodland areas need improved management. Additional windbreaks and shelterbelts will add to the beauty of the landscape, increase protection to farmsteads and crops, and furnish additional wildlife habitat.

Programs of the U.S. Department of Agriculture will continue to improve the conservation, development, and utilization of land, water, wildlife, and related resources.

SPECIFIC CONCLUSIONS:

1. Twelve upstream watersheds, Long Branch, South Branch Little Nemaha, Middle Big Nemaha, Upper Little Nemaha, Turkey Creek, Big Muddy Creek, Northeast Cass, Weeping Water, Squaw-Camp, Peru-Brownville, Lower Big Nemaha, and Lower Little Nemaha are feasible for project action that should be installed in the next 10-15 years. Structural measures that should be installed in these twelve watershed projects include: 107 floodwater retarding structures, including five with recreation and fish

and wildlife features, and 299 grade stabilization structures. The total estimated installation cost of these structural measures is $26,729,000. The estimated federal share of this is $22,778,000 and the non-federal $3,951,000 under current cost-sharing criteria. These measures are estimated to produce current average annual primary benefits of $2,632,120 at an average annual cost of $1,696,800, based on an interest rate of 5-7/8 percent. The benefit-cost ratio for the watershed structural measures is 1.6 to 1.0. Table VIII-6, page VIII-8 lists the average annual benefits and costs of the structural measures for a range of interest rates. Before implementation of any of the proposed watershed project or structural developments, detailed investigations need to be made to ascertain the possible beneficial and adverse effects certain measures may have in regard to environmental values and existing wildlife habitat.

2. Information, technical assistance, and cost-sharing programs should be intensified throughout the basin to maintain and increase the use of conservation measures on all land. The needed land treatment measures will: treat critical sediment producing areas; improve natural water courses; improve range, pasture, and forest land management; improve irrigation efficiencies; and control feedlot pollution. It has been projected that an additional 562,200 acres of agricultural land needs to be treated by 2020. Of this, some 269,000 acres require improved management, vegetative and/or mechanical practices and 293,200 acres need improved management practices only. The total installation cost for all needed treatment measures, using current prices, is estimated to be $12,388,000. This includes $624,000 for treatment of 34,400 acres of forest and woodland.

3. Opportunities exist to assist in the installation of new works or to improve existing water supply and sewage treatment facilities in a number of urban and rural communities in the basin. The proposed facilities needed in these communities are estimated to cost $2,290,000.

Estimates of beneficial and adverse effects within the accounts of national economic development, environmental quality, regional development, and social well-being are displayed in Tables IX-1 through IX-7. Table S-1 presents a composite display of selected plan effects as extracted from the tables cited above.

Table S-1 COMPOSITE DISPLAY OF SELECTED PLAN EFFECTS
Nemaha River Basin, Nebraska

Component	National Economic Development Account Monetary		Regional Development Account						Environmental Quality Account	Social Well-Being Account	Capability of Recommended USDA Plan to Satisfy Component Needs		
			Income				Employment	Population Distribution Economic Base and Stability					
	Beneficial Effects	Adverse Effects	Beneficial Effects		Adverse Effects		Net Beneficial Effects	Beneficial and Adverse Effects	Beneficial and Adverse Effects	Beneficial and Adverse Effects	Component	Provides	Remaining
			Nemaha River Basin	Rest of Nation	Nemaha River Basin	Rest of Nation							
	Average Annual Dollars											Dollars	
Flood Prevention 107 reservoirs	1,437,520	930,000	1,437,520	--	127,200	802,800	1. 83 permanent semi-skilled jobs. 2. 34 permanent seasonal semi-skilled jobs. 3. 30 semi-skilled jobs per year for 15 years. 4. 5 semi-skilled jobs per year for 50 years.	Population Distribution 1. Creates emoloyment cited in column to the left, primarily in a rural area which has declined 6% in population between 1960 and 1970. 2. Project take-area annually displaces 26 permanent semi-skilled jobs due to direct, indirect and induced effects. Economic Base and Stability 1. Provides for storage of: a. 108,820 acre-feet of floodwater. b. 34,420 acre-feet of sediment. c. 3,870 acre-feet of water for recreation. 2. Creates net employment effect cited in column to the left.	Areas of Natural Beauty 1. Create 107 lakes-4,950 surface acres. 2. Inundate 4,950 acres of land. 3. Disruption of rural tranquility by 165,100 recreation visits per year. 4. Develop 360 acres for recreation areas. Quality Considerations 1. Prevent voiding by erosion on 2,145 acres. 2. Reduce sediment by 1,935 acre-feet per year. 3. Reduce erosion on 562,200 acres. 4. Improve water quality through sediment reduction and installation of 19 sewage treatment facilities. Biological Resources 1. Provide 4,950 acres of resting area for migratory waterfowl. 2. Create 5 lakes containing 26,290 acre-feet of water for fish production. 3. Enhance wildlife habitat on 562,200 acres. Irreversible Commitments 1. Convert 4,950 acres of land to reservoir use. 2. Periodic inundation of up to 8,320 acres of land with floodwater storage.	Income Distribution 1. Create low to medium income jobs as specified under net beneficial employment effects in the RD account. 2. Distribute regional benefits and costs to all income classes, dominantly in $3,000-10,000 class. Recreational Opportunities 1. Provide for 165,100 recreation visits. Life, Health and Safety 1. Provide flood protection to 89,250 acres of land. 2. Adverse effects deriving from water-based activities. 3. Provide dependable water of good quality to 15 communities. 4. Provide adequate sewage treatment facilities to 18 communities.	Flood Damage Reduction Total average annual	1,437,520	1,663,690
Grade Stabilization 299 structures	947,100	576,000	947,100	--	71,700	504,300					Erosion Control-Gully Total average annual	947,100	154,930
Recreation 5 multipurpose reservoirs	247,500	70,000	247,500	--	35,000	35,000					Recreation Water-acres	3,480	12,210
											Developed land-acres	360	220
Land Treatment 562,200 acres	792,000	730,000	792,000	--	365,000	365,000					Land Treatment Acres	562,200	402,000
Water Quality Sewage treatment facilities 10 new 8 improved	138,000	71,000	138,000	--	35,500	35,500					Municipal Sewage Treatment Number of systems	18	15
Water Supply Systems 2 new 13 improved	81,000	64,000	81,000	--	32,000	32,000					M & I Water Supply Number of systems	15	0
O M & R	--	194,600	--	--	194,600								
External Economic Effects[1/]	84,000	20,000	1,477,325[1/]	-1,393,325[1/]	398,000	-378,000							
Total Effects	3,727,120	2,655,600	5,120,445[1/]	-1,393,325[1/]	1,259,000	1,396,600							
Net Effects	1,071,520	--	3,861,445[1/]	--	--	-2,789,925[1/]							

1/ Excludes secondary effects associated with structural and land treatment programs. See Table IX-3, footnotes 3/ and 4/
Source: Tables IX-1 through 7.

USDA REPORT ON WATER AND RELATED LAND RESOURCES
NEMAHA RIVER BASIN, NEBRASKA

CHAPTER I
INTRODUCTION

This report on the Nebraska portion of the Nemaha River Basin was prepared by the U.S. Department of Agriculture under the authority of Section 6 of the Watershed Protection and Flood Prevention Act, as amended (Public Law 83-566, 1954). The Nemaha River Basin begins at the confluence of the Platte and the Missouri River and proceeds downstream to the Kansas state line. It consists of all the west bank direct tributaries to the Missouri River in the southeastern corner of Nebraska. See location map. This cooperative Type IV river basin survey was authorized for study by the Administrator of the Soil Conservation Service on June 15, 1966. The river basin study was requested by the Nemaha River Watershed Association[1/] through the state coordinating agency, the Nebraska Soil and Water Conservation Commission.[2/]

The Nebraska Soil and Water Conservation Commission, in cooperation with the Nemaha River Watershed Association, developed a plan of work which sets forth the objectives for a basinwide plan of soil and water resource development and lists the assistance they desire from the various state and federal agencies. In addition to the USDA, the State Commission requested assistance from the Bureau of Reclamation and Fish and Wildlife Service, Department of the Interior; U.S. Army Corps of Engineers; Nebraska Department of Water Resources; Nebraska Health Department; Nebraska Game and Parks Commission; the Extension Service; and the Conservation and Survey Division of the University of Nebraska. The State Commission coordinated the efforts of the various state and federal agencies who carried out surveys and investigations for the cooperative survey.

The three participating agencies of the U.S. Department of Agriculture were requested to:

1. Identify the principal water and land resource management problems in the basin.

2. Identify and evaluate major obstacles to achieving a desirable pattern of water and land resource utilization and installation of needed conservation and development measures.

3. Identify how, and appraise the extent to which, USDA programs can contribute to the solution of water and land resource problems in the basin with emphasis on project-type solutions.

1/ This Association has been incorporated into the Nemaha and Lower Platte South Natural Resources Districts.

2/ As of July 1, 1972, the new name is Nebraska Natural Resources Commission (NNRC).

4. Identify alternative water and related land resource utilization, conservation, and development measures, and formulate a plan of development for the basin to alleviate management problems, meet production requirements, provide watershed protection and flood prevention, and achieve stability and growth in the basin's economy for the target years 1980, 2000, and 2020.

5. Provide basic reconnaissance data on land and water use and water-related problems within each delineated watershed which will guide the long-range coordination and planning of future small watershed projects within a basinwide framework.

6. Outline additional actions which will aid in attaining basinwide objectives.

7. Provide basic information, data, analyses, and recommendations in a USDA report.

Investigations and survey activities of the U.S. Department of Agriculture were performed under the direction of the USDA Field Advisory Committee composed of one representative each from the Soil Conservation Service (SCS), the Economic Research Service (ERS), and the Forest Service (FS). The Field Advisory Committee prepared an outline of work, coordinated the department's survey procedures and activities, arranged for field review of problems, recommended actions and reports, and guided the working relationships with the Nebraska Natural Resources Commission (NNRC) and other state and federal agencies.

USDA representatives analyzed the water and related land resource problems and needs within each delineated watershed area in the basin. This was done after consultation with the District Supervisors, of the affected Soil and Water Conservation Districts,[3/] local SCS field office staffs, local officials, and residents.

The Nebraska Natural Resources Commission coordinated the efforts and inputs of the various participating agencies. It held meetings to acquaint local people on the progress of planning activities and will continue to hold such information meetings throughout the basin. The NNRC plans to consolidate the data and findings of the various agencies into a single state report for the basin. This USDA report will be furnished to all interested individuals, groups, and entities in the study area.

Coordination between state and federal agencies was accomplished by meetings to discuss the various phases of the study and by the exchange of data. Efforts were made to prevent duplication of investigations and to coordinate development proposals. The potential water and related land resource development proposals of the various agencies are generally unilateral and present all potentials deemed desirable within the authorities and responsibilities of each concerned agency.

3/ On July 1, 1972, the local districts were incorporated into the Natural Resources Districts.

U. S. DEPARTMENT OF AGRICULTURE

LEGEND

- TOWNSHIP LINE
- STATE BOUNDARY
- COUNTY BOUNDARY
- HIGHWAY
- RAILROAD
- TOWN
  - UNDER 2500
  - OVER 2500
- DRAINAGE
- RIVER BASIN BOUNDARY
- STATE PARK
- STATE RECREATION AREA
- STATE HISTORICAL PARK
- STATE WAYSIDE AREA
- STATE SPECIAL USE AREA
- SCOUT RESERVATION
- INDIAN LANDS

SOURCE.
SCS BASE MAP 5,R-28,977 AND DATA
FURNISHED BY FIELD TECHNICIANS.
LAMBERT CONFORMAL CONIC PROJECTION
USDA-SCS-LINCOLN, NEBR. 1974

LOCATION MAP
NEMAHA RIVER BASIN
NEBRASKA

REV. 8-20-75
5,P-34,269

The development of a comprehensive coordinated plan cannot be accomplished by combining all of the unilateral agency plans. This can be accomplished only through joint efforts of all concerned in coordinated plan formulation such as in the current Level B study[4/] authorized by the U.S. Water Resources Council for the Nebraska portion of the Platte River Basin or by some other coordinated federal-state-local planning effort.

4/ Level B and Type IV studies both deal with water and related land resource problems of an area. A type IV study is a cooperative effort between the USDA and a state. A level B study is a multiple federal agency study involving one or more states.

CHAPTER II
NATURAL RESOURCES OF THE BASIN

An endowment of physical resources is basic to the potential development of land, water, and related resources. Climate, physiography, geology, soils, land use, water quality and quantity, fish and wildlife, and the environment are factors which must be considered in planning resource development. Each factor is important and makes a unique contribution to the potential development of the basin. This chapter describes and inventories those resources which are important to the water and related land resource development of the basin.

A. Location and Size

The drainage area of the Nemaha River and other tributaries is located in the southeastern corner of Nebraska and the northeastern portion of Kansas. The drainage area begins at the confluence of the Platte and the Missouri Rivers and proceeds downstream approximately 105 miles to the Kansas state line. It consists of direct tributaries to the Missouri River totaling some 3,377 square miles or 2,161,500 acres. This includes all or portions of the following eight counties in Nebraska: Cass, Gage, Johnson, Lancaster, Nemaha, Otoe, Pawnee, and Richardson and portions of Brown, Marshall, and Nemaha Counties in Kansas.

The area studied is the portion of the drainage area that is in Nebraska and contains approximately 2,771 square miles or about 82 percent of the total area (Table II-1). This area is referred to as the Nemaha River Basin in this report. The three principal streams in the basin are Weeping Water Creek and the Little and Big Nemaha Rivers, each a separate direct tributary to the Missouri River. Weeping Water Creek has a drainage area of 262 square miles and flows into the Missouri River 25 river miles below the mouth of the Platte River. The Little Nemaha River has a drainage area of 887 square miles and its mouth is approximately 43 river miles below that of the Weeping Water Creek. The Big Nemaha River, with a drainage area of 1,311 square miles in Nebraska, outlets 33 river miles below that of the Little Nemaha River and five miles above the Kansas state line. In addition to the three streams, a number of small tributaries containing approximately 311 square miles of drainage area also empty directly into the Missouri River.

Beginning in 1910, widespread channel straightening was done in the Big and Little Nemaha Rivers. This initiated a cycle of erosion in channels and the stream courses are still in the process of stabilization. Elevations range from 1,400 feet msl at the heads of the three principal streams to about 850 feet near the mouth of the Big Nemaha River. Generally, stream gradients range from about two feet per mile on the lower reaches of the main stems to over 20 feet per mile in the headwaters.

Table II-1 AREA BY COUNTIES
Nemaha River Basin, Nebraska

County	Total Area	Area of County in Basin	
	Acres	Acres	Percent
Cass	361,000	188,900	52.3
Gage	549,100	56,600	10.3
Johnson	241,300	241,300	100.0
Lancaster	541,400	62,000	11.4
Nemaha	259,200	259,200	100.0
Otoe	398,700	398,700	100.0
Pawnee	277,100	213,200	76.9
Richardson	353,900	353,900	100.0
TOTAL 1/		1,773,800	-

1/ This does not include the hydrologic area (387,500 acres) of the Nemaha River located in the State of Kansas.

Source: U.S. Department of Commerce, Bureau of Census, area measurement report, 1960.

The principal streams drain an eroded loess-capped plain underlain by glacial till and limestone bedrock. The plain is dissected by numerous valleys partly filled with alluvium. The relief ranges from nearly level on the tops of the broader divides to an extremely rough and dissected bluff-land area adjacent to the Missouri River flood plain. This dissected area ranges from less than half a mile to about three miles in width and consists of a series of sharp-topped divides separated by an intricate network of deep, narrow, V-shaped valleys.

The valley lands of both the Nemaha Rivers have similar topographic characteristics and range from one-half to two miles in width. The land surfaces of the valleys are gently to moderately undulating, are dissected by many intermittent side-hill drainageways, and are cut-up by old stream meanders which have been isolated by channel straightening. The flood plain of Weeping Water Creek ranges from one-fourth to one-half mile in width, and most of the alluvial bottomland is only six to seven feet above the normal water surface of the stream.

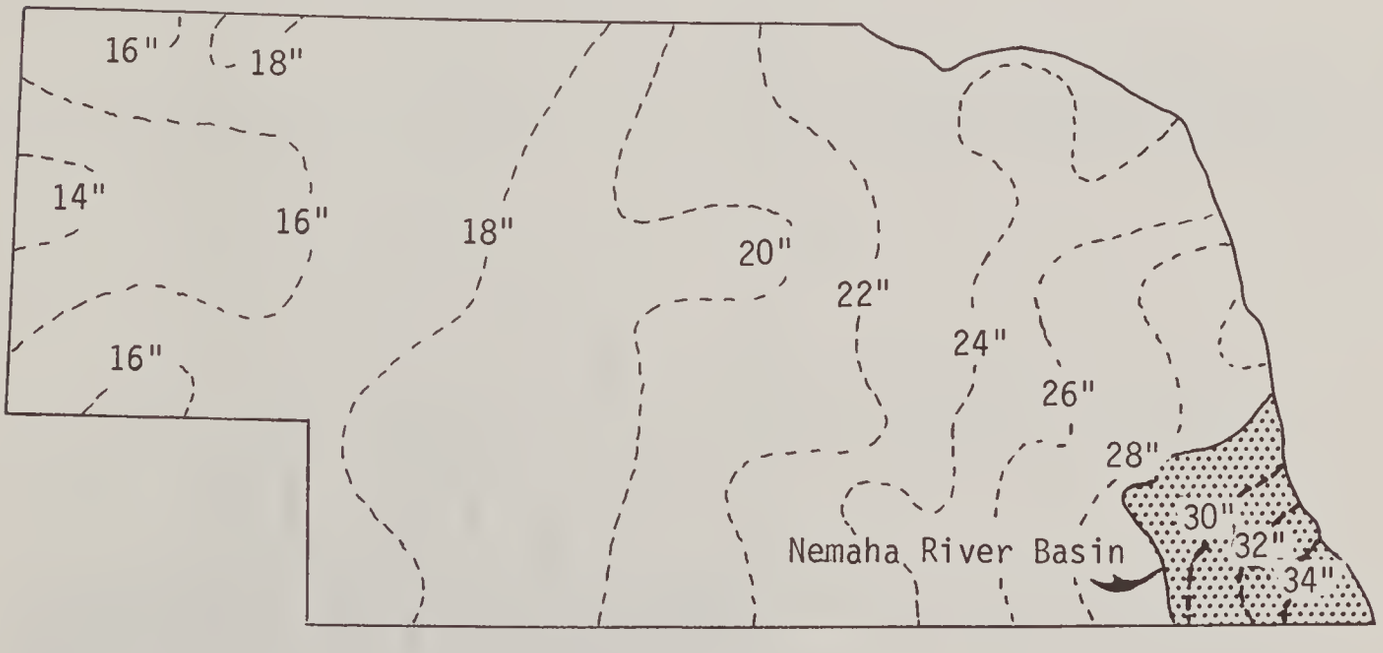
B. Climate

The climate of the Nemaha River Basin and adjacent area is of a continental character with frequent and rather large changes in weather conditions. However, due to its southeastern location in the state, the area escapes a portion of the extreme variability in the weather that is experienced in other sections of Nebraska. There are no major climatological barriers close to this area. The Rocky Mountains are 500 to 600 miles to the west and have only a moderate influence on the air that reaches this location from the west.

Normal annual precipitation ranges from 28 inches in the northwestern portion to over 35 inches in the southeastern portion of the area (Figure II-1). There is a large variability in the daily and monthly amounts of precipitation received. Figure II-2 is a graphical presentation of normal monthly precipitation and extremes of record at Lincoln and Falls City, Nebraska, and are considered to be representative of the basin and surrounding area. From 70 to 75 percent of the total annual precipitation falls during the growing season - April through September. Normal monthly rainfall is highest in June. The distribution of rain throughout the year is generally favorable to the growing of crops even though severe storms of cloudburst intensity occur occasionally.

Snowfall is about 25 inches in the average season. Minimum depths of less than ten and maximum depths of nearly 60 inches have been recorded in and near the basin area.

Figure II-1 MEAN ANNUAL PRECIPITATION
Nemaha River Basin, Nebraska



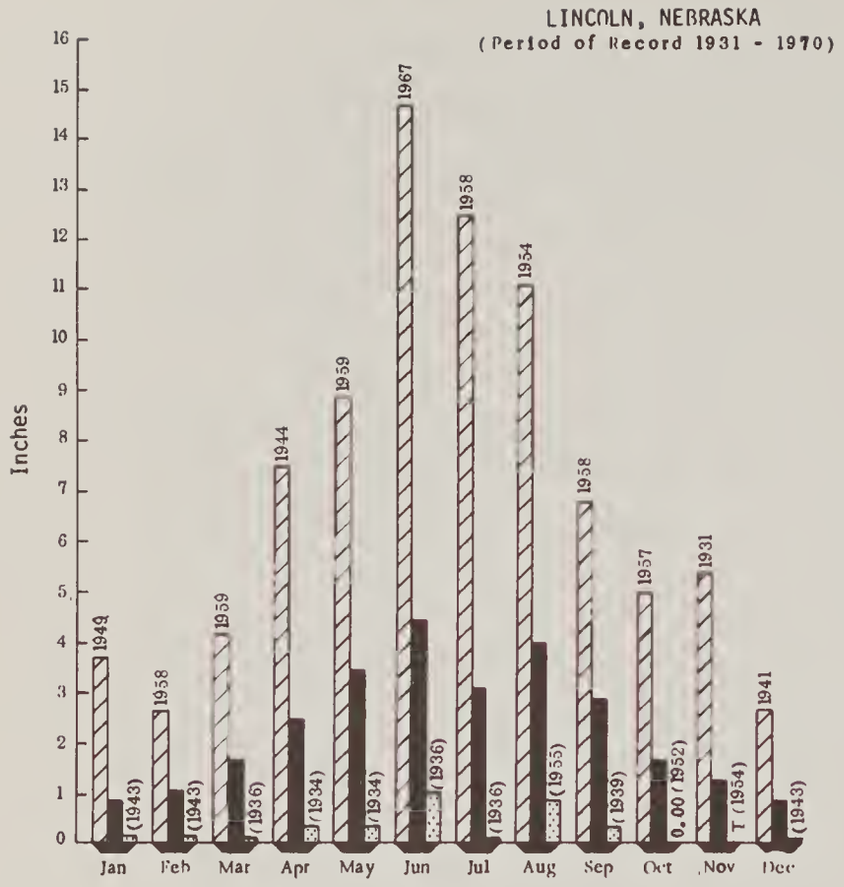


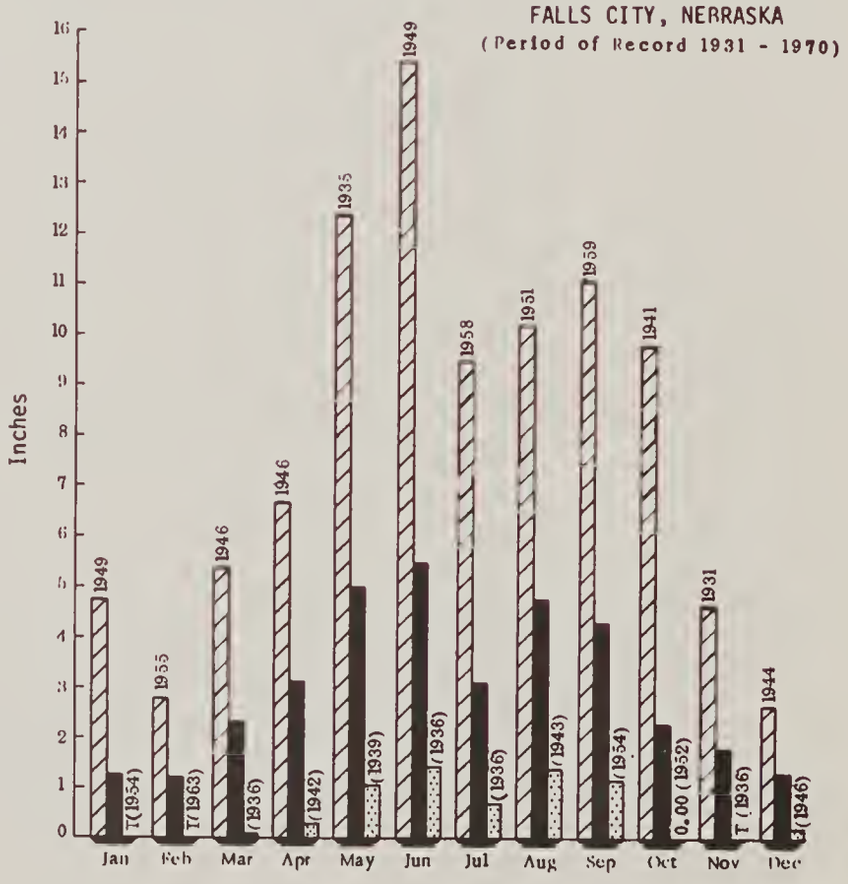
FIGURE II-2.

MONTHLY DISTRIBUTION OF PRECIPITATION
NEMAHA RIVER BASIN, NEBRASKA

Record Maximum (Figure Indicates Year of Occurrence)

Normal (Based on 30-Year Period 1931-1960)

Record Minimum (Figure Indicates Year of Occurrence)
Actual Amount Given When too Small to be Graphed.



Normal annual basin air temperature is about 53°F. Large fluctuations in daily temperatures are common in spring and summer during thunderstorm activity. Maximum temperatures of over 100 degrees occur about three years in four. In about one season out of four, the minimum temperature fails to reach ten degrees below zero. Normal monthly maximum, minimum, average, and extreme temperatures at Lincoln and Falls City, Nebraska, are shown on Figure II-3.

Annual lake or reservoir evaporation averages about 43 inches. Net evaporation from free water surfaces averages about 18 inches. Net evaporation takes into account the factors of runoff and precipitation.

Alternate periods of drought and wet-spells of varying severity have occurred during the past 40 years. Figure II-4 is a graphical illustration of both severity and duration of past moisture conditions.

Prevailing wind direction is northerly in February and southerly in the other quarter-points of May, August, and November. March and April are the windiest months with an average of 12 to 14 miles per hour. In the summer the higher winds are associated with thunderstorms.

The frost-free period (32°F threshold) ranges from 155-180 days. The date of the last frost in spring ranges from April 20 to 30 while the date of the first fall frost ranges from October 10 to 20.

There is much sunshine, averaging 64 percent of the possible duration. Mean annual relative humidity is estimated to be about 70 percent, varying from about 80 percent at 6:00 am (CST) to 55 percent at noon. Mean relative humidity in July ranges from less than 50 to over 80 percent on a daily basis.

Tornadoes occur infrequently in spring and early summer but have caused extensive damage. Hailstorms occur over limited areas most years but damage generally is not severe.

C. Physiography and Geology

The Nemaha River Basin lies within the Dissected Till Plains section of the Central Lowland province in the Interior Plains division.[1/] In USDA usage, the basin lies within the Nebraska and Kansas Loess-Drift Hills Land Resource Area.

The general surface configuration is that of a plain sloping toward the southeast with the original upland surface modified by

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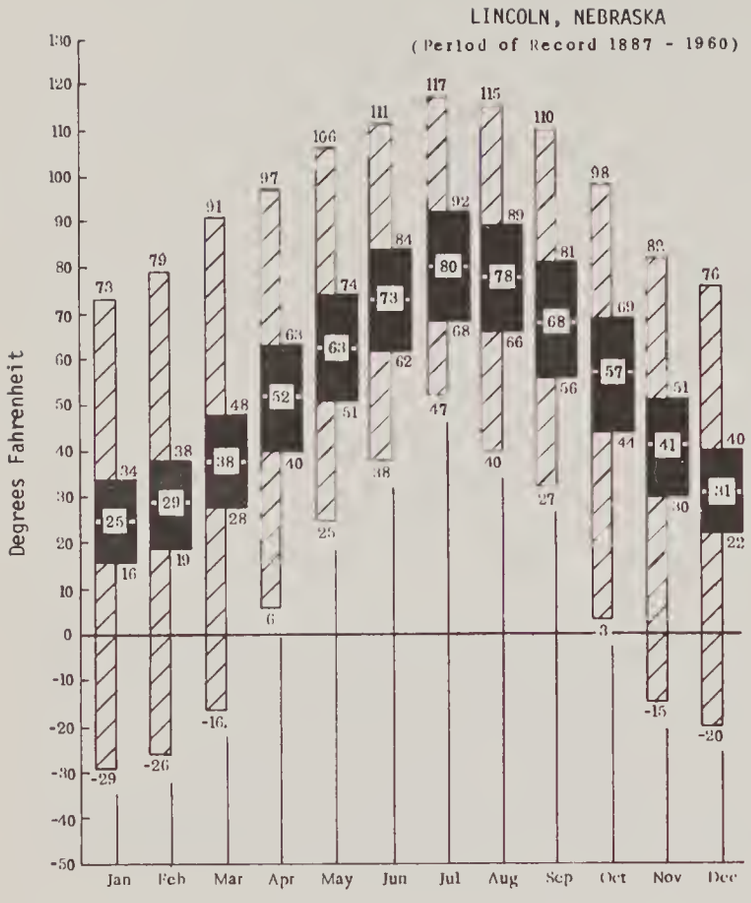
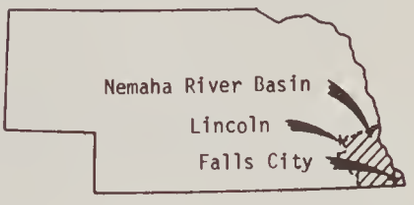
1/ Fenneman, N. M. Physiographic Division, of the United States - U.S.G.S., 1930.

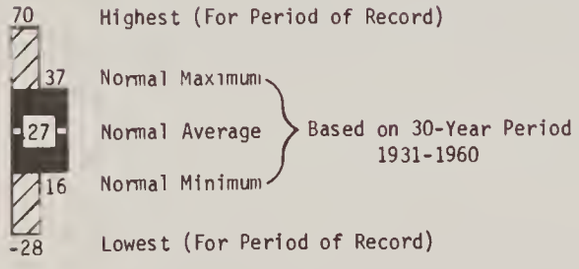
FIGURE II-3.

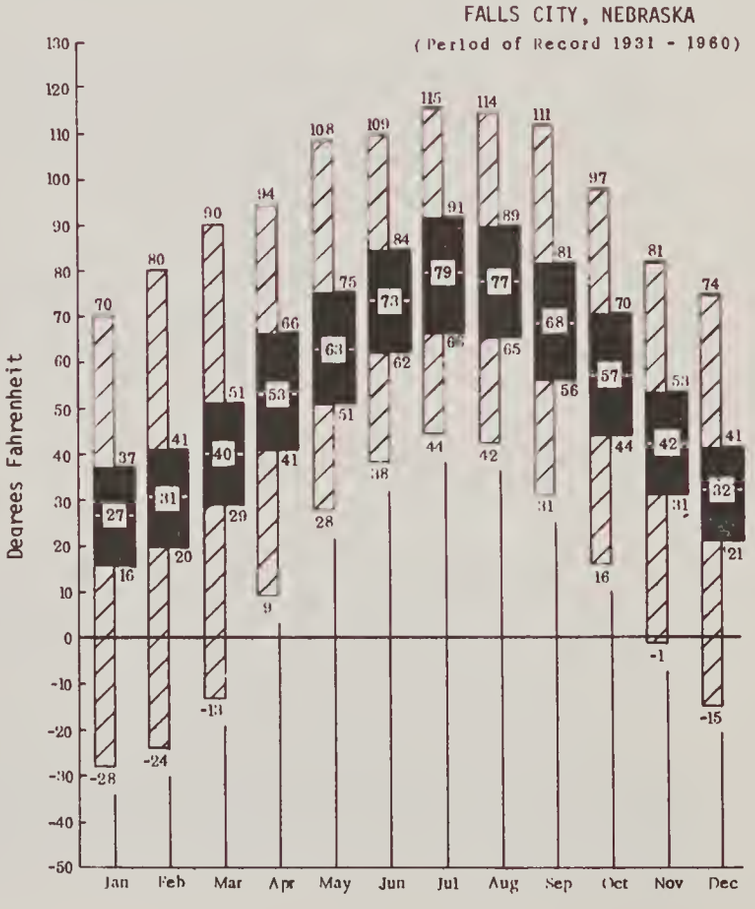
MONTHLY DISTRIBUTION OF TEMPERATURES
NEMAHA RIVER BASIN, NEBRASKA





LOCATION OF FALLS CITY AND LINCOLN

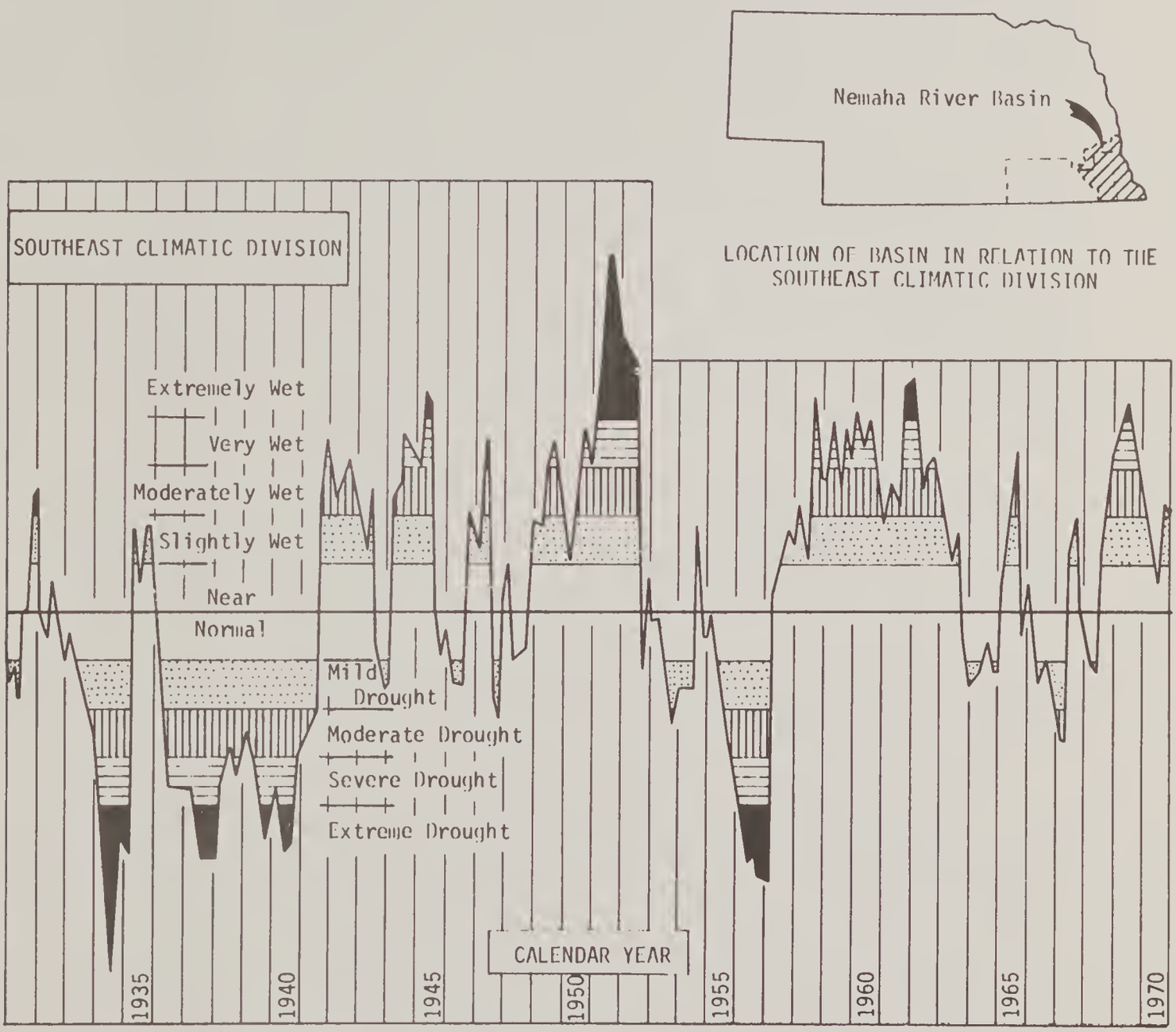




USDA-SCS-LINCOLN, NEBR 1974-5R

FIGURE II-4

DROUGHT AND WET SPELL PERIODS FOR SOUTHEAST CLIMATIC DIVISION, NEBRASKA



Source: Palmer Drought Index, National Weather Service

USDA SCS LINCOLN, NEBR 1974 SR

erosion. Glacial and stream erosion and deposition have produced three main topographic features: the uplands; the terraces, and the river bottoms.

The roughest and most dissected topography in the basin occurs in the southeastern portion. The drainage system is intricate and the surface is marked by numerous steep and precipitous slopes, a result of bedrock at or near the surface. The steep slopes occur largely along the stream courses of the Nemaha River drainage system.

Geologic materials in the Nemaha River Basin occur as unconsolidated deposits of Pleistocene Age overlying bedrock formations of Cretaceous, Permian, and Pennsylvanian Age.

The stratigraphic position of the various geologic formations, their general description and their water-bearing properties are listed in Table II-2. The distribution of these geologic units within the basin are shown on two maps. Plate 1 shows the Pleistocene sediments and Plate 2 is a generalized geologic bedrock map showing the Cretaceous, Permian and Pennsylvanian formations.

The wind-deposited loess mantles the uplands throughout a major portion of the basin. These deposits range in thickness from a few feet to about 80 feet, thinning gradually to the southeast.

Glacial till of Kansan and Nebraskan age underlie the loess and rests on bedrock throughout the basin. Erosion has removed much of the loess in the southern portion of the basin. The till deposits of Kansan age are well exposed. The Kansan till is a heterogeneous mixture of sands, gravels, cobbles and some boulders with a clay matrix.

Bedrock exposures are abundant in the basin as shown in Plate 2. The Humboldt fault occurs about three miles east of the west boundary of Richardson County. Vertical displacement along the fault and subsequent erosion has exposed rocks west of the fault that are older than those at the surface immediately east of the fault.

The average thickness of sedimentary rocks above the Precambrian basement is approximately 3,000 feet. Of this thickness approximately 1,000 feet is exposed within the basin.

The principal mineral resources of the basin include sand, gravel, agricultural limestone, shale, and clay. Presently, about 30 commercial sand and gravel pits are active in the basin. About 32 commercial limestone quarries are active in the basin. The limestone is used for concrete aggregate, roadstone, agricultural lime, and riprap.

Limestone quarries are concentrated in Cass County with production from the Ervine Creek and Plattsmouth limestone members of the Deer Creek and Oread limestone formations.

Table II-2 GEOLOGIC FORMATIONS AND THEIR WATER-BEARING PROPERTIES
Nemaha River Basin, Nebraska

System	Series	Stratigraphic Unit	Thickness (feet)	Texture	Water Supply
Quaternary	Recent	Surficial alluvium, eolian silts and sands and soil	0-20	Reworked silt, clay, sand and gravels in flood plains and terraces bordering stream channels; eolian silt and sand on slopes and upland	Generally above water table, significant only as a transmitting medium for recharge to the ground water reservoir
	Pleistocene	Loess and alluvial silts	0-100	Principally wind-blown silts of the Peoria and Loveland formations; locally the Peoria and Loveland may include a basal sand and gravel member; also includes silts and clays of the Sappa formation	The Loesses are generally above the water table but can yield water at a slow rate when saturated. Sand and gravel members can yield abundant supplies where coarse-textured and below the water table.
		Alluvial sands and gravels	0-200+	Stream deposited sands and gravels with lenses of silt and clay. Attains maximum thickness in broad pre-Pleistocene channels.	A principal source of water in the basin. Abundant yields can be obtained from thicker deposits, ordinarily within a depth of 20-30 feet.
		Kansan Drift	0-100	A heterogeneous mixture of silt, sand, gravel, cobbles and boulders with a clayey matrix; includes the pro-Kansan sand with some gravel of the Atchison Formation. Consists of till and associated glacialfluvial deposits	A principal source of water in the basin. Overall it is a fairly good source of ground water supply. Local areas with thick sand and gravel deposits yield up to 660 gpm
		Aftonian	0-50	Clayey silt overlain by fine grained sand	Relative wide distribution and location below the water-table give it importance as a source of good quality ground water. Well installation is difficult due to "quicksand" characteristics of the formation.
		Nebraskan Drift	0-60	Clayey silt containing a moderate amount of pebbles and cobbles. Contains some lenses of sand and gravel	Poor source of ground water supply
Cretaceous	Lower Cretaceous	Dakota Sandstone	0-350	Sandstone, silty to clayey sands, sandy to clayey shales. Exposed and underlies only a portion of Gass County	Sandstones yield water readily to a few wells. Water may be moderately to high mineralized; especially where well depths exceed 100 feet
Permian	Big Blue	Chase Group	0-290+	Limestone and shale; limited in extent to a small portion of the western boundary of the basin.	Not a known source of water supply
		Gouncil Grove Group	0-311	Limestone and shale; underlies a portion of the southern half of the basin.	May yield small quantities locally; not an important aquifer
		Admire Group	0-165	Limestones and shales, including the Indian cave sandstone member in Nemaha County	Locally, shallow wells may yield small amounts of water for domestic or livestock use.
Pennsylvanian	Virgil	Wabannsee Group	0-400	A series of limestone and shales with some sandstone underlying the basin.	Ground water in useable amounts locally can be obtained. Not a significant aquifer throughout the basin. Bedrock wells are most successful along the Humboldt fault. Below a depth of 100 feet the water becomes too highly mineralized for most uses
		Shawnee Group	0-250	A series of limestones and shales.	Not a known source of water supply.
		Douglas Group	0-150	A series of limestones and shales	Not a known source of water supply.
	Missouri	Lansing Group	0-60	A series of limestones and shales	Not a known source of water supply.

The first oil field discovered in Nebraska is in Richardson County. Oil production from 1939 to 1961 totaled 9,032,256 barrels. Since 1961 production has steadily decreased. Most of the oil is produced from Upper Devonian rocks.

D. Land Resources

The USDA has developed a major land classification system that has divided the United States into Land Resource Regions which are further divided into Land Resource Areas (LRA's). These LRA's have unique characteristics of topography, soils, elevation, and precipitation with contrasts between land resource areas usually distinct and in some cases, very abrupt.

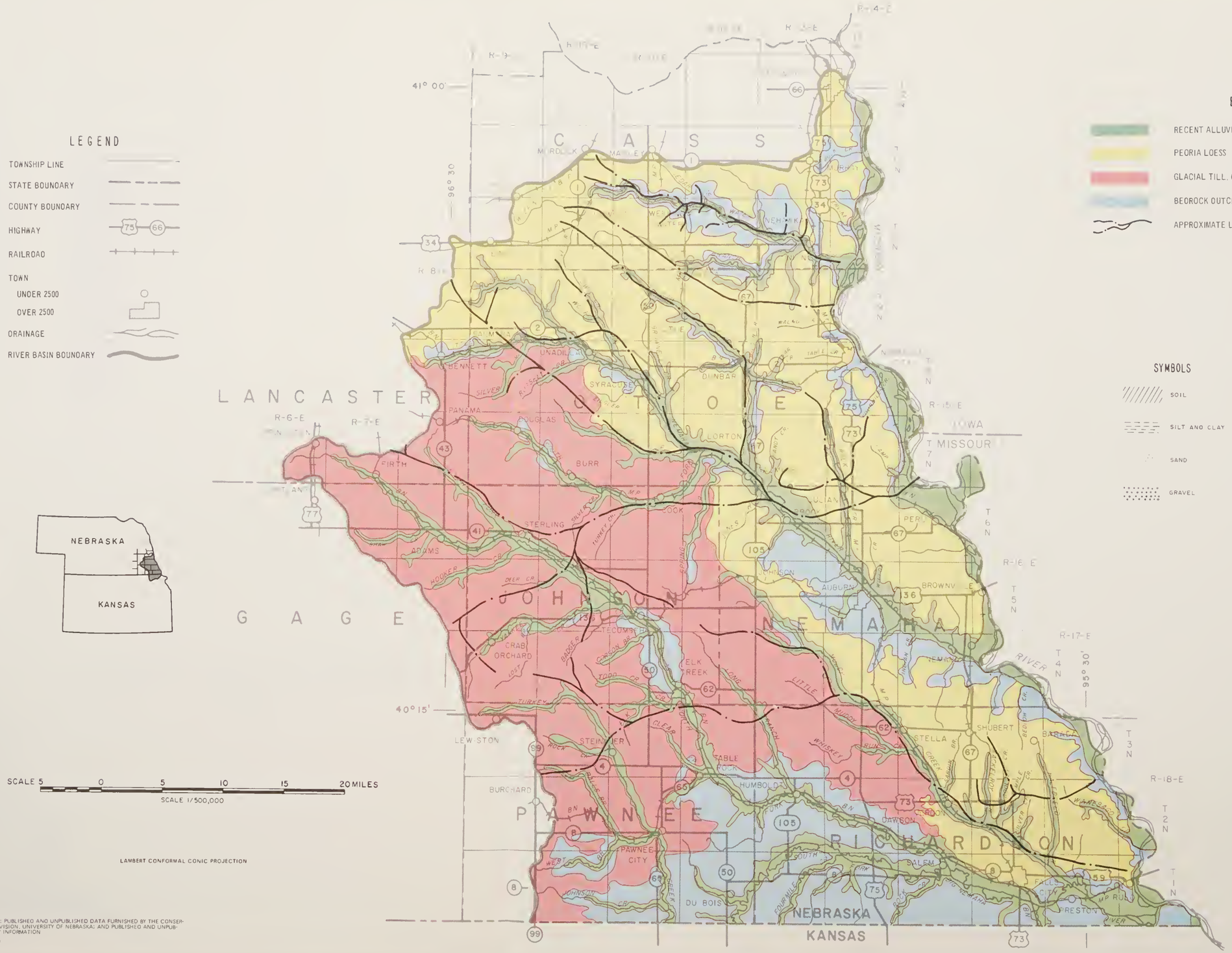
The Nemaha River Basin is located in the Central Feed Grains and Livestock Region and is entirely within the Nebraska and Kansas Loess-Drift Hills Land Resource Area (LRA). Within this LRA, the major differences are those associated with the existing soil resources. These soil resources have been grouped into soil associations that are located on the general soil map shown in Plate 3. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, drainage, or other characteristics that affect management. A description for each association is as follows:

Kennebec-Judson-Wabash Association: Deep, nearly level to gently sloping, silty and clayey soils; formed in alluvium on bottom lands and colluvium on foot slopes.

This soil association consists of foot slopes, bottom lands, and stream terraces in the valleys of the Big Nemaha River and adjoining streams. Slopes range from nearly level to gently sloping. This association represents the lowest relative elevations of the landscape. Some areas on bottom lands are flooded for short periods after heavy rains. Kennebec (40 percent), Judson (20 percent), and Wabash (20 percent) soils are dominant. Kennebec soils are deep and moderately well-drained. They formed in silty alluvium near the rivers and creeks. Kennebec soils have a black silt loam surface layer and very dark grayish-brown silt loam underlying material.

U S DEPARTMENT OF AGRICULTURE



PLEISTOCENE DEPOSITS

NEMAHA RIVER BASIN

NEBRASKA

SOURCE:
SCS DRAWING 5,S-31,649; PUBLISHED AND UNPUBLISHED DATA FURNISHED BY THE CONSERVATION AND SURVEY DIVISION, UNIVERSITY OF NEBRASKA; AND PUBLISHED AND UNPUBLISHED SCS SOIL SURVEY INFORMATION

USDA SCS-LINCOLN, NEBR. 1973

PLATE I

5,S-32,234

U. S. DEPARTMENT OF AGRICULTURE

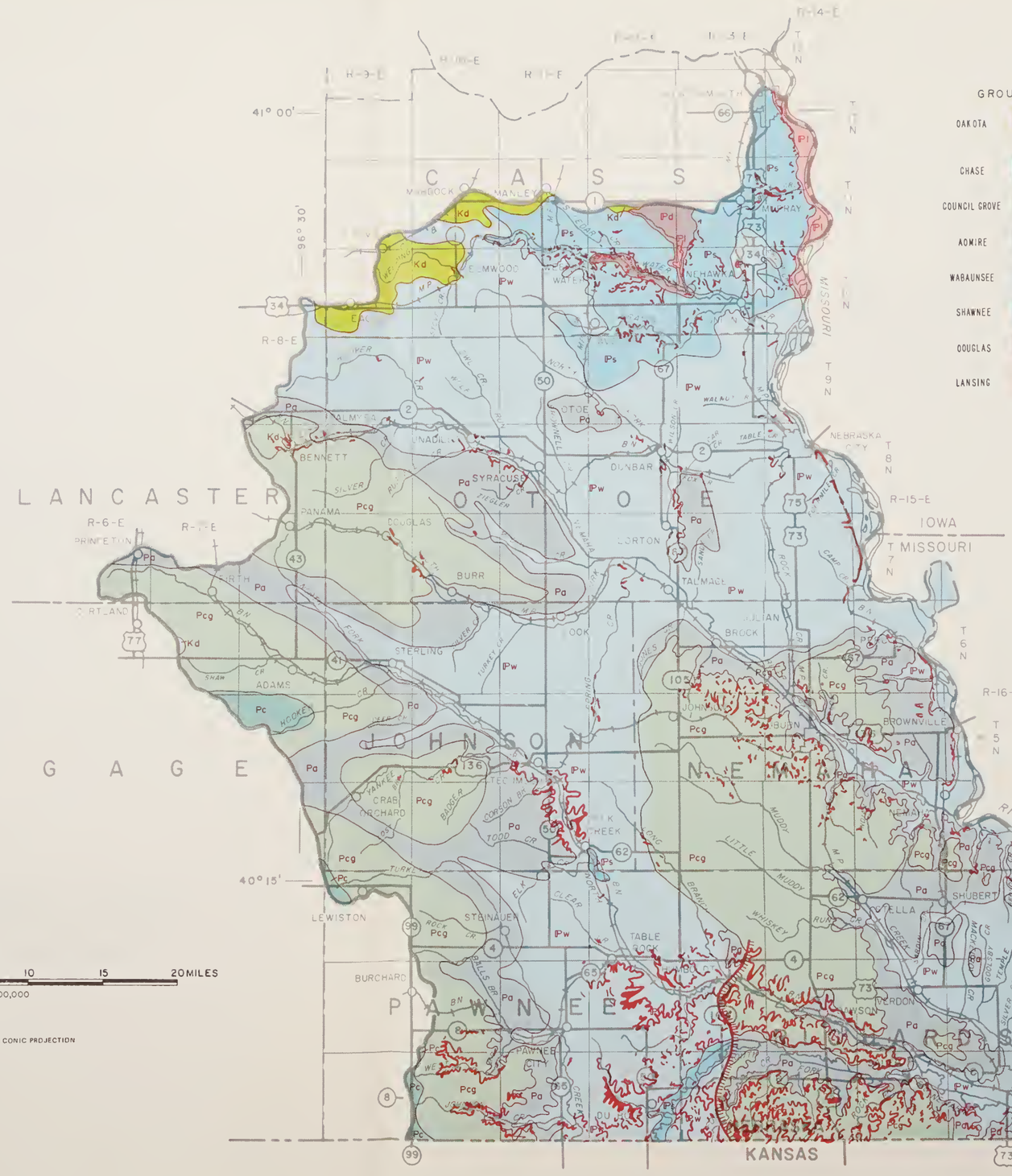
GENERALIZED GEOLOGIC BEDROCK MAP

NEMAHA RIVER BASIN

NEBRASKA

BASE LEGEND

- TOWNSHIP LINE
- STATE BOUNDARY
- COUNTY BOUNDARY
- HIGHWAY (73, 66)
- RAILROAD
- TOWN
  - UNDER 2500
  - OVER 2500
- DRAINAGE
- RIVER BASIN BOUNDARY



GROUP

OAKOTA	Kd
CHASE	Pc
COUNCIL GROVE	Pcg
ADMIRE	Pa
WABAUNSEE	Pw
SHAWNEE	Ps
DOUGLAS	Pd
LANSING	Pl

LEGEND

COMPOSITE LITHOLOGIC SECTION	GROUP / FORMATION		SERIES	SYSTEM
	DAKOTA	OMAOI	LOWER CRETACEOUS	CRETACEOUS
		SKULL CREEK		
		FALL RIVER FUSON LAKOTA		
	CHASE		BIG BLUE	PERMIAN
	COUNCIL GROVE			
	ADMIRE			
	WABAUNSEE		VIRGIL	PENNSYLVANIAN
	SHAWNEE			
	DOUGLAS		MISSOURI	
	LANSING			

EXPLANATION OF SYMBOLS

- SILT OR CLAY
- SHALE (GREEN OR GRAY)
- SHALE (RED)
- SAND OR SANDSTONE
- GYPSUM OR ANHYDRITE
- CHALK
- LIMESTONE
- DOLOMITE
- CHERT
- OUTCROPS
- FAULT (DOWN / UP)

N

SCALE 5 0 5 10 15 20 MILES

SCALE 1/500,000

LAMBERT CONFORMAL CONIC PROJECTION

SOURCE:
SCS DRAWING 5,S-31,649 AND GEOLOGIC BEDROCK MAP OF NEBRASKA PREPARED BY THE CONSERVATION AND SURVEY DIVISION, UNIVERSITY OF NEBRASKA (1969).

USDA SCS-LINCOLN NEBR 1973

PLATE 2

5,S-32,235

U. S. DEPARTMENT OF AGRICULTURE

LEGEND

TOWNSHIP LINE

STATE BOUNDARY

COUNTY BOUNDARY

HIGHWAY

RAILROAD

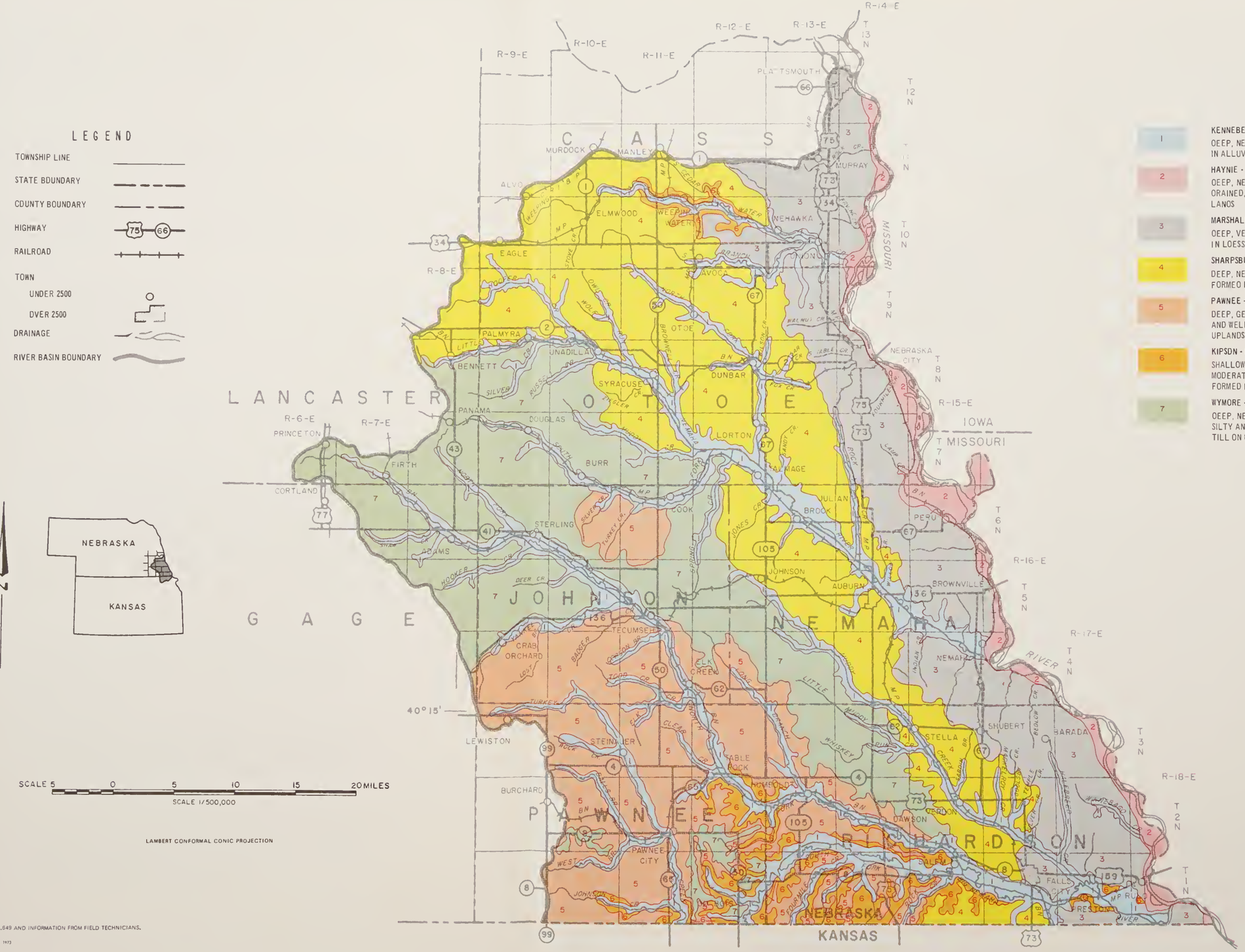
TOWN

UNDER 2500

OVER 2500

DRAINAGE

RIVER BASIN BOUNDARY



SCALE 5 0 5 10 15 20 MILES

SCALE 1/500,000

LAMBERT CONFORMAL CONIC PROJECTION

SOIL ASSOCIATIONS

1 — **KENNEBEC - JUDSON - WABASH ASSOCIATION:**
DEEP, NEARLY LEVEL TO GENTLY SLOPING, SILTY AND CLAYEY SOILS FORMED IN ALLUVIUM ON BOTTOM LANDS AND COLLUVIUM ON FOOT SLOPES

2 — **HAYNIE - ALBATON ASSOCIATION:**
DEEP, NEARLY LEVEL, MODERATELY WELL-DRAINED, SILTY SOILS AND POORLY DRAINED, CLAYEY SOILS; FORMED IN ALLUVIUM ON MISSOURI RIVER BOTTOM LANDS

3 — **MARSHALL - MONONA ASSOCIATION:**
DEEP, VERY GENTLY SLOPING TO STEEP, WELL-DRAINED, SILTY SOILS FORMED IN LOESS ON UPLANDS

4 — **SHARPSBURG ASSOCIATION:**
DEEP, NEARLY LEVEL TO STRONGLY SLOPING, WELL-DRAINED, SILTY SOILS FORMED IN LOESS ON UPLANDS

5 — **PAWNEE - BURCHARD - WYMORE ASSOCIATION:**
DEEP, GENTLY SLOPING TO MODERATELY STEEP, MODERATELY WELL-DRAINED AND WELL-DRAINED, LOAMY AND CLAYEY SOILS; FORMED IN GLACIAL TILL ON UPLANDS

6 — **KIPSON - BENFIELD - SOGN ASSOCIATION:**
SHALLOW AND MODERATELY DEEP, SOMEWHAT EXCESSIVELY DRAINED AND MODERATELY DEEP, WELL-DRAINED, GENTLY SLOPING TO STEEP, SILTY SOILS; FORMED IN SHALE AND LIMESTONE ON UPLANDS

7 — **WYMORE - PAWNEE ASSOCIATION:**
DEEP, NEARLY LEVEL TO STRONGLY SLOPING, MODERATELY WELL-DRAINED, SILTY AND LOAMY SOILS WITH CLAYEY SUBSOILS; FORMED IN LOESS AND GLACIAL TILL ON UPLANDS

GENERAL SOIL MAP

NEMAHA RIVER BASIN

NEBRASKA

SOURCE:
SCS DRAWING 5,S-31,649 AND INFORMATION FROM FIELD TECHNICIANS.

USDA-SCS-LINCOLN NEBR 1973

PLATE 3
5,S-32,233

Judson soils are deep, well-drained, and on foot slopes. They formed in silty sediments locally washed from adjacent uplands. These soils have a black silt loam or silty clay loam surface layer and a dark-brown silty clay loam subsoil.

Wabash are deep, poorly drained soils formed in clayey alluvium. Wabash soils are nearly level and in depression-like areas. They have a black silty clay surface layer and a very dark-gray underlying material.

Small areas of land occurring along meandering streams are subject to frequent overflow. Most of the acreage is cultivated. Corn, grain sorghum, and wheat are the principal crops.

The principal limitations when using these soils are maintenance of fertility levels and good tilth. Flooding is a hazard and the need for drainage is a concern of management on some areas. Water erosion is ordinarily not a hazard except on the gently sloping Judson soils.

Haynie-Albaton Association: Deep, nearly level, moderately well-drained, silty soils and poorly drained, clayey soils; formed in alluvium on the Missouri River bottom lands.

This soil association occupies low bottom land within oxbows or bends of the Missouri River. Haynie soils comprise 60 percent and Albaton soils 20 percent of the total soil in the association. The areas are not connected where the river channel reaches adjoining bluffs. Topography is mainly nearly level to gently undulating. Very gentle and gentle slopes occur around the few intermittent lakes and the few oxbows or swales of old stream channels.

Haynie soils are deep, moderately well-drained silty soils. They formed in moderately alkaline, stratified, silty alluvium. The surface layer is very dark grayish-brown silt loam and the underlying material is stratified silt loam that is high in lime.

Albaton soils are deep, poorly drained, clayey soils. They formed in clayey alluvial sediments in slightly depressioned landscapes of bottom lands. They have a very dark-gray silty clay surface layer and dark-gray silty clay underlying material.

Onawa and Sarpy are less extensive soils in this association. Onawa soils are mainly in an area where the Nemaha River empties into the Missouri River. Sarpy soils are slightly undulating and sandy.

Nearly all of this association has been cleared of trees and is used for growing corn, soybeans, and grain sorghum. The main concerns of management are improving drainage, maintaining the fertility level and good tilth. Flooding is a hazard in places not protected by levees.

Marshall-Monona Association: Deep, very gently sloping to steep, well-drained, silty soils; formed in loess on uplands.

This association consists of a dissected loess upland. It is made up of a succession of ridges and narrow valleys. It has a rolling appearance. Except for very steep land or bluffs bordering the Missouri River Valley, slopes range from 1 to 30 percent. Very gentle slopes are on upland divides.

Marshall (60 percent) and Monona (20 percent) soils are dominant. Marshall soils are very gently sloping to moderately steep, deep, well-drained soils formed in loess. The surface layer is very dark-brown silty clay loam. The subsoil and underlying material is brown or yellowish-brown silty clay loam.

Monona soils are gently sloping to steep, deep, well-drained soils formed in loess. The surface layer is very dark-brown silt loam and the subsoil is yellowish-brown silt loam.

Less extensive in this association are Ida and Judson soils and rough, broken land, loess. Eroded areas on moderately steep knolls are occupied by Ida soils. Judson soils are on colluvial foot slopes. Rough broken land, loess is on the bluffs along the Missouri River Valley.

Most of this association is used for cultivated crops. Corn is the principal crop grown. Some of the steeper areas are cultivated, but the steepest areas are used mostly for pasture or habitat of wildlife. The main concern of management is controlling runoff, erosion, and sedimentation. Maintaining vigor in plants used for permanent cover on the steeper soils is also a concern.

Sharpsburg Association: Deep, nearly level to strongly sloping, well-drained, silty soils; formed in loess on uplands.

This association consists of a dissected, loess upland plain made up of divides, ridges, sideslopes, and narrow valleys. Gently sloping ridgetops and smooth sloping hillsides are dominant. Slopes are nearly

level on some upland divides and are strongly sloping on a few valley sides.

Sharpsburg soils (comprising 80 percent of the association) are deep, well-drained, nearly level to strongly sloping hills. The surface layer is very dark-brown silty clay loam and the subsoil is brown silty clay loam.

Judson, Geary, and Marshall are less extensive soils in this association. Judson soils are on colluvial foot slopes. Geary soils are on the stronger sideslopes. Marshall soils are on stronger slopes in the eastern part of the association. Burchard and Pawnee soils formed in glacial till and occur in strongly sloping upland areas adjacent to drainageways.

Nearly all of this association is used for cultivated crops. Corn and grain sorghum are the principal crops, but soybeans, wheat, and alfalfa are also grown. The main concern of management is maintaining the fertility level and controlling runoff, erosion, and sedimentation.

Pawnee-Burchard-Wymore Association: Deep, gently sloping to moderately steep, moderately well-drained and well-drained, loamy and clayey soils; formed in glacial till on uplands.

This association consists of the tops and sides of upland ridges and the dissected upper valley hillsides. These soils have formed largely in material of glacial origin. A few loess-capped ridge tops are on less sloping areas. Slopes range from gently sloping to moderately steep. Included are many narrow bottoms of the drainageways that extend into the uplands. Boulders, stones, gravel and sand pockets are at the surface in many places. Many areas are severely eroded. Extensive areas of erosion are in the lower, more dissected part of the basin. Pawnee (50 percent), Burchard (20 percent), and Wymore (10 percent) are the dominant soils.

Pawnee soils are deep, gently sloping to strongly sloping and are moderately well-drained. They are on ridge tops above the Burchard soils. The surface layer is very dark-brown clay loam. The subsoil is brown clay. Below a depth of 3 feet is olive-brown heavy clay loam.

Burchard soils are deep, well-drained soils formed in glacial till. They are not so fine textured in the subsoil as Pawnee or Wymore soils. The surface layer is very dark-brown clay loam. The subsoil is grayish-brown clay loam. The underlying material is mottled olive-brown clay loam.

Wymore soils are deep, moderately well-drained soils formed in loess. They are on ridge tops in the highest part of the landscape. The surface layer is black silty clay loam. The subsoil is grayish-brown silty clay. The underlying material is mottled olive-gray silty clay loam.

About 50 percent of this association is used for cultivated crops. The remainder is mainly in hayland, pasture and range. The principal cultivated crops are grain sorghum and wheat. Erosion by water is the principal hazard to the soils of this association. Other concerns of management are maintenance of fertility, areas in grass need grazing, brush, and weed control to insure vigorous growth of the grasses.

Kipson-Benfield-Sogn Association: Shallow and moderately deep, somewhat excessively drained and moderately deep, well-drained, gently sloping to steep, silty soils; formed in shale and limestone on uplands.

This association consists of a thoroughly dissected upland plain made up of unique bedrock highs and narrow areas of sloping soils along the valley sides of major streams. Many areas occur intermittently along valley sides of major streams in the southern part of the basin. Slopes are mostly moderately steep and steep. They are less steep on some of the lower sides and on the few ridge tops. Kipson (40 percent), Benfield (30 percent), and Sogn (10 percent) are dominant soils.

Kipson soils are shallow over shale, gently sloping to steep, and are somewhat excessively drained. The surface layer is very dark-brown silty clay loam and the underlying material is grayish-brown silty clay loam. At about a depth of 20 inches is olive-gray clayey to silty shale.

Benfield soils are moderately deep, gently sloping to moderately steep, and are well-drained. The surface layer is dark-brown silty clay loam. The subsoil is reddish-brown silty clay. At a depth of about 40 inches is olive-gray clayey shale.

Sogn soils are shallow over limestone, gently sloping to steep, and are somewhat excessively drained. The surface layer is very dark-brown silty clay loam 8 to 15 inches thick over level thin-bedded limestone.

Soils of minor extent in this association are in the Morrill, Wymore, and Judson series. They are on ridge tops and foot slopes of narrow valleys.

Most of this association is grassland. A few trees are along drainageways and on lower slopes adjacent to valleys. Some of the Benfield soils are cultivated. The main concerns of management are conserving moisture, controlling erosion, and maintaining a desirable permanent plant cover.

Wymore-Pawnee Association: Deep, nearly level to strongly sloping, moderately well-drained, silty and loamy soils with clayey subsoils; formed in loess and glacial till on uplands.

This association is on the loess and till uplands. The nearly level and gently sloping ridge tops are loess capped. The soils on sideslopes to valleys are commonly formed in glacial till. Included are the uppermost parts of some natural drainageways. This association represents some of the highest elevations of the landscape in the upper part of the basin.

Wymore (60 percent) and Pawnee (20 percent) soils are dominant. The nearly level to gently sloping Wymore soils are on ridge tops and are deep and moderately well-drained. They formed in loess. The surface layer is black silty clay loam. The underlying material is mottled olive-gray silty clay loam.

Pawnee soils are deep, gently sloping to strongly sloping and are moderately well-drained. The surface layer is very dark-brown clay loam. The subsoil is brown clay. Below a depth of 3 feet is olive-brown heavy clay loam.

Minor soils in this association are Judson soils on colluvial foot slopes, Kennebec soils on narrow bottom lands, and Burchard soils on sloping valley sides.

A large portion of this association is used for cultivated crops. Grain sorghum and wheat are the principal crops, but corn and alfalfa are also grown. Grain sorghum is grown more than corn because the soils release moisture slowly to plants during hot, dry days. Concerns of management are controlling runoff and erosion and selecting crops that are best suited to the soil and climate.

Within each of the soils associations there is an additional classification of the soil resource. This is a capability classification which is a practical method of grouping soils for use, treatment, and management. There are eight general classifications (Class I through Class VIII). The hazards and limitations on use are as follows:

Class I: Soils with few limitations that restrict their use when cultivated.

Class II: Soils with minor limitations that restrict their use. Easily applied conservation measures are needed when cultivated.

Class III: Soils with severe limitations and require special conservation measures when cultivated.

Class IV: Soils with very severe limitations, require intensive conservation measures and very careful management if occasionally cultivated.

Class V: Soils with no erosion hazard. They are wet or subject to overflow. Their use is limited to pasture, range or wildlife.

Class VI: Soils with limitations that make them unsuited for cultivation. Their use is limited to range, woodland, wildlife or recreation. Seeding or reseeding is practical.

Class VII: Soils with very severe limitations that limit their use to range, woodland, wildlife or recreation. Reseeding is generally not practical.

Class VIII: Soils that are not suited to agricultural production. They have value for wildlife and recreation.

The above capability classes are further divided into subclasses that show the principal kinds of problems involved. The subclasses are: erosion as indicated by e, such as IIIe; wetness indicated by w, such as Vw; soil limitations (shallowness or droughtiness) indicated by s, such as IVs; and climatic limitations indicated by c, such as IIc.

Table II-3 shows the present major land use by Land Capability Classes in the Nemaha River Basin. About four percent of the soils are in Class I. They are suited for a wide range of plants and can be safely cultivated by following good soil management practices. When Class I soils are irrigated with gravity systems, some land leveling and reshaping of the surface may be necessary in order to obtain more uniform applications of water. Over 7,100 acres of Class I land are used for pasture and range, and unless it occurs in small areas or in locations not practical to cultivate, much of this land could be used for cropland.

About 25 percent of the soils in the basin are in Land Capability Class II. When cultivated, Class II lands need a conservation cropping system with minimum tillage and crop residue management to improve and maintain the soil in good physical condition. Class II lands can be used for pasture, range, woodland, or wildlife habitat, if proper use and good management practices are followed. Presently, almost 81,000 acres of Class II land are used for pasture and forest land. Most of this land is suitable for the production of cultivated crops.

Table II-3 PRESENT MAJOR LAND USE BY LAND CAPABILITY CLASSES
Nemaha River Basin, Nebraska

Land Capability Class	Cropland	Pasture & Range	Forest Land	Other	Total Ag.	Non-Agricultural	Total
				Acres			
I	46,310	7,130	7,860	1,860	63,160		
II	345,281	63,070	17,760	12,480	438,590		
III	686,210	162,350	13,110	24,980	886,650		
IV	114,290	63,840	7,380	2,480	187,990		
V	400	810	0	0	1,210		
VI	17,190	48,220	32,750	3,170	101,330		
VII	620	3,680	7,240	330	11,870		
TOTAL	1,210,300	349,100	86,100	45,300	1,690,800	83,000	1,773,800
				Percent			
I	2.6	9.4	0.4	0.1	3.5		
II	19.5	3.6	1.0	0.7	24.8		
III	38.7	9.1	0.8	1.4	50.0		
IV	6.4	3.6	0.4	0.2	10.6		
V	T	T	0	0	0.1		
VI	1.0	2.7	1.9	0.2	5.7		
VII	T	0.2	0.4	T	0.6		
TOTAL	68.2	19.6	4.9	2.6	95.3	4.7	100.0

Source: 1967 USDA Conservation Needs Inventory.

About 50 percent of the soils in the basin are Class III. Water erosion is the major hazard. Conservation cropping systems with minimum tillage, crop residue management, contour farming, terraces, and grassed waterways are needed if these lands are cultivated. Alternate uses of Class III lands are pasture, forest, and wildlife habitat. Over 175,000 acres of Class III land are used for pasture and forest land. Much of this land is suitable for cropland. Proper use of pastures and good management and adequate fire protection of woodland and wildlife areas are required to maintain sufficient cover to retard soil loss and reduce runoff.

Nearly 11 percent of the soils in the basin are in Land Capability Class IV. Water erosion is the major hazard. Most of the lands in Class IV are sloping with various degrees of erosion. The number of years that Class IV soils are continuously cultivated should be limited. The cropping systems required consist of mostly close-drilled crops with stubble mulch tillage operations that will leave sufficient crop residue on the surface. Pasture, forest, and wildlife habitat are more desirable uses of these lands. Over 114,000 acres of Class IV land are used for cultivated crops.

There are only about 1,200 acres of soils in Land Capability Class V. Most of the Class V lands in the basin have a high water table and are used for pasture and range.

About six percent of the agricultural land in the basin is in Land Capability Class VI. These soils are unsuited for cultivation. Most of the Class VI lands are on the steep slopes bordering the bottomlands. They contribute large amounts of sediment to flood plains and to stream channels. These steep areas should be used for range or planted to trees and shrubs which, under proper management, will provide a permanent cover and materially reduce runoff and soil erosion. Over 17,000 acres are being cropped and should be converted to permanent cover.

Class VII lands occupy less than one percent of the basin area. These lands are unsuited to cultivation. Their use is largely restricted to pasture, forest, or wildlife habitat. Most of the Class VII lands in the basin are now in pasture, range, and forest land. Proper use and careful management are necessary for adequate treatment. Areas of Class VII land in crops should be seeded to grasses or planted to trees for permanent cover.

Over 95 percent of the area in the basin is used for agricultural purposes. Of this, 68 percent is cropland; 19 percent is pasture, range, and native hay; and five percent is forest land. The balance of the basin consists of farmsteads, idle land, wildlife areas, water, and miscellaneous areas not otherwise classified.

Over 1,210,000 acres of cropland exist in the basin. The principal crops grown in the basin are corn, grain sorghum, winter wheat, soybeans, and alfalfa hay.

Most of the 349,000 acres in grass land are classified as pasture. Pastures are of tame grasses and legumes on the better soils and of native grasses on the more sloping, shallow soils. Rangeland is land used for grazing livestock and on which the climax (natural potential) plant community is dominated by grasses. Most of the small grassed areas near farmsteads are in introduced grasses and are usually minor parts of a general farming enterprise. These areas are smaller than where grazing is the predominate land use.

About 86,000 acres or 4.9 percent of the basin is commercial forest land. This includes land which is capable of producing usable crops of wood, that is economically available now or prospectively and is not withdrawn from timber utilization. Also, included are shelterbelts that are a minimum of 120 feet wide and one acre or larger.

The forest areas occur mainly on bottom lands in narrow fingers adjacent to drainageways. The common species are hackberry, boxelder, elm, ash, cottonwood, oak, hickory, and walnut. Shelterbelts include introduced species such as Russian olive, Russian mulberry, Ponderosa pine, and Austrian pine.

These areas are important for their ability to trap sediment and provide recreation, wildlife habitat, forage, and timber.

E. Water Resources

Ground water currently supplies about three-fourths of the basin's total annual water demand. Domestic requirements are wholly reliant upon ground water while surface water from the streams supply some usage by industry, recreation, and irrigation.

Adequate supplies of ground water are difficult to locate because of the variance in composition and lateral persistence of the water-bearing sands and gravels. Much of the ground water occurs under water table conditions in aquifers underlying principal stream valleys (Figure II-5). Perched water tables are common in the upland areas but only provide limited amounts of water from shallow wells. Deep well yields range from low to negligible and the water is highly mineralized (Figure II-6).

The region near the Missouri River has sufficient thickness of saturated sands and gravels to yield large quantities of water. This aquifer is recharged from the river when water is removed by pumping. Ground water here is also mineralized and needs to be treated to be suitable for domestic use.

There are an estimated 7-8 million acre-feet of water in storage in the basin's aquifers. Depth to the water table ranges from a few feet in the stream valleys to as much as 150 feet in upland areas. Recharge is primarily from local precipitation, and water levels in many wells respond rapidly to fluctuations in precipitation.

FIGURE II-5
GROUND WATER IN STORAGE

LEGEND

Feet of Water

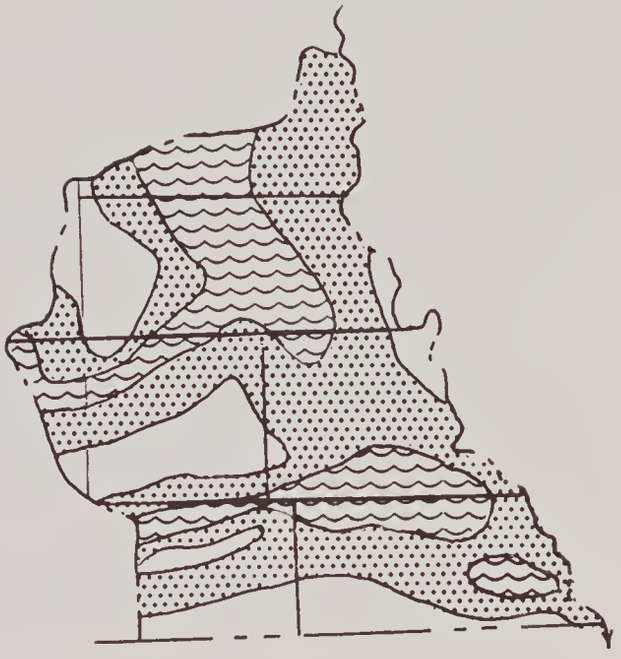
20 to 40

4 to 20

0 to 4

Note:
A storage coefficient of 0.20 was assumed for volume estimates, that is, each foot of water represents 5 feet of permeable water-bearing material, principally Pleistocene Deposits.
Source:
Conservation and Survey Div., Univ. of Nebr.

FIGURE II-6
GROUND WATER QUALITY



LEGEND

Concentration of total dissolved solids in Milligrams Per Liter

170 to 400

400 to 700

700+

Note:
Samples taken from wells generally less than 400 feet deep

Data Sources:
U. S. Geological Survey
College of Ag., Univ. of Nebr.
Nebraska Dept. of Health

Present (1970) ground water use totals 14,600 acre-feet annually. Domestic usage is the principal demand requiring 8,100 acre-feet annually, or 55 percent of the total basin use. Annual demands for livestock are 3,800 acre-feet, irrigation accounts for 2,600 acre-feet, and industries (separate from municipal systems) use about 100 acre-feet.

Surface water within the basin is supplied by runoff from precipitation. The eastern border of the basin is the Missouri River. There are three major streams within the study area, Weeping Water Creek, and the Little and Big Nemaha Rivers. They flow in a southeasterly direction to the Missouri River. Many miles of the Nemaha Rivers have been straightened in their lower reaches and have subsequently deepened and widened.

Records of streamflow for more than 10 years are available from seven U.S.G.S. stream gauging stations. Table II-4 is a summary of the annual volume of runoff at each station. Mean annual unit runoff volumes for each station and the incremental drainage areas are computed for the common period of record. Additional records covering the last two years are available for Weeping Water Creek.

Little use is made of streamflow for irrigation in the basin. Crop requirements are generally met by rainfall. Water right claims and appropriations in the basin as of September 30, 1970, totaled 276. Direct flow appropriations for irrigation accounted for 207 of these rights with an average diversion of 1.5 cfs (680 gpm). The Nemaha Natural Resources District holds 54 separate claims for storage in reservoirs built under the PL-566 Small Watershed program. The remainder of the claims and appropriations are applied to domestic, resort and light industry. Table II-5 is a summary of the magnitude and number of the claims by drainage areas.

Table II-6 is a tabulation of the extremes and selected frequencies (chance of occurrence) of the lowest mean discharges for seven-day and 30-day consecutive periods at the gauging stations. The period or record is given by climatic years. The climatic year, beginning April 1, is used for processing low-flow data to properly reflect the general flow recession that begins in the summer months and may persist through the winter months. The 1970 climatic year began April 1, 1970, and ended March 31, 1971.

Present annual consumptive use of surface water totals 10,600 acre-feet. About 9,000 acre-feet of this is attributed to irrigation. Livestock water supply is the only other major basin usage of surface water. It amounts to about 1,600 acre-feet annually. Minor amounts of surface water are consumed by demands for recreation, fish, wildlife, and gravel pits. There are no hydroelectric or steam power plants currently using surface water.

A study was conducted by the Nebraska Department of Health and the results were published as Chemical Analyses of Nebraska Municipal

Table II-4 HISTORIC RUNOFF VOLUMES
Nemaha River Basin, Nebraska

USGS Station No. and Name	Total. Drainage Area	Period of Record	Median[1] Annual	Maximum Annual (& Yr.)	Minimum Annual (& Yr.)	Mean[2] Annual & (Period of Record)
	Sq. Mi.	Water Year		Acre Feet		Ac. Ft. Per Sq. Mi.
#8105 Little Nemaha[3] R. near Syracuse	218	1952-69	33,000	91,890 (1965)	11,310 (1968)	207 (215)
#8115-8105 Area between gauges	575	1952-69	108,260	254,800 (1952)	36,840 (1968)	221 (303)
#8115 Little Nemaha R. at Auburn	793	1950-71	147,000	625,000 (1951)	48,150 (1968)	217 (247)
#8140 Turkey Creek nr. Seneca, Kansas	276	1949-71	59,750	374,900 (1951)	2,350 (1956)	247 (316)
#8145 North Fork Big Nemaha R. at Humboldt	548	1953-71	81,900	278,000 (1969)	35,830 (1966)	253 (238)
#8150-(8140+8145) Area between gauges	516	1953-71	93,450	320,500 (1960)	4,170 (1956)	268 (256)
#8150 Big Nemaha R. at Falls City	1,340	1945-71	293,300	1,455,000 (1951)	62,910 (1956)	257 (304)
#8155 Muddy Creek at Verdon	186	1953-71	39,430	119,400 (1958)	17,150 (1956)	281 (266)
#8065 Weeping Water Creek at Union	241	1951-71	50,050	158,000 (1951)	14,420 (1956)	216 (236)

1/ Tabular values for the period of record shown equaled or exceeded approximately one-half of the years.
2/ Mean Annual unit runoffs are shown for the 17-year concurrent period (1953-1969 water-years). The entire period of record is shown in parentheses.
3/ Discontinued September 1969.
Source: Water Supply Papers published by Water Resources Division, U.S. Geological Survey.

Table II-5 NATURE OF WATER RIGHT CLAIMS AND APPLICATIONS
Nemaha River Basin, Nebraska

Use to Which Applied	Number of Claims	Total Provisional Grant	Appropriator
		BIG NEMAHA RIVER	
Irrigation	109	180.57 cfs	----------
Storage	10	548.3 AF	Upper Big Nemaha Conservancy District[1/]
"	4	177.0 AF	Rock Creek Conservancy District[1/]
"	1	1,798 AF	Nebr. Game & Parks Comm. (Burchard Lake)
Domestic	3	7.93 cfs	Falls City, Tecumseh & Burlington No.
Resort	3	76 AF	Boy Scouts, Humboldt & Tecumseh
		LITTLE NEMAHA RIVER	
Irrigation	79	117.09 cfs	----------
Storage	22	1,311.81 AF	Wilson Creek Conservancy District[1/]
"	10	675.07 AF	Spring Creek Conservancy District[1/]
"	8	506.49 AF	Ziegler Creek Conservancy District[1/]
"	5	119.72 AF	Other
		WEEPING WATER CREEK	
Irrigation	9	7.51 cfs	----------
Domestic	1	2.00 cfs	Weeping Water
Light Industry	2	10.00 cfs	Ice - 8 cfs; Limestone - 2 cfs
		REMAINING AREA	
Irrigation	10	9.98 cfs	----------

1/ These claims now belong to the Nemaha Natural Resources District.
Source: Nebraska Department of Water Resources Thirty-Eighth Biennial Report.

Table II-6 LOWEST MEAN DISCHARGE FOR CONSECUTIVE PERIODS OF 7 AND 30 DAYS
Nemaha River Basin, Nebraska

Period of Record	USGS Gauging Station Identification Numbers						
	8065	8105	8115	8140	8145	8150	8155
	1950-70	1952-68	1950-70	1949-70	1953-70	1944-70	1953-70
	Cubic Feet Per Second						
7-Day (Consecutive) Duration:							
Maximum	36.1	15.0	92.4	31.3	32.1	176.0	25.7
(& Year)	(1951)	(1960)	(1951)	(1951)	(1960)	(1951)	(1961)
2-Year	8.1	3.4	30.2	2.6	15.3	41.1	10.2
10-Year	1.9	0.4	12.8	0	8.3	14.4	3.5
20-Year	0.3	0.2	10.0	0	6.9	10.4	2.4
Minimum	0.1	0.1	9.8	0	7.0	6.8	2.1
(& Year)	(1955)	(1956)	(1955)	(56&57)	(1957)	(1957)	(1955)
30-Day (Consecutive) Duration:							
Maximum	43.6	19.6	112.8	37.4	42.4	198.0	41.2
(& Year)	(1951)	(1952)	(1951)	(1951)	(1960)	(1951)	(1959)
2-Year	11.6	5.1	43.2	4.7	23.1	59.9	14.1
10-Year	1.2	0.6	17.6	0.1	12.3	27.3	6.4
20-Year	0.5	0.3	13.4	0	10.2	21.9	5.1
Minimum	0.2	0.3	12.5	0	10.2	16.2	4.5
(& Year)	(1955)	(1956)	(1955)	(56&57)	(1956)	(1956)	(1956)

Note: See Table II-4, "Historic Runoff", for name, location, and drainage area of the above gauging stations.

Source: Streamflow data supplied by Water Resources Division, U.S. Geological Survey.

Water Supplies, January 1973. Table II-7 lists the highest test value of selected parameters for 47 communities whose supply wells were tested. Samples were obtained at these wells before any water treatment had been given. Those values underlined exceed Public Health Service's recommended standards for drinking water. All except four communities have drinking water high in iron and manganese and 27 have high total dissolved solids. Concentrations of combined iron and manganese above the standard of 0.3 mg/l give water an objectionable taste and cause discoloring of laundry and water fixtures but usually produce no adverse physiological effects. The cities of Table Rock, Pawnee City, and Auburn have had problems treating water due to high total dissolved solids content and have relocated wells to obtain better quality water.

The quality of the basin's streams, according to the standards of the Nebraska Environmental Control Council, limits their use somewhat in the raw state. Two categories of water have been established, Category I, with two classes A and B; and Category II for streams in Nebraska. Category I consists of impoundments and perennial flowing waters with a seven consecutive day, one in 10-year low flow greater than 0.1 cfs. Class A water connotates the following uses: full body contact sports, domestic water supply, fish, wildlife, and other aquatic and semiaquatic life. Class B water connotates the following uses: partial body contact sports, agricultural, industrial, fish, wildlife, and other aquatic and semiaquatic life. Category II (intermittent waters) consist of those waters which: (a) have periodic zero flows; and (b) low flows of less than 0.1 cfs for the seven consecutive day, one in 10-year low flow. Table II-8 lists all the waters in the basin that are classified as Class A waters. All the remaining waters will be either Class B or Category II waters. Table II-9 indicates for the various parameters selected the existing water quality of the streams in the basin. The parameters of hydrogen ion (pH), dissolved oxygen (DO), total dissolved solids expressed in terms of conductivity (COND.) and toxic and deleterious substances expressed in terms of ammonia nitrogen concentrations (NH_3-N) best reflect the potential agricultural oriented pollutants of the basin.

The hydrogen ion (pH) standards for Nebraska nontrout streams is to range between 6.5 and 8.5 for Class A waters. Class B and Category II waters are to range between 6.5 and 9.0. There were no Class B and Category II violations of the PH parameter.

The dissolved oxygen (DO) standard shall not be lower than 5 mg/l in warm water. Four of the sampling stations had violations of this standard. They are as follows: Little Nemaha River at Nemaha - one violation at 3.3 mg/l; Little Nemaha River at Bennet - eighteen violations with 1.7 mg/l the low; Hooper Creek south of Eagle - one violation at 2.9 mg/l; and Big Nemaha River at Falls City - one violation at 4.7 mg/l.

The total dissolve solids, expressed as conductivity, standards for Class A waters shall not exceed 900 micromhos per cm. at 25°C.

Table II-7 HIGH TEST RESULTS FOR MUNICIPAL RAW WATER SUPPLIES, JANUARY 1973
Nemaha River Basin, Nebraska

Parameter	pH	TS	Fe	Mn	NO_3	Cl	SO_4
Public Health Service Drinking Water Standards	8.5	500	0.3	0.05	10.0	250	250
				mg/l			
Adams	8.0	390	0.3	0.1	9.0	14	60
Alvo	7.9	370	0.1	0.1	0.1	8	2
Auburn	7.7	1000	5.6	1.4	14.8	68	139
Avoca	7.5	650	0.8	0.1	16.3	42	25
Bennet	8.3	610	0.0	0.1	8.9	30	99
Brock	8.7	820	1.1	0.3	0.0	42	152
Brownville	7.2	880	0.1	2.8	0.1	66	16
Burr	7.5	380	1.3	0.5	5.2	12	16
Cook	7.5	450	0.3	0.2	0.0	10	56
Dawson	8.6	790	0.1	0.1	4.1	62	102
Douglas	7.8	1690	0.5	0.3	0.6	82	211
DuBois	8.8	714	0.1	0.1	19.4	26	85
Dunbar	7.1	310	0.0	0.0	3.2	8	20
Eagle	7.9	420	0.8	0.3	0.1	22	36
Elk Creek	8.5	570	0.3	0.7	5.9	20	126
Elmwood	7.3	430	0.1	0.1	22.4	28	2
Falls City	8.6	720	7.0	2.7	0.5	56	86
Firth	8.1	370	0.3	0.0	1.3	4	27
Humboldt	7.2	410	0.1	0.1	5.2	8	4
Johnson	7.4	1370	0.2	0.1	0.1	8	1140
Julian	7.3	270	0.1	0.1	1.6	4	0
Lewiston	7.3	520	0.2	0.2	0.2	0	14
Murdock	7.9	290	0.8	0.1	4.2	6	10
Murray	6.9	455	11.5	0.1	6.5	18	18
Nebraska City	7.7	570	7.1	1.5	0.1	20	51
Nehawka	7.4	550	9.8	2.2	1.2	68	27
Nemaha	7.8	430	0.2	0.2	8.4	8	25
Otoe	8.6	374	6.9	2.0	0.0	12	2
Palmyra	8.7	626	1.8	2.6	22.9	40	65
Panama	7.7	770	0.2	0.6	8.9	52	144
Pawnee City	7.1	350	0.1	0.1	0.6	1	4
Peru	7.3	750	2.2	1.0	1.2	34	16
Plattsmouth	7.9	530	9.0	2.2	0.9	30	47
Salem	8.3	794	23.2	2.0	5.1	78	55
Shubert	8.6	344	0.2	0.1	15.7	18	33
Steinhauer	8.6	630	0.2	0.2	14.6	60	86
Stella	7.6	790	0.4	0.0	4.2	48	121
Sterling	6.8	520	0.2	0.3	10.8	24	74
Syracuse	8.4	830	6.5	0.5	6.1	88	146
Table Rock	7.2	800	0.2	0.2	28.7	82	20
Talmage	8.7	680	6.8	1.6	0.0	26	153
Tecumseh	8.3	536	0.2	0.1	3.0	10	131
Unadilla	6.8	830	0.0	0.2	6.7	52	97
Union	7.4	435	0.1	0.1	10.6	16	10
Verdon	7.2	450	0.1	0.0	4.4	26	138
Weeping Water	7.1	220	0.2	0.1	0.8	2	0

Table II-8 CLASS "A" WATERS IN THE NEMAHA BASIN AS OF JUNE 11, 1973

Missouri River	Burchard Lake State Use Area
Plattsmouth City Lake	Pawnee City Park Lake
Auburn City Lake	Table Rock City Lake
Johnson City Lake	Verdon State Recreational Area
Steinhart Lake, Nebraska City	Humboldt City Lake
Gritzka Lake, Talmage	Falls City Park Pond
Weeping Water City Lakes	Tecumseh City Park Lake
Pawnee Prairie State Use Area	

Source: Nebraska Department of Environmental Control

Table II-9 EXISTING WATER QUALITY
Nemaha River Basin, Nebraska

Nebraska Department of Environmental Control No. and Location	Date Record Began	Number of Samples	pH Min.	pH Max.	O.D. Mg/L Min.	O.D. Mg/L Max.	Cond. U mho/ccm Min.	Cond. U mho/ccm Max.	Nitrate as N Mg/L Min.	Nitrate as N Mg/L Max.
300903										
Little Nemaha River @ Nemaha	3/28/61	176	7.3	8.6	3.3[1/]	15.0	160	1,150	0	5.8[1/]
301140										
Little Nemaha River @ Auburn	3/20/68	22	7.4	8.4	5.5	13.1	178	640	0	5.8[1/]
301141										
Little Nemaha River @ Talmage	6/5/68	20	7.5	8.3	6.3	12.9	140	660	0	3.8[1/]
301142										
Little Nemaha River @ Syracuse	5/15/62	53	7.2	8.7	6.0	13.6	145	740	0	3.8[1/]
300923										
Little Nemaha River @ Bennet	1/13/65	124	6.9	8.6	1.7[1/]	14.0	8	1,175	0	5.0[1/]
301258										
Wolf Run East of Unadilla	3/22/74	8	8.0	8.8	8.6	11.4	431	610	1.2	2.7[1/]
301260										
So. Fork Little Nemaha NE of Cook	3/22/74	8	8.1	8.5	5.5	11.0	391	659	0.2	2.9
301261										
So. Fork Little Nemaha SE of Burr	3/22/74	8	7.9	8.6	7.4	19.2	420	680	0.5	3.4
301262										
So. Fork Little Nemaha S of Douglas	3/22/74	8	7.9	8.5	7.4	12.0	382	570	1.0	1.6
301264										
Silver Creek S of Palmyra	3/22/74	7	8.3	8.6	7.7	13.0	559	700	0.3	2.1
301265										
Little Nemaha River @ Palmyra	3/22/74	8	8.0	8.5	8.8	12.3	569	680	1.0	2.3
301266										
Hooper Creek S of Eagle	3/22/74	5	7.4	8.5	2.9[1/]	11.0	435	639	0.2	2.0
300904										
Big Nemaha River @ Preston	1/13/65	119	7.4	8.6	5.4	14.2	180	1,700	0	5.9[1/]
300933										
Big Nemaha River @ Falls City	1/13/65	72	7.5	8.6	4.7[1/]	14.1	225	1,422	0	3.4
301132										
Muddy Creek @ Preston	6/15/70	16	7.6	8.4	6.8	13.2	410	670	0.1	5.8[1/]
301177										
Muddy Creek @ Verdon	6/15/70	16	7.6	8.4	6.8	12.8	410	630	0.1	5.8[1/]
301247										
Turkey Creek @ Pawnee City	1/29/74	4	7.7	8.1	8.6	15.7	394	770	0	2.0
301274										
Long Branch Creek @ Humboldt	3/22/74	8	8.0	8.5	6.4	11.2	419	621	0.1	4.1[1/]
301275										
Long Branch Creek NW of Humboldt	3/22/74	8	8.0	8.5	6.2	13.0	399	540	1.1	2.4
301276										
Kirkham Creek NW of Humboldt	3/22/74	8	7.8	8.5	5.1	11.0	419	628	0.1	1.8
301250										
No. Fork Big Nemaha @ Elk Creek	3/22/74	7	8.0	8.8	6.9	13.5	491	652	0.1	2.1
301251										
No. Fork Big Nemaha @ Tecumseh	3/22/74	7	8.5	8.9	8.7	14.0	509	690	0.4	1.9
301252										
Badger Creek SW of Tecumseh	3/22/74	7	8.3	8.7	7.4	11.4	440	670	0.7	2.1
301253										
Yankee Creek NW of Tecumseh	3/22/74	7	7.8	8.5	5.9	11.2	470	730	0	0.6
301254										
No. Fork Big Nemaha NW of St. Mary	3/22/74	7	8.1	8.5	7.0	11.0	478	618	0.2	1.7
301145										
Weeping Water Creek @ Weeping Water	5/28/68	17	7.6	8.3	6.5	13.5	310	560	0	6.5[1/]
301144										
Weeping Water Creek @ Nehawka	6/18/70	11	7.5	8.5	6.4	11.9	340	570	0.2	7.9[1/]
301143										
Weeping Water Creek @ Union	5/28/68	17	7.4	8.4	6.4	13.7	270	550	0	8.1[1/]
Nebraska Standards		Class A	6.5	8.5	5.0	-	-	900	-	pH< 3.5-8.3
		Class B	6.5	9.0	5.0	-	-	2,250	-	pH< 2.9-8.4
										pH< 2.4-8.5
										pH< 2.1-8.6
										pH< 1.8-8.7

1/ Violation of Nebraska Standards.

Class B and Category II water shall not exceed 2250 at 25°C. There were no Class B or Category II violations of this standard noted.

The toxic and deleterious substances, expressed with the parameter ammonia nitrogen concentrations (NH_3-H), standard shall not exceed 3.5 mg/l in warm waters where the pH in these waters does not exceed 8.3. If the pH value of a warm water exceeds 8.2 the maximum allowable limits of ammonia expressed as nitrogen shall be as follows: pH 8.3-N 3.5, pH 8.4-N 2.9, pH 8.5-N 2.4, pH 8.6-N 2.1, pH 8.7-N 1.8. Thirteen of the sampling stations had violations of this standard. They are as follows: Little Nemaha River at Nemaha - seven violations high of 5.8 mg/l; Little Nemaha River at Auburn - one violation of 5.8 mg/l; Little Nemaha River at Talmage - one violation of 3.8 mg/l; Little Nemaha River at Syracuse - one violation of 3.8 mg/l; Little Nemaha River at Bennet - three violations high of 5.0 mg/l; Wolf Run east of Unadilla - one violation of 2.7 mg/l; Big Nemaha River at Preston - three violations high of 5.9 mg/l; Muddy Creek at Preston - three violations high of 5.8 mg/l; Muddy Creek at Verdon - one violation of 5.8 mg/l; Long Branch Creek at Humboldt - one violation of 4.1 mg/l; Weeping Water Creek at Weeping Water - three violations high of 6.5 mg/l; Weeping Water Creek at Nehawka - one violation of 7.9 mg/l; Weeping Water Creek at Union - three violations high of 8.1 mg/l.

F. Wildlife Resources

The rural lands of the basin are well suited to gallinaceous birds and small game animals and are moderately productive for big game animals. From the standpoint of valued game species, the white-tailed deer and prairie chicken are thought to be most important. Prairie chickens do not occur in large numbers but their existence is important whereas white-tailed deer provide the bulk of big game hunting and harvest. Of considerable importance at a level beneath the two previously mentioned are the pheasant and quail. The occurrence of these species is variable in the basin but both are popularly hunted and are suitably adapted. Minimally important are several species of small mammals and some waterfowl.

White-tailed deer prefer riparian habitat, bluff-type hardwood forests and shelterbelts, and use croplands for foraging. They occur in numbers of one to three per square mile in their preferred habitat. The mule deer is better suited to the grasslands and timber to the west of the basin. Its occurrence in the Nemaha River Basin must be considered rare to uncommon.

Two partial prairie chicken outliers are located within the basin and a third may reach the northern boundary. These birds are limited to a few locations in eastern Nebraska with populations of none to five per square mile.

The ringneck pheasant, with an estimated population of 25 to 200 per square mile, do very well in agricultural lands so long as enough cover is present for nesting, roosting, and overwintering. The higher numbers of pheasants in the basin occur where there is a good mixture of habitat.

Bobwhite quail number from 100 to 300 per square mile in the Nemaha River Basin. They prefer woody habitats and riparian vegetation bordering streams. The quail population reaches its peak in the southeast corner of the state. Generally, the population is variable with larger numbers in wooded areas and fewer in the flat, heavily agriculturalized regions.

Cottontail rabbits, with populations ranging from less than 100 to 300 per square mile, are generally well adapted to human activity. The highest populations are in areas of mixed agricultural, woods, and rough land. The clearing of border woods and "junk" trees in water courses tends to decrease the population.

Fox squirrels, which number from 10 to 100 per square mile, prefer woodland habitats, especially the Bur oak and hardwood forest in the basin. This type of habitat is also liked by the gray squirrel. An exact population estimate of the gray squirrel is difficult to determine because of the interrupted distribution. An increase in the acreage of hardwood trees will lead to an increase in the numbers of gray squirrels.

Other species of small mammals in the basin include mink, raccoon, red fox, gray fox, opossum, striped skunk, badger, coyote, muskrat, and beaver.

The basin is not considered prime waterfowl habitat due to the lack of large bodies of water and wetlands. The waterfowl which are found utilize farm ponds and surrounding farmland as habitat. Species of waterfowl common to the basin include mallard, pintail, blue and green-winged teal, gadwall, baldpate, scaup, shoveller, American merganser and wood ducks, coot, snow and blue geese, greater and lesser Canadian honkers and white-fronted geese.

The Missouri River provides habitat for waterfowl. This habitat is augmented by a waterfowl refuge, the Plattsmouth Waterfowl Management Area, located just outside, but adjoining, the basin at the confluence of the Platte and Missouri Rivers. Major use of the river and refuge occur during waterfowl migration.

No known endangered species have been found in the basin, but the American osprey, golden eagle, and bald eagle which are considered rare can sometimes be found.

Over 200 species of birds have been observed in the basin. Important to bird watchers and photographers are many of the song birds including the rose-breasted grosbeak, catbird, cardinal, red-breasted nuthatch, Baltimore oriole, orchard oriole, scarlet tanager, eastern bluebird, cedar waxwing, American redstart, indigo bunting, common redpoll, rufous-sided towhee, loggerhead shrike and house wren.

Waterfowl Utilizing Farm Pond

Thirty-three species of fish occur in the watershed. The two most important species to the fisheries of the watershed are the channel catfish which is popular and abundant and the largemouth bass which is not too abundant but is highly sought by fishermen. Of lesser stature are the carp (abundant but not too desirable), bullheads, and smaller sunfishes.

Of the thirty-three species of fish found, all but one (the carp and its relatives) are native to the area. There are no known endangered species of fish found in the basin.

G. Historical and Archaeological Resources

There are many historical and archaeological sites in the Nemaha River Basin, some of which have national interest and significance. The publication "Historic Preservation in Nebraska",

Preservation Report No. 1, 1971, Nebraska State Historical Society has a listing of most of the important sites. Survey work under way will likely add to this inventory. Among the more important sites in the basin is Arbor Lodge in Nebraska City. Arbor Day was created as a result of activities of J. Sterling Morton, who actively promoted a program of tree planting. The 52-room Colonial Revival Family Mansion, some furniture, and 65 acres of handsomely landscaped land is now the Arbor Lodge State Historical Park. Brownsville, formerly a bustling Missouri River steamboat town, has been declared a historical district. Fourteen houses, including the Bailey House (built in 1877) now occupied by the Brownsville Historical Society, the Brown-Canon House (begun in 1860), two churches, a number of commercial buildings, Brewery Cave, and a saloon are in the district. Both of these sites have become important tourist attractions.

In addition to the Arbor Lodge Historical Park, there are six houses and cabins in Otoe County that have historical significance, including two Octagon Houses in the Camp Creek vicinity. The Mayhew Cabin, Nebraska City, was associated with the "underground railroad" and used as a hiding place for fugitive slaves by associates of the famed abolitionist, John Brown. Other sites in Nebraska City and vicinity include four churches, two commercial buildings, County Court House, U.S. Post Office, Burlington Roundhouse, the sites of an old steamship town, Wyoming, Wildwood Park, Buffalo City, and the Table Rock Treaty Site.

Nemaha County has numerous historical sites of interest in addition to Brownsville. These include some houses and the Burlington Depot in Peru and the County Court House, a bank building, several churches, and two houses in Auburn. Others include a school near Rohrs, and churches in or near Johnson and Nemaha.

Cass County is especially rich in prehistoric cultural remains as over a hundred archaeological sites have been identified. Among these is a site east of Ashland where excavated materials represent a Nebraska Culture occupation of the period 1200 to 1450 A.D. Another is the Nebraska Flint Quarries about two miles north of Nehawka, where flint was quarried by Prehistoric Indians, probably the Nebraska Culture Indians of 1200 to 1450 A.D. period. Several of the ancient quarries have been damaged by modern quarrying operations. Excavation at the Walker Gilmore site, five miles south of Murray, indicate it was occupied during the period 1 - 800 A.D. by Woodland Indians and later by the Nebraska Culture Indians. Other points include five houses or cabins in or near Nehawka, Murray, Rock Bluff, Weeping Water, and Elmwood. Two churches in these towns are of historical interest, as is the County Court House in Plattsmouth and the abandoned site of Factoryville, formerly a promising city with stores, mills, and a Methodist college. King Hill and Queen Hill, west bank bluffs, were well known landmarks for early travelers along the Missouri River.

The City Hall, County Court House and jail, several commercial buildings, and several houses are points of historical interest in

Tecumseh. Other points in Johnson County include houses and a cabin in Elk Creek, the Catchpole House in Sterling, and an old-style windmill in Cook.

There are a number of sites in Richardson County that are of historical interest. In Falls City two houses, a brewery, and a mill have been designated as historical sites as have a flour mill near Salem and four sites yielding historic Indian material. The Indian Cave site, now the Indian Cave State Park, in the southeast corner of the county contains Indian petroglyphs. The Iron Monument, a seven-foot high obelisk situated on the Kansas-Nebraska border, marks the starting point of all Nebraska surveys.

In Pawnee County there are several sites of historical interest. One and one-half miles east of Table Rock there is a group of Indian carvings, and three miles northeast of Table Rock is a type site of the Nebraska Aspect. Also in Table Rock, the Opera House and State Bank are points of interest. In or near the city of Pawnee City are several additional places of historical significance. The Turner Cabin, one and one-half miles east of DuBois, an original log cabin built in 1854, is probably the oldest structure in the county. The Pawnee City Historical Society has recently moved several buildings into an outdoor museum complex. Included in the complex are the Benz Building, built in 1863 as Pawnee City's first school, the Butler House and the Crackerbox School, a one-story frame structure built near Burchard in the 1880's. There are several houses and commercial buildings, most of them built in the last half of the nineteenth century, that are of historical interest.

H. Quality of Natural Environment

Previous sections of this chapter give an inventory of the natural resources of the basin, quantities and qualities which help make up the physical environment. Climate, availability of water, and land use are major factors which characterize the quality of the physical environment.

The natural environment is influenced by the use that has been, and is being made, of the area and its resources. The major industry in the Nemaha River Basin is generalized agriculture with major emphasis upon dryland cropping. Therefore, the environmental aspects of the landscape are influenced by the characteristics of general farming.

In those areas (five percent of the basin) that are forested, the trees add to the landscape characteristic being viewed and provide the visual variety likely to be more appealing than ones tending toward monotony. Forested areas are important for their ability to trap sediment and provide recreation, wildlife, forage, timber, windbreaks, and shelterbelts. In utilizing the forest resources, deviations will be created in the landscape; however, these deviations can be designed to achieve visually acceptable variety and still meet the resource needs.

Arbor Lodge

J. Sterling Morton's Home

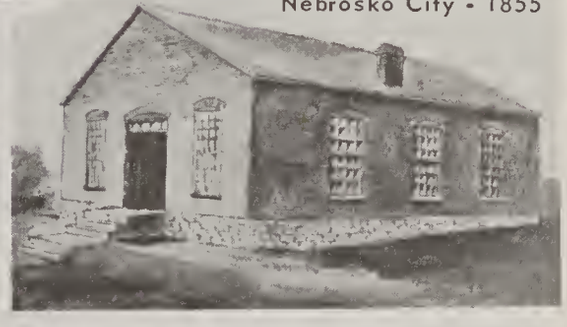
Nebraska State Historical Society

First producing oil well in Nebroska
Richordson County - 1939

All Nebraska surveys storted ot this
iron monument on the Konsos - Nebrosko
border neor the Missouri River.

Honey Creek Coal Mine

Methodist Church
Nebrosko City - 1855



First Nebraska State Fair
Brownville - 1870

Brownville - 1881

Early day
Table Rock

Plattsmouth River Front - 1872

Factoryville - 1880 (did not survive)

First Cass County Courthouse

CHAPTER III
BASIN ECONOMY

In looking at the resources of a river basin and their potential for development, it becomes important that information on the changes to be derived from development be noted. An economic base study helps to fulfill this need. The base study provides information on what the situation now is and how it came to be as well as where it is going in the future without project development. The county building block technique was applied to this study. The counties of Cass, Johnson, Otoe, Nemaha, Pawnee, and Richardson were used as approximations of the basin for most data. The land inventory and other strictly hydrologically related items were tabulated on the basis of the hydrologic boundary.

This report contains a survey of current conditions as well as projections of those conditions for 1985, 2000, and 2020.

A. Historical Development

The Nemaha River Basin is part of that vast area of prairies which Stephen Lery, in 1819, told the government officials in Washington was a great desert. The Indians who owned the area viewed it as a great feeding ground for buffalo herds. The tribes in this area were the Missouri and Otoe tribes while others such as the Pawnee hunted in the area.

Lewis and Clark were probably the first serious explorers to view the basin although some of the Spanish gold seekers passed through the area. The Lewis and Clark expedition came as a result of the Louisiana Purchase in 1803 and the desire of the government to know what they had purchased.

The first permanent settlement in the basin was in 1844 when the federal government established an Army post on the site of what is now Nebraska City. Prior to that time the area was in possession of the Indians who objected to the visits of the itinerant fur traders.

In 1853 a settlement was established in what is now Cass County and a trading post was established at St. Derain in what is now Nemaha County.

President Pierce signed a treaty in March 1854 with the Indians which permitted white men to settle on land bordering the west bank of the Missouri River. There were quite a few people already there and by 1856 a good share of the bottomlands had been settled and settlement was spreading throughout the upland.

Most of the area was settled under the Pre-emption Act of 1841 which allowed settlement of 160 acres for residence with the payment of $1.25 per acre.

Settlers to the basin came mostly from Iowa, Indiana, Missouri, Illinois, Tennessee, and the New England states. Some of the settlers, however, were of foreign extraction and included Germans, Swedes, Welsh, Bohemians, Irish, English, and French.

The six principal counties of Cass, Johnson, Nemaha, Otoe, Pawnee, and Richardson were created by the Territorial legislature in 1854 and 1855, though some of the present boundaries were not established until the 1900's.

Other early settlements in the basin were at Brownville in 1854, north of Falls City in 1855, and southeast of Tecumseh in 1855.

The agricultural economy which was established by the settlers has remained the mainstay of the basin. Much drainage and channel work was done early to increase the productivity of the area and reduce flooding problems. The area experienced the general boom of the early 1880's and the economic depression, drought, and blizzards of 1887 and 1888.

From the late 1800's through the early 1900's there was a sifting out of farm operations, the adoption of technology, and the consolidation of farm units which caused the population growth rate to decline, farm numbers to decrease, and the agricultural industry to adjust itself to the environment of the area.

B. Economic Indicators

1. Population

The population of the basin has been steadily declining since 1940. This trend has been somewhat slower, however, in the 1960 to 1970 period. Decline in population in the basin is due to its rural agriculture nature. Technology and the economics of farming as well as the pull of the population centers of Omaha and Lincoln have decreased farm employment, farm population, and the associated services to this population.

The share of the population in urban areas of the basin has continued to increase proportionately as well as in absolute numbers.

In the rural nonfarm segment are the small communities and the rural nonfarm residents. This sector has vacillated somewhat due to the growth of some communities, the decline of others, and the death of many who left the farm and moved to small communities. Some small communities have shown a spurt of growth in the last decade, much of which can be attributed to rest homes, etc. Such growth is likely to be only temporary.

Net migration in the six-county area amounted to over seven thousand people between 1960 and 1970. All counties except Cass showed a net outmigration. Table III-1 shows population change by component and

the migration by county. The net outmigration for the area was 10.7 percent. Much of this migration has been in the 25-44 age group.

Table III-1 POPULATION CHANGE AND NET MIGRATION TO AND FROM COUNTIES, 1960 to 1970
Nemaha River Basin, Nebraska

County	Population		Percent Change 1960 to 1970	Components of Change			Net Migration rate
	1970	1960		Births to Resident Mothers	Deaths of Residents	Net Migration	
	No.	No.	Pct.	No.	No.	No.	Pct.
Cass	18,076	17,821	+ 1.4	3,701	1,930	-1,516	- 8.5
Johnson	5,743	6,281	- 8.6	972	801	- 709	-11.3
Nemaha	8,976	9,099	- 1.4	1,284	1,122	- 285	- 3.1
Otoe	15,576	16,503	- 5.6	2,633	1,953	-1,607	- 9.7
Pawnee	4,473	5,356	-16.5	599	764	- 718	-13.4
Richardson	12,277	13,903	-11.7	1,984	1,842	-1,768	-12.7
TOTAL	65,121	68,963	- 5.6	11,173	8,412	-6,603	-10.7

Source: Stanley W. Voelker, "Population Change and Net Migration", Great Plains Agricultural Council Publication No. 52.

Historical and projected population estimates for the basin are in Table III-2.

In projecting population it was assumed that rural farm population would continue to decline but at a declining rate over time. Projections show the rural farm population decreasing from 18.2 thousand in 1970 to 15 thousand in 1985 and down to 12 thousand in 2020. The decline is tied to the increasing productivity of the individual farmers and the projected onfarm employment.

The urban sector was projected to continue to grow based on past trends and the expected overflow effect from the growth of the Omaha-Council Bluffs Standard Metropolitan Statistical Area (SMSA) as well as some from the Lincoln SMSA. The spin off growth from the SMSA's would be expected to be in Plattsmouth and Nebraska City. Another factor in the growth would be some migration not leaving the basin but moving to the larger towns rather than the small communities. Urban population was projected to increase from a current 22.9 thousand to 28 thousand by 2020.

Table III-2 HISTORICAL AND PROJECTED POPULATION BY COMPONENTS
Nemaha River Basin, Nebraska

Year	Urban	Rural Nonfarm	Rural Farm	Total
1940	21,390	21,770	41,960	85,120
1950	21,370	22,370	31,520	75,260
1960	22,340	23,380	23,250	68,970
1970	22,840	24,120	18,160	65,120
1985	23,600	24,500	15,000	63,100
2000	25,000	26,000	13,000	64,000
2020	28,000	27,000	12,000	67,000

Source of Historical Data: U.S. Department of Commerce, Bureau of Census, U.S. Census of Population.

Rural nonfarm population was projected to show a steady although small increase over time. Again, much of this may be attributed to the pushing out of people from the SMSA's which are in direct proximity to the basin. Projections show an increase from 24.1 thousand in 1970 to 24.5 thousand in 1985.

Table III-3 shows the cities and villages in the basin by 1970 class. The largest city is Nebraska City with 7,441 in 1970, followed by Plattsmouth with 6,371.

Table III-3 POPULATION OF CITIES AND VILLAGES BY 1970 CLASS
Nemaha River Basin, Nebraska

Population Class	Number of Places	Years			
		1940	1950	1960	1970
2,500-10,000	4	21,392	21,371	22,323	22,906
1,000- 2,500	6	8,232	8,372	8,012	8,604
200- 1,000	26	9,965	8,672	8,024	8,359
Less than 200	16	3,253	2,431	2,166	1,990

Source: U.S. Department of Commerce, Bureau of Census, U.S. Census of Population.

Table III-4 gives a breakdown of the population by age and sex for 1970. The distribution between male and female is fairly equal, with females having greater numbers after age 19. Cumulative percentage by age groups shows that 34 is near the point in age where 50 percent of the population is younger and 50 percent is older.

Table III-4 POPULATION DISTRIBUTION BY AGE AND SEX, 1970
Nemaha River Basin, Nebraska

Age	Male	Female	Total	Percent	Cumulative Percent
Under 5 years	2,378	2,289	4,667	7.2	7.2
5- 9 years	3,025	2,828	5,873	9.1	16.3
9-14 years	3,198	3,079	6,277	9.7	26.0
15-19 years	2,869	2,406	5,275	8.1	34.1
20-24 years	1,923	1,968	3,891	6.0	40.1
25-29 years	1,630	1,676	3,306	5.1	45.2
30-34 years	1,502	1,529	3,031	4.7	49.9
35-39 years	1,531	1,617	3,148	4.9	54.8
40-44 years	1,783	1,792	3,575	5.5	60.3
45-49 years	1,737	1,826	3,563	5.5	65.8
50-54 years	1,887	1,969	3,856	6.0	71.8
55-59 years	1,824	1,887	3,711	6.0	77.8
60-64 years	1,764	1,886	3,650	5.8	83.6
65 + years	4,304	6,294	10,598	16.4	100.0
TOTAL	31,365	33,046	64,411	100.0	

Source: U.S. Department of Commerce, Bureau of Census, U.S. Census of Population.

2. Employment

Employment in the Nemaha River Basin has followed closely the decline of the agricultural work force. Because the economy has been tied so closely to agriculture, the increasing technology and efficiency

of food production has taken its toll in total employment. The decline in farm employment has been partially offset by increases in the manufacturing, trade and services sectors. The growth of manufacturing in Auburn, Tecumseh, and Nebraska City has been responsible for most of the growth in the nonagriculture sectors.

Table III-5 shows the historical employment by major industry classification in the basin. The distribution of 1970 employment among industries is led by agriculture with 21 percent, followed closely by services with 20 percent, and trade with 19 percent. Manufacturing makes up 16 percent of the basin's employment. The remaining 24 percent is distributed as: 7 percent government; 6 percent transportation; 8 percent construction and mining; and 3 percent finance, insurance, and real estate.

Table III-5 EMPLOYMENT BY MAJOR INDUSTRIES
Nemaha River Basin, Nebraska

Industry	Employment			
	1940	1950	1960	1970
Agriculture, Forestry and Fisheries	13,370	12,600	8,570	5,230
Mining	250	220	250	280
Contract Construction	1,170	2,000	1,510	1,660
Manufacturing	1,250	1,570	3,080	3,990
Transportation, Communications and Public Utilities	1,490	2,190	1,720	1,500
Wholesale and Retail Trade	3,500	4,310	4,350	4,800
Finance, Insurance and Real Estate	410	480	530	690
Services	4,350	3,890	4,380	4,830
Government	660	1,040	1,530	1,750
TOTAL	26,450	28,300	25,920	24,730

Source: U.S. Department of Commerce, Bureau of Census, U.S. Census of Population.

The 1970 Census of Population shows that of those reporting, about 78 percent of the workers were employed in their home county. From the census data it is hard to determine just how many workers are actually employed outside of the basin. From all indications it appears safe to assume that in excess of 15 percent of the employment is outside of the basin itself. This percentage is expected to increase over time under the influence of the two SMSA's in close proximity to the basin.

Number of unemployed persons is shown by occupational class within each county and for the basin in Table III-6. Percentage unemployment in the basin was a moderate 3 percent, with operators and craftsmen comprising about half the total number of unemployed. Farm laborers

accounted for about 7 percent unemployed. Cass County had the greatest percentage unemployment at 3.8 percent of the civilian labor force, while Pawnee County had the lowest rate of unemployment at 1.2 percent.

County underemployment may be measured as the ratio of the county actual median income to the adjusted national median income. In relation to any given county the factors of age-color mix, educational status, percentage of the people who receive income that are in the labor force, and the proportion of civilian to armed forces employees are applied to the national median income to establish a required county median income. Division of the actual median income by the required median income and multiplication by 100 establishes an economic utilization index for the county. This index is a measure of how fully the county labor force was employed. An index of 100 would indicate that the labor force was employed at full capacity. Underemployment is considered severe when the labor force is at 80 percent or less of its full capacity.

Table III-6 UNEMPLOYMENT BY LAST OCCUPATION[1/]
Nemaha River Basin, Nebraska

Last Occupation of Unemployed	Number Unemployed by County						Basin Total
	Cass	Johnson	Nemaha	Otoe	Pawnee	Richardson	
Professional and Managerial	15	--	6	4	--	8	33
Sales	4	--	--	9	--	11	24
Clerical	57	14	9	9	5	--	94
Craftsmen	38	5	15	23	--	29	110
Operators	41	13	66	56	6	51	233
Nonfarm Labor	14	18	11	33	5	18	99
Farm Labor	10	15	5	10	5	5	50
Services	28	--	11	15	--	14	68
Other	23	4	--	5	--	--	32
Total No. Unemployed	230	69	123	164	21	136	743
Percent Unemployment	3.8	3.2	3.2	2.6	1.2	3.0	3.0

1/ Males and females 16 years old and over.
Source: U.S. Department of Commerce, Bureau of Census, 1970 Census of Population.

The economic utilization listed for the basin counties in Table III-7 indicate severe underemployment of both males and females in each county. Least severe underemployment was in Cass County while Pawnee County had the most severe underemployment. For the basin the ratio of economically unutilized male labor to that of female labor was on the order of 3:1. The data shows that basin underemployment amounted to 8,446 man-years.

Table III-7 ESTIMATED UNDEREMPLOYMENT
Nemaha River Basin, Nebraska

County	Economic Utilization Index 1/		Percentage Underemployed 2/		Man-years of Economically Unutilized Labor 3/		
	Male	Female	Male	Female	Male	Female	Total
Cass	79.1	77.1	20.9	22.9	915	363	1,278
Johnson	50.7	64.6	49.3	35.4	896	279	1,175
Nemaha	56.3	65.4	43.7	34.6	1,016	307	1,323
Otoe	74.9	78.3	25.1	21.7	1,061	385	1,446
Pawnee	44.0	50.4	56.0	49.6	850	338	1,188
Richardson	61.4	66.9	38.6	33.1	1,476	560	2,036
TOTAL					6,214	2,232	8,446

1/ An index of 100 would indicate that the county labor force was employed at full capacity.
2/ Percentage underemployment is the product of subtracting the Economic Utilization Index from 100.
3/ Derived by multiplying the rate of underemployment by the number of employed civilians in the labor force.
Source: Underemployment Estimates by county, United States, 1960. Agricultural Economics Report No. 166, Economic Research Service, U.S. Department of Agriculture.

Table III-8 shows the projected employment in the basin by industry groups. Employment is expected to follow the population trend, the two interacting with each other so that one is determined at least in part by the other. Total employment is assumed to continue to decline slightly, to stabilize and then to begin to climb as the population increases. Agriculture is the only industry which is expected to continue to decline in numbers of workers, although more slowly than the historic rate of decline.

While the growth rates of the other industries are not so great as in the rest of the state, they are at least moving in a positive direction but at a much slower rate than the state and nation.

Table III-8 PROJECTED EMPLOYMENT
Nemaha River Basin, Nebraska

Industry	Employment		
	1985	2000	2020
	Thousands		
Agriculture	4.8	4.2	3.8
Mining	.3	.3	.3
Contract Construction	1.7	1.7	1.9
Manufacturing	4.0	4.2	4.6
Transportation, Communications and Public Utilities	1.5	1.6	1.7
Wholesale and Retail Trade	4.8	5.0	5.5
Finance, Insurance and Real Estate	.7	.7	.8
Services	4.9	5.0	5.4
Government	1.8	1.8	1.9
TOTAL	24.5	24.5	25.9

Projected unemployment within each county and for the basin is presented in Table III-9. The number of unemployed persons within counties is not expected to vary markedly over time. No significant shift is foreseen in the position of any county relative to the others with regard to the severity of unemployment over time. The data indicates that unemployment will hover around 2.8 percent, very near the 1970 figure of 3 percent as reported in Table III-6.

3. Income and Earnings

Total personal income in the basin has trended upward going from 92 million dollars in 1950 to 175 million dollars in 1968. In 1968 personal income sources, less personal contributions for social insurance, were 44 percent from proprietor income, 19 percent from property income, and 11 percent from transfer payments.

Table III-10 shows a historical breakdown of income and earnings for the basin. In 1950 farm earnings accounted for 49 percent of the total. Farm earnings have declined in percentage of the total while increasing in absolute terms over time. In 1965 they were only 31 percent while in 1967 they accounted for 29 percent. In 1968 the

Table III-9 PROJECTED UNEMPLOYMENT
Nemaha River Basin, Nebraska

County	Projected Unemployment				
	1980	1985	1990	1995	2000
	Number				
Cass	205	219	225	232	241
Johnson	61	61	60	60	60
Nemaha	101	101	101	103	106
Otoe	187	189	189	190	193
Pawnee	45	44	43	41	41
Richardson	127	126	124	123	123
TOTAL	726	740	742	749	764
Percent Unemployed 1/	2.8	2.8	2.8	2.8	2.8

1/ Percent unemployed of projected total civilian employment, rounded to the nearest one-tenth of one percent.
Source: Bureau of Business Research, University of Nebraska, Lincoln; Nebraska Economic and Business Reports, Number 7, July 1974, Nebraska Economic Projections.

percentage dropped to 21. Due to the cyclical nature of agriculture a normal level appears to be around 30 percent of total earnings coming from the farm sector.

Private nonfarm earnings have continued to increase in importance both in absolute terms as well as percentage. In 1950 the sector accounted for 40 percent of all earnings. In 1965 it had risen to 52 percent, in 1967 to 53 percent, and in 1968 to 59 percent.

In the projected time frames, the current trends were assumed to continue as modified by other pertinent factors. As in the past, agriculture is projected to increase in absolute amounts while decreasing percentagewise. Table III-11 shows the projected earnings by major industry for the basin.

The distribution of family incomes and percentage of families in each class is shown in Table III-12. Almost 22 percent of the families in the Nemaha River Basin have net income of less than 4,000 dollars per year while about 19 percent of the families have net incomes over 12,000 dollars per year.

The inequality of incomes can be viewed graphically by constructing an income distribution curve with percent of income on one axis

Table III-10 INCOME AND EARNINGS 1/
Nemaha River Basin, Nebraska

Item	1929	1940	1950	1959	1962	1965	1966	1967	1968
	Thousands of Dollars								
Total Personal Income	42,214	31,678	92,367	103,711	118,177	153,048	172,862	171,453	174,516
Total Wage and Salary Disbursements	13,826	10,996	29,865	45,708	51,784	61,644	66,545	69,527	78,661
Other Labor Income	155	125	575	1,627	1,915	2,421	2,675	2,888	3,052
Proprietors Income	21,977	15,481	45,350	29,626	33,204	48,984	59,991	51,713	42,424
Property Income	5,329	3,727	11,706	19,090	21,914	29,274	32,200	33,654	34,355
Transfer Payments	992	1,498	5,612	9,469	11,725	13,515	14,983	17,833	20,367
Less: Personal Contributions for Social Insurance	65	149	741	1,809	2,355	2,790	3,442	4,162	4,343
Total Earnings	35,958	26,602	75,790	76,961	86,903	113,049	129,211	124,128	124,137
Farm Earnings	19,269	12,703	37,211	17,769	19,690	34,745	45,594	35,471	25,521
Total Nonfarm Earnings	16,689	13,899	38,579	59,192	67,213	78,304	83,617	88,657	98,616
Government Earnings:	2,321	4,001	8,137	13,490	16,833	19,659	21,082	23,219	25,344
Total Federal	648	2,452	1,866	5,093	6,471	6,690	7,518	8,018	7,917
State and Local	1,673	1,549	6,191	8,507	10,362	12,969	13,564	15,201	17,427
Private Nonfarm Earnings:	14,368	9,898	30,442	45,602	50,380	58,645	62,535	65,438	73,272
Manufacturing	2,320	1,253	4,055	8,799	9,097	11,292	12,638	13,163	13,789
Mining	243	169	406	1,587	1,933	1,787	1,840	1,627	1,305
Contract Construction	812	427	2,162	3,940	3,899	4,513	4,717	4,630	8,412
Transportation, Communications & Public Utilities	3,023	1,802	5,308	6,910	7,496	6,991	7,198	7,023	7,470
Wholesale and Retail Trade	4,397	3,692	11,809	15,281	16,856	18,854	20,009	21,156	22,673
Finance, Insurance and Real Estate	630	324	917	1,574	1,797	2,739	2,875	2,818	2,925
Services	2,907	2,206	5,422	6,871	8,543	9,765	10,270	11,587	13,121
Other	36	25	363	640	759	2,704	2,988	3,434	3,577

1/ Current year price base.
Source: Bureau of Economic Analysis, U.S. Department of Commerce.

Table III-11 PROJECTED EARNINGS BY MAJOR INDUSTRIES 1/
Nemaha River Basin, Nebraska

Industry	1985	2000	2020
	Thousands of Dollars		
Agriculture	36,000	46,000	61,000
Mining	2,000	2,423	3,584
Contract Construction	8,118	11,958	21,410
Manufacturing	21,624	32,802	59,602
Transportation, Communications and Public Utilities	9,890	13,967	23,473
Wholesale and Retail Trade	33,291	50,848	94,636
Finance, Insurance and Real Estate	4,042	6,076	10,973
Services	21,922	36,828	73,238
Government	42,510	69,883	133,253

1/ 1958 Price Base.
Source: Office of Business Economics - Economic Research Service (OBE-ERS) 1972 Economic Area 108.

and percent of families on the other axis. Figure III-1 illustrates such a curve which is constructed for the Nemaha River Basin. The diagonal line illustrates a uniform distribution. For example, if we read off the diagonal line, 50 percent of the families would receive 50 percent of the income.

The curve to the right of the diagonal is that constructed for the Nemaha River Basin. Reading from the constructed curve, it is noted that 50 percent of the families received 24 percent of the income and 80 percent of the families received 52 percent of the income in the basin. Conversely it can be stated that 50 percent of the families received 76 percent of the income and 20 percent of the families recieved 48 percent of the income of the basin.

4. Transportation and Communication

The basin is served by an adequate system of primary and secondary roads. The principal highways are U.S. 73, 75, and State 50 running north and south; and U.S. 136 and State 2 running east and west. Farm to market roads are well distributed and about 75 percent of the mileage is gravel or surfaced. However, the remaining 25 percent of the rural county and township roads are unsurfaced, some of which becomes impassible seasonally. The basin is well served by commercial truck lines.

The Burlington Northern and Missouri Pacific railroads provide freight service to most of the basin. There is no rail passenger service available.

Table III-12 DISTRIBUTION OF FAMILY INCOMES, 1969
Nemaha River Basin, Nebraska

Family Income	Number of Families	Percent of Families
Less than $4,000	3,772	21.5
4,000 - 4,999	1,378	7.8
5,000 - 5,999	1,470	8.4
6,000 - 6,999	1,511	8.6
7,000 - 7,999	1,433	8.2
8,000 - 8,999	1,493	8.5
9,000 - 9,999	1,180	6.7
10,000 - 11,999	1,920	10.9
12,000 - 14,999	1,687	9.6
15,000 - 24,599	1,458	8.3
25,000 - 49,999	229	1.3
Over 50,000	36	.2
TOTAL	17,567	100.0

Source: U.S. Department of Commerce, Bureau of Census, 1970 U.S. Census of Population.

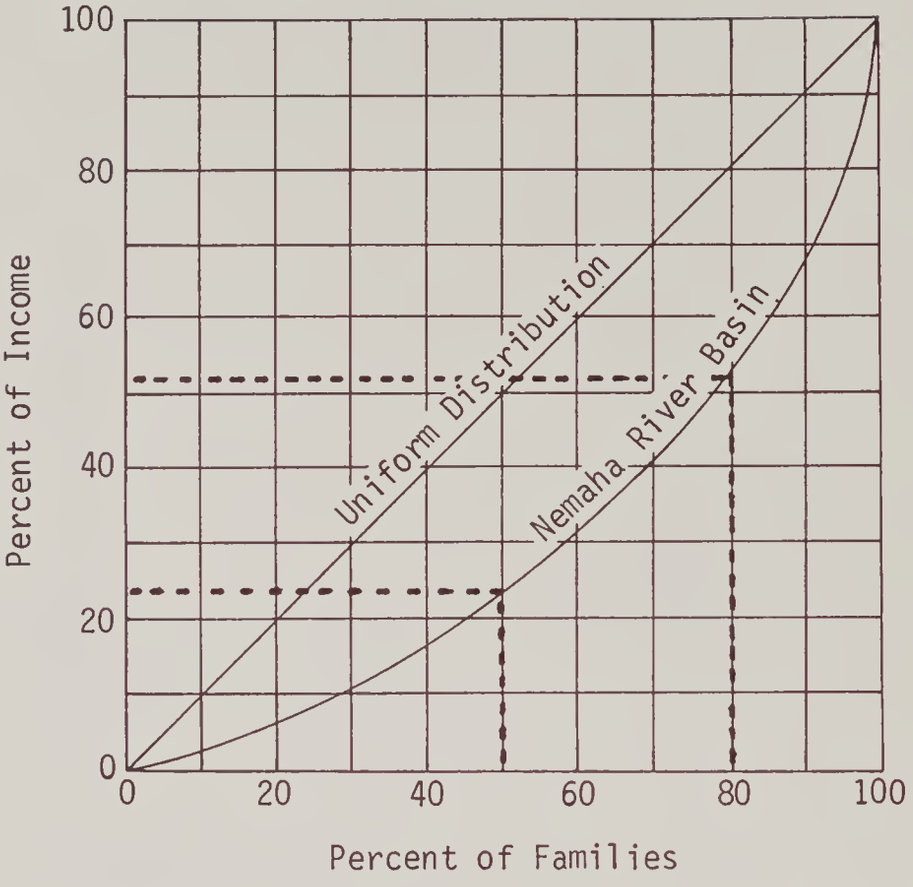
There is no commercial air service within the basin. The nearest commercial service is available at Lincoln and Omaha, Nebraska, and St. Joseph, Missouri. Municipal airports are located at Tecumseh, Nebraska City, Syracuse, and Falls City within the basin.

Telephone service is available to all of the basin. The basin receives adequate coverage from radio and television stations, and newspapers, both within the basin and adjacent to the basin.

5. Medical Services

Medical services in the basin are usually located in incorporated places that have 1,000 or more in population. Two lone exceptions are Elmwood (pop. 638) and Nehawka (pop. 293) each having one doctor.

Figure III-1 DISTRIBUTION OF INCOME
Nemaha River Basin, Nebraska



The location of towns that have one or more doctors is quite evenly distributed throughout the basin, allowing close to even access for residents in the smaller villages and rural areas. It should be noted that "even" access doesn't mean quick or necessarily easy access. For example, Talmage, due to its central location, has even access to hospitals in Nebraska City, Syracuse, Tecumseh, and Auburn, but quick access to none, since all are close to thirty miles away. The situation of "even access to all but close to none" is not unique to Talmage, as a glance at the map will verify. (Figure III-2). Table III-13 lists doctors located within the basin.

The seven hospitals in the basin are located in communities of 1,000 or more population and all except three recorded above 70 percent occupancy during Fiscal Year 1971. Syracuse and Pawnee City hospitals reported 46.6 percent and 40.7 percent occupancy respectively. The northern end of the basin, the southern end of Cass County, and the northern half of Otoe County, have doctors but no hospitals. This is apparently due to the short distance and good accessibility to hospital facilities in Lincoln and Omaha. A listing of hospitals in the basin is found in Table III-14.

The 18 homes for the aged in the basin seem to be of more than secondary importance when the high median age of the population is brought into focus.

When considering care for the aged, the southern half of the basin has smaller, lower class establishments than the northern half.

Figure III-2 MEDICAL FACILITIES
Nemaha River Basin, Nebraska

Table III-13 LOCATION AND SPECIALTY OF DOCTORS
Nemaha River Basin, Nebraska

County and Town	No.	Specialty 1/
Cass:		
Elmwood	1	GP
Nehawka	1	GP
Plattsmouth	2	GP
Weeping Water	1	ORS
Johnson:		
Tecumseh	2	GP
Nemaha:		
Auburn	3	GP
	1	GP-OBG
Otoe:		
Nebraska City	5	GP
	1	GS
	1	OPH-OTO
Syracuse	3	GP
Pawnee		
Pawnee City	2	GP
Richardson:		
Falls City	5	GP
	1	OPH-OTO
Humboldt	1	GP
	1	GP-GS

1/

GP	General practitioner
GS	General surgeon
OBG	Gynecology-obstetrics
OPH-OTO	Eyes, Ear, Nose, and Throat
ORS	Bone specialist

	No. of Doctors
GP	25
GS	1
GP-GS	1
GP-OBG	1
OPH-OTO	2
ORS	1
Total	31

Source: Nebraska State Medical Association, 1972.

In terms of bedspace, the northern half has the largest percentage of the total number of beds and the largest percentage of better quality bedspace.

6. Educational Facilities

In terms of attendance, those schools in class I districts which have less than 7 teachers educate 10.4 percent of the total public elementary and secondary school enrollment of the basin. These districts maintain only kindergarten through 8th grade (K-8) school systems and educate 14.3 percent of the approximate (K-8) enrollment of

Table III-14 CHARACTERISTICS OF AVAILABLE HOSPITALS
Nemaha River Basin, Nebraska

County and City	Bedspace	Admissions	Percent Occupancy
Cass:	-	-	-
Nemaha:			
Auburn	26	1,304	83.5
Richardson:			
Falls City	42	1,549	72.6
Humboldt	35	505	38.6
Otoe:			
Syracuse	26	616	46.6
Nebraska City	110	1,982	76.9
Pawnee:			
Pawnee City	25	509	40.7
Johnson:			
Tecumseh	28	1,043	82.1
TOTAL	292	7,508	

Source: The Hospital (August, 1971).

9,984. Table III-15 shows a tabulation of class I schools in the basin.

Table III-15 CHARACTERISTICS OF CLASS I SCHOOLS
(Less than 7 Teachers)
Nemaha River Basin, Nebraska

County	Enrollment	No. of Teachers	No. of Schools
Cass	220	17	14
Johnson	63	7	6
Nemaha	134	10	7
Otoe	361	28	24
Pawnee	76	7	3
Richardson	271	24	18
TOTAL	1,125	93	72

Source: Statistics and Facts About Nebraska Schools, 1971-1972. Department of Education, Lincoln, Nebraska.

Educators are generally of the opinion that class I schools offer less than a desirable program. Possible exceptions to this opinion could be the state accredited class I Murray Elementary School with 234 pupils and 11 teachers.

Class II districts are the least populated districts that maintain elementary and secondary school systems. Class II schools educate 10.2 percent of the total elementary and secondary public enrollment in the basin. Class II districts contain elementary and rural high school systems and are usually located in small rural communities.

Class III school districts maintain the largest elementary and secondary schools and account for 79.3 percent of the total enrollment in the basin's public schools. Class III schools are usually located in the larger communities. Some class III schools, however, are located in smaller rural communities and are the result of consolidation of former class I and II districts. Table III-16 shows school enrollment by county and class.

All consolidated districts have been accredited and all except Dawson-Verdon are in class III districts. Dawson-Verdon is in class II.

Of the six non-consolidated class II schools, three are not accredited, a ratio of 50 percent. The same ratio applied when considering the two class I elementary schools with seven or more teachers. Only one, Murray, is accredited. All class III schools, consolidated and non-consolidated, have been accredited.

Private schools account for 5.8 percent of the basin's total elementary and secondary school enrollment. The majority of the private schools are located in Falls City, Nebraska City, Tecumseh, and Plattsmouth.

Peru State Teachers College at Peru is the only institution of higher learning in the basin. The enrollment in the spring of 1972 was 1,001 comprised of 258 residents and 743 nonresidents of the state. The positive externality of the college in Peru (pop. 1,380) and in the local area, due to the out-state and out-of-state transfer of income to the area, is apparent. Figure III-3 shows the location of educational facilities in the basin.

7. Other Social Services

Other social services such as police and fire protection are well organized throughout the basin. Rural fire protection, including range and forest fire control, is provided for by the Nebraska State Forester. The U.S. Forest Service, through the Clarke-McNary Cooperative Fire Control Program, assists the State Forester in providing for fire protection by supplying federal funds, training, surplus property, and technical expertise. There is some duplication in police services between communities and county sheriffs departments.

Table III-16 ELEMENTARY AND SECONDARY SCHOOL ENROLLMENT, 1971-1972
Nemaha River Basin, Nebraska

County	Class I		Class II		Class III		Total All Classes	State Operated	Non Public	Total
	Res.	Non-Res.	Res.	Non-Res.	Res.	Non-Res. 1				
Cass: without Murdock and Louisville	453	1	178	34	2,442	144	3,252		116	3,368
Johnson	63		394	18	927	59	1,461		105	1,566
Nemaha	134				1,550	49	1,733			1,733
Otoe	435		117	2	2,804	191	3,549	57 1/	372	3,978
Pawnee	76		377	53	480	4	990			990
Richardson	271		212	17	2,103	141	2,744		258	3,002
TOTAL	1,432	1	1,278	124	10,306	588	13,729	57	851	14,637

1/ State operated school in Otoe County is the Nebraska School for the Visually Handicapped.

Figure III-3 EDUCATIONAL FACILITIES
Nemaha River Basin, Nebraska

C. Agricultural Sector

1. Land Use

Cropland is the predominant land use in the basin, accounting for 1.2 million acres of the total 1.8 million acres or about 68 percent of the total.

The next major land use is pastureland with 349,000 acres. Forest land, urban, and built-up lands, other lands and water areas are each less than 100,000 acres. Table III-17 shows the current major land use of the basin.

Table III-17 CURRENT MAJOR LAND USE
Nemaha River Basin, Nebraska

Item	Subtotal	Total
Water Areas		20,800
Large Water Areas	14,300	
Small Water Areas 1/	6,500	
Cropland		1,210,300
Irrigated Cropland	11,000	
Non-Irrigated Cropland	1,199,300	
Pastureland		349,100
Forest land		86,100
Non-grazed Commercial Forest	36,500	
Grazed Commercial Forest	49,600	
Urban and Built-up Lands		62,200
Other Lands		45,300
Total Basin Areas		1,773,800

1/ Ponds, lakes or reservoirs more than 2 acres and less than 40 acres; and rivers and streams that are less than 1/8 mile wide.
Source: 1967 Conservation Needs Inventory.

2. Farm Characteristics

The number of farms has been steadily decreasing from over 9,000 in 1950 to about 5,600 in 1969. With the decrease in farm numbers has come an increase in farm size. In 1950 the average farm size was 200 acres. In 1969 the average size was over 300 acres.

The land actually in farms has decreased about 5 percent since 1950. The decrease is due to change in definition of farms, withdrawal for roads and urban build-up, county residences not classified as farm residences, and some abandonment of land unsuited to agriculture. Table III-18 shows the number of farms and additional characteristics for 1964 and 1969.

Table III-18 FARM SIZE AND CHARACTERISTICS 1964 AND 1969
Nemaha River Basin, Nebraska

Item	Unit	1964	1969
Number of Farms	No.	6,429	5,594
Average Size of Farms	Acres	281	311
Value of Land and Buildings 1/	Million Dollars	332,489	443,642
Average Value of Land and Buildings Per Acre 1/	Dollars	185	258

1/ Current year price base.
Source: U.S. Department of Commerce, Bureau of Census, U.S. Census of Agriculture.

Tenure of farm operators as shown in Table III-19 has shifted away from tenancy toward partial and full ownership. In 1964, full owners accounted for 38 percent of all farms while in 1969 they accounted for 42 percent. In the same period, all tenants decreased from 31 percent to 24 percent and part owners increased from 31 percent to 34 percent.

Table III-20 shows the breakdown of farms by type of agriculture.

3. Cropping Patterns and Production

Corn and grain sorghum are the major crops in the Nemaha River Basin followed by soybeans and wheat. Table III-21 shows the current cropping pattern for the basin as well as the current and projected

yields expected.

Table III-19 FARMS BY TENURE OF OPERATOR 1964 AND 1969
Nemaha River Basin, Nebraska

Tenure	1964	%	1969	%
Full Owners	2,440	38	2,330	42
Part Owners	1,980	31	1,890	34
All Tenants	2,009	31	1,370	24
TOTAL	6,429	100	5,590	100

Source: U.S. Department of Commerce, Bureau of Census, U.S. Census of Agriculture.

Table III-20 NUMBER OF FARMS BY TYPE OF OPERATION 1964 AND 1969
Nemaha River Basin, Nebraska

Type of Operation	1964	1969
Cash Grain	2,122	1,982
Poultry	83	8
Dairy	268	178
Livestock Farms Other Than Poultry and Dairy	2,437	2,313
Livestock Ranches	42	45
General Farms	428	195
All Other Farms 1/	1,049	869
TOTAL	6,429	5,590

1/ Includes those farms with sales less than $2,500.

Source: U.S. Department of Commerce, Bureau of Census, U.S. Census of Agriculture

The projected yields were derived from work done for the Missouri River Basin study by the Great Plains Agricultural Council and updated for this study.

The current agricultural production and gross value, using October 1973 current normal prices, is shown in Table III-22.

Projected cropland production was derived from past trends, productive capability, and national projections. Irrigated cropland was

projected to increase from a current 11,000 acres to 16,000 acres based upon assumptions and information contained in the Nebraska State Water Plan.

Table III-21 CURRENT CROPPING PATTERNS AND CURRENT AND PROJECTED YIELDS
Nemaha River Basin, Nebraska

Crop	Unit	1969		Projected Yield		
		Acres	Yield	1985	2000	2020
Nonirrigated						
Corn Grain	Bu.	296,400	68.0	80.9	100.0	115.6
Grain Sorghum	Bu.	203,800	72.2	85.2	106.1	127.1
All Wheat	Bu.	107,000	43.2	51.0	63.1	78.2
Other Small Grains	Bu.	10,500	45.2	53.8	67.3	79.1
Soybeans	Bu.	138,300	26.7	29.9	33.9	36.8
Corn Silage	Ton	10,000	11.2	13.8	16.9	18.9
Sorghum Silage	Ton	4,900	14.0	17.2	21.1	23.7
Alfalfa Hay	Ton	82,200	2.7	3.1	3.7	4.1
Other Tame hay	Ton	23,100	1.8	1.9	2.1	2.3
Wild Hay	Ton	17,500	1.3	1.4	1.5	1.7
Cropland Pasture	F.U. 1/	30,000	2,419	2,830	3,314	3,629
Other Crops	--	4,000	--	--	--	--
Summer Fallow	--	22,100	--	--	--	--
Idle Cropland	--	249,500	--	--	--	--
Total Nonirrigated		1,199,300				
Irrigated						
Corn Grain	Bu.	8,000	126.5	156.9	212.5	251.7
Sorghum Grain	Bu.	1,650	91.6	109.9	145.6	171.3
Soybeans	Bu.	470	37.2	40.9	48.4	54.7
Alfalfa Hay	Ton	240	3.4	3.9	4.6	5.2
Other Irrigated Crops	--	200	--	--	--	--
Idle Irrigated Cropland	--	440	--	--	--	--
Total Irrigated		11,000				
Total Cropland		1,210,300				
Pasture	F.U.	349,100	828	1,073	1,228	1,327
Grazed Forest	F.U.	49,600	255	306	320	330

1/ F.U. - Feed Unit - one feed unit has the feed value of 1 lb. shelled corn or its equivalent.

Projected cropping pattern and production for the Nemaha Basin are shown in Table III-23. While there will likely be some withdrawal of current cropland for other uses during the projection periods, it is expected that shifts from other uses to cropland will occur in approximately equal measures.

Table III-22 CURRENT AGRICULTURAL PRODUCTION AND GROSS VALUE
Nemaha River Basin, Nebraska

Crop	Unit	Production	Current Normal Price 1/	Gross Value
Row Crops and Grains				
Corn Grain	Bu.	21,167,200	1.40	29,634,080
Sorghum	Bu.	14,865,500	1.31	19,473,805
Wheat	Bu.	4,622,400	1.58	7,303,392
Other Small Grains	Bu.	474,600	.77	365,442
Soybeans	Bu.	3,710,094	3.62	13,430,540
Subtotal				70,207,259
Roughages				
Silage	Ton	180,600	10.00	1,806,000
All Hay	Ton	268,208	26.60	7,134,332
Cropland Pasture	F.U. 2/	72,570,000	.025	1,814,250
Subtotal				10,754,582
Livestock				
Cattle & Calves	Lb.	134,854,000	.3880	52,323,352
Hogs	Lb.	95,966,000	.2770	26,582,582
Sheep & Lambs	Lb.	812,000	.3255	264,326
Chickens	Lb.	1,195,000	.211	252,145
Eggs	Doz.	7,000,000	.282	1,794,000
Milk	Cwt.	1,030,000	6.84	7,045,200
Subtotal				88,261,605
Grand Total				169,223,446

1/ U.S. Water Resources Council Price Standards, February 1974
2/ F.U. - Feed Unit - One feed unit has the feed value of 1 lb. shelled corn or its equivalent.

Livestock production projections are shown in Table III-24 and were adopted from the Missouri River Basin Comprehensive Framework Study.

4. Income

Total net farm income has shown a steady growth over time with some cyclical lows and highs.

In 1940 the makeup of gross income in the basin was distributed as: 49 percent from livestock receipts; 24 percent from crop receipts; 18 percent from government payments; and 9 percent from other sources. A second category includes home consumption, imputed rent, rent received by farm landlords, and change of inventory. In 1965 the distribution was: 51 percent livestock; 24 percent crops; 16 percent government payments; and 9 percent other. The 1967 distribution was: 54 percent livestock; 34 percent crops; 7 percent government payments; and 5 percent other.

Table III-23 PROJECTED CROPPING PATTERNS AND PRODUCTION
Nemaha River Basin, Nebraska

Crop	Unit	1985		2000		2020	
		Acres	Production	Acres	Production	Acres	Production
Nonirrigated							
Corn Grain	Bu.	297,000	24,027,300	300,000	30,000,000	300,000	34,680,000
Sorghum Grain	Bu.	200,000	17,040,000	215,000	22,811,500	220,000	27,962,000
All Wheat	Bu.	90,200	4,600,200	90,000	5,679,000	90,000	7,038,000
Other Small Grains	Bu.	11,000	591,800	10,000	673,000	10,000	791,000
Soybeans	Bu.	170,600	5,100,000	180,000	6,102,000	200,000	7,360,000
Corn Silage	Ton	10,000	138,000	10,000	169,000	10,000	189,000
Sorghum Silage	Ton	5,000	86,000	5,000	105,000	5,000	118,500
Alfalfa Hay	Ton	80,000	248,000	80,000	296,000	80,000	328,000
Other Tame Hay	Ton	23,000	43,700	20,000	42,000	20,000	46,000
Wild Hay	Ton	17,500	24,500	17,500	26,250	17,500	29,750
Cropland Pasture	F.U.1/	30,000	84,900,000	30,000	99,420,000	30,000	110,887,000
Other Crops		4,000	---	4,000	---	4,000	---
Summer Fallow		18,600	---	17,000	---	17,000	---
Idle Cropland		237,400	---	215,800	---	190,800	---
Total Nonirrigated		1,194,300		1,194,300		1,194,300	
Irrigated							
Corn Grain	Bu.	12,000	1,882,800	12,000	2,550,000	12,000	3,020,400
Sorghum Grain	Bu.	2,200	241,780	2,200	320,320	2,000	342,600
Soybeans	Bu.	600	24,540	600	29,040	1,000	54,700
Alfalfa Hay	Ton	300	1,170	300	1,380	300	1,560
Other Irrigated Crops	Acres	300	---	300	---	300	---
Idle Irrigated Cropland	Acres	600	---	600	---	400	---
Total Irrigated	Acres	16,000		16,000		16,000	
Total Cropland		1,210,300		1,210,300		1,210,300	

1/ F.U. - Feed Unit - One feed unit has the feed value of 1 lb. shelled corn or its equivalent.

Table III-24 CURRENT AND PROJECTED LIVESTOCK PRODUCTION
Nemaha River Basin, Nebraska

Item		Current	1985	2000	2020
Beef and Veal	1,000 lbs.	134,854	164,521	215,766	310,164
Pork	1,000 lbs.	95,966	103,643	142,030	199,609
Lamb and Mutton	1,000 lbs.	812	828	1,015	1,502
Farm Chickens	1,000 lbs.	1,195	1,195	1,219	1,434
Eggs	1,000 no.	84,000	79,800	88,200	121,800
Milk	1,000 lbs.	103,000	103,000	118,450	169,950
		Indices of Production			
Beef		100	122	160	230
Pork		100	108	148	208
Lamb		100	102	125	185
Chickens		100	100	102	120
Eggs		100	95	105	145
Milk		100	100	115	165

Source: Missouri River Basin Comprehensive Framework Study

Production expenses are around 70 to 72 percent of total gross income on a long-term basis. The range, however, has been from around 65 to as high as 96 since 1929.

Table III-25 shows a breakdown of specified farm expenditures as reported in the Agricultural Census of 1964 and 1969.

D. Forest Resources and Related Economic Activity

Historically, timber resources of the basin have been used locally. Early settlers and timber cutters took the best trees of the more valuable species for fuel, fence posts, building material, and furniture. They used the forest lands for pasturing their livestock during the summer and for shelter during the winter. These practices continue today leaving the present forestland and woodlands made up largely of defective trees of low-value species.

Although the basin should not be thought of as a timber products producing area, the forest resource does provide a supplemental income to the landowner, and contributes to meeting the basins needs for forest products. There are eight sawmills within the basin which produce rough lumber, pallets, and special order dimension material. Total annual production varies from 1.8 million to 3.4 million board feet. Annual employment is estimated at 20 man years.

Table III-25 SPECIFIED FARM EXPENDITURES FOR 1964 AND 1969
Nemaha River Basin, Nebraska

Item	1964	1969
	---------(Dollars)---------	
Feed Purchased	1,591,950	6,014,141
Livestock and Poultry Purchased	13,558,814	34,680,411
Gasoline and Other Fuels and Oils	4,185,174	4,400,849
Fertilizer	4,116,838	5,944,499
Hired Labor	1,516,639	2,149,518
Machine Hire	1,612,469	2,124,058
Seed, Bulbs and Plants Purchase	1,295,813	1,914,916

Source: U.S. Department of Commerce, Bureau of Census, U.S. Census of Agriculture.

Income to the landowner from the sale of forest products can vary considerably depending on the volume per acre and the value of the species. High quality black walnut veneer logs bring as much as $2,000 per thousand board feet. Stumpage prices for the other species ranges from $5 for cottonwood to $50 per thousand board feet for oak, ash, and maple.

E. Industrial Sector

Manufacturing is not a major segment of the economy of the Nemaha River Basin. In 1970 total earnings from manufacturing amounted to about 15.1 million dollars or 10 percent of total earnings in the basin. The 1970 employment in manufacturing was listed as 3,990 employees or 16 percent of the total employment.

Table III-27 lists manufacturers by employment class. The firms were classed according to their major products or first listed product if they were multiple product producers.

About one-half of the 77 firms operating in the basin are small operations which employ less than 10 people. The largest concentration of these firms is in the printing and publishing business. Nineteen

Table III-26 FARM INCOME
Nemaha River Basin, Nebraska

Farm Income 1/	1929	1940	1950	1959	1962	1965	1966	1967	1968
	(1,000 Dollars)								
Total Net Income - All Farms	16,735	11,452	34,441	16,405	14,511	32,189	43,563	33,193	23,983
Total Gross Income - All Farms	38,291	24,570	77,717	65,543	72,887	105,337	127,535	118,631	120,127
Cash Receipts - Livestock	26,120	11,997	46,832	43,379	43,771	53,743	63,101	64,293	70,331
Meat Animals and Other Livestock	20,342	8,144	37,077	36,186	37,193	47,916	56,632	58,181	64,199
Dairy Products	2,446	2,033	4,018	4,007	3,767	3,801	4,202	4,368	4,546
Poultry	3,323	1,820	5,737	3,186	2,811	2,026	2,267	1,734	1,586
Cash Receipts - Crops	9,306	5,770	25,187	27,457	26,982	25,500	38,090	40,307	36,903
Truck Crops and Melons	48	43	49	8	6	12	13	14	19
Fruits and Nuts	--	328	360	101	106	163	166	176	171
Greenhouse, Nursery and Forest Products	127	78	265	89	108	127	132	85	109
Other Field Crops	9,131	5,312	24,513	27,258	26,672	25,198	37,779	39,996	36,604
Government Payments	--	4,536	563	1,111	11,203	16,462	11,818	8,679	13,921
Other	2,865	2,267	5,135	-6,404	-8,979	9,632	14,526	5,352	-1,028
Total Production Expenses - All Farms	26,731	16,575	55,927	62,697	69,674	72,248	83,972	85,438	96,144

1/ Current Year Price Base
Source: U.S. Department of Commerce, Bureau of Census, U.S. Census of Agriculture

firms employ between 10 and 25 persons with 8 of these being in Standard Industrial Class (SIC) group 32 (stone, clay, glass and concrete products). There are three firms with employment in the 200-499 employee range. Two of the three firms are food processing industries, Morton House Kitchens, Inc. and Ocoma Food Company, and the third, American Meter Division, a metal products and control instrument firm. All three firms are located in Nebraska City.

Campbell Soup Company in Tecumseh is the only firm in the basin which employs between 500-1,000 people. It is the largest single employer in the basin and processes poultry for soup.

Table III-27 INVENTORY OF MANUFACTURERS
Nemaha River Basin, Nebraska

Standard Industrial Class Groups	Employment Class 1/ No. Firms							
	A	B	C	D	E	F	G	Total
20. Food and Kindred Products	7	4	-	1	1	2	1	16
23. Apparel and Other Finished Products Made From Fabrics and Similar Materials	-	1	-	1	2	-	-	4
24. Lumber and Wood Products, Except Furniture	3	-	-	1	-	-	-	4
25. Furniture and Fixtures	-	-	-	-	1	-	-	1
27. Printing, Publishing and Allied Industries	11	2	1	-	-	-	-	14
28. Chemicals and Allied Products	-	1	-	-	-	-	-	1
30. Rubber and Miscellaneous Plastic Products	-	1	1	-	-	-	-	2
32. Stone, Clay, Glass and Concrete Products	4	8	1	3	-	-	-	16
33. Primary Metal Industries	1	-	-	1	-	1	-	3
34. Fabricated Metal Products, Except Ordnance, Machinery and Transportation Equipment	5	-	-	-	-	-	-	5
35. Machinery, Except Electrical	3	1	-	1	-	-	-	5
37. Transportation Equipment	-	-	-	1	1	-	-	2
39. Miscellaneous Manufacturing Industries	3	1	-	-	-	-	-	4
TOTAL	37	19	3	9	5	3	1	77

1/ Employment Class: A - Under 10
B - 10-24
C - 25-49
D - 50-99
E - 100-199
F - 200-499
G - 500-999

Source: Directory of Nebraska Manufacturers and Their Products, 1970, 71.

Table III-28 gives a geographic breakdown of firms by employment class.

Manufacturing provides a stabilizing base for the basin economy. It provides permanent employment as well as part-time or supplemental employment for basin residents as well as providing an opportunity for many wives to supplement the family income.

Table III-28 NUMBER OF FIRMS BY TOWN AND EMPLOYMENT CLASS
Nemaha River Basin, Nebraska

Towns	Employment Class							
	A	B	C	D	E	F	G	Total
Auburn	2	4	-	2	2	-	-	10
Tecumseh	3	1	-	-	-	-	1	5
Syracuse	1	1	-	-	-	-	-	2
Peru	1	-	-	-	-	-	-	1
Pawnee City	2	-	-	1	-	-	-	3
Humboldt	3	-	-	1	1	-	-	5
Weeping Water	2	3	-	1	-	-	-	6
Sterling	1	-	-	-	-	-	-	1
Adams	1	-	-	-	-	-	-	1
Table Rock	3	-	-	-	-	-	-	3
Verdon	1	-	-	-	-	-	-	1
Brownville	1	-	-	-	-	-	-	1
Nebraska City	7	5	3	1	1	3	-	20
Plattsmouth	1	2	-	-	-	-	-	3
Falls City	8	3	-	3	1	-	-	15
TOTAL	37	19	3	9	5	3	1	77

Source: Directory of Nebraska manufacturers and Their Products, 1970-71.

Manufacturing is fairly diverse in the basin and it is expected to remain so in the projected time frames.

Sheet and Rill Erosion Remove Valuable Top Soil

CHAPTER IV
WATER AND RELATED LAND RESOURCE PROBLEMS

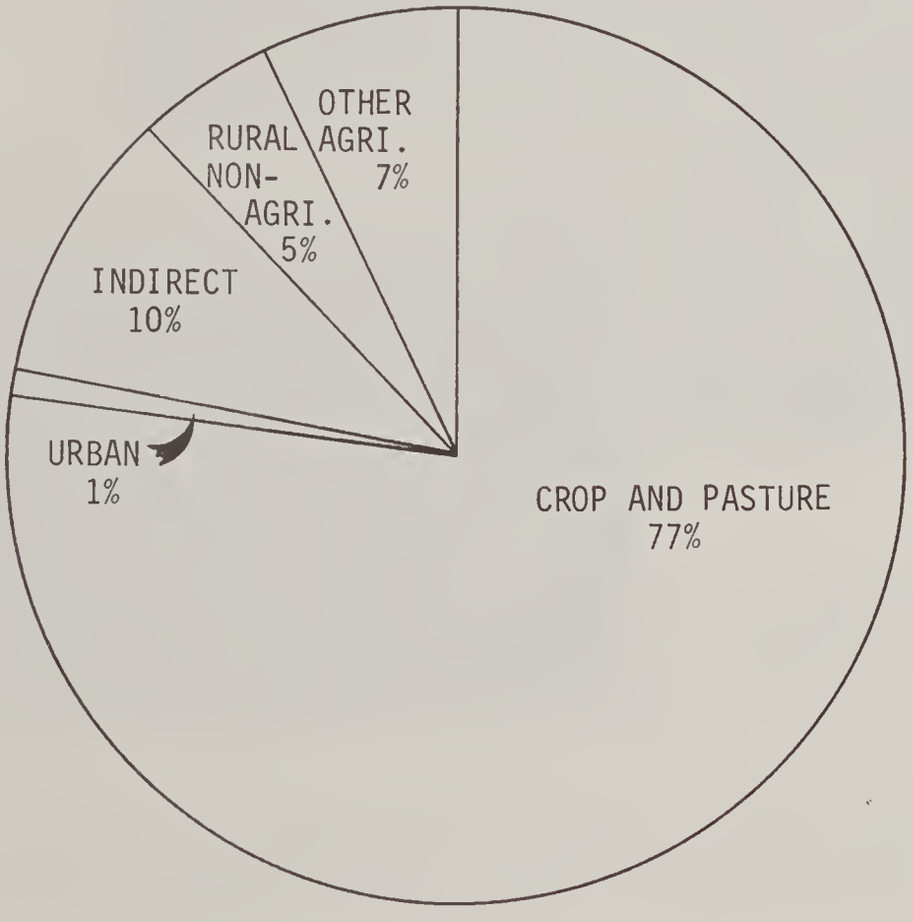
Water and land resource problems which adversely affect the basin are identified. Analysis of problems describe causes, extents, frequencies, and social and economic consequences. Analyses, when possible, are in physical and monetary terms. Other problems are identified and analyzed whose solutions would result in economic growth, increased production efficiency, or general enhancement of the physical environment.

A. Floodwater and Sediment Damages

Floodwater damage ranges from minor to severe depending largely on the degree of development and the amount and location of the area subject to damage. Annual variations in climate and precipitation generally have a lesser effect than do the differences in land use, soil, and topographic characteristics. It is estimated that about 213,300 acres in the basin are subject to flooding by a 100-year frequency flood.

The greatest sediment deposition is on cultivated floodplains which, in some areas, causes loss of crops with moderate to severe limitations for future crop use (Figure IV-1). Most of this sediment comes from erosion of cropland, but some is from sand and gravel pumping operations.

Figure IV-1 AVERAGE ANNUAL FLOODWATER AND SEDIMENT DAMAGE
Nemaha River Basin, Nebraska



The deposition of sediment lowers the capacity of reservoirs to store water planned for other purposes. Excessive deposition of sediment also forms levees along stream banks and subsequently disrupts the functioning and maintenance of drainage systems.

Other agricultural damage includes floodwater and sediment damage to fences, harvested crops, machinery, and livestock. Farmsteads and lots are generally located above the floodplain and therefore are usually free of flood damage.

Damage to road bridges throughout the basin is principally to secondary and unimproved roads. These crossings are more susceptible to damage because most bridges and approaches are at or near the elevation of the floodplains. Many of these bridge and culvert openings are limited in capacity and flood flows overtop the roads. Damages to bridges, culverts and roadbed fills are the most frequent types of damage to railroad facilities.

Losses occur in urban areas through inundation of and sediment and debris damage to homes, public buildings, utilities, and commercial and industrial businesses located on the floodplain. Some urban floodwater damages are also caused by storm water disposal systems which have inadequate capacity.

Flood Hazards
Are Increased by
Debris Problems

The flooding hazard is often increased by trees and shrubs on banks of streams. These trees and shrubs often fall into the channels,

partially blocking flows. Periodic floods pick up trees, logs, and vegetative debris which often lodge at bridges causing increased bridge damage and increased flood stages.

The current residual floodwater and sediment damages are estimated to average $3,101,210 annually. Crop and pasture damages are estimated to be $2,386,410 and other agricultural damages $220,500. Rural nonagricultural damages are $160,130. Urban damages are estimated at $37,420. Indirect damages are those losses which stem from flooding even though the area or property may not have been flooded and are estimated to be $296,750. Examples included interruptions to travel, necessary rerouting of traffic, temporary dislocation of persons from work, extra time and travel required for delivering farm products, interrupted mail and delivery schedules, and disruption and damage to utility systems. Table IV-1 lists the current residual damage for each delineated watershed. The location of each watershed is shown in Plate 4.

B. Erosion Damages

The basin is located in the Nebraska and Kansas Loess-Drift Hills Land Resource Area. Most of the area is in farms. Approximately 68 percent of the total area is cropland. About one-fourth of the area is in pastureland. Woodland is confined to narrow bands on slopes bordering stream valleys and to some wet bottomlands.

This dissected loess-drift plain is mantled in most places by thick loess. Ridgetops are broad and smooth, and slopes are undulating to rolling. Stream valleys are bordered by relatively narrow, hilly to steep slopes. Water and wind erosion are causing the gradual removal of the cap of highly productive loess over a part of the basin. Erosion is particularly evident on steeper slopes. The loss of valuable top soil results in reduced productivity.

Much of the acreage used for introduced grasses is in small pastures near farmsteads. The general practice of over-grazing of these pastures and lack of care and maintenance makes these areas vulnerable to severe erosion. Much of the native grassland has been and is overstocked. Overstocking causes suppression and killing out of the taller and more desirable species of native grasses. When stands deteriorate, native grassland decreases in productivity and is subject to increased soil erosion, both by wind and water.

The method of harvesting woodland products has been to cut the better trees, leaving the defective trees of low value species. There has been very little planned replacement. Many woodland areas have a long history of heavy grazing which has adversely affected the quality, composition, and productivity of the tree population. Grazing has also caused destruction or deterioration of the undercover, which in turn has changed the hydrologic condition resulting in increased runoff and erosion. Past timber cutting practices and grazing practices have also adversely affected the wildlife habitat and recreational qualities of the

Table IV-1 SUMMARY OF CURRENT RESIDUAL FLOODWATER AND SEDIMENT DAMAGES BY WATERSHED
Nemaha River Basin, Nebraska

Delineated Watershed Identification Number	Name	Drainage Area (Acres	Area Needing Project Action (Acres)	Floodwater and Sediment - Average Annual Damage [1] Under Current Economic Development: Crop & Pasture	Other Agri.	Rural Non-Agri.	Urban	Indirect	Total
				(Dollars)					
37-1	Upper Little Nemaha	123,500	10,700	263,840	43,110	5,000	0	31,610	343,560
37-2	Brownell[2]	15,100	800	1,220	500	1,040	0	0	2,760
37-3	Ziegler[2]	17,600	500	1,060	0	0	0	110	1,170
37-4	South Branch Little Nemaha	126,700	6,700	108,670	10,860	6,260	0	13,110	138,900
37-5	Wilson[2]	77,900	5,200	67,650	7,500	7,600	1,300	5,540	89,590
37-6	Spring[2]	33,500	3,100	16,880	1,930	3,640	0	2,550	25,000
37-7	Lower Little Nemaha	173,600	29,600	328,370	32,830	4,000	2,000	37,640	404,840
	Subtotal Little Nemaha	567,900	56,600	787,690	96,730	27,540	3,300	90,560	1,005,820
38-1	Upper Big Nemaha[2]	114,900	9,900	82,040	11,610	13,930	1,410	13,060	122,050
38-2	Middle Big Nemaha	131,000	14,000	313,940	8,060	6,000	300	33,650	361,950
38-4	Long Branch	46,900	1,610	103,360	10,340	6,900	250	13,120	133,970
38-3,5	Lower Big Nemaha	91,300	16,900	118,820	4,830	7,950	0	14,280	145,880
38-7	Rock[2]	9,600	500	5,650	950	1,150	0	1,030	8,780
38-6,8,9	Turkey Creek	120,600	18,600	391,290	39,060	23,700	500	48,600	503,150
38-11	South Fork[2]	30,400	600	2,610	130	0	0	270	3,010
38-12	South Fork Nemaha Tribs	82,900	2,680	185,310	3,700	6,000	0	20,350	215,360
38-13	Pony Creek	5,500	980	38,640	1,290	2,200	0	4,520	46,650
38-14	Walnut Creek[2]	3,700	800	3,850	30	70	0	100	4,050
38-15	Big Muddy Creek	176,800	18,000	208,660	29,270	9,300	0	26,030	273,260
38-16	Nemaha Bottom	25,500	8,000	3,540	320	500	0	520	4,880
	Subtotal Big Nemaha	839,100	92,570	1,457,710	109,590	77,700	2,460	175,530	1,822,990
00-23	Plattsmouth[2]	2,500	200	0	0	190	960	90	1,240
00-24	Northeast Cass	33,800	1,600	1,840	510	1,200	0	420	3,970
00-25	Weeping Water	167,500	10,200	58,850	5,920	43,800	29,200	19,180	156,950
00-26A	Squaw-Camp	53,200	3,700	69,860	6,520	7,900	1,500	9,470	95,250
00-26B	Peru-Brownville	34,500	3,000	The floodwater and sediment damages are included in 00-26A Squaw-Camp					
00-27	Miscellaneous Area	63,100	1,500	10,460	1,230	1,800	0	1,500	14,990
00-28	Winnebago-Bean[2]	12,200	0	0	0	0	0	0	0
	Subtotal Missouri Tribs	366,800	20,200	141,010	14,180	54,890	31,660	30,660	272,400
	Total	1,773,800	169,370	2,386,410	220,500	160,130	37,420	296,750	3,101,210

[1] Only remaining damages listed for watersheds approved for installation of structural measures.
[2] Watersheds approved for installation of structural measures under PL 83-566.

U. S. DEPARTMENT OF AGRICULTURE

LEGEND

- TOWNSHIP LINE
- STATE BOUNDARY
- COUNTY BOUNDARY
- HIGHWAY
- RAILROAD
- TOWN
  - UNDER 2500
  - OVER 2500
- DRAINAGE
- RIVER BASIN BOUNDARY
- SUB-RIVER BASIN BOUNDARY
- WATERSHED BOUNDARY
- WATERSHED NUMBER 00-27

NEMAHA RIVER BASIN - NEBRASKA

LITTLE NEMAHA

Number	Name	Acres
37- 1	Upper Little Nemaha	123,500
37- 2	Brownell	15,100
37- 3	Ziegler	17,600
37- 4	South Branch Little Nemaha	126,700
37- 5	Wilson	77,900
37- 6	Spring (Johnson Co.)	33,500
37- 7	Lower Little Nemaha	173,600
	Subtotal	567,900

BIG NEMAHA

Number	Name	Acres
38- 1	Upper Big Nemaha	114,900
38- 2	Middle Big Nemaha	131,000
38- 4	Long Branch	46,900
38-3 & 5	Lower Big Nemaha	91,300
38- 7	Rock (Pawnee Co.)	9,600
38-6, 8, & 9	Turkey Creek	120,600
38-11	South Fork	30,400
38-12	South Fork Nemaha Tribs	82,900
38-13	Pony Creek	5,500
38-14	Walnut Creek	3,700
38-15	Big Muddy Creek	176,800
38-16	Nemaha Bottom	25,500
	Subtotal	839,100

MISSOURI TRIBS

Number	Name	Acres
00-23	Plattsmouth	2,500
00-24	Northeast Cass	33,800
00-25	Weeping Water	167,500
00-26a	Squaw-Camp	53,200
00-26b	Peru-Brownville	34,500
00-27	Miscellaneous Area	63,100
00-28	Winnebago-Bean	12,200
	Subtotal	366,800
	Grand Total	1,773,800

WATERSHED IDENTIFICATION NUMBERS

Individual watersheds in this report are identified by a system outlined in the "Atlas of River Basins of the United States" prepared by the Soil Conservation Service, in June 1970. The Atlas provides specific identification for each subbasin having a drainage area greater than 700 square miles. The National Inventory of Soil and Water Conservation Needs provided specific instructions for the delineation of the subbasin areas into watersheds less than 250,000 acres. Each delineated watershed was assigned a numerical designation beginning in the upper portion of the subbasin and proceeding downstream.

The complete identification code developed for each delineated watershed consists of five parts, (a) the state, (b) major drainage area, (c) principal drainage basin, (d) subbasin, and (e) the numerical designation of the delineated watershed. For example, Upper Little Nemaha Watershed has a complete watershed identification number of Neb-MR-Little Nemaha River 37-1. In this report only (d) and (e), the subbasin and the watershed numbers, are shown.

The three subbasins in this report are 37-Little Nemaha River, 38-Nemaha River, and 00-Missouri River Direct Tributaries. Numerical designations of the delineated watersheds are shown in the watershed identification list.

WATERSHED DELINEATION MAP
NEMAHA RIVER BASIN
NEBRASKA

SOURCE:
SCS BASE MAP 5,R-28,977 AND DATA FURNISHED BY FIELD TECHNICIANS

USDA SCS LINCOLN NEBR 1974

REV. 5-28-74
5,S-31,649
PLATE 4

woodland areas. There are some localized woodland fires and many trees bear the scars of past fires.

The 1967 USDA Nebraska Conservation Needs Inventory (CNI) shows some 1,497,100 acres of land having an erosion problem in the basin. It is estimated that 1,092,600 acres with erosion problems are in cropland, 200 acres of which is irrigated. There are 317,100 acres of pasture and range, 40,300 acres of forest, and 47,100 acres of other agricultural land having erosion problems. Table IV-2 is an inventory of the erosion problem, by land capability units.

Table IV-2 AGRICULTURAL LAND WITH EROSION PROBLEMS
BY LAND CAPABILITY UNITS
Nemaha River Basin, Nebraska

Item	Land Capability Unit					
	IIe	IIIe	IVe	VIe	VIIe	Total
	(Thousands of Acres)					
Cropland	270.2	688.9	120.4	12.5	0.6	1092.6
Irrigated	(-)	(0.2)	(-)	(-)	(-)	(0.2)
Non Irrigated	(270.2)	(688.7)	(120.4)	(12.5)	(0.6)	(1092.4)
Pasture & Range	52.2	169.6	67.3	24.1	3.9	317.1
Forest	8.0	10.9	6.4	8.4	6.6	40.3
Other	10.8	31.9	3.3	0.7	0.4	47.1
TOTAL	341.2	901.3	197.4	45.7	11.5	1497.1

Source: 1967 USDA Nebraska Conservation Needs Inventory

Streambank erosion is extensive in the basin, and the rate of erosion is relatively severe in some areas. The channels, which are cut into the deep loess soils of the area, have been enlarged out of proportion to the respective drainage areas. This enlargement, along with channel improvements and rectification accomplished by local interests, has at least partially stabilized the channels, and only moderate erosion has occurred during recent years. However, a sustained period of high streamflow will result in severe additional erosion losses.

Streambank erosion, together with other forms of erosion, has wide-ranging economic and social consequences including land losses, sedimentation of reservoirs, and environmental degradation. The value and productive ability of lands are adversely affected. More critical problems exist where streambank erosion threatens to destroy transportation facilities or other structures. The erosion has resulted in greatly increased costs of bridge construction and maintenance. At numerous locations, bridges of 75 to 100 foot lengths now occupy sites where simple 10 to 20 foot spans were adequate before erosion occurred.

Streambank erosion is very severe in areas of loess deposits, particularly in the loess zones adjacent to the Missouri River floodplain. Erosion rates in loess areas are extreme, and damages from erosion and

sediment deposition constitute a large portion of flood-related damages. The sediment from these areas, in addition to damaging local floodplain lands and improvements, increases the maintenance cost of the improved channel of the Missouri River. The downstream channel aggradation causes increased frequency of overflow with severe damage to crops and other properties from the sediment-laden floodwaters.

Streambank Erosion Damages Agricultural Land

About 112 miles of streambank are affected by streambank erosion in the basin. Damage is considered serious on about 49 miles with current average annual damages estimated to be $58,800. These damages include loss of land, deposition of infertile sediment, and damage to transportation facilities.

Gully erosion is accelerated by the lack of vegetative cover and is ordinarily most severe in cultivated areas on rolling topography. The watershed projects section of the 1967 Conservation Needs Inventory reports that about 752,300 acres in the basin have a gully erosion problem (Plate 5). Not all of this area has gully problems that are of the size and nature that need treatment by project type action. In this study, it was estimated that 555,700 acres could be treated with land treatment measures by individual landowners or operators with the remaining 196,600 acres requiring project development. The problem area and the area needing project action for each of the delineated watersheds is shown in Table IV-3.

U. S. DEPARTMENT OF AGRICULTURE

LEGEND

- TOWNSHIP LINE
- STATE BOUNDARY
- COUNTY BOUNDARY
- HIGHWAY (75, 66)
- RAILROAD
- TOWN
  - UNDER 2500
  - OVER 2500
- DRAINAGE
- RIVER BASIN BOUNDARY
- SUB-RIVER BASIN BOUNDARY
- WATERSHED BOUNDARY
- WATERSHED NUMBER 00-27
- FLOODWATER
- EROSION
  - STREAMBANK
  - GULLY PROBLEM AREAS:

PERCENT OF AREA NEEDING TREATMENT		SITE REQUIREMENTS NO. NEEDED	AV. D.A. ACRES
	65	188	200
	45	332	250
	40	380	500
	35	333	640
	30	81	1280

SCALE 5 0 5 10 15 20 MILES
SCALE 1/500,000

SOURCE:
SCS DRAWING 5,S-31,649 AND INFORMATION FROM FIELD TECHNICIANS.
LAMBERT CONFORMAL CONIC PROJECTION
USDA SCS LINCOLN NEBR 1974

GENERALIZED FLOODWATER AND EROSION PROBLEM MAP

NEMAHA RIVER BASIN
NEBRASKA

PLATE 5
5,S-34,029

Table IV-3 SUMMARY OF WATER AND RELATED LAND RESOURCE PROBLEMS AND NEEDS
Nemaha River Basin, Nebraska

Delineated Watershed Identification			Flood Prevention				Agric. Water Mgmt.1/	
			Floodwater & Sediment		Gully Erosion		Impaired Drainage	
Number	Name	Drainage Area	Area Having Problem	Area Needing Project Action	Area Having Problem	Area Needing Project Action	Area Having Problem	Area Needing Project Action
			(Acres)					
37-1	Upper Little Nemaha	123,500	10,700	10,700	37,900	11,800	2,000	0
37-2	Brownell	15,100	800	800	15,000	2,500	500	0
37-3	Ziegler	17,600	2,800	500	15,000	100	400	0
37-4	South Branch Little Nemaha	126,700	16,100	6,700	47,000	22,400	3,200	0
37-5	Wilson	77,900	5,200	5,200	32,000	200	1,200	0
37-6	Spring	33,500	3,100	3,100	21,000	2,300	600	0
37-7,8,9	Lower Little Nemaha	173,600	29,600	29,600	66,600	17,300	2,700	0
	Subtotal Little Nemaha	567,900	68,300	56,600	234,500	56,600	10,600	0
38-1	Upper Big Nemaha	114,900	9,900	9,900	38,500	4,200	1,300	0
38-2	Middle Big Nemaha	131,000	15,600	14,000	65,000	16,000	1,500	0
38-4	Long Branch	46,900	3,400	1,610	19,500	5,200	400	0
38-3,5	Lower Big Nemaha	91,300	16,900	16,900	47,000	7,700	3,700	0
38-7	Rock	9,600	500	500	8,000	1,800	0	0
38-6,8,9	Turkey Creek	120,600	18,600	18,600	51,200	8,600	1,800	0
38-11	South Fork	30,400	4,600	600	16,900	3,800	500	0
38-12	South Fork Nemaha Tribs.	82,900	16,200	2,680	26,900	7,000	2,300	0
38-13	Pony Creek	5,500	11,600	980	20,500	2,600	2,500	0
38-14	Walnut Creek	3,700	800	800	3,000	2,900	300	0
38-15	Big Muddy Creek	176,800	18,000	18,000	81,200	25,300	5,100	0
38-16	Nemaha Bottom	25,500	8,000	8,000	3,000	1,900	5,000	4,000
	Subtotal Big Nemaha	839,100	124,100	92,570	380,700	87,000	24,400	4,000
00-23	Plattsmouth	2,500	200	200	100	100	0	0
00-24	Northeast Cass	33,800	1,600	1,600	16,000	16,000	0	0
00-25	Weeping Water	167,500	10,200	10,200	60,000	12,800	3,500	0
00-26A	Squaw-Camp	53,200	3,700	3,700	18,000	9,000	1,800	1,000
00-26B	Peru-Brownville	34,500	3,000	3,000	17,000	6,100	1,700	1,000
00-27	Miscellaneous Area	63,100	1,500	1,500	18,000	8,300	500	0
00-28	Winnebago-Bean	12,200	700	0	8,000	700	0	0
	Subtotal Missouri Tribs.	366,800	20,900	20,200	137,100	53,000	7,500	2,000
	TOTAL	1,773,800	213,300	169,370	752,300	196,600	42,500	6,000

1/ Irrigation needs included in "Water Shortages" section

Monetary damages from gully erosion have been estimated for each of the delineated watersheds. Average annual damage under current economic development is estimated to be $1,107,030. Table IV-4 lists the summary of current residual gully erosion damages for each of the delineated watersheds in the basin.

Table IV-4 SUMMARY OF CURRENT GULLY EROSION DAMAGES NEEDING PROJECT ACTION
Nemaha River Basin, Nebraska

Delineated Watershed Identification		Drainage Area	Area Needing Project Action	Area Subject To Damage 50-Year Period	Average Annual Damage Under Current Economic Development	
Number	Name		(Acres)			(Dollars)[1]
37-1	Upper Little Nemaha	123,500	11,800	210	5	108,680
37-2	Brownell	15,100	2,500	35	1	10,230
37-3	Ziegler	17,600	100	5	0	2,090
37-4	South Branch Little Nemaha	126,700	22,400	310	6	132,990
37-5	Wilson	77,900	200	5	0	200
37-6	Spring	33,500	2,300	55	1	840
37-7,8,9	Lower Little Nemaha	173,600	17,300	180	4	94,380
	Subtotal Little Nemaha	567,900	56,600	800	17	349,410
38-1	Upper Big Nemaha	114,900	4,200	30	1	7,290
38-2	Middle Big Nemaha	131,000	16,000	300	6	90,090
38-4	Long Branch	46,900	5,200	70	1	30,600
38-3,5	Lower Big Nemaha	91,300	7,700	120	2	57,200
38-7	Rock	9,600	1,800	70	1	1,550
38-6,8,9	Turkey Creek	120,600	8,600	90	2	40,040
38-11	South Fork	30,400	3,800	25	1	9,640
38-12	South Fork Nemaha Tribs.	82,900	7,000	70	1	42,900
38-13	Pony Creek	5,500	2,600	20	1	8,870
38-14	Walnut Creek	3,700	2,900	15	0	8,580
38-15	Big Muddy Creek	176,800	25,300	405	8	160,160
38-16	Nemaha Bottom	25,500	1,900	20	1	9,150
	Subtotal Big Nemaha	839,100	87,000	1,235	25	466,070
00-23	Plattsmouth	2,500	100	5	0	1,000
00-24	Northeast cass	33,800	16,000	130	3	61,400
00-25	Weeping Water	167,500	12,800	145	3	82,900
00-26A	Squaw-Camp	53,200	9,000	90	2	42,900
00-26B	Peru-Brownville	34,500	6,100	95	2	45,760
00-27	Miscellaneous Area	63,100	8,300	95	2	53,630
00-28	Winnebago-Bean	12,200	700	15	0	3,960
	Subtotal Missouri Tribs.	366,800	53,000	575	12	291,550
	TOTAL	1,773,800	196,600	2,610	54	1,107,030

1/ Current normalized prices were used for all watersheds.

C. Impaired Drainage

An analysis of the Conservation Needs Inventory shows that over 42,500 acres, or about two percent of the basin, are designated as having excess water for agricultural production. Of this area approximately 78 percent is currently in cropland with the remaining 22 percent in pasture-land or range.

A major portion of the problem area is located on the floodplains of the Little Nemaha, Big Nemaha, and Missouri Rivers. Bottomland soils with slow internal drainage and inadequate surface drainage often have high water table conditions that reduce yields and interfere with efficient farming operations. Crops normally grown in the area are subject to delayed plantings, additional farming operations, and untimely harvests which reduce yields, lower quality, and increase production cost. In many cases, if the impaired drainage conditions are not corrected, crops must be limited to those species tolerant to wet soil conditions.

Some problem areas occur on the flat uplands and shallow depressions where the existing surface drainage outlets are inadequate to remove runoff. This problem is magnified when precipitation falls on recently irrigated fields that are still at or near field moisture capacity.

D. Water Shortages

The basin is dependent upon rainfall for water supply, so periods of drought have a pronounced detrimental effect. Dependable supplies of good quality ground water for all beneficial uses is limited and in some areas is impossible to locate. Areal extent of most good aquifers (quantity- and quality-wise) is small and few wells yield large amounts (greater than 300 gpm). Perched water tables owe their existence to infiltration from precipitation. During prolonged below normal periods of rainfall, the water table drops resulting in shallow wells becoming dry. Recharge of ground water aquifers is minimal, at best, due to the poor transmissive characteristics of surface soils. The zone of saturation in much of the area not only yields water at low rates but also accepts water at similarly low rates.

Moisture shortages in root zones during the growing season affect agricultural crops by lowering the quantity and quality of yields. Profit margins are minimized. Since the basin is agriculturally oriented, periods of low rainfall during critical development times of the growing season have a lasting effect on all residents.

The livestock industry depends, of course, on crop production which is in turn dependent upon adequate moisture supplies. Low crop yields adversely affect feed supply. Where surface water is the principal source of water for drinking, a drought period produces a critical situation.

Municipal, industrial, and rural domestic water supply functions have not been so severely influenced as agriculture in periods of below normal precipitation. These functions depend on ground water and shortages are usually limited by the ground water reservoirs. Rural water districts have been or are being formed to eliminate, as much as possible, the limited shortages experienced.

Streamflow is first affected by lack of rainfall. Stagnation of

water in ponds and pools (where they don't become dry) occurs, damaging the fish and wildlife population and propagation. Water-oriented recreation activities are also sharply curtailed during dry periods.

E. Range and Forest

An average of about 210 range and forest fires occur each year in the basin, burning an average of about 2,440 acres. Wildfires destroy the ground cover of litter and humus and kill young trees and shrubs. Other damages of perhaps greater impact, but not so easily measured, are the indirect effects of damage to the hydrologic condition, the increase in surface runoff which increases soil erosion, the reduction in tree growth, the reduction in timber quality, and the reduction in resistance of trees to disease and insect infestation.

Prescribed fire can and should be used, however, as a hazard reduction tool. By burning during cool weather with moderate fuel moisture, the volume of fuel can be reduced without damage to live trees of large pole and sawtimber size; thus, if wildfire does occur, it is easier to control and does less damage.

Livestock are another source of damage to woodlands, used for grazing, shade, and shelter. Browsing soon kills seedlings and young trees and removes the understory vegetation. The heavy trampling and trailing of livestock compacts the soils and humus and seriously impairs the capacity of the woodlands to infiltrate precipitation and reduce runoff and erosion.

Insects and diseases cause losses in timber production through reduction in growth, lower quality, deformities, rot and death of trees. Dutch Elm Disease is killing or has killed most of the American Elm. The loss of these trees leaves a temporary void in the tree population. Dead trees clog channels, cause increased flooding and damage to bridges, and add to the debris left on land by floods.

Commercial production of timber products has been a minor enterprise in the basin. Consequently, there has been little management of woodlands for the purpose of enhancing commercial production. Instead, trees have been "picked over", the best trees taken and the inferior trees left. Very little planned replacement of trees has been performed and often the areas have been invaded by dense stands of seedlings of less desirable species.

F. Pollution

The problem of pollution in the Nemaha River Basin primarily involves ground and surface waters. Air pollution problems are usually rare and, when existent, are generally local in extent, constituting nuisances rather than substantial hazards. Pollution of air or water

is usually of concern only when pollutants are present in large enough concentrations to constitute a menace to the health of mammals and fish.

Historically, streams have been used to carry away waste water and pollutants that are transported to them by overland runoff or that are introduced by human design. When large amounts of dilution water are available, pollution is not a serious problem; however, wastes added to streams deteriorate the quality of water. This reduced quality can cause health hazards for humans and has been and will continue to be damaging to fish and wildlife dependent on stream flows for survival.

A current inventory of the 52 incorporated communities shows that 31 have secondary waste treatment systems, 6 have primary waste treatment systems, and 15 do not have treatment systems. The amount or seriousness of the pollution problem for any of these municipal communities is dependent on a number of factors, and existing conditions need to be evaluated for each community. It is reasonable to assume that some smaller communities currently having no public treatment system may now be adequately treated with individual septic tank systems.

In addition to the municipal wastes from incorporated communities potential pollution problems arise from industries that do not discharge their wastes into municipal treatment systems. Also potential pollution problems exist in unincorporated communities and rural households located in the basin; although many have adequate individual treatment facilities.

Sediment resulting from soil erosion is one of the most damaging forms of pollution in the Nemaha Basin. Sedimentation, a by-product of erosion, is a natural process which takes place even in soils in virgin condition. Sedimentation becomes a problem when it greatly increases beyond virgin conditions. The soil loss on much of the land in the basin exceeds the tolerable soil loss (often in the range of 3-5 tons annually). A tolerable soil loss is that rate at which land can be used for an indefinite period of time. When the soil loss exceeds the tolerable rate, the agricultural life of the land is reduced and will be terminated in the near future.

Sedimentation and erosion studies show that 11,957,000 tons of soil move on the land annually as a result of erosion in the basin. Of this, about 17 percent or an estimated 2,035,400 tons, are delivered as far as the Missouri River. As a result of years of erosion, the fertility and physical qualities of the sediment deposited on bottomlands have deteriorated causing reduction of yields. Of the total amount of soil moved by erosion annually in the basin, an estimated 83 percent does not reach the Missouri River that year. Much of it is deposited in areas adjacent to the point of origin doing such damage as covering crops in low areas, clogging road ditches and drains, silting in small reservoirs and farm ponds, and covering fences.

The increased sediment load affects fish habitat, carries nutrients into streams, causes changes in the hydrologic characteristics of streams, carries pesticides and herbicides into the streams, and changes the yield characteristics of soils where it is deposited.

Many urban areas use water from streams for drinking and household purposes and for various industrial uses. The presence of sediment; high nutrient levels; and insecticides, herbicides, and other foreign substances associated with sediment, increases the cost of processing and purification of water necessary to condition the water for safe usage.

In areas of excessive sedimentation, turbidities result in fish kills. At high states of turbidity, the sediment may clog the gills causing them to cease as oxygen exchange sites, resulting in eventual kills. The deposition of sediment reduces the survival rate of fish eggs. These conditions exist especially in small reservoirs and farm ponds.

Sediment is transported by runoff water. Sheet and rill erosion of cropland and pastureland produces the most sediment. Although the farm is the primary source of sediment, it is also produced by surface mining, roadbanks, eroding streambanks, highway construction, and housing developments. Sediment is also the greatest contributor to the degradation of the physical quality of surface waters. 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 water. In addition, the sediments are deposited in stream channels, farm ponds, and reservoirs thereby reducing their capacities.

Figure IV-2 shows generally the probable sediment yield from drainage areas in excess of about 100 square miles. Values are given in ranges to help compensate for radical changes encountered in some areas. Many areas have been treated with conservation measures, therefore, the lower value of the range might correctly apply. For small areas and where abrupt changes in erosion patterns occur, detailed field studies should probably be considered.

Increasing numbers of livestock are being fattened in parts of the basin, but the increasing rate is less than in most other areas of the state. Cattle feeding, the major feeding operation, has increased from about 123 thousand in 1966 to over 189 thousand in 1971. A major portion of this increase has occurred in Richardson and Cass Counties. An estimate of the number of cattle on feed for that portion at each county within the basin is shown in Table IV-5.

Methods of livestock production have changed in the last decade. Specialized, large scale production in feedlots and confined housing has introduced new pollution problems. This confinement has increased odor, dust, and insect problems in addition to water pollution potential.

Current Nebraska law requires feedlots to be registered with the Department of Environmental Control. Requirements for registration are:

a. When 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

Table IV-5 CATTLE ON FEED
Nemaha River Basin, Nebraska

County	1966	1968	1970	1971 1/
Cass	19,800	44,500	46,100	51,600
Gage	4,100	5,200	5,100	5,400
Johnson	11,400	13,100	10,400	11,300
Lancaster	2,300	2,600	2,300	2,500
Nemaha	13,600	18,200	20,700	22,500
Otoe	27,500	30,200	24,600	28,100
Pawnee	5,300	5,700	6,700	7,300
Richardson	39,300	46,200	49,200	60,700
TOTAL	123,300	165,700	165,100	189,400

1/ Preliminary estimate
Source: Nebraska 1971 Preliminary County Statistics, Nebraska Department of Agriculture and State-Federal Division of Agricultural Statistics, April 1972.

(5) 2,000 or more sheep
(6) 3,000 or more turkeys
(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 water course
c. Any other feedlot that has a water pollution potential
d. Any feedlot whose operator elects to register

Table IV-6 shows the number of livestock in confinement on registered lots in the Nemaha River Basin according to major stream course. The existing feedlot regulation, issued by the Nebraska Department of Environmental Control, is that feeders must retain on their own property the runoff which can be expected from a 10-year, 24 hour storm.

Many variable factors such as location of feedlots relative to water courses, management practices, slope, and soil characteristics make quantification of pollution from confined feeding operations difficult.

Current Agricultural Research Service studies indicate that the quantity of sediment produced by confined livestock feeding is largely a function of area of feedlots rather than number of livestock. Runoff from a sloping feedlot one acre in size lacking runoff control measures will produce a quantity of sediment roughly equivalent to that from an acre of cropland which lacks conservation treatment. However, runoff and sediment from feedlots has a greater pollutional effect than from cropland because of the higher coliform count and the higher biochemical oxygen demand (BOD).

Odors from the evaporation of liquid wastes and the anerobic decomposition of liquid and solid waste is disagreeable to residents living

Table IV-6 NUMBER OF LIVESTOCK IN CONFINEMENT ON OFFICIALLY REGISTERED FEEDLOTS ACCORDING TO MAJOR STREAMCOURSE
Nemaha River Basin, Nebraska

County		Number Registered	Number of Head (Capacity) Feeder Cattle	Beef Cows	Dairy Cows	Swine	Sheep	Chickens
Cass	No. Br. Weeping Water Creek	5	1,900			200		
	So. Cedar Creek	3	30,600			300		
	Rock Creek	2	600					
	Ervine Creek	1	50			350		
	So. Br. Weeping Water Creek	1			60			
	No. Fork Little Nemaha River	2	1,460					
	Coal Creek	2	440	25		700		
Gage	Hooker Creek	1	500					
Johnson	Little Nemaha River	1	225			400		
	Big Nemaha River	2	350			200		500
	Others1/	3	540			80		
Lancaster	Little Nemaha River	1	40	20				
	No. Fork Big Nemaha River	1	400			200		
	Middle Br. Big Nemaha River	3	900			650		
Nemaha	Rock Creek	1	400					
	Jones Creek	3	20	10		770		
	Muddy Creek	9	1,735			750		
	Hochens Creek	1	60			700		
	Ord Creek	1	70			100		200
	Little Nemaha River	2	535					
	Coddington Creek	1	350					
	Hughes Creek	2	925					
	Indian Creek	1	150			100		
	Deroin Creek	1	800					
	Others1/	3	275	200		350		
Otoe	Hooper Creek	2	45					12,000
	Little Nemaha River	8	1,400	40	20	515	130	50
	Muddy Creek	3	1,325	10	10	200	45	
	So. Fork Little Nemaha River	2	400			325		150
	Brownell Creek	1	100			100		
	No. Fork Little Nemaha River	1				850		
	So. Table Creek	1				450		
	No. Table Creek	1	250	100				
	Camp Creek	1	2,800					
	Four Mile Creek	1	5,000					
Pawnee	Taylor Creek	1	350					
	Turkey Creek	1	30	10		300	2,500	500
Richardson	Big Nemaha River	10	2,335	60		1,690	300	
	Winnebago Creek	3	240	20		540		150
	Sardine Creek	2	300		105			
	Muddy Creek	12	1,765			1,290		
	Honey Creek	1	35	40	30	200		
	Rock Creek	4	6,100					
	Rattlesnake Creek	1	50	50				
	So. Fork Big Nemaha River	1	100			100		
	Hoosier Creek	1	30	25		30	70	
	Early Creek	1	60					
	Halfbreed Creek	5	650			525		
	Long Branch	5	1,550	40		800		
	McElroy Creek	1			55	400		
	Bean Creek	1	100	120		200		
	Others1/	3	250		30	550		
	TOTAL	127	68,590	770	310	14,915	3,045	13,550

1/ Includes those without legal description and those without discernible drainage patterns.
Source: Interim Plan for Water Quality Management in the Nemaha River Basin by Nebraska Natural Resources Commission

close to feedlots. In addition, airborne ammonia from evaporation of liquid wastes contributes nitrogen to nearby bodies of water, accelerating the natural eutrophication of these waters.

G. Impairment of Natural Beauty

The natural beauty of the Nemaha River Basin is often impaired by the forces of man and nature. Excessive amounts of erosion scars the landscape. Periods of drought diminish or destroy much of the beauty of the vegetative cover. Man litters the landscape with his waste.

Excessive sheet and gully erosion produces excessive sedimentation of streams and rivers and increases the turbidity of streams, ponds, and lakes. As this happens the natural beauty is impaired.

During periods of drought, the beauty of the area is reduced as the vegetation becomes dormant. Without a vigorous vegetative cover the soil is more susceptible to erosion damage. When the limited natural woodland is managed with the objective of maximizing grazing rather than the production of forest products, the beauty associated with the forest environment is decreased. The bare and bleached limbs of dead American Elms mar the landscape.

Man has littered the landscape with hard waste such as old car bodies, worn-out machinery, tin cans, and bottles. This has resulted in some unsightly dump grounds in or near urban and rural communities and along main highway and county roads. Many of these dump grounds and auto graveyards are not adequately screened with trees, shrubs, or fences. Abandoned farmsteads and other manifestations of our past and modern society also impair the natural beauty of the basin.

Thoughtless Dumping

Gullies Mar the Landscape, Destroy or Limit Uses of Agricultural Land and Increase Sediment Downstream

FIGURE IV-2

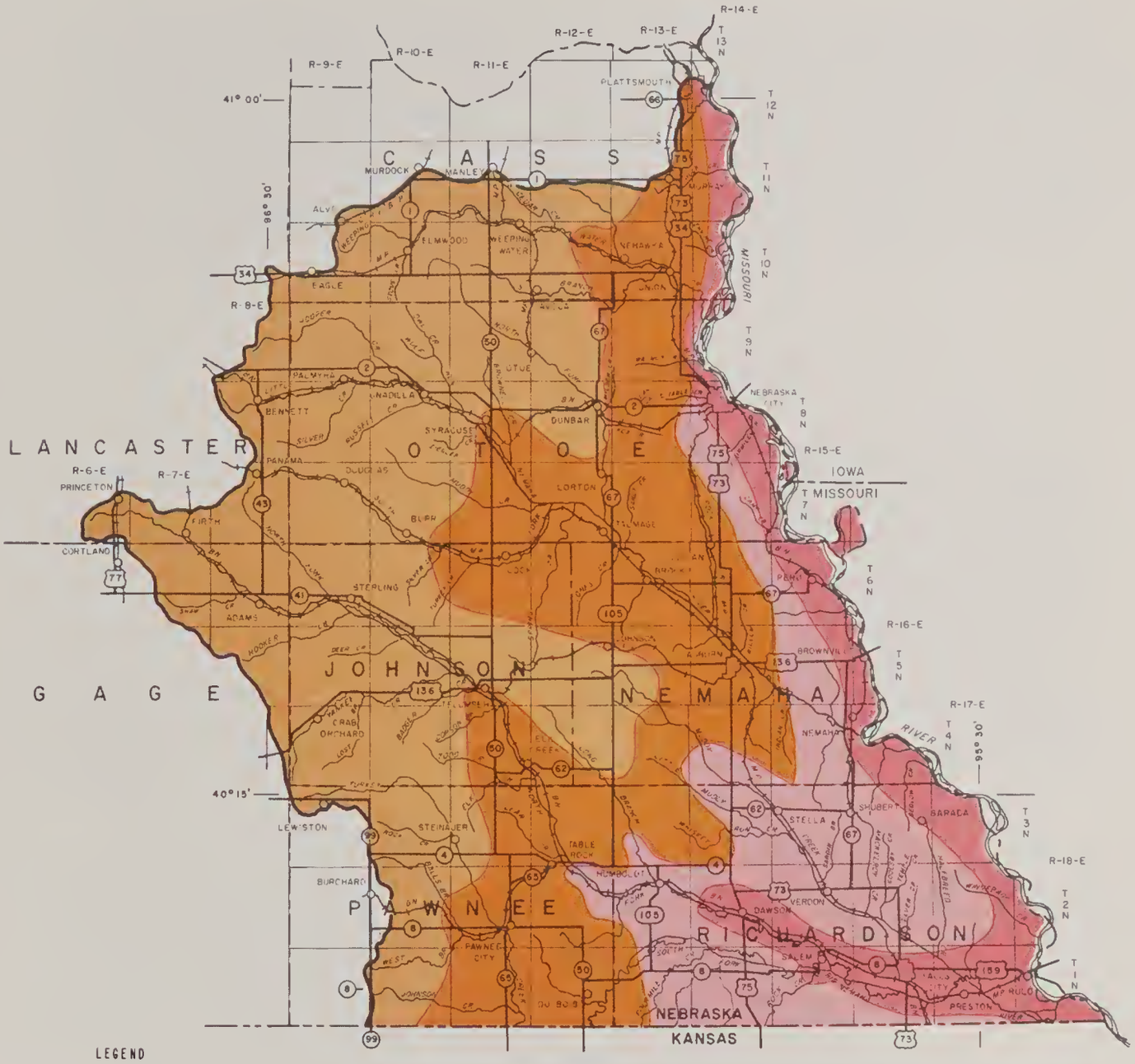
GENERALIZED

SEDIMENT YIELD

DRAINAGE AREAS IN EXCESS OF 100 SQUARE MILES

NEMAHA RIVER BASIN

NEBRASKA



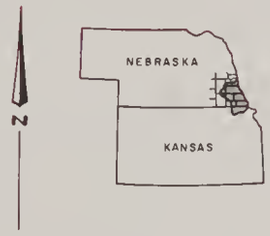
LEGEND

- TOWNSHIP LINE
- STATE BOUNDARY
- COUNTY BOUNDARY
- HIGHWAY
- RAILROAD
- TOWN
  - UNDER 2500
  - OVER 2500
- DRAINAGE
- RIVER BASIN BOUNDARY

SEDIMENT YIELD

TONS/SQ. MI./YR.	AC. FT/SQ MI./YR.
5000 TO 6000	3.3 TO 3.9
4000 TO 5000	2.6 TO 3.3
3000 TO 4000	2.0 TO 2.6
1000 TO 3000	0.7 TO 2.0

NOTE "DO NOT USE FOR DESIGN PURPOSES"



SCALE 5 0 5 10 15 20 MILES

SCALE 1/850000

SOURCE
SCS DRAWING 5,S-31,649, HYDROLOGIC ANALYSES AND PROJECTIONS APPENDIX, MISSOURI RIVER BASIN STUDY, 1971, AND INFORMATION FROM FIELD TECHNICIANS
LAMBERT CONFORMAL CONIC PROJECTION

USDA SCS LINCOLN, NEBR. 1974

REV 5-31-74
5,S-34,028

CHAPTER V
PRESENT STATUS AND FUTURE NEEDS FOR WATER AND RELATED LAND RESOURCE DEVELOPMENTS

The application measures to protect and manage crop, pasture and forest lands is needed throughout the basin. This includes all types of conservation treatment and practices to develop and utilize land and water resources. Land should be treated in accordance to its needs and used in accordance to its capabilities. Structural measures are often required to protect lands subject to flooding, reduce erosion, provide storage for water supplies, and enhance other beneficial uses. Application of nonstructural measures are needed to limit or reduce future flood damages.

A. Land Treatment and Management

Proper management and vegetative and mechanical land treatment practices are needed to control erosion on agricultural land. Management practices include, but are not limited to, maintenance of soil fertility, proper management of plant residue, efficient use of irrigation water, and controlled grazing. Vegetative practices include, but are not limited to, range seeding and reseeding, tree planting, and establishment of grassed waterways. Mechanical practices include, but are not limited to, terracing, diversions, land leveling, and grade control structures. Some types of erosion problems need only proper management practices. Other erosion problems necessitate, in addition to proper management, the application of vegetative and/or mechanical practices.

Out of a total of 1,690,800 acres of agricultural land in the Nemaha Basin, 726,700 acres, or 43 percent, is adequately treated. Of the remaining 57 percent, 32 percent, or 538,900 acres, needs management, vegetative, and mechanical practices, and 25 percent, or 425,200 acres, needs only management practices. Table V-1 gives a breakdown of the treatment status of agricultural land in the basin by major land use, as shown in the USDA, Conservation Needs Inventory, 1967.

Over 20 percent of the agricultural land in the basin, or 349,000 acres, is used for pasture and range. Twenty percent of the pasture and range is adequately treated, 14 percent needs vegetative and/or mechanical practices, and 66 percent needs only management practices.

Seventy-one percent or 1,210,000 acres, of the agricultural land in the basin is used for crop production, and only 11,000 acres of this is irrigated cropland. Of the 1,199,000 acres of nonirrigated cropland, 52 percent is adequately treated, 10 percent needs proper management, and 38 percent needs vegetative and/or mechanical practices in addition to proper management. Of the 11,000 acres of irrigated cropland, 51 percent is adequately treated, 10 percent needs only proper management, and 39 percent needs vegetative and/or cultural practices.

Table V-1 CONSERVATION TREATMENT NEEDS
Nemaha River Basin, Nebraska

Item	Total	Land Adequately Treated		Land Needing Treatment: Proper Mgmt. Prac. Only		Land Needing Treatment: Proper Mgmt. & Veg. and/or Mech. Prac.	
	1,000 Acres	1,000 Acres	Percent	1,000 Acres	Percent	1,000 Acres	Percent
Cropland							
Nonirrigated	1,199.3	623.6	52	119.9	10	455.8	38
Irrigated	11.0	5.6	51	1.1	10	4.3	39
Total Cropland	1,210.3	629.2	52	121.0	10	460.1	38
Pasture & Range	349.1	69.8	20	230.4	66	48.9	14
Forest Land	86.1	8.7	10	60.7	71	16.7	19
Other Agr. Land	45.3	19.0	42	13.1	29	13.2	29
Total Agr. Land	1,690.8	726.7	43	425.2	25	538.9	32
Urban & Built-up	62.2						
Water Areas	20.8						
TOTAL	1,773.8						

Source: From USDA, Conservation Needs Inventory, 1967.

Only 86,100 acres, or about 5 percent, of the agricultural land in the basin is used for forest and woodlands. Of the 86,100 acres, only 8,750 acres, or about 10 percent, is adequately treated; about 71 percent of the area needs only proper management; and about 19 percent of the area needs vegetative and mechanical practices in addition to proper management.

Inspection of Soil Conservation Service District Office and Natural Resources District records indicate that considerable progress has been made in the installation of conservation treatment measures during the period 1967 to 1974. Specific information by land class, year, and treatment needs is not available. However, there are indications during this period that the amount of land adequately treated has increased by approximately 10 percent, bringing the level of land adequately treated to about 53 percent in 1974.

About 14,900 acres of capability class I land and 80,830 acres of capability class II land are currently used for forest, range and pasture use. Much of this land could be profitably converted to cropland.

Conversely, 132,500 acres of capability class IV-VII land are currently being cropped, much of which should probably be diverted to forest or range uses.

Due to past overgrazing, 16,690 acres of forest land need to be re-established or reinforced by seeding or planting. Judicious use of prescribed burning can be applied to portions of this area as an excellent, economical method of site preparation. Some 60,660 acres need timber stand improvement work such as thinning, release, weeding, and pruning. In general, landowners need to be better informed of the income potential and other benefits of properly managed forest land.

B. Flood Prevention and Sediment Control

The present and future needs for flood prevention and sediment control are based on the current average annual damages and their projection for the bench mark years of 1985, 2000, and 2020. In this study, damages were determined for 169,370 acres needing project action.

The current average annual flood damage is estimated to be $3,101,210. Under projected economic development, this damage is expected to increase to $4,434,800 by 1985, $5,706,180 by 2000, and $8,063,260 by 2020. A detailed evaluation for each watershed in the basin is shown in Table V-2.

The programs needed to reduce and minimize flood damages include both structural and nonstructural measures. Full consideration should be given to land treatment measures and flood plain land use regulation before project type structural measures are applied. Structural solutions to flood problems include floodwater retarding structures, channel modifications, levees, and dikes. An integrated approach considering flood, sediment, and related problems in determining the need for structural measures and supporting watershed management and protection practices should be followed.

Application of nonstructural measures (in addition to land treatment and structural measures) is needed to reduce future flood damages. Nonstructural measures that could be used to reduce flood damages include: land management; flood forecasting; emergency floodfighting; floodway regulation; flood plain planning and zoning; and flood proofing of buildings. The applicability and implementation of regulatory programs in lieu of structural measures will be subject to legal and institutional arrangements. Flood insurance for existing buildings is desirable. Although it will not reduce flood damages, it provides a means of spreading the cost of flood losses and achieving regulation of future flood plain development.

C. Gully and Streambank Stabilization

There is need for wide variety of gully stabilization measures on

Table V-2 SUMMARY OF CURRENT AND PROJECTED RESIDUAL FLOODWATER AND SEDIMENT DAMAGES
Nemaha River Basin, Nebraska

Number	Delineated Watershed Identification Name	Drainage Area	Area Needing Project Action	Current Flood Damage	Average Annual Damage Under Projected Economic Develop.		
					1985	2000	2020
		(Acres)	(Acres)	----------	Dollars	----------	
37-1	Upper Little Nemaha	123,500	10,700	343,560	491,290	632,150	393,260
37-2	Brownell 1/	15,100	800	2,760	3,950	5,080	7,120
37-3	Ziegler 1/	17,600	500	1,170	1,720	2,090	3,080
37-4	S. Branch Little Nemaha	126,700	6,700	138,900	198,630	255,580	361,140
37-5	Wilson 1/	77,900	5,200	89,590	128,110	164,850	232,930
37-6	Spring 1/	33,500	3,100	25,000	35,750	46,000	65,000
37-7	Lower Little Nemaha	173,600	29,600	404,840	578,920	744,910	1,052,580
	Subtotal Little Nemaha	567,900	56,600	1,005,820	1,438,370	1,850,660	2,615,110
38-1	Upper Big Nemaha 1/	114,900	9,900	122,050	174,530	224,570	317,330
38-2	Middle Big Nemaha	131,000	14,000	361,950	517,590	665,990	941,070
38-4	Long Branch	46,900	1,610	133,970	191,580	246,500	348,320
38-3,5	Lower Big Nemaha	91,300	16,900	145,880	208,610	268,420	379,290
38-7	Rock 1/	9,600	500	8,780	12,560	16,070	22,830
38-6,8,9	Turkey Creek	120,600	18,600	503,150	719,500	925,800	1,308,190
38-11	South Fork 1/	30,400	600	3,010	4,330	5,480	7,890
38-12	South Fork Nemaha Tribs	82,900	2,680	215,360	307,960	396,260	559,940
38-13	Pony Creek	5,500	980	46,650	66,710	85,840	121,290
38-14	Walnut Creek 1/	3,700	800	4,050	5,750	7,490	10,530
38-15	Big Muddy Creek	176,800	18,000	273,260	390,760	502,800	710,480
38-16	Nemaha Bottom	25,500	8,000	4,880	6,980	8,930	12,740
	Subtotal Big Nemaha	839,100	92,570	1,822,990	2,606,860	3,354,150	4,739,900
00-23	Plattsmouth 1/	2,500	200	1,240	1,800	2,290	3,200
00-24	Northeast Cass	33,800	1,600	3,970	5,680	7,300	10,360
00-25	Weeping Water	167,500	10,200	156,950	224,440	288,790	408,070
00-26A	Squaw-Camp	53,200	3,700	95,250	136,210	175,260	247,650
00-26B	Peru-Brownville	34,500	3,000	Damages are included in 00-26A Squaw-Camp.			
00-27	Miscellaneous Area	63,100	1,500	14,990	21,440	27,730	38,970
00-28	Winnebago-Bean 1/	12,200	0	0	0	0	0
	Subtotal Missouri Tribs	366,800	20,200	272,400	389,570	501,370	708,250
	TOTAL Nemaha Basin	1,773,800	169,370	3,101,210	4,434,800	5,706,180	8,063,260

1/ Watersheds approved for installation of structural measures. Only remaining damages listed for these watersheds.

Price Base: Long-Term projected prices for completed watershed projects. Current normalized prices for the remainder of the watersheds.

the 752,300 acres having gully erosion problems. Means of reducing the effects of gully erosion include the installation of conservation practices in the upland areas and the construction of grade stabilization structures in gully problem areas.

Approximately 555,700 acres of the total problem area has been classed as an onfarm problem that can be controlled by land treatment measures. Since these needs are included in the "Land Treatment and Management" section of this chapter, the present and future needs presented in this section are for the remaining 196,600 acres needing project action. To appraise these needs, it is necessary to review the current and projected damages. In this study, the current average annual gully erosion damages have been estimated to be $1,107,030. This damage is projected to increase to $1,605,100 in 1985, $2,047,900 by 2000 and $3,044,400 by 2020. A detailed evaluation for each watershed is shown on Table V-3.

About forty percent of the basin's streambanks are being severely eroded. Most efforts to stabilize eroding banks have been of an emergency or temporary nature. The measures installed have been aimed only at protecting the most critical areas, and it can be assumed that emergency measures will continue to be used for temporary protection. The installation of permanent measures is needed.

D. Drainage Improvement

Present and future drainage needs are dependent on the desired use of the areas having impaired drainage problems. The potential economic return for the landowners will usually determine the use.

Generally, soils in land capability classes IIw, IIIw, and IVw are feasible to treat for agricultural production. There are presently 60,740 acres in these classes. Some of the area is already adequately treated while other areas have partial treatment. The Nebraska Conservation Needs Inventory, 1967, USDA (CNI) reports 42,500 acres having impaired drainage problems, 6,000 acres of which need some type of project development requiring group action. The installation of open or closed drains is needed to properly dispose of the excess water. Land leveling, diversions, and other drainage practices will also often be needed to adequately treat the problem areas.

E. Irrigation

Rainfall in the Nemaha River Basin normally supplies enough water for crop production. However, in periods of drought, additional water is needed. Irrigation and related developments are needed to supply this water and help provide economic stability for individual farm operators.

Table V-3 SUMMARY OF CURRENT AND PROJECTED GULLY EROSION DAMAGES
Nemaha River Basin, Nebraska

Number	Delineated Watershed Identification Name	Drainage Area	Area Needing Project Action	Current Gully Damages	Average Annual Damage[2] Under Projected Economic Development		
					1985	2000	2020
		(Acres)	(Acres)	Dollars			
37-1	Upper Little Nemaha	123,500	11,800	108,680	157,600	201,100	298,900
37-2	Brownell[1]	15,100	2,500	10,230	14,800	18,900	28,100
37-3	Ziegler[1]	17,600	100	2,090	3,000	3,900	5,700
37-4	S. Branch Little Nemaha	126,700	22,400	132,990	192,800	246,000	365,700
37-5	Wilson[1]	77,900	200	200	300	400	600
37-6	Spring[1]	33,500	2,300	840	1,200	1,600	2,300
37-3	Lower Little Nemaha	173,600	17,300	94,380	136,900	174,600	259,500
	Subtotal Little Nemaha	567,900	56,600	349,410	506,600	646,500	960,800
38-1	Upper Big Nemaha[1]	114,900	4,200	7,290	10,600	13,500	20,000
38-2	Middle Big Nemaha	131,000	16,000	90,090	130,600	166,700	247,700
38-4	Long Branch	46,900	5,200	30,600	44,400	56,500	84,200
38-3,5	Lower Big Nemaha	91,300	7,700	57,200	82,900	105,800	157,300
38-7	Rock[1]	9,600	1,800	1,550	2,200	2,900	4,300
38-6,8,9	Turkey Creek	120,600	8,600	40,040	58,100	74,100	110,100
38-11	South Fork [1]	30,400	3,800	9,640	14,000	17,800	26,500
38-12	South Fork Nemaha Tribs	82,900	7,000	42,900	62,200	79,400	118,000
38-13	Pony Creek	5,500	2,600	8,870	12,900	16,400	24,400
38-14	Walnut Creek[1]	3,700	2,900	8,580	12,400	15,900	23,600
38-15	Big Muddy Creek	176,800	25,300	160,160	232,200	296,300	440,400
38-16	Nemaha Bottom	25,500	1,900	9,150	13,300	17,000	25,200
	Subtotal Big Nemaha	839,100	87,000	466,070	675,800	862,400	1,281,700
00-23	Plattsmouth[1]	2,500	100	1,000	1,400	1,900	2,800
00-24	Northeast Cass	33,800	16,000	61,400	89,000	113,600	168,900
00-25	Weeping Water	167,500	12,800	82,900	120,200	153,400	228,000
00-26A	Squaw-Camp	53,200	9,000	42,900	62,200	79,400	118,000
00-26B	Peru-Brownville	34,500	6,100	45,760	66,400	84,700	125,800
00-27	Miscellaneous Area	63,100	8,300	53,630	77,800	98,700	147,500
00-28	Winnebago-Bean[1]	12,200	700	3,960	5,700	7,300	10,900
	Subtotal Missouri Tribs	366,800	53,000	291,550	422,700	539,000	801,900
	TOTAL Nemaha Basin	1,773,800	196,600	1,107,030	1,605,100	2,047,900	3,044,400

1/ Watersheds approved for installation of land treatment and structural measures.
2/ Current normalized prices.

Sprinkler Irrigation System

In the basin, it is estimated that 11,000 acres are currently being irrigated. Both surface water and ground water serve as the source of supply. The use of supplemental irrigation water is well established and future irrigation development is dependent on the availability of suitable land having an adequate water supply. More than one-half million acres of land in the basin have been classed as suitable for irrigation.

It is anticipated that future irrigation requirements will be satisfied by private development. By 1985, it is estimated that an additional 5,000 acres will be developed. Further development is not expected between 1985 and 2020.

F. Livestock Water Supply

The present and future needs for livestock water are dependent on existing and projected livestock numbers and on the source of water used to satisfy the need. The present consumption requirements were estimated using the livestock numbers on hand January 1, 1966. Consumption rates used were 30 gallons per day (gpd) for milk cows, 12 gpd for beef cattle and calves, 4 gpd for hogs, 1.8 gpd for sheep, and 0.06 gpd for chickens. The current requirement for the basin was estimated to be 7.9 million gallons per day (24.3 acre feet) with the annual consumption requirement being 8,900 acre feet.

Ground water is the most important source of livestock water in the basin. About 70 percent of the current consumptive requirements are satisfied by this source. Water from ground supplies are usually more uniform in quality and more dependable than water from surface supplies. These factors along with the availability of ground water in sufficient quantities for livestock use have been conducive to a stable livestock industry in the basin.

In areas with adequate ground water supplies, some of the livestock water requirements are met from surface sources. Ground water developments require wells and pumps with some source of power, such as windmills. These installations are subject to the absence of winds, occasional breakdowns, and operational costs. To overcome these deficiencies, as well as to secure better distribution of grazing, stockmen need to construct livestock ponds or rely on existing lakes and streams to furnish the remaining 30 percent of the livestock water needs.

Many of the existing livestock ponds have relatively small storage capacities and their effectiveness is dependent on surface runoff to replace the annual consumptive use and an amount lost to evaporation and seepage. The seepage losses are negligible, but the evaporation losses are a sizeable amount in comparison to consumptive use and need to be included to obtain the total livestock water requirement. In order to determine evaporation loss, a study of pond numbers and surface areas was made in estimating the current annual evaporation loss of 920 acre feet.

Future livestock water requirements were made by projecting livestock numbers at the target periods of 1980, 2000, and 2020. It is expected that livestock production will double by 2000 and nearly triple by 2020. This will increase the consumptive use from the existing 5,400 acre feet to 13,930 acre feet by 2020.

Ground water will continue to be the principal source of livestock water and will furnish most of the additional requirements. The existing 70 percent ground water and 30 percent surface water was used in projecting the future requirements for each source.

Table V-4 LIVESTOCK WATER REQUIREMENTS
Nemaha River Basin, Nebraska

Item	Current 1/	1980	2000	2020
Water Consumption				
Annual Use - Ac.Ft.	5,400	6,970	9,290	13,930
Ground Water - Ac.Ft.	(3,780)	(4,879)	(6,503)	(9,751)
Surface Water - Ac.Ft.	(1,620)	(2,091)	(2,787)	(4,179)
Evaporation				
Livestock Ponds - No.	650	-	-	-
Surface Area - Acres	650	900	1,230	1,790
Annual Use - Ac.Ft.	920	1,288	1,750	2,480
Total Water Requirement				
Annual Use - Ac.Ft.	6,320	8,260	11,040	16,410

1/ January 1, 1966
Source: Basic data from Nebraska State Water Plan.

In estimating the future evaporation losses, it was assumed that the number of livestock ponds will remain about the same. However, there is expected to be a shift toward the installation of larger ponds in larger drainage areas. These new ponds will provide a more dependable supply for both the existing and additional livestock surface water requirements. Due to the greater total surface area of these new livestock ponds, the projected evaporation losses will increase from the existing 920 acre feet to 2,480 acre feet by 2020.

The total livestock water requirements, including both consumption and livestock pond evaporation, will increase from the current 6,320 acre feet to 16,410 acre feet by 2020. A detailed analysis for all time periods is shown in Table V-4.

G. Municipal, Industrial and Rural Domestic Water Supply

The present and future requirements for municipal and rural domestic water use were estimated for the 1970 population and for the projected populations for 1985, 2000 and 2020. Industrial use, other than that supplied by municipal water systems, was obtained from data in the Nebraska State Water Plan.

Water use rates for urban, rural, and rural nonfarm populations are estimated to increase during the period 1970 to 2020.

The annual 1970 water supply requirements for the urban area were estimated to be 4,350 acre feet. The projected increases in population and water use rate will increase this requirement to 6,270 acre feet by 2020. The 1970 requirement for the rural nonfarm population grouping was estimated to be 2,840 acre feet with the 2020 requirement, 3,630 acre feet. A slight increase is projected in the rural farm requirements from 1,020 acre feet in 1970 to 1,080 acre feet by 2020. When the three population groupings that make up the total municipal and rural domestic water supply requirements are combined, the needs increase from 8,210 acre feet in 1970 to 10,980 acre feet by 2020. Table V-5 shows these requirements for all projection periods for each population grouping.

It was estimated that no additional water would be required for industrial use. This demand is now met from municipal systems. The municipal systems are expected to meet this demand in the future.

Ground water has been used exclusively for municipal and rural domestic use. It appears that all future needs will be supplied from this source. In a study of the 50 incorporated cities and villages in the basin, 35 presently have an adequate water system. Thirteen villages need to improve their existing systems and two communities need systems. The remaining villages do not have a large enough population to justify a public water supply. Details of the existing municipal water supply need are shown in Table V-6.

Table V-5 ESTIMATED 1970 AND PROJECTED MUNICIPAL, INDUSTRIAL AND RURAL DOMESTIC WATER SUPPLY REQUIREMENTS
Nemaha River Basin, Nebraska

Item	1970	1985	2000	2020
Urban				
Population	22,840	23,600	25,000	28,000
Rate/Capita (gpcd)	170	185	195	200
Ac. Ft./Yr.	4,350	4,890	5,460	6,270
Rural Non-Farm				
Population	24,120	24,500	26,000	27,000
Rate/Capita (gpcd)	105	110	115	120
Ac. Ft./Yr.	2,840	3,020	3,350	3,630
Rural Farm				
Population	18,160	15,000	13,000	12,000
Rate/Capita (gpcd)	50	60	70	80
Ac. Ft./Yr	1,020	1,020	1,020	1,080
Sub-Total				
Population	65,120	63,100	64,000	67,000
Ac. Ft./Yr.	8,210	8,920	9,830	10,980
Industrial				
Ac. Ft./Yr.	0	0	0	0
Total				
Ac. Ft./Yr.	8,210	8,920	9,830	10,980

Source: Nebraska State Water Plan, 1971.

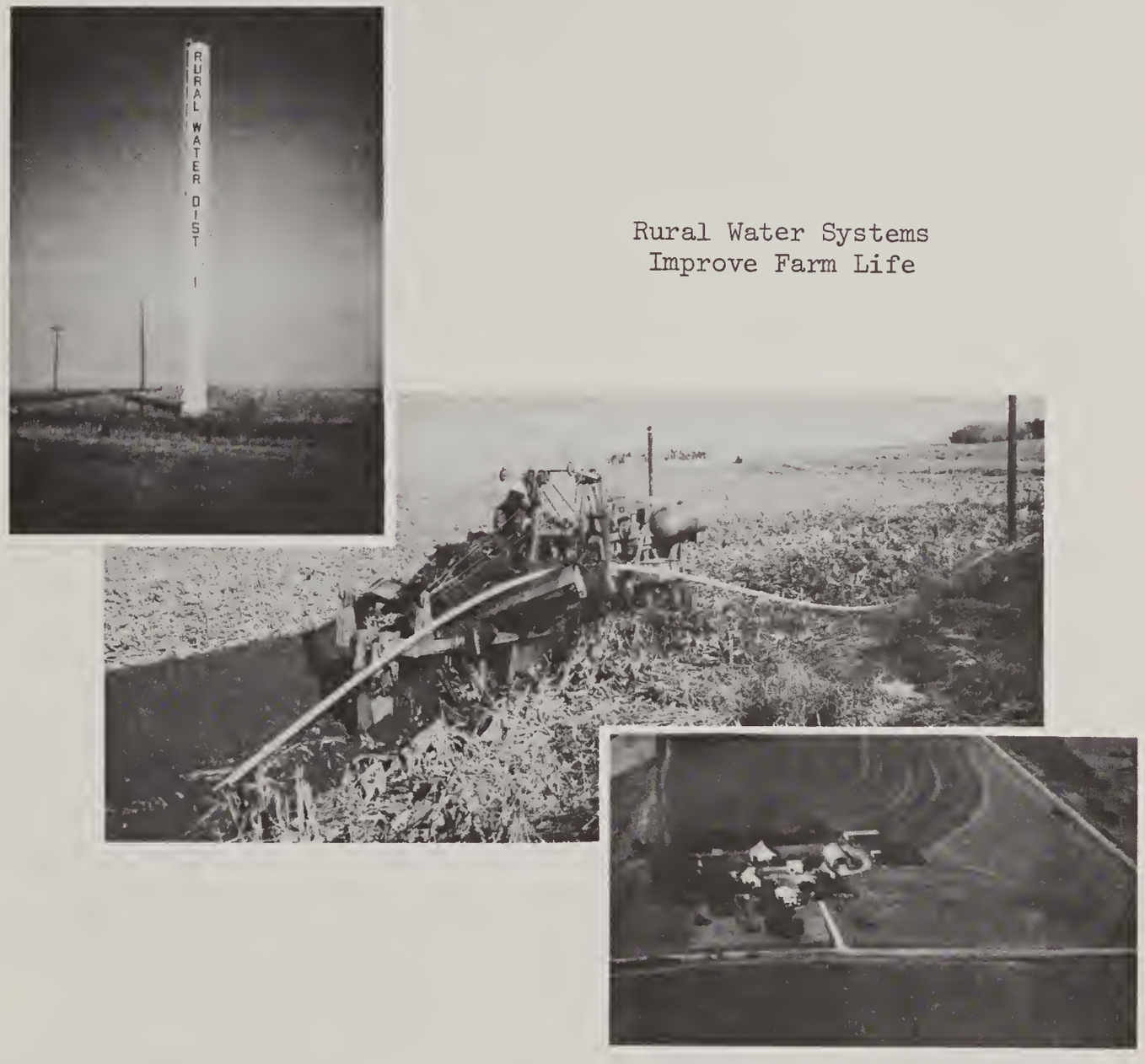
Table V-6 MUNICIPAL WATER SUPPLY NEEDS
Nemaha River Basin, Nebraska

Category	System Adequate		Improved Existing System		New System Needed	
	Places	Pop[1/]	Places	Pop[1/]	Places	Pop[1/]
Incorporated Communities						
Over 2,500	3	19,256	1	3,650		
1,000 - 2,500	5	6,413	1	2,058		
500 - 1,000	0					
250 - 500	14	4,727	6	2,132		
100 - 250	10	1,843	5	823	1	105
Under 100	3	215			1	96
TOTALS	35	32,454	13	8,663	2	201

1/ 1970 Census data

No detailed evaluation has been made of the facility needs of the people living in unincorporated communities and in rural farm and nonfarm households. A major portion of these households have adequate individual water supplies and pressure systems.

Some very small communities, such as small unincorporated villages and clusters of rural nonfarm dwellings, need to install very simple central water systems (over-sized farm systems). Such installations would be less costly than individual systems, would be more amenable to health inspections, and would give better fire protection. In many cases, rural water districts may be a needed alternative.



Rural Water Systems
Improve Farm Life

H. Recreation, Fish and Wildlife

1. Factors Influencing Demand

Data from the 1968 Comprehensive Plan for Outdoor Recreation in Nebraska was used to determine present and projected demand for recreation. In this plan, compiled by the Nebraska Game and Parks Commission,

the state was divided into 14 Socio-Economic Areas (SEA) to facilitate regional studies. Current and projected recreational demand was determined for each of these areas with the state demand being the total of the 14 Socio-Economic Areas.

The Nemaha River Basin occupies portions of the Lincoln, Omaha and Beatrice SEA's. Data from these three SEA's were prorated according to ratio of area of basin in each SEA to total area of each SEA. For this study 32 percent of the Beatrice SEA, 38 percent of the Lincoln SEA, and nine percent of the Omaha SEA was used to determine the peak season plus current and projected recreational demand for the Nemaha River Basin. These peak season demands were then converted to annual demand totals for each of the 19 outdoor recreation activities inventoried in the Nebraska Game and Parks Commission comprehensive plan

The Comprehensive Plan for Outdoor Recreation was used to determine the activities that should be considered in this basin. The data shown in Table V-7 for 1970 and 1980 is from the Commission's Report.

Present and future demand for recreation, including fishing and hunting in the basin is dependent on the population that uses the facilities. This population is considered to be those people who are living within the basin plus those that are located within the area of influence outside the basin. The population affecting the recreation demand for 1970 was 65,120. This population is projected to decrease to 63,100 by 1985 and to increase to 67,000 by 2020.

In projecting future outdoor recreation demand, factors other than size of population must also be considered. As people become more aware of the opportunities for recreation, the demand for recreational facilities will increase. An example is the projected increase in water skiing which indicates that the projected increase in demand is greater than the population effect.

The rural part of the population in the basin, a decreasing proportion of the total population from 1920 to 1960, is projected to decrease still further in the future. Conversely, the urban portion of the population will increase, which generally means an increase in recreational demand. In rural communities, especially, old world customs and philosophies have carried over for several generations. One of the beliefs of many such groups has been that work is the only worthwhile activity. In recent years this work ethic has been replaced with an attitude more tolerant of recreation. This attitude is expected to continue to increase and new generations will demand yet more recreation.

Farm workers, who exert relatively low demand for outdoor recreation, are being replaced in the work force by nonagricultural wage and salary earners. Application of recreation research findings indicate that as this trend continues, demand for outdoor recreation will increase. All occupational groups are expected to be greater consumers of recreation due to the general upgrading and expansion of educational facilities in recent years.

Table V-7 CURRENT AND PROJECTED ANNUAL DEMAND FOR OUTDOOR RECREATION
Nemaha River Basin, Nebraska

Activity	Total Recreation Visits			
	1970	1980	2000	2020
	(1,000)			
Boating	490	730	1,450	2,180
Water Skiing	180	300	740	1,090
Swimming	910	1,420	2,840	3,920
Subtotal	(1,580)	(2,450)	(5,030)	(7,190)
Picnicking	550	870	1,540	2,410
Camping	140	220	460	630
Outdoor Sporting Events	570	730	1,260	1,880
Subtotal	(1,260)	(1,820)	(3,260)	(4,920)
Walking	2,410	3,340	6,500	9,880
Outdoor Games & Sports	2,770	4,190	8,720	17,540
Driving for Pleasure	3,520	4,650	8,160	9,860
Sightseeing	1,060	1,400	2,620	3,810
Bicycling	600	690	970	1,500
Ice Skating	180	280	580	210
Nature Walks	390	520	970	1,430
Outdoor Concerts	90	130	270	390
Horseback Riding	140	170	270	360
Sledding	40	50	100	150
Hiking	30	60	100	160
Subtotal	(11,230)	(15,480)	(29,260)	(45,290)
Fishing	580	700	1,070	1,220
Hunting	180	190	220	260
Subtotal	(760)	(890)	(1,290)	(1,480)
Total Recreation-Visits	14,830	20,640	38,840	58,880
Activity Days	5,930	8,260	15,540	23,550

1/ Recreation-visits ÷ 2.5 = Activity days

Source: Outdoor Recreation for Nebraska, A Comprehensive Plan, Vol. 1, Nebraska Game and Parks Commission, 1968.

A study of urban and rural population change in the state based on 1920 shows that by 1960 the urban population had gained 361,000 or 89.0 percent while the rural population decreased 246,000 or a decrease of about 27 percent. Population projections for 1980 indicate that the urban population will increase by 825,000 for a 214 percent increase over 1920, while rural population will decrease by 344,000 or 38 percent (Table V-8).

Table V-8 HISTORICAL AND PROJECTED POPULATION TRENDS
STATE OF NEBRASKA
Nemaha River Basin, Nebraska

	Urban			Rural			Rural	Urban
	Pop.	Change from 1920		Pop.	Change		% of Total	
	(Thousands)		%	(Thousands)		%		
1980	1,230	825.0	214.0	547	344	-38.0	30.5	69.5
1960	766	361.0	89.0	645	246	-27.6	45.7	54.3
1920	405			891			68.7	31.3

At the present time rural people constitute about 46 percent of the state population while suburbanites are the fastest growing segment of the population. Suburban people are more active than city residents in outdoor recreation participation. In activities such as swimming, driving for pleasure, and picnicking they participate more than any other group.

The greatest concentration of population in Nebraska is in the eastern part of the state. Fourteen counties in the Lincoln and Omaha Socio-Economic Areas (SEA's), having only 9.4 percent of the total land area, account for 52.2 percent of the 1966 population. The Omaha and Lincoln SEA's are two of only three SEA's in the state that have shown an increase in population from 1920 to 1966. The urban population of the basin has increased from 21,390 in 1940 to 22,340 in 1960 and is projected to increase to 28,000 by 2020. The projected increase in population, not only of the basin, but of the eastern part of Nebraska, will increase the need for recreation. The Nemaha River Basin is within the 100 mile radius of Lincoln and Omaha and therefore the demand for recreational water is very high from large urban populations outside the basin.

An analysis of the outdoor characteristics of the area within a 100 mile radius of Omaha generally shows a deficiency in recreational land and water. This area has 898,000 people with only 12 state recreational areas having a total of 4,891 acres, 800 of which are water surface. This is a little over 0.5 acre per each 100 people. The Game and Parks Commission has suggested that Nebraska should own or control

recreational land in the proportion of some three acres per 100 residents. At this rate, for 898,000 people there should be over 26,900 acres of recreation lands within the Omaha radius of 100 miles.

2. Methodology

Recreation is presently regarded as a free commodity, no fee being charged for access to and for use of reservoirs. The dollar value of outdoor recreation can be assumed to be equivalent to the amount that people will pay to use alternative and equivalent reservoirs at some substantial distance away. What people will pay for travel cost and the value of time used in commuting can be considered as an indication of the value of facilities.

It is possible and reasonable to utilize standards of usage for recreational water. An acre of water, for example, should satisfy some quantity of activity-days of a given recreational activity. Such rates may be occasionally varied in a general, across-the-board manner but should usually remain relatively constant. Determination of demand involves estimation of the required activity-days of specific recreation activities. To express demand only in activity-days is less than totally meaningful. Demand should also be quantified in terms of acres of water, developed land and undeveloped land.

In order to determine needed regional water area, recreational activities are grouped into three general categories:

(1) Those outdoor recreational activites (excluding hunting and fishing) which are directly dependent on water resource developments. Boating and water skiing are major activities of the needed area.

(2) Those activities which are incidental to water resource developments, such as camping and picnicking, but can be used to determine required acreages of developed and undeveloped land. Needed acreage of undeveloped land is a multiple of required acreage of developed land.

(3) Hunting and fishing.

Current and projected peak demand was considered of primary significance in determining the extent of water and land required for recreational purposes. This peak demand was determined for those selected seasonal activities which are extravagant in their demand upon water and land facilities. Estimates of current and projected peak demand for selected outdoor recreation activities are shown in Table V-9.

The peak demand for boating and water skiing was used to set the acreage demand for recreational reservoirs. Table V-10 shows that the demand for water areas will increase from: 20,540 acres in 1970 to 32,900 acres by 1980; to 75,630 acres by 2000; and to 111,570 acres by 2020. The peak demand for picnicking, camping, and outdoor sporting events was used to determine the demand for developed land.

Nebraska Game and Parks Commission

Burchard Lake - Important Wildlife and Recreation Area
Made Possible Thru Local Sportsmen Contributions

Table V-9 CURRENT AND PROJECTED PEAK DEMAND ACTIVITIES FOR SELECTED OUTDOOR RECREATION
Nemaha River Basin, Nebraska

Activity	Activity Days			
	1970[1]	1980	2000	2020[2]
	(1,000)			
Boating	380	560	1,120	1,610
Water Skiing	140	240	570	840
Subtotal	(520)	(800)	(1,690)	(2,450)
Picnicking	460	730	1,280	2,010
Outdoor Sporting Events	310	390	660	990
Subtotal	(770)	(1,120)	(1,940)	(3,000)
Camping	130	200	420	570
Totals	1,420	2,120	4,050	6,020

1/ 1967 data prorated to 1970
2/ 2020 projected by SCS.

Accordingly, the demand for developed land increased from 830 acres in 1970 to 3,430 acres in 2020. The demand for undeveloped land was considered to be ten times the acreage of developed land. Therefore the demand for undeveloped land in 1970 was 8,300 acres, increasing to 34,300 acres in 2020.

Table V-10 CURRENT AND PROJECTED DEMAND FOR RECREATIONAL LAND AND WATER USE
Nemaha River Basin, Nebraska

Item	1970	1980	2000	2020
	(Acres)			
Water				
Boating	7,280	10,620	21,250	32,010
Water Skiing	13,260	22,280	54,380	79,560
Subtotal	(20,540)	(32,900)	(75,630)	(111,570)
Developed Land				
Picnicking	330	520	920	1,440
Outdoor Sports	220	280	470	710
Camping	280	440	930	1,280
Subtotal	(830)	(1,240)	(2,320)	(3,430)
Undeveloped Land				
Subtotal	(8,300)	(12,400)	(23,200)	(34,300)
Totals	29,670	46,540	101,150	149,300

3. Analysis of Annual Demand

The projection of recreation demands are expressed by the number of activity-days required to supply recreationists with appropriate opportunities.

Total annual demand for outdoor recreation in the Nemaha River Basin was estimated to be about 5,930,000 activity-days in 1970. This demand is projected to increase to 23,550,000 activity-days by 2020. Table V-7 lists the activities considered and the projections for 1980, 2000, and 2020.

Currently, there is a developed supply of 250 acres of municipal land and 12 acres of municipal water area in the basin. Nonmunicipal public areas account for 5,556 acres of the land and 336 acres of water. In addition, there are some 536 miles of Type IV streams, some 1,900 acres of water in farm ponds and grade stabilization structures, and some 2,600 acres of water area in reservoirs authorized through the Watershed Protection and Flood Protection Act. All of this supplies some 6,125,000 activity-days of recreation.

In addition to the supply from public areas there is an undetermined amount of private recreation development and private access to water areas. The 1969 Census of Agriculture shows that over 32 farms or ranches in the basin provide some recreation services. Many other farms provide incidental recreation facilities with nearly all of the

wildlife habitat and hunting provided on private lands.

The current and projected demand for outdoor recreation minus the present supply gives some indication of the need for present and future recreation. The remaining needs to satisfy the projected demand for 2020 is for about 17,425,000 activity-days.

4. Fishing

The annual demand for fishing in 1970 in the basin was 580,000 recreation-visits (Table V-7) and is projected to increase to 700; 1,070; and 1,220 thousand recreation-visits in 1980, 2000, and 2020 respectively. The present supply of fishing waters, (including streams, ponds, natural lakes, and reservoirs) provides about 209,000 recreation-visits leaving a need to supply opportunity for about 370,000 recreation-visits in order to satisfy current resident and nonresident fishing demand. Most of the increased demand that can be supplied in the future will be in reservoirs. At the rate of 100 recreation-visits per acre, the additional acreage of reservoirs needed to satisfy the present fishing demand would be 3,700 acres in 1970, and 10,100 acres in 2020.

Reservoirs Provide Fishing Opportunities

5. Hunting

The 1970 demand for hunting was 180,000 activity-days. The projected hunting demands are not expected to increase greatly in the future. The diversity of hunting, and the fact that most of it will be on private lands, makes unrealistic any suggested figure for acreage needed to satisfy such a demand. It is enough to say that the effective supply of hunting lands is dependent on the accessibility to private lands.

I. Water Quality Control

Chemical analysis of the area's ground water classifies it as at least permissible for drinking water even though it tends to be highly mineralized or "hard". Most ground water needs some treatment - either filtering or chlorination or both - to be desirable for drinking. It would be desirable to soften the water, especially for washing clothing and for prolonging the usefulness and beauty of water fixtures.

Future demands on ground water as drinking water are expected to be met from sources within the area. Rural communities are expected to rely on rural water districts to meet future needs. The quality of this water is expected to be equal to or slightly better than that currently used.

The use of surface water in the future will be partially dependent upon its quality. In order to maintain good quality streamflows, the sources of pollutants need to be controlled. The major sources of stream pollution in this basin are municipal, industrial, and agricultural wastes; applied agricultural chemicals; and sediment. Progress has been made to date in reducing the amount and type of pollutants entering the streams. Additional measures are needed, including measures to reduce streambank and sheet erosion.

Since this basin is agriculturally oriented, the greatest need is to reduce the quantity of sediment entering streams. This can be accomplished by increased use of land treatment practices such as terracing and grassed waterways on cropland and proper grazing on grasslands. Also, practices to reduce runoff and safely dispose of wastes from feedlots will reduce sediment and organic waste discharge into streams.

There is need to reduce the quantities of nitrates and phosphates that enter surface waters and result in over-enrichment of water. Proper management application and use of chemical fertilizers is needed to reduce leaching of nitrates and phosphates into ground water that eventually is discharged into streams. The reduction of sediment into streams will also tend to reduce the amount of phosphorous entering surface waters from fertilized fields.

Continued research is needed to determine economically feasible practices which will permit proper disposal of wastes from feedlot and confined livestock feeding operations. Specific practices currently

under study include holding ponds and lagoons. Control of the location and design of new feedlots is needed to reduce the possible pollution hazard.

Although municipal sewage treatment facilities have been provided in 37 of the 50 incorporated communities, only 17 of these systems have been classed as providing an adequate level of sewage treatment. The other 20 communities need to improve their facilities either by adding to their collection system, by providing additional capacity to their existing treatment plant, or by providing secondary treatment.

All 15 incorporated communities having no public sewage treatment facilities are considered to need some type of municipal treatment system.

A grouping of the municipal sewage treatment needs is shown for all of the incorporated communities in the basin in Table V-11.

Table V-11 MUNICIPAL SEWAGE TREATMENT NEEDS
Nemaha River Basin, Nebraska

Category	System Adequate		Improve System		New System	
	Places	Pop. 1/	Places	Pop. 1/	Places	Pop. 1/
Incorporated Communities						
Over 2,500			4	22,906		
1,000-2,500			6	8,604		
500-1,000	1	548				
250-500	8	2,485	9	3,429	3	1,048
100-250	7	1,158	1	175	7	1,318
Under 100	1	88			3	223
Total	17	4,279	20	35,114	13	2,465

1/ Population 1970 Bureau of Census
Source: Nebraska Department of Environmental Control

In addition to the municipal sewage treatment needs, there is need for additional waste treatment facilities in small unincorporated villages and rural nonfarm households. In the past, individial waste treatment systems have satisfied these treatment needs; however, to more economically meet the sewage disposal needs in the future, more research is needed to explore new ways of disposing of human waste.

Most industries in the basin use municipal waste treatment facilities to treat their waste discharges. Only a limited number of existing industries need added treatment facilities. No inventory of individual industrial treatment needs was made by this study; however, industries such as sand and gravel processors, oil wells, and related waste

discharges and processors of agricultural products need to provide measures to keep their wastes from entering the streams. Also, certain types of industries (such as tanning, meat processing, and some food processing) often need to provide their own waste treatment systems in order that municipal systems not be over-taxed. There also is need to provide temporary measures to areas under construction such as industrial sites, residential sites, highways, and county roads that will control erosion during the period when there is no vegetative cover.

CHAPTER VI
EXISTING WATER AND RELATED LAND RESOURCE PROJECTS AND PROGRAMS

A variety of programs provide technical services and financial assistance to develop water and related land resources. These projects and programs are administered by a number of state and federal agencies. Although the programs administered by these agencies are comprehensive, the present level of funding is below present requirements. Discussion of these programs follows.

A. USDA PROGRAMS

1. Soil Conservation Service

The Soil Conservation Service (SCS) is the technical agency of the U.S. Department of Agriculture having the primary responsibility to assist farmers with soil and water conservation. The SCS brings together the various disciplines needed to solve land and water conservation problems and gives on-site technical assistance to individuals in preparation of conservation plans for their land. In conservation planning, a soil and land capability map or a range site and range condition map based on a detailed soil survey of the farm, ranch, or other land unit is prepared. After consideration of suitable alternatives for using and treating the land within its needs and capability, a conservation plan is prepared with the individual owner or operator deciding what to do on his land. The plan outlines needed actions to conserve and develop soil, water, plant, and wildlife resources and includes a timetable for doing these things. The SCS provides technical assistance for the more difficult practices called for in the conservation plan, such as layouts, design, and supervision of construction of farm ponds, terrace systems, diversions, and waterways. Technical assistance in the development of private income producing outdoor recreation developments is also given. Guidance is provided for maintaining the measures and practices after they have been applied.

Nearly 6,400 landowners or operators of about 1,250,000 acres of land in the basin are cooperators with their local Natural Resources District. Nearly 5,100 conservation plans have been prepared on 970,000 acres.

Over 726,600 acres of land have adequate land treatment measures applied. Cumulative land treatment in the basin includes: (1) over 37,700 miles of terraces, (2) nearly 43,000 acres of grassed waterways and outlets for terrace systems, (3) about 2,250 grade stabilization structures, (4) nearly 24,000 acres of range seeding, (5) nearly 64,000 acres of pasture and hayland planting, (6) the conversion of 55,000 acres of cropland to grassland, and (7) the conversion of about 1,800 acres of cropland to wildlife and recreation lands.

Proper Land Use and Treatment Assure a
Stable, Prosperous Agricultural Economy

Incidental to its primary responsibility to assist farmers with soil and water conservation, the SCS is involved with environmental control. As a result of the reduction of soil erosion, sedimentation of streams is reduced. More directly, it is involved with feedlot design to reduce water pollution and is now actively involved with urban construction to reduce on-site erosion.

SCS provides soil maps and interpretations to local officials or planning boards, to developers and engineers, and to others engaged in regional and community planning. Use of this information results in savings of time and money and in more accurate estimates of construction costs. It also results in land uses compatible with soil conditions, landscape, and flood hazard and in improved design of highways, parks, and houses. Detailed soil surveys have been completed on approximately 635,000 acres in the basin.

Small Watershed Program

The SCS has the overall leadership for the Department of Agriculture project activities carried out under the Watershed Protection and Flood Prevention Act (P.L. 83-566, as amended). The SCS works with local organizations that sponsor watershed projects and with individual land users in the project areas. Assistance includes helping in the preparation of a watershed work plan and the design and supervision of

construction of structural measures. This may include measures for watershed protection, flood prevention, irrigation, drainage, water supply, public recreation, and fish and wildlife developments.

Nine watershed projects have been constructed or are under construction in the Nemaha River Basin. These watersheds are: Brownell - 15,100 acres, Ziegler - 17,600 acres, Wilson - 77,900 acres, Spring - 33,500 acres, Upper Big Nemaha - 114,900 acres, Rock - 9,600 acres, Plattsmouth - 2,500 acres, Winnebago-Bean - 12,200 acres, and South Fork - 30,400 acres. The Walnut Creek watershed project was constructed in Kansas.

The total structural program in these projects includes 95 floodwater retarding structures controlling 125,910 acres of drainage area including one structure enhanced for recreation in the South Fork Watershed and 244 grade stabilization structures. These measures will reduce flooding on 20,800 acres of flood plain. The total installation cost of all planned structural measures amounts to $9,615,397. These projects will result in an average annual benefit of $658,317, at an average cost of $458,340 annually.

Floodwater Retarding Structures Protect Downstream Properties

A watershed work plan is currently under review for the Long Branch Watershed. Preliminary investigation reports have been completed on the Upper Little Nemaha, South Branch Little Nemaha, and Middle Big Nemaha which indicate that the development of a watershed project is feasible in these watersheds.

Resource Conservation and Development Projects

The SCS is authorized to provide technical and financial assistance to local groups in conserving and developing their natural resources. These rural-urban projects are locally initiated, sponsored and directed, and provide local groups the opportunity to coordinate and use federal, state, and local facilities to develop the natural resources for economic improvement and community betterment.

Locally developed goals may include, but are not limited to the following:

(1) Developing the land and water resources for agriculture, municipal, or industrial use.
(2) Providing land and water information to other planning agencies for agricultural and nonagricultural uses.
(3) Carrying out conservation measures for watershed protection and flood prevention.
(4) Accelerating soil surveys.
(5) Reducing pollution of air and water.
(6) Increasing conservation work on individual farms, ranches, and other private holdings.
(7) Making needed adjustments in land use.
(8) Improving or expanding recreational facilities.
(9) Promoting the preservation of historical and scenic attractions.
(10) Encouraging existing industries to expand and new ones to locate in areas in order to create jobs.
(11) Training or retraining residents in needed job skills.
(12) Encouraging construction of needed community facilities such as hospitals, roads, and sewage treatment plants.

2. Forest Service

Cooperative state and private forestry programs are varied and cover virtually all major fields of forest management and protection. Cooperative programs include fire protection; technical assistance services; forest pest, insect, and disease control; tree seeding and planting; tree seedling production; forest watershed management; forest products harvesting, processing, and marketing; and forest research. The major cooperative programs are:

A. Section 2 of the Clark-McNary Act of 1924 provides authority for cooperative fire control. Under this act, the state and federal government have joined to provide for or make available adequate fire control on nonfederal lands. The federal government can match state and private expenditures up to 50 percent.

B. Section 4 of the Clark-McNary Act of 1924 gives the U.S. Forest Service authority to cooperate with the state in growing and distributing tree seeds and planting stock to landowners.

C. The Agricultural Act of 1956, Title IV, charges the Forest Service to assist the state in bringing into production commercial forest land not adequately stocked with marketable tree species.

D. Cooperative Forest Management Act of 1951, amended 1962, provides for programs designed to give assistance to private forest owners, especially owners of small woodlands. It also provides for assistance to loggers and processors of primary forest products. Technical assistance is provided for the acceleration of forestry practices in PL 83-566 small watershed projects and other applicable programs. The Forest Service does research in tree improvement by means of genetic tree selection and breeding, tree windbreak management, tree disease control , and working cooperatively in tree planting and shelterbelt research with the State Experiment Stations.

3. Extension Service

The Extension Service is part of the cooperative Extension Service partnership. Federal, state, and county levels of government share in financing, planning, and carrying out information and educational programs. The Extension Service acts as the educational agency of the U.S. Department of Agriculture and the land grant universities. Extension specialists and county agents work with other agencies to provide local people with information relating to soil and water conservation programs plus other types of information and assistance. This work has been an integral part of USDA since, 1914, when the Smith-Lever Act became law.

4. Agricultural Stabilization and Conservation Service

The Agricultural Stabilization and Conservation Service administers the USDA Agricultural Farm Program, relating to agriculture production control. It also administers the Agriculture Commodity Storage and Loan Program. Cost sharing for installing conservation practices is provided by ASCS under an annual program, long term agreement program, and in emergencies caused by a natural disaster.

5. Farmers Home Administration

The Farmers Home Administration channels credit to farmers, rural residents, and communities. It helps borrowers gain maximum benefit from loans through counseling and technical assistance. Farmers have several credit programs they can call upon through FmHA to help purchase, expand, improve, and operate farms. Credit is also available to construct, acquire, and improve service buildings and dwellings for self and hired labor.

Individual housing loans are available to buy, build, improve, or

relocate homes. In addition, FmHA makes loans in rural areas to provide rental housing for persons with low or moderate income and for persons age 62 or older. Credit is available to local organizations to construct, enlarge, extend, or improve water, sewer, and solid waste disposal systems and other community facilities that provide essential services to rural residents, and to pay necessary costs connected with such facilities.

Some loan programs are strictly for individuals and their families, others involve associations, partnerships, corporations, and public bodies.

6. Economic Research Service

The Economic Research Service conducts national and regional programs of research, planning, and technical consultation and services pertaining to economic and institutional factors and policy which relate to the use, conservation, development, management, and control of natural resources. This includes their extent, geographic distribution, productivity, quality, and the contribution of natural resources to regional and national economic activity and growth. Also included are: resource requirements, development potentials, and resource investment economics; impact of technological and economic change on the utilization of natural resources; resource income distribution and valuation; and the recreational use of resources. The agency also participates in departmental and inter-agency efforts to formulate policies, plans, and programs for the use, preservation, and development of natural resources.

7. Agricultural Research Service

The Agricultural Research Service conducts research aimed at improving and maintaining production in all phases of agriculture and protecting the invaluable soil and water resources. The research program within the field of soil, water, and air sciences is oriented primarily to the needs of farmers and conservationists for scientific determination of the feasibility and effectiveness of soil and water conservation practices. Research is continually pursued on both the physical requirements and the physical effects of soil and water conservation. Examples of the many studies underway are water management, including soil-water storage, crop use and improving water quality through efficient use of chemicals; sediment yield, delivery rates, and nutrient losses; conservation cropping, including the chemical and microbiological aspects and residue management; management and utilization of agricultural wastes, including animal wastes; and the hydraulic characteristics of overland runoff and of surface methods of irrigation.

B. U.S. Army Corps of Engineers Programs

In the Nemaha River Basin the Corps of Engineers have constructed 60 miles of levees, including tie backs, along the west bank of the Missouri River. This work is a part of the Missouri River Levee System authorized by the Flood Control Act of 1944. The average height of the levees is 12.6 feet and top width is 10 feet. Drainage structures through the levees are provided to avoid ponding water on the protected land. These levees protect more than 24,000 acres in the basin.

Under authorization of the River and Harbors Act of 1945, the Corps is maintaining the Missouri River from Sioux City, Iowa to its confluence with the Mississippi River for navigation. The authorization provides for a navigable channel 9 feet deep and 300 feet wide. In connection with the channel maintenance, bank stabilization is provided as needed.

C. Natural Resources Districts

The application of conservation practices to the land by individual landowners and operators is the largest single activity in the development and utilization of water and land resources in the basin. This program has, until recently, been in progress throughout the basin under the local direction of soil and water conservation districts. As of July 1, 1972, the 86 soil and water conservation districts in Nebraska were incorporated into 24 natural resources districts.

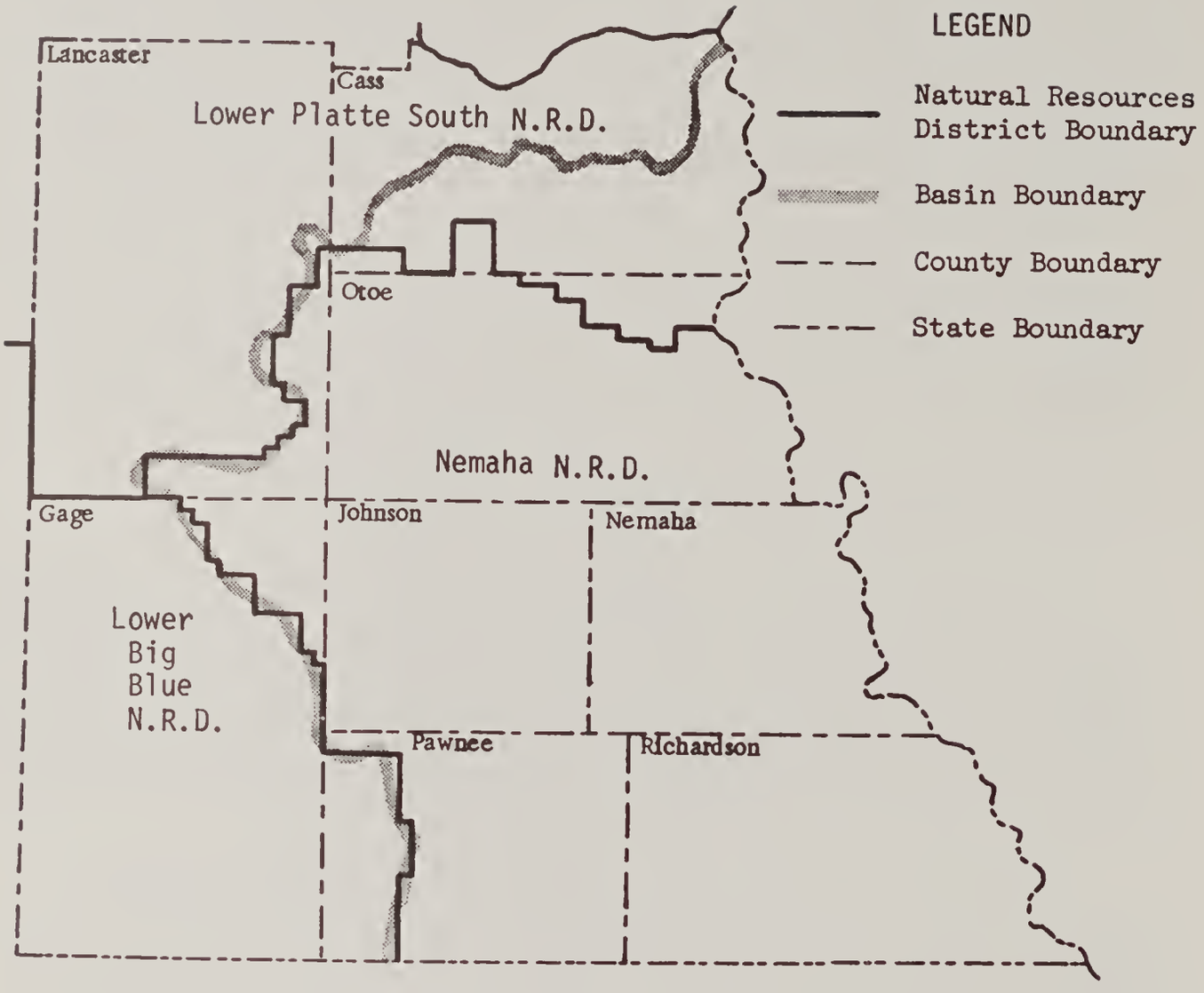
The reorganization of these legal entities usually resulted in the formation of districts with boundaries approximating hydrologic patterns. The area in the Nemaha River Basin is located in two natural resources districts; the Nemaha Natural Resources District with headquarters in Tecumseh, Nebraska, and the Lower Platte South Natural Resources District with offices in Lincoln, Nebraska.

The area drained by the Weeping Water Creek and the direct tributaries to the Missouri between the Platte River Basin and the Weeping Water Creek drainage are included in the area encompassed by the Lower Platte South Natural Resources District. The balance of the Nemaha River Basin is included in the boundaries of the Nemaha Natural Resources District. (Figure VI-1)

D. Irrigation Projects

There are no project-type irrigation developments in the basin. All existing irrigation in the basin has been privately developed. Presently it is estimated that 11,000 acres are irrigated. Most of the water for this irrigation comes from ground water supplies. However, over 276 surface water rights claims are on record with the Nebraska Department of Water Resources.

Figure VI-1 NATURAL RESOURCES DISTRICTS
Nemaha River Basin, Nebraska



E. Drainage Projects

While there are no current project-type drainage projects in the basin, numerous small drainage developments are being installed by individual landowners to reduce crop and pasture damages on flatland and depressional areas.

F. Recreation

A number of recreation and fish and wildlife developments exist in the basin. These developments are owned by state and local entities of government. Many private owners also provide recreational facilities. This is especially true of hunting, the opportunity for which is primarily supplied by the private sector.

The State of Nebraska owns 5,594 acres of nonmunicipal land and water in eight recreational developments in the basin. These include two special use areas (SUA), a state historical park (SHP), three state recreational areas (SRA), a state park, and a waterfowl management area. These areas contain 5,352 acres of land and 242 acres of water. They are used primarily for picnicking, camping, fishing, and hunting with other activities being supplied in some of these areas. Table VI-1 shows the class and type of area in each of the state owned facilities.

State recreation areas are those areas with a primary value for day use, but with secondary overnight use facilities. Most of these areas are oriented to basic water resources that are suitable for water oriented activity.

State special use areas are those areas that are primarily used for public hunting, fishing, or for other wildlife values. They include such items as wildlife refuges, game management areas, access sites to reservoirs or river, and natural areas which have not been developed for day use.

Other recreational lands include about 325 acres administered or owned by municipalities. This includes over 30 picnic areas with about 80 acres of land and nearly 400 picnic tables. Also included are nine swimming pools with a gross area of over 62,000 square feet of pool. All of the pools are in class I or urban places (over 2,500 population) and in class II towns (none in villages).

Nearly 9,800 acres of cropland have been converted to wildlife recreation uses. Also, about 2,150 acres of farmstead and feedlot windbreaks and nearly 183,000 feet of field windbreaks have been established which have some usage for such purposes.

In addition to the developed recreation areas, six small watershed projects approved for installation will provide some incidental recreation use and one (South-Fork) will provide an 85-acre pool of water and 226 acres of land developed for public recreation. These six watersheds will have an aggregate sediment pool surface area of 2,670 acres.

There are an estimated 2,060 farm ponds with a surface area of 3,000 acres. Approximately 1,050 of these ponds are stocked with fish. All ponds provide incidental recreation and hunting benefits. About 530 miles of class IV streams are of value to local fishermen (do not attract fisherman from a distance).

Table VI-1 EXISTING NONMUNICIPAL PUBLIC OUTDOOR RECREATIONAL LANDS
Nemaha River Basin, Nebraska

Item	Area[1]	Type			Class[2]		
		Land	Water	Total	II	III	VI
Plattsmouth Waterfowl Mgt. Area [3]		1,281	29	1,310	10	1,300	
Riverview	SRA	37		37	37		
Brownville	SRA	17		17	17		
Verdon	SRA	30	45	75	75		
Pawnee Prairie	SUA	792	8	800		800	
Burchard Lake	SUA	400	160	560	30	530	
Indian Cave State Park		2,730		2,730		2,730	
Arbor Lodge	SHP	65		65			65
TOTAL		5,352	242	5,594	169	5,360	65

1/ SRA - State Recreational Area-Areas with a primary value for day use.
SUA - Special Use Area-wildlife value.
SHP - State Historical Park.
2/ II - General Outdoor - utilized for recreation irrespective of location.
III - Natural Environment - used in natural state with a minimum of manmade development.
VI - Historical and Cultural Sites.
3/ Data included as this area adjoins the basin.

G. Rural and Urban Electrification

All rural electric systems in Nebraska, except for three cooperative membership corporations, are publicly owned. These public power districts are political subdivisions of the state, the directors of each being elected by public ballot

The Enabling Act legislation, passed by the Nebraska Legislature in 1933 and which followed previous similar legislation, set up statutory machinery for organizing most of today's rural electric systems in Nebraska as public power districts. Congress, under the Rural Electrification Act of 1936 (REA), offered technical and financial assistance through two percent loan money to rural groups to organize and to build their own rural electrical distribution systems to supply rural areas. Today these distribution systems in Nebraska are now known as power districts or cooperatives. Rural public power districts either purchase their power directly from large wholesale suppliers, or buy through contracting firms which act as purchasing agents.

Most Nebraska towns over 2,500 in population can have municipal power distribution systems. Towns of around 2,500 in size, however,

usually purchase electricity directly from the Nebraska Public Power District (NPPD). All municipal systems also have the right to generate their own electricity. Smaller towns, because they are classified as rural, are usually supplied by NPPD or by rural systems.

The electrical power situation in the Nemaha Basin is similar to that which prevails generally over Nebraska. In 1923, only 7.1 percent of Nebraska's farms and ranches had electric service, nearly all of which is supplied through public power districts or cooperatives. Now the task is to meet the increasing demand, doubling about every seven years, of rural people for more electric power. Meeting this increasing demand calls for heavier power lines, the replacement of substations, and the finding of new sources of power.

All of the area in the Nemaha River Basin, except for that part lying in Lancaster and Gage County, are supplied by the Omaha Public Power District, Omaha. The small parts of the basin located in Lancaster and Gage Counties are supplied by the Norris Public Power District, Beatrice.

H. Rural Water Districts

The Nemaha County Rural Water Districts No. 1 and No. 2 and Richardson County Rural Water District No. 1 have been completed. These water systems serve 747 users. Other rural water districts are being formed and are under various stages of completion. The systems now being organized are Johnson County Rural Water District No. 1, Pawnee County Rural Water District No. 1, and Richardson County Rural Water District No. 2. These districts supply domestic and livestock water to the various users that they serve.

I. Municipal, Rural Domestic, and Industrial Water Supply Developments

Forty-eight of the 50 incorporated communities in the basin are supplied by a municipal water system. The 1970 census shows that 41,490 people live in these communities with 22,906 located in the four urban areas greater than 2,500 and 18,584 residing in the 44 rural communities that are under 2,500. The remaining two incorporated communities have individual water systems with 201 inhabitants. There are 23,430 people located in rural households that are also supplied by individual water systems. These rural households include the population located in unincorporated communities and those living in farm and nonfarm households. A grouping of the existing water supply developments, using 1970 population data, is shown in Table VI-2.

Table VI-2 MUNICIPAL AND RURAL DOMESTIC WATER SUPPLY DEVELOPMENTS
Nemaha River Basin, Nebraska

Category	Public Water Systems[1]		Individual Water Systems[1]		Total	
	Places	Pop.	Places	Pop.	Places	Pop.
Incorporated Communities						
Over 2,500	4	22,906			4	22,906
1,000-2,500	6	8,604			6	8,604
500-1,000	1	548			1	548
250-500	20	6,716			20	6,716
100-250	14	2,501	1	105	15	2,606
Under 100	3	215	1	96	4	311
Subtotal	48	41,490	2	201	50	41,691
Rural Households[2]				23,430		23,430
Total Basin	48	41,490	2	23,631	50	65,121

1/ 1970 Census data
2/ Includes farm, nonfarm, and unincorporated communities. The population served by rural water districts is included.

J. Municipal, Rural Domestic, and Industrial Sewage Treatment Developments

Thirty-seven of the 50 incorporated urban and rural communities in the basin have municipal waste treatment systems. These sewage treatment facilities provide a central waste disposal service to 39,393 residents. The remaining 13 incorporated communities and rural households, with a total population of 2,298, are supplied by individual household waste treatment facilities. A grouping of the existing sewage treatment developments using 1970 population data is shown in Table VI-3.

Table VI-3 MUNICIPAL AND RURAL DOMESTIC SEWAGE TREATMENT DEVELOPMENTS
Nemaha River Basin, Nebraska

Category	Municipal Waste Treatment Systems		Individual Waste Treatment Systems		Total	
	Places	Pop.1/	Places	Pop.1/	Places	Pop.1/
Incorporated Communities						
Over 2,500	4	22,906			4	22,906
1,000-2,500	6	8,604			6	8,604
500-1,000	1	548			1	548
250-500	17	5,914	3	802	20	6,716
100-250	8	1,333	7	1,273	15	2,606
Under 100	1	88	3	223	4	311
Subtotal	(37)	(39,393)	(13)	(2,298)	(50)	(41,691)
Rural Households2/				23,430		23,430
Total Basin	37	39,393	13	25,728	50	65,121

1/ 1970 Census Data
2/ Includes farm, nonfarm, and unincorporated communities
Source: State of Nebraska, interim Plan for Water Quality Management in the Nemaha River Basin, Nebraska Soil and Water Conservation Commission, April 1972.

Agricultural Levee - Part of the Missouri River System

CHAPTER VII
WATER AND RELATED RESOURCE DEVELOPMENT POTENTIAL

The water and land resources of the basin have capability to supply the needed resource developments. The following is a discussion of the physical potential for water and related land development to meet identifiable needs.

A. Availability of Land

Sufficient land is available in the basin to allow attainment of a wide range of alternate goals. Only a small amount of land will be needed for increased nonagricultural uses. Additional land for new urban and built-up areas can be converted from existing agricultural land. There is considerable potential for the conversion of land use.

About 18,000 acres of land in Land Capability Classes V, VI, and VII are presently cropped. This acreage should be established in a permanent cover of grass or trees. Over 230,000 acres of Class I, II, and III soils are in pasture and range. Most of this acreage could be converted to cropland if needed for farm efficiency or national needs. Good management of both cropland and grassland in the basin would permit increased production of crops and livestock and still permit use of the land according to its capabilities.

B. Impoundments

The topography and soil conditions in most of the basin are suitable for the installation of water storage reservoirs. Sites with adequate storage potential exist throughout the basin. Many of the potential upstream impoundment sites could be efficiently developed for multiple-purpose use. These sites could provide storage for flood prevention, irrigation, municipal and industrial water supply, recreation, fish, wildlife, and water quality control functions. Estimated upstream reservoir storage potentials in selected sites are shown in Table VII-1 for each delineated watershed.

The total upstream reservoir storage potential is estimated to be 407,790 acre-feet. Of this amount 60,410 acre-feet are allocated to sediment storage, 171,280 acre-feet are allocated to flood prevention storage, and the remaining additional 176,100 acre-feet of storage are available for other beneficial uses. The additional storage capacity is based on the estimated mean annual yield minus reservoir evaporation and seepage losses.

In addition to the upstream project reservoirs a potential exists for many smaller impoundments that will satisfy farm and local needs for livestock water, grade stabilization, irrigation, and flood prevention. These smaller reservoirs would also have incidental benefits for recrea-

TABLE VII-1 UPSTREAM RESERVOIR STORAGE POTENTIAL IN SELECTED SITES
Nemaha River Basin, Nebraska

Delineated Watershed Identification		Watershed Drainage Area	Potential Reservoirs	Area Controlled	Storage Capacity			
Number	Name				Sediment	Other 1/	Floodwater	Total
		(Acres)	(No.)	(Acres)	(Acre-Feet)			
37-1	Upper Little Nemaha	123,500	18	61,400	6,000	15,000	15,600	36,600
37-2	Brownell 2/	15,100	9	3,910	210	1,100	730	2,040
37-3	Ziegler 2/	17,600	0	0	0	0	0	0
37-4	S. Br. Little Nemaha	126,700	15	28,800	2,400	8,100	7,500	18,000
37-5	Wilson 2/	77,900	22	31,800	4,000	8,700	8,070	20,770
37-6	Spring 2/	33,500	7	12,900	1,560	3,900	2,280	7,740
37-7,8,9	Lower Little Nemaha	173,600	9	33,300	4,000	11,100	9,600	24,700
	Subtotal Little Nemaha	567,900	80	172,110	18,170	47,900	43,780	109,850
38-1	Upper Big Nemaha 2/	114,900	38	64,400	7,930	16,300	16,290	40,520
38-2	Middle Big Nemaha	131,000	19	54,400	4,000	17,100	21,000	42,100
38-4	Long Branch	46,900	13	20,500	1,420	6,500	5,920	13,840
38-3,5	Lower Big Nemaha	91,300	9	30,700	3,500	9,400	8,000	20,900
38-7	Rock 2/	9,600	5	4,600	530	1,200	1,140	2,870
38-6,8,9	Turkey Creek	120,600	20	76,800	8,000	20,700	29,000	57,700
38-11	South Fork 2/	30,400	3	7,400	810	2,100	2,290	5,200
38-12	S. Fork Nemaha Tribs	82,900	6	24,300	2,060	8,700	6,590	17,350
38-13	Pony Creek	5,500	1	640	80	250	160	490
38-14	Walnut Creek 2/	3,700	0	0	0	0	0	0
38-15	Big Muddy Creek	176,800	13	77,400	8,600	28,400	20,200	57,200
38-16	Nemaha Bottom	25,500	0	0	0	0	0	0
	Subtotal Big Nemaha	839,100	127	361,140	36,930	110,650	110,590	258,170
00-23	Plattsmouth 2/	2,500	10	950	140	250	360	750
00-24	Northeast Cass	33,800	0	0	0	0	0	0
00-25	Weeping Water	167,500	15	60,900	5,170	17,300	16,550	39,020
00-26A	Squaw-Camp	53,200	0	0	0	0	0	0
00-26B	Peru-Brownville	34,500	0	0	0	0	0	0
00-27	Miscellaneous Area	63,100	0	0	0	0	0	0
00-28	Winnebago-Bean 2/	12,200	0	0	0	0	0	0
	Subtotal Missouri Tribs	366,800	25	61,850	5,310	17,550	16,910	39,770
	Total Nemaha Basin	1,773,800	232	595,100	60,410	176,100	171,280	407,790

1/ Mean annual yield minus evaporation and seepage from sediment pool.
2/ Watersheds approved for installation of land treatment and structural measures.

tion, fish, wildlife, and ground water recharge. No estimate has been made of the potential storage involved in these developments.

The land rights required to permit construction of many of the potential multiple-purpose reservoirs must be acquired either by easement or by acquiring title to the land. Some sites have farmsteads located on or near the bottomland areas where they will be inundated by the potential reservoirs. Some have roads and railroads that would be submerged by these impoundments and would have to be modified, closed, or relocated. In some situations, public utilities and pipelines would also be affected. All of these factors add to the costs associated with land rights and the total installation costs for proposed sites.

The location and design data of potential upstream project reservoirs is based upon various types of field investigations. These range from preliminary locations selected from existing soil and topographic maps to complete field surveys. The level of planning reflects the stage of project formulation found in various watersheds.

C. Ground Water Developments

Future development of ground water will be related to such consideration as intended use and geographic and geologic locations. Figures in Chapter II of this report have presented a general quantification regarding depth to water and a real extent and saturated thickness of the water-bearing strata.

The potential for additional ground water development is small due to the difficulty in locating adequate supplies. At the present time there is no recognized need for artificial recharge in the basin.

D. Channel Improvements and Levees

A potential exists for installing multiple-purpose flood prevention and drainage channels in many of the river bottoms including the Missouri River flood plain. These channels would remove excess surface water and flood runoff resulting from abnormally high precipitation events within a time that would minimize crop damage.

The installation of potential channel improvements will require careful consideration of possible environmental damage. The design of these channels should protect wildlife areas while providing benefits to agricultural lands.

E. Gully and Streambank Stabilization

Potentials for gully and streambank stabilization measures exists in some areas of the basin. The minimum level of stabilization is that

which is necessary to prevent the deterioration of the land resource that is located in the path of advancing gullies or streambank erosion. In some situations the potential also exists to restore lands that have already been voided or depreciated by these types of erosion.

In addition to preventing the destruction of the land resource, the potential exists to reduce damages to improvements such as roads, bridges, buildings, and fences that are located on affected lands. Potential land stabilization will also reduce the production of damaging sediment which affects downstream landowners, communities, and the public-at-large.

A potential exists to control a major portion of the gully erosion problems by onfarm land treatment measures. Effective measures include drop inlets, chutes, and drop spillway structures to control gully overfalls and reduce grade in degrading channels. Other measures to control and stabilize watercourses and channels include diversions; grassed waterways; tree plantings; the sloping of channel banks; the installation of channel linings; and the use of jetties, deflectors, and riprap.

Grade Stabilization Structures Control Gullies, Reduce Erosion and Establish Base Grade for Land Treatment Measures

In most areas in the basin there is a potential for grade stabilization by project development. This is generally limited to the more serious erosion problems with the type of measures needed the same as, but on a larger scale than, those used to treat the smaller problems that can be controlled by individual landowners. A total of 1,344 potential grade stabilization structures were located in the basin. See Table VII-2 for the number of potential structures by watersheds.

Table VII-2 POTENTIAL GRADE STABILIZATION STRUCTURES
Nemaha River Basin, Nebraska

Delineated Watershed Identification		Drainage Area	Potential Grade Stabilization Structures
Number	Name	(Acres)	(No.)
37-1	Upper Little Nemaha	123,500	105
37-2	Brownell 1/	15,100	62
37-3	Ziegler 1/	17,600	36
37-4	S. Br. Little Nemaha	126,700	112
37-5	Wilson 1/	77,900	179
37-6	Spring 1/	33,500	72
37-7,8,9	Lower Littel Nemaha	173,600	80
Subtotal	Little Nemaha	567,900	646
38-1	Upper Big Nemaha 1/	114,900	102
38-2	Middle Big Nemaha	131,000	90
38-4	Long Branch	46,900	18
38-3,5	Lower Big Nemaha	91,300	40
38-7	Rock	9,600	25
38,6,8,9	Turkey Creek	120,600	40
38-11	South Fork 1/	30,400	26
38-12	S. Fork Nemaha Tribs	82,900	35
38-13	Pony Creek	5,500	5
38-14	Walnut Creek 1/	3,700	5
38-15	Big Muddy Creek	176,800	100
38-16	Nemaha Bottom	25,500	10
Subtotal	Big Nemaha	839,100	496
00-23	Plattsmouth 1/	2,500	6
00-24	Northeast Cass	33,800	40
00-25	Weeping Water	167,500	41
00-26A	Squaw-Camp	53,200	30
00-26B	Peru-Brownville	34,500	20
00-27	Miscellaneous Area	63,100	40
00-28	Winnebago-Bean 1/	12,200	25
Subtotal	Missouri Tribs	366,800	202
Total	Nemaha Basin	1,773,800	1,344

1/ Watersheds approved for installation of land treatment and structural measures.

F. Irrigation

There is considerable land suitable for irrigation in the Nemaha River Basin. The major factor limiting future development is the lack of an adequate water supply. In most years the rainfall received during the growing season is adequate for the production of most crops, reducing the need for irrigation.

In this study the total irrigation potential, including existing development, was estimated to be over 31,000 acres. An estimate of this potential is shown in Table VII-3 for each delineated watershed. To develop this potential both private and project-type developments may be required. Improved onfarm irrigation efficiencies will be required on both existing and new irrigated areas.

Because major project-type surface irrigation development is beyond the scope of the USDA study, the development projected in this report has been limited to private irrigation development. This private development is projected to increase from the current normal of 11,000 acres to 16,000 acres by 1985. Of this total, 80 percent is projected to be in the "adequately treated" category because it will have adequate land preparation and satisfactory water management. There is some potential to use surface water stored in small private irrigation reservoirs. Such reservoirs could be filled from runoff or could be filled by pumping from off-season base flows of larger streams.

G. Recreation, Fish, and Wildlife

The reservoir potential previously discussed can supply a significant water surface area for recreation, fish, and wildlife development. Such reservoirs can provide surface areas for major water-based recreational activities such as boating and water skiing. Supplementing these reservoirs can be land developed with physical facilities for activities such as camping, picnicking, and hiking, plus areas of undeveloped lands which are conducive to the total recreational environment.

A potential exists to satisfy a part of the recreational demand by increased public support of the existing recreation and parks programs. Increased financial support can make possible a more diversified recreation program and provide more adequate maintenance of park facilities. Local governmental units are often limited in their capacity to provide facilities for the chief water-based recreational activities.

An excellent potential exists for the development of water impoundments for fishing. The reservoirs could provide for the augmentation of low flows necessary to maintain permanent fishing streams and provide additional quantities of water for fish production. An increase in fishing potential can also be accomplished by improved access to existing streams, reservoirs, and ponds on private lands. Some financial assistance may be required to develop this potential.

Table VII-3 SUMMARY OF POTENTIALLY IRRIGABLE LAND
Nemaha River Basin, Nebraska

Delineated Watershed Identification Number	Name	Drainage Area	Potentially Irrigable 1/
		(Acres)	
37-1	Upper Little Nemaha	123,500	1,000
37-2	Brownell	15,100	300
37-3	Ziegler	17,600	0
37-4	South Branch Little Nemaha	126,700	1,000
37-5	Wilson	77,900	500
37-6	Spring	33,500	0
37-7,8,9	Lower Little Nemaha	173,600	2,500
Subtotal Little Nemaha		567,900	5,300
38-1	Upper Big Nemaha	114,900	5,700
38-2	Middle Big Nemaha	131,000	1,000
38-4	Long Branch	46,900	0
38-3,5	Lower Big Nemaha	91,300	3,000
38-7	Rock	9,600	0
38=6,8,9	Turkey Creek	120,600	0
38-11	South Fork	30,400	200
38-12	South Fork Nemaha Tribs	82,900	1,000
38-13	Pony Creek	5,500	3,000
38-14	Walnut Creek	3,700	500
38-15	Big Muddy Creek	176,800	4,000
38-16	Nemaha Bottom	25,500	4,000
Subtotal Big Nemaha		839,100	22,400
00-23	Plattsmouth	2,500	0
00-24	Northeast Cass	33,800	0
00-25	Weeping Water	167,500	2,500
00-26A	Squaw-Camp	53,200	800
00-26B	Peru-Brownville	34,500	700
00-27	Miscellaneous Area	63,100	0
00-28	Winnebago-Bean	12,200	0
Subtotal Missouri Tribs		366,800	4,000
Total Nemaha Basin		1,773,800	31,700

1/ Includes some 11,000 acres of presently irrigated land.

Over 95 percent of the basin is privately owned, therefore, a major part of the hunting potential is on privately owned land. To improve this potential some type of economic incentive will also be required to motivate landowners to develop the necessary habitat to increase wildlife production and provide the access needed so that a greater part of the hunting demand can be met.

H. Water Quality Control

As population and productivity increases in the basin, both surface and ground waters will be used more intensively and water quality problems can be expected to increase. There is definitely a potential for maintaining and improving the quality of the basin's waters, especially in the tributary streams.

Feedlot Runoff Control Structures Improve Water Quality

Adequate improvements and enlargements to municipal and industrial waste treatment systems are readily responsive to designated need. The potential for accomplishment of such improvements is dependent more on available financing than on engineering possibility. This is partially true for the control procedures of agricultural wastes also. Land conservation measures can reduce the volume of overland runoff and the associated sediment, chemicals, and debris. Beneficial results can be obtained by improving the control, selection, and use of agricultural chemicals and also by minimizing feedlot runoff.

The potential floodwater retarding structures and grade stabilization sites can provide storage for over 94,000 acre-feet of sediment. The storage of sediment in these sites will reduce the downstream delivery rates, thereby improving the water quality for the streams.

I. Associated Land Treatment and Adjustments

Potentially, every acre of agricultural land could be used in accordance with its greatest capability and could be treated in accordance with its need. However, it is reasonable to expect that desired land treatment and proper land use will be less than the ideal goal because of such factors as land ownership changes, depreciation of mechanical practices, and lag in application of conservation practices. The current and projected status of land treatment of agricultural land in the basin by 2020 time period is shown in Table VII-4.

Table VII-4 CURRENT AND PROJECTED STATUS OF AGRICULTURAL LAND TREATMENT
Nemaha River Basin, Nebraska

Land Use	Projected Basin Acreage 2020	Current Adequate Treatmt.	Projected Land Treatment: Proper Mgmt. Pract.	Proper Mgmt. & Veg. or Mech. Pract.	Sub-Total	Proj. Adequate Treat. by 2020: Total	Percent
	(1,000 Acres)						
Cropland							
NonIrr.	1,188.0	623.6	110.8	216.0	326.8	950.4	80
Irr.	16.0	5.6	1.4	5.0	6.4	12.0	75
Subtotal	1,204.0	629.2	112.2)	(221.0	333.2	962.4	80
Pasture & Range	347.0	69.8	143.1	30.0	173.1	242.9	70
Forest & Woodland	86.0	8.7	27.4	7.0	34.4	43.1	50
Other Ag. Land	45.0	19.0	10.5	11.0	21.5	40.5	90
Total Ag. Land	1,682.0	726.7	293.2	269.0	562.2	1,288.9	77

It is projected that 562,200 additional acres of agricultural land will achieve the status of adequate treatment by 2020, bringing the total land with adequate treatment to over 1,288,000 acres or 77 percent of the agricultural land. About 293,000 acres will be treated using only management practices with 269,000 acres requiring both management and more intensive practices to become adequately treated.

By 2020 it is projected that 333,000 more acres of cropland will attain the status of adequate treatment with the total acreage adequately treated reaching the total of 962,000 acres or 80 percent of the cropland. Approximately 221,000 acres of the additional cropland treated will require both management and vegetative or mechanical practices with the remaining 112,000 acres needing only management practices.

An estimated 6,400 acres of the new and existing irrigation area is projected for treatment during this period.

About 173,000 additional acres of pasture and range will be treated during the projection period with the total area adequately treated by 2020 being 242,000 acres. This will be 70 percent of the pasture and range area.

Projections for the treatment of forest and woodland are influenced by the degree of economic opportunity to be provided by forest land. Estimates are that only 50 percent of forest and woodland area will be adequately treated by 2020. This includes planting of trees in windbreaks to provide protection for farmsteads, livestock, and wildlife and in other limited areas that will be utilized for the production of forest products.

Net annual growth of sawtimber could be increased by 20 percent or more if the problems of heavy grazing, high-grading, and large acreages of nonstocked and understocked land could be overcome. The value of forest products harvested can also be increased through proper management.

In Nebraska, the State Forestry Organization is an integral part of Civil Defense and Rural Fire Defense efforts. In support of these programs, equipment could be modernized and additional fire management training could be provided.

An additional 21,000 acres of other agricultural land will be treated with the total area adequately treated reaching 40,500 acres or 90 percent of this land use.

J. Nonstructural Measures

Nonstructural measures provide additional potential for reducing flood damages and achieving proper land use in the Nemaha River Basin. Flood plain management and zoning are important complementary measures which can reduce potential flood damages. This entails knowledge of the flood hazard and the restriction of land susceptible to flooding to uses which minimize flood losses. In cities and towns such uses could be parks, playgrounds, open spaces, and parking lots. In rural areas flood damages could be minimized by growing only low-value flood resistant crops, including grass and trees, on land subject to flooding. Flood plain zoning regulations are usually necessary to realize the maximum benefits from flood plain management. The National Flood Insurance Program can be used to supplement these alternatives.

Adequate warning of floods will also help reduce the damages from floods. The adequacy of the warning is dependent on accurate flood forecasting and the extent of preflood planning accomplished. Much damage can be avoided if perishable items are moved from the lower level of buildings to higher levels or to areas outside the flood zone.

Other measures to reduce flood damages also exist. These measures are not strictly nonstructural or structural as usually defined. Among these are relocation of buildings out of areas susceptible to flooding or flood proofing if relocation is not feasible. Another related measure, that does not actually reduce the initial flood damage but which can minimize resulting damages, is effective emergency action after the flood occurs. The success of emergency action will be greatly dependent on the thoroughness and extent of preflood planning.

Unprotected Soils Have
High Rates of Soil Loss

Conservation Treatment Reduces
Soil Losses and Sediment Yields

CHAPTER VIII
OPPORTUNITIES FOR DEVELOPMENT THROUGH USDA PROGRAMS

Opportunities for solving identified problems and for meeting anticipated needs through USDA programs are presented in this chapter. The initiative required for using USDA program resources generally rests with the residents and landowners in the basin. Land treatment measures such as terraces, waterways, and establishment of grass or trees will be accomplished only when the individual landowner is motivated to do so. Other measures such as floodwater retardation, municipal and industrial water supply, or public recreational facilities or structures require group or community action. Land treatment measures, when combined with a structural program, provide an integrated watershed management program. There is a continuing program to inform landowners of the assistance available from USDA agencies in order that they may select the combination of action programs that best meet their needs and desires.

A. Land Treatment and Land Use Programs

Land treatment practices are primary instruments contributing to full agricultural land and water development in the basin. It is projected that the total percent adequately treated will reach 77 percent by 2020. This means that 562,200 more acres will be adequately treated from 1971 to 2020.

The areas projected for treatment in Chapter VII which are expected to be adequately treated by 2020 are as follows: nonirrigated cropland 326,800 acres; irrigated cropland 6,400 acres; pasture and range 173,100 acres; forest and woodland 34,400 acres; and other agricultural land 21,500 acres.

The total estimated cost of the projected land treatment is $12,388,000 (See Table VIII-1). This averages about 22 dollars per acre which includes a maintenance cost of about 40 to 50 cents per acre annually.

B. Small Watershed Projects

It is recommended that project action be initiated in twelve small watershed projects in the Nemaha River Basin within the next 10-15 years. These watersheds are physically and economically feasible and ready for project development. The watersheds are: Long Branch, South Branch Little Nemaha, Middle Big Nemaha, Upper Little Nemaha, Turkey Creek, Big Muddy Creek, Northeast Cass, Weeping Water, Squaw-Camp, Peru-Brownville, Lower Big Nemaha, and Lower Little Nemaha. The location of these watersheds is shown on Plate 6.

The primary objective for development in these watersheds, which contain 1,279,400 acres, is to reduce floodwater and sediment damage,

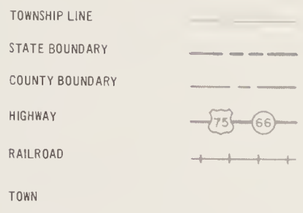
Table VIII-1 ESTIMATED COST OF PROJECTED LAND TREATMENT
Nemaha River Basin, Nebraska

Type of Treatment	Area	Cost
	Acres	Dollars
Nonirrigated Cropland		
Management Only	110,800	997,000
Mgmt., Vegetative & Mech	216,000	8,640,000
Subtotal	326,800	9,637,000
Irrigated Cropland		
Management Only	1,400	11,000
Mgmt., Vegetative & Mech	5,000	500,000
Subtotal	6,400	511,000
Pasture and Range		
Management Only	143,100	429,000
Mgmt., Vegetative & Mech	30,000	532,000
Subtotal	173,100	961,000
Forest and Woodland		
Management Only	27,400	274,000
Mgmt., Vegetative & Mech	7,000	350,000
Subtotal	34,400	624,000
Other Agricultural Land		
Management Only	10,500	105,000
Mgmt., Vegetative & Mech	11,000	550,000
Subtotal	21,500	655,000
TOTAL AGRICULTURAL LAND	562,200	12,388,000

U. S. DEPARTMENT OF AGRICULTURE

LEGEND

- TOWNSHIP LINE
- STATE BOUNDARY
- COUNTY BOUNDARY
- HIGHWAY (75, 66)
- RAILROAD
- TOWN
  - UNDER 2500
  - OVER 2500
- DRAINAGE
- RIVER BASIN BOUNDARY
- SUB-RIVER BASIN BOUNDARY
- WATERSHED BOUNDARY
- WATERSHED NUMBER 00-27



SCALE 5 0 5 10 15 20 MILES

SCALE 1/500,000

SOURCE:
SCS DRAWING 5,S-31,649 AND INFORMATION FROM FIELD TECHNICIANS.
LAMBERT CONFORMAL CONIC PROJECTION
USDA SCS LINCOLN NEBR 1975

EXPLANATION

- WATERSHED APPROVED FOR INSTALLATION (COMPLETED OR UNDER CONSTRUCTION)
- WATERSHEDS IN WHICH PROJECT ACTION SHOULD BE INITIATED BY 1985
- WATERSHED IN WHICH PROJECT ACTION SHOULD BE INITIATED BY 1985 IN KANSAS
- WC — WATERFLOW CONTROL MEASURES (FLOODWATER RETARDING RESERVOIRS & CHANNEL MODIFICATION)
- LS — LAND STABILIZATION GULLY EROSION (GRADE STABILIZATION STRUCTURES)
- R — RECREATION

WATERSHEDS FEASIBLE FOR PROJECT ACTION

NEMAHA RIVER BASIN

NEBRASKA

PLATE 6

REV 8-20-75
5,S-34,030

control erosion, and increase recreation opportunity. Applications for watershed planning assistance have been submitted to the SCS for these watersheds. Final planning is underway in the Long Branch, South Branch Little Nemaha, Middle Big Nemaha, and Upper Little Nemaha Watersheds.

The project structural measures proposed for the 12 watersheds include 107 reservoirs and 299 grade stabilization structures. The total proposed storage in the 107 reservoirs is estimated to be 147,110 acre-feet, with 34,420 acre-feet allocated for sediment, 3,870 acre-feet for recreation, and the remaining 108,820 acre-feet for floodwater. The total permanent water surface for the 107 proposed reservoirs would be 4,950 acres. Recreation developments have been proposed at five reservoirs with a water surface area of 3,480 acres. Details of the proposed developments in each feasible watershed are shown in Tables VIII-2 and VIII-3.

The total installation cost of all structural measures amounts to $26,729,000. This consists of $25,549,000 for flood prevention measures and $1,180,000 for recreation development. Under present cost-sharing criteria it is estimated that $22,778,000 of the total installation cost would be federal and $3,951,000 nonfederal. Table VIII-4 gives the cost-sharing and functional costs for each feasible watershed.

The total average annual structural cost for the recommended watersheds is estimated to be $1,696,800. This includes $1,575,600 for amortization of the installation cost and $121,200 for operation and maintenance. The average annual primary benefits from these watersheds are estimated to be $2,632,120. Flood prevention benefits are estimated to be $1,437,520, grade stabilization benefits $947,100, and recreation benefits $247,500. The benefit-cost ratio for these 12 watershed projects is 1.3 to 1.0. The details of the benefit-cost analyses for each watershed are shown on Table VIII-5. The effect of a range of interest rates on the average annual cost is shown on Table VIII-6. An alternative system of structural measures may prove feasible upon detailed analyses of the watersheds.

C. Cooperative State-Federal Forestry Programs

A number of opportunities exist for landowners to use cooperative state-federal forestry programs to obtain technical assistance for forest management and financial assistance to provide trees and plant shelterbelts and windbreaks.

No attempt has been made in this section to determine what amounts might be furnished by any given agency. Instead the total cost of the proposed improvements have been included in the land treatment section of this chapter by 2020.

There are 77,350 acres of commercial forest land in the Nemaha River Basin needing various types of treatment. It is projected in Table VII-4 and Table VIII-1, that 50 percent of the commercial forest

Table VIII-2 SUMMARY OF STRUCTURAL MEASURE DATA QUANTITIES AND COST FOR THOSE WATERSHEDS ECONOMICALLY FEASIBLE
Nemaha River Basin, Nebraska

Delineated Watershed Identification		Drainage Area	Reservoir Data											Grade Stabilization Structures			Total Structural Installation Cost 1/
			No.	Drainage Area Controlled	Storage Capacity				Water Surface Area (Top of Pool)		Reservoir Installation 1/			No.	Drainage Area Controlled	Installation 1/	
Number	Name				Sediment	Recreation	Floodwater	Total	Permanent	Floodwater	Sediment & Floodwater	Recreation & Facilities	Total				
		Acres		Acres	---------Acre-Feet----------				---Acres---		-------$1,000-------				Acres	------$1,000-----	
38-4	Long Branch	46,900	13	20,500	1,420	1,400	5,920	8,740	350	810	1,105	280	1,385	11	2,700	368	1,753
37-4	South Branch Little Nemaha	126,700	15	28,800	2,400	400	7,500	10,300	450	1,200	1,860	150	2,010	45	11,000	1,475	3,485
38-2	Middle Big Nemaha	131,000	19	54,400	4,000	500	21,000	25,500	660	2,200	3,059	250	3,309	35	8,000	1,166	4,475
37-1	Upper Little Nemaha	123,500	18	61,400	6,000	570	15,600	22,170	900	2,200	3,070	200	3,270	35	8,500	1,166	4,436
38-6,8,9	Turkey Creek	120,600	20	76,800	8,000	0	29,000	37,000	950	3,100	2,680	0	2,680	15	3,000	502	3,182
38-15	Big Muddy Creek	176,800	13	77,400	8,600	1,000	20,200	29,800	1,120	2,500	2,450	300	2,750	40	10,000	1,340	4,090
00-24	Northeast Cass	33,800	0	0	0	0	0	0	0	0	0	0	0	20	16,000	600	600
00-25	Weeping Water	167,500	0	0	0	0	0	0	0	0	0	0	0	22	12,800	660	660
00-26A	Squaw-Camp	53,200	0	0	0	0	0	0	0	0	0	0	0	14	9,000	410	410
00-26B	Peru-Brownville	34,500	0	0	0	0	0	0	0	0	0	0	0	12	6,100	475	475
38-3,5	Lower Big Nemaha	91,300	0	0	0	0	0	0	0	0	0	0	0	20	5,000	605	605
37-7,8,9	Lower Little Nemaha	173,600	9	33,300	4,000	0	9,600	13,600	520	1,260	1,553	0	1,553	30	7,500	1,005	2,558
TOTAL		1,279,400	107	352,600	34,420	3,870	108,820	147,110	4,950	13,270	15,777	1,180	16,957	299	99,600	9,772	26,729

1/ 1972 installation cost.

Table VIII-3 RECREATION OPPORTUNITIES IN MULTIPURPOSE RETARDING SITES IN WATERSHEDS HAVING PROJECT FEASIBILITY
Nemaha River Basin, Nebraska

Number	Watershed Name	Developed Areas	Permanent Storage		Water Surface		Additional Land	Developed Land	Recreation Visits	Additional Installation Cost
			Additional	Total	Additional	Total				
		No.	Acre-Feet		----------Acres----------				No.	Dollars
38-4	Long Branch	1	1,400	2,820	100	350	700	70	20,000	280,000
37-4	South Branch Little Nemaha	1	400	2,800	30	450	500	50	40,000	150,000
38-2	Middle Big Nemaha	1	500	4,500	40	660	600	60	20,700	250,000
37-1	Upper Little Nemaha	1	570	6,570	40	900	900	80	44,000	200,000
38-15	Big Muddy Creek	1	1,000	9,600	50	1,120	1,100	100	40,400	300,000
GRAND TOTAL		5	3,870	26,290	260	3,480	3,800	360	165,100	1,180,000

Table VIII-4 COST SHARE SUMMARY OF WATERSHEDS FOUND ECONOMICALLY FEASIBLE
Nemaha River Basin, Nebraska

Number	Delineated Watershed: Identification Name	Functional Allocation: Flood Prevention 1/ Federal	Flood Prevention 1/ Nonfederal	Flood Prevention 1/ Total	Recreation Federal	Recreation Nonfederal	Recreation Total	Total Installation Cost Federal	Total Installation Cost Nonfederal	Total Installation Cost Total
		1,000 Dollars								
38-4	Long Branch	1,332	141	1,473	140	140	280	1,472	281	1,753
37-4	South Branch Little Nemaha	2,990	345	3,335	75	75	150	3,065	420	3,485
38-2	Middle Big Nemaha	3,640	585	4,225	125	125	250	3,765	710	4,475
37-1	Upper Little Nemaha	3,601	635	4,236	100	100	200	3,701	735	4,436
38-6,8,9	Turkey Creek	2,567	615	3,182	0	0	0	2,567	615	3,182
38-15	Big Muddy Creek	3,250	540	3,790	150	150	300	3,400	690	4,090
00-24	Northeast Cass	580	20	600	0	0	0	580	20	600
00-25	Weeping Water	640	20	660	0	0	0	640	20	660
00-26A	Squaw-Camp	390	20	410	0	0	0	390	20	410
00-26B	Peru-Brownville	455	20	475	0	0	0	455	20	475
38-3,5	Lower Big Nemaha	585	20	605	0	0	0	585	20	605
37-7,8,9	Lower Little Nemaha	2,158	400	2,558	0	0	0	2,158	400	2,558
GRAND TOTAL		22,188	3,361	25,549	590	590	1,180	22,778	3,951	26,729

1/ Includes floodwater retarding structures and grade stabilization structures.

Table VIII-5 AVERAGE ANNUAL BENEFITS AND COST OF STRUCTURAL MEASURES FOR WATERSHEDS FOUND ECONOMICALLY FEASIBLE
Nemaha River Basin, Nebraska

Number	Delineated Watershed Identification: Name	Average Annual Primary Benefits: Flood Prevention	Grade Stabilization	Recreation	Total	Average Annual Cost: Amortization of Installation Cost 1/	Operation and Maintenance Cost	Total
		Dollars						
38-4	Long Branch	113,430	30,600	30,000	174,030	103,300	9,000	112,300
37-4	South Branch Little Nemaha	96,740	132,990	60,000	289,730	205,400	20,000	225,400
38-2	Middle Big Nemaha	231,570	90,090	31,000	352,660	263,800	14,000	277,800
37-1	Upper Little Nemaha	245,430	108,680	66,000	420,110	261,500	25,000	286,500
38-6,8,9	Turkey Creek	401,760	40,040	0	441,800	187,500	9,900	197,400
38-15	Big Muddy Creek	194,100	160,160	60,500	414,760	241,100	25,000	266,100
00-24	Northeast Cass	0	61,400	0	61,400	35,400	2,200	37,600
00-25	Weeping Water	0	82,900	0	82,900	38,900	2,400	41,300
00-26A	Squaw-Camp	0	42,900	0	42,900	24,200	1,500	25,700
00-26B	Peru-Brownville	0	45,760	0	45,760	28,000	1,700	29,700
38-3,5	Lower Big Nemaha	0	57,200	0	57,200	35,700	2,200	37,900
37-7,8,9	Lower Little Nemaha	154,490	94,380	0	248,870	150,800	8,300	159,100
GRAND TOTAL		1,437,520	947,100	247,500	2,632,120	1,575,600	121,200	1,696,800

1/ Amortized at 5-7/8 percent interest over 100 years. Price Base: Current normalized prices October 1973.

Table VIII-6 AVERAGE ANNUAL BENEFITS AND COSTS OF STRUCTURAL MEASURES FOR WATERSHEDS FOUND ECONOMICALLY FEASIBLE UNDER A RANGE OF INTEREST RATES
Nemaha River Basin, Nebraska

Number	Delineated Watershed Identification: Name	Average Annual Primary Benefits	Average Annual Costs (100-Year Evaluation Period) Interest Rates: 5 7/8%	6 1/8%	6 3/8%	6 7/8%
		Dollars				
38-4	Long Branch	174,030	112,300	116,700	121,000	129,700
37-4	South Branch Little Nemaha	289,730	225,400	234,000	242,600	259,900
38-2	Middle Big Nemaha	352,660	277,800	288,800	299,900	322,000
37-1	Upper Little Nemaha	420,110	286,500	297,400	308,400	330,300
38-6,8,9	Turkey Creek	441,800	197,400	205,300	213,200	228,900
38-15	Big Muddy Creek	414,760	266,100	276,200	286,300	306,500
00-24	Northeast Cass	61,400	37,600	39,000	40,500	43,500
00-25	Weeping Water	82,900	41,300	42,900	44,600	47,800
00-26A	Squaw-Camp	42,900	25,700	26,700	27,700	29,700
00-26B	Peru-Brownville	45,760	29,700	30,900	32,000	34,400
38-3,5	Lower Big Nemaha	57,200	37,900	39,400	40,900	43,800
37-7,8,9	Lower Little Nemaha	248,870	159,100	165,400	171,700	184,400
TOTAL		2,632,120	1,696,800	1,762,700	1,828,800	1,960,900

land will receive adequate treatment by the year 2020. To accomplish this task in the scheduled time frame, the following major opportunities for land treatment measures should be considered:

- Forest management technical assistance for harvesting, thinning, weeding, pruning, and release of 27,400 acres of forested land.

- There are 7,000 acres of forest that are producing below their potential because of inadequate stocking and need to be seeded or planted. Site preparation will be needed in most areas.

- Timber surveys and management plans are needed to develop a viable sustained yield timber crop.

- Insects and disease have caused losses in timber production through reduction in growth, lower quality, deformities, rot, and death of trees. To protect the forested areas, a continued program of forest insect and disease control and detection needs to be maintained to include salvage cuts, thinning, etc.

- Distribution of seedling trees for reforestation, shelterbelts, and windbreaks.

- Maintain and improve fire control organizations through more training, improved equipment, etc.

- Consider the recreation and wildlife values in harvesting timber and grazing the forested areas.

- Cooperative watershed protection and flood prevention program-livestock control and critical area treatment.

- Reduce or eliminate grazing on 15,000 acres of forested land and improve 7,500 additional acres of grazed forest land so as to prevent further soil deterioration. Many forested areas have a history of heavy grazing which has adversely affected the quality, composition, and productivity of the forest. The heavy trampling and trailing of livestock compacts the soils and humus, and seriously impairs the capacity of the forest to retard erosion and reduce peak runoff.

Most of the forest land treatment can be installed on a cost-sharing basis through cooperation with the Nebraska State Forester.

D. Resource Conservation and Development Projects

Resource conservation and development projects boost the economy of local communities by speeding up conservation activities through acceleration of soil surveys, encouraging land use adjustments; promoting conservation planning; developing and managing water resources for recreation, wildlife, agriculture, industry and municipalities; and encouraging new industries to locate in the area to process and market products of the area. A need for this type of program was found in the basin.

E. Water Supply and Sewage Treatment Programs

Opportunities exist to install new or improve existing water supply and sewage treatment facilities in a number of the urban and rural communities in the basin. Programs of the Farmers Home Administration (FmHA) can assist with these developments in communities with a population of 5,500 or less by providing grants and loans for planning and construction of these facilities. Under existing policy, it is necessary to evaluate the needs of each community to determine what assistance can be provided under the Loan and Grant Program.

An analysis of the incorporated communities of less than 5,500 population shows that currently there is opportunity for FmHA assistance for water supply developments in the following communities: Alvo, Auburn, Crab Orchard, Dunbar, Elk Creek, Elmwood, Manley, Murray, Nehawka, Otoe, Palmyra, Steinauer, Table Rock, Tecumseh, and Union. Two of these developments are for new systems in communities without public water service. The other proposed development would be an improvement of an existing water system. The estimated cost of these water supply improvements is $1,085,000. A portion of this amount could be eligible for assistance from FmHA. Table VIII-7 groups the proposed developments using 1970 data.

There is an opportunity to assist with the installation of sewage treatment facilities in the following communities: Adams, Bennet, Crab Orchard, Douglas, Falls City, Firth, Humboldt, Julian, Lorton, Murray, Nehawka, Otoe, Palmyra, Rulo, Salem, Syracuse, Tecumseh, Talmage, and Union. Eight of these proposed developments will be for the improvement of existing treatment facilities. The total estimated cost for these developments is $1,205,000. The amount of assistance eligible under the FmHA program is dependent on the amount of assistance that might be provided by other agencies of government and the existing situation in each of the communities where the treatment facilities are proposed.

The total cost for water supply and sewage treatment facilities is estimated to be $2,290,000.

Table VIII-7 MUNICIPAL WATER SUPPLY AND SEWAGE TREATMENT OPPORTUNITIES
Nemaha River Basin, Nebraska

Category of Incorporated Communities[1]	Improve Existing Systems		New Systems		Total	
	Place No.	Institutional Cost Dollars	Place No.	Institutional Cost Dollars	Place No.	Institutional Cost Dollars
Water Supply[2]						
2,500-5,500	1	600,000			1	600,000
1,000-2,500	1	100,000			1	100,000
500-1,000						
250-500	6	202,000			6	202,000
100-250	5	100,000	1	40,000	6	140,000
Under 100			1	43,000	1	43,000
Subtotal	13	1,002,000	2	83,000	15	1,085,000
Sewage Treatment[3]						
2,500-5,500			1	55,000	1	55,000
1,000-2,500	2	223,000	1	359,000	3	582,000
500-1,000						
250-500	5	184,000	3	145,000	8	329,000
100-250	1	14,000	2	66,000	3	80,000
Under 100			3	159,000	3	159,000
Subtotal	8	421,000	10	784,000	18	1,205,000
TOTAL		1,423,000		867,000		2,290,000

1/ Grouping using 1970 Census data.
2/ Source: Preliminary estimate made by the FmHA.
3/ Source: State of Nebraska, Interim Plan for Water Quality Management in the Nemaha River Basin, Nebraska Soil and Water Conservation Commission, April 1972.

CHAPTER IX
IMPACTS OF SELECTED USDA PROJECTS AND PROGRAMS

The selected USDA projects and programs will affect the physical landscape, environment, culture, and economy of the basin. Not all of these impacts can be quantified. In some instances they are not readily identifiable and may not become apparent until a development program is implemented. The needed conservation land treatment and management practices developed in this study will maintain or improve the productivity of the basin's agricultural land and conservation and utilization of its water resources. Action or inaction in one sector directly or indirectly affects the other.

A. Physical and Biological Effects

Sedimentation

Sediment entering streams will be reduced by proper land use, application of proper land treatment, and the building of floodwater retarding and grade stabilization structures. Reduced rates of sedimentation will prolong the life of water impoundments, improve the efficiency of drainage systems, maintain a reasonable hydraulic capacity in streams, reduce stream turbidity, improve water quality and assist in the maintenance of soil fertility.

Runoff

Installation of the required land treatment program will reduce the volume of runoff from the upland areas. Installation of floodwater retarding reservoirs will reduce flood crests on the flood plains.

The relatively slow release of floodwater through the principal spillway conduits and limited seepage from the permanent pools will prolong streamflows. This, together with reservoir storage, will increase ground water recharge.

Water Quality

The small watershed program and the land treatment program will enhance the overall quality of the water in the basin by reducing the amount and velocity of runoff, which in turn will reduce erosion and sediment production. Cropland on which precipitation and irrigation waste water runoff are held to a minimum will contribute less pollutants, such as agricultural chemicals and soil nutrients, to the receiving streams.

Careful consideration should be given to the quality of the runoff before multiple-purpose impoundments are planned in order to avoid adverse, near-irreversible effects of eutrophication and other conditions detrimental to desirable environmental uses.

Recreation, Fish, and Wildlife

The selected measures and projects which can be installed through the USDA programs will have a significant impact in supplying the needed recreation, fish, and wildlife resources in the basin. There are 107 water impounding reservoirs proposed in the twelve watershed projects presented in this report which will provide increased water surface area.

Table VIII-3 lists the watersheds where recreation, fish, and wildlife purposes have been included. A total of five reservoirs are feasible for recreational development. An additional 3,870 acre-feet of permanent storage has been added to these reservoirs. The water surface area for the proposed multiple-purpose reservoirs totals 3,480 acres. In addition to the normal flood pool areas, 3,800 acres of additional land have been proposed for recreation and wildlife use. Adequate facilities needed to accommodate the anticipated use have been included in the $1,180,000 installation cost.

The projected recreational use for the proposed developed areas associated with the multiple-purpose impoundments is estimated to be 165,100 annual recreational visits. The major activities to be supplied by these developments include camping, swimming, boating, picnicking, fishing and hunting.

The 107 reservoirs and their surrounding land areas will contribute significantly to both wildlife habitat and recreational use. In this part of Nebraska, these impoundments will be used by migrating waterfowl. Also, a limited amount of productive nesting will take place in the cover around the reservoirs. The impoundment shorelines and the surrounding area provide useful habitat for many other game and nongame birds and mammals. Various fur bearing animals, marsh and wading birds, and shorebirds will be provided more desirable habitat needed to increase their numbers.

A significant impact for recreation and wildlife will occur from a wide variety of private onfarm developments that receive technical and financial assistance from USDA programs. Farm ponds, though small in size, will furnish wildlife habitat and can satisfy a part of the demand for fishing and hunting. Single purpose wildlife habitat and other wetland developments will provide nesting areas for both waterfowl and upland game birds in addition to supplying a significant portion of the hunting demand. The extent of this onfarm type of development depends on the financial incentives that will make recreation a more profitable enterprise than other alternatives that may be selected by the private landowners.

No detailed evaluations were made in this study to determine the adverse effects which some proposed developments may have on areas that currently provide habitat to existing wildlife. When any of the specific projects proposed are ready for detailed planning, possible damage to the existing wildlife habitat resources will be carefully evaluated. Mitigation measures will be provided where appreciable adverse effects are determined.

B. Economic Effects

This section is concerned with the indirect effects of the proposed USDA projects and programs. Income and employment effects associated with the construction phase of the structural program are evaluated. The value of increased output and reduction in damage from floodwater and sediment are then summarized in relation to the effects of the structural program on agricultural production. Effects of the increased outputs of goods and services on income and employment are then traced through components of the formulated structural program. As appropriate throughout this analysis the relevant account tables at the end of the chapter are referenced. These account tables are concerned with Natural Economic Development (NED), Environmental Quality (EQ), Regional Development (RD), and Social Well-Being (SWB). The RD account tables relate to income, employment, population distribution and social well-being.

The data base supportive to analysis of the indirect effects of the proposed structural program is distributed throughout the report. Data that are directly relevant to the analytical aspect at hand are cited and referenced, particularly as they participate in the account tables.

Installation Costs

Certain of the federal expenditures during the construction phase represent new money to the basin economy, thereby stimulating income and employment effects. Allocation of costs to the basin and the rest of the nation for each factor in the total recommended program is shown in Table IX-3. Average annual costs during the life of the project do not provide a suitable basis for assessing the indirect effects of infusion of federal funds into the basin economy. For purposes of analysis it is assumed that the total recommended program, with the exception of other conservation systems, would be installed within a 15-year period.

Federal expenditures are further assumed to be made available in equal increments during each of the installation years. Federal cost share includes $22,188,000 for flood control and grade stabilization, $590,000 for recreation developments (Table VIII-4), and $1,145,000 for water supply and sewage treatment systems. The total

estimated federal investment, excluding that associated with the installation of land treatment measures, amounts to $23,923,000. Adjusted for a share of the federal engineering and administration costs incurred outside the basin, the federal investment totals $19,138,400, or approximately $1,276,000 annually for 15 years. This is direct income to the basin which generates further expenditures that are a multiple of the original increase in income. The extent of these indirect and induced effects is measured by means of an income multiplier. The income multiplier developed for use in the basin is 1.89, application of which yields an estimated average annual increase in income of $1,135,600 (Table IX-3).

Effects of federal expenditures for construction on unemployed or underemployed labor resources can be estimated. Studies in comparable areas indicate that a construction output of approximately $80,000 is required to support one man-year of employment. The annual federal expenditure of $1,276,000 for construction purposes produces a direct employment effect of 16 man-years. Application of an employment multiplier developed and adopted for the basin indicates an indirect employment effect of 14 man-years. The total direct and indirect employment effects of the federal expenditure in the basin is 30 semi-skilled jobs during each of the 15 construction years (Table IX-4).

It remains to evaluate the income and employment effects of the federal investment in land treatment measures. Table VIII-1 shows a total projected land treatment cost by the year 2020 of $12,388,000. The federal share is estimated at 50 percent or $6,194,000, assumed to be made available in equal increments over a 50-year period. Indirect and induced income effects of the average annual federal investment of $123,900 are assessed as a .89 multiple or $110,000 (Table IX-3). An estimated $30,000 in agricultural output is required per man-year of employment. The average annual investment of $123,900 in federal funds for 50 years yields a direct employment effect of 4 man-years annually. Indirect employment effects approximate 1 man-year annually (Table IX-4).

Required Land Resources

Land ownership and use changes will accompany the structural program, the associated beneficial and adverse effects of which are shown in the NED and RD account displays Tables IX-1 and IX-3). Table VIII-2 reveals that 4,950 acres of the project-take area would be permanently inundated. Floodwater storage involves an additional 8,320 acres. An additional 3,800 acres are required for recreation, fish and wildlife. Total project effects on land ownership and use involves 17,070 acres of land currently available for agricultural use.

The required floodwater storage area cited above would not be completely lost to agricultural production. A 25 percent average annual production loss on 50 percent of the area is estimated, amounting to an average annual equivalent loss of 1,040 acres. This, combined

with the required permanent water storage area and recreation, fish, and wildlife lands, totals 9,790 acres that can no longer contribute to total value of agricultural production. The adverse effects of project-take area on production have been netted out of the beneficial income effects listed in Tables IX-1 and IX-3. It remains to consider the adverse income effects of loss of indirect and induced effects of the foregone value of agricultural production. Additionally, the direct effect of project-take area on agricultural employment and associated indirect and induced employment effects require evaluation.

No precise measure of the value of agricultural production lost because of project-take area is available. However, a reasonable estimate can be developed, based on the assumption that the land use of the take area would be comparable to that of the total basin. Table II-3 shows that land is used for crop and pasture on 87.8 percent of the basin area. This infers that 8,596 acres of the project-take area are in crop and pasture use. From Table III-22 it can be seen that the total value of row crop, grain and roughage production is $80,961,841. This revenue is produced from 1,559,400 acres of crop and pasture land (Table II-3), amounting to about $52 per composite acre. Thus, the estimated average annual value of agricultural production lost because of project-take area is (8,596 acres x $52 per acre) about $447,000. This figure is useful to the extent that it permits computation of associated loss of indirect and induced income and employment.

Procedures for measuring external diseconomies are the same as those for measuring external economies. Application of the 1.89 income multiplier to the $447,000 production loss figure developed above yields an estimated $398,000 annual income loss due to external diseconomies (Table IX-3). Losses in agricultural employment because of the project-take area would be a function of the output required to support the employment of one agricultural worker. Recent studies in areas with an agricultural economy similar to that of the basin indicate that about $33,000 output from the crop and/or livestock sector is required to employ one worker. The estimated production loss divided by output per worker leads to an employment loss estimate of 14 agricultural employees because of project-take area. Adverse indirect and induced employment effects occur as a result of direct employment losses. Application of the employment multiplier leads to an estimated loss of 12 jobs as a function of indirect and induced employment effects. Adverse employment effects total 14 man-years of agricultural employment and 12 permanent semi-skilled jobs (Table IX-4).

Agricultural Production

The data base supporting analyses of the economic effects of the recommended structural program is distributed throughout the report. These data are extracted from appropriate tables and summarized. The purpose is to clearly establish the with and without projects scenario and to develop and reference data appearing in the account displays at the end of this chapter.

Damage Reduction

Tables IV-1 and IV-4 list the detail of current average annual damage due to floodwater, sediment and gully erosion in the without project situation. Total damage is estimated at $4,327,050, distributed as $3,101,210 from floodwater and sediment and $1,225,840 from gully erosion. Average annual agricultural damages total $3,382,750, being made up of $2,906,910 from floodwater and sediment and $1,225,840 from gully erosion. The difference between total damage and agricultural damage is comprised of $160,130 to rural nonagriculture, $37,420 in the urban sector and $296,750 in indirect effects. These damages annually pertain to 169,370 acres of flood plain lands and 252,200 acres of land subject to gully erosion and in need of project action (Tables V-2 and V-3).

The structural program proposed in the 12 new watershed projects included in this report includes: 107 water impounding structures for the control of floodwater and sediment, five of which incorporate additional storage for recreational purposes; and 299 grade stabilization structures (Table VIII-2). Installation of the structural program will provide average annual primary benefits of $1,437,520 through flood prevention and $947,100 through grade stabilization, totaling $2,384,620. Residual damages amount to $1,942,430. Recreation development measures will provide an additional $247,500 in average annual benefits (Table VIII-5) deriving from an estimated 165,100 recreation visits.

Value of Increased Output

The value of increased output expected from the structural program is $2,384,620. These are total direct project benefits which require further refinement in order to compute indirect and induced effects. Nonagricultural benefits, indirect benefits deriving from primary benefits (Table VIII-5) and regional costs are deducted from total direct project benefits. Average annual primary benefits from the flood prevention measures total $1,437,520, an estimated $1,150,000 of which are obtained through more intensive use of cropland and pasture and reduction in damages from flood plain sediment and scour. Similarly, the $947,100 in average annual primary benefits shown for grade stabliization include an estimated $631,000 in project effects on net productivity. Total estimated net average annual increase in total value of agricultural production because of implementing the structural program is $1,781,000. These data exclude recreational benefits and net out the loss of agricultural production from the project-take area.

To the extent that additional production and associated economic activity merely displaces production in other areas or affect market prices, the above economic benefits may not truly be national gains. However, it is assumed in this case that the output increasing effects

are not large enough on an interregional basis, to cause significant displacement or price effects.

Since indirect and induced effects in the basin are dependent upon increased income after all costs, the cost of project works to be borne within the basin are deducted. Average annual installation costs of $197,300 and operation and maintenance costs of $121,200 total $318,500 in within-basin costs. A balance of $1,462,500 of additional average annual income due to project effects remains, providing the basis for estimating external effects.

Income and Employment:

Floodwater Retarding and Grade Stabilization Structures

Income and employment multipliers are again the instruments used for quantifying external economies brought about by the direct economic effects of the proposed structural program. Application of the basin income multiplier of 1.89 to the $1,462,500 in additional annual income in a with-projects situation results in estimated additional average annual beneficial indirect and induced income effects of $1,301,625 (Table IX-3).

The effect of the $1,462,500 average annual direct benefits on agricultural employment is the result of the amount of agricultural output required to employ one person. This output multiplier is estimated at $33,000 per employee, which when divided into the direct benefits results in an expected gain of 44 agricultural workers. Application of the employment multiplier to interpret indirect and induced employment effects results in an estimate of 39 additional permanent semi-skilled jobs. Total estimated employment effect is estimated at 83 workers.

Recreation

Direct, indirect and induced economic effects resulting from the 3,800-acre area for recreation, fish and wildlife have been evaluated in terms of associated land use and ownership changes and the external effects of the federal share of construction costs on the basin economy. Indirect and induced effects of the basin income expected to be generated from recreational development have not yet been considered. Extent of use of the proposed recreational developments is estimated as 165,100 recreational visits (Table VIII-3). Direct income effects associated with this activity are estimated as $247,500 (Tables VIII-5, IX-1 and IX-3).

Indirect and induced income effects are estimated by use of an income multiplier characteristic of the sector within the basin to which benefits accrue. With regard to the recreation services sector, a multiplier of 1.71 is applied, providing an estimated $175,700 in

indirect and induced income effects. This amount in combination with the indirect effects associated with the structural program, sums to the amount shown in Table IX-3. The dollar output required per man-year of labor in the services sector is estimated at $11,000. Direct annual income of $247,500 from recreational developments divided by the output per worker results in a direct employment effect of 23 jobs. An employment multiplier of 1.48 is applied to the direct employment effect, resulting in an estimated 11 additional permanent semi-skilled jobs.

Water Supply and Sewage Treatment Systems

Proposed projects included in this category are listed in Table VIII-7. Thirteen villages need improvements to their existing water supply systems and two communities need new systems. Improved sewage treatment facilities are needed by eight villages and new systems are proposed for ten communities. Total cost of the proposed projects is $2,290,000. Average annual income effects from these developments are listed in Tables IX-1 and IX-3. Although no attempt was made to determine the direct economic effects of this program, availability of adequate water and sewage facilities may often be the deciding factor in bringing new industries to rural communities in the basin. Indirect and induced economic effects of the investment of federal funds in the basin for the construction of the proposed developments were included in an analysis presented earlier in this section.

Social and Institutional Effects

Development of the water, land, wildlife, and related resources will improve the social well-being of the rural and urban areas. Beneficial and adverse effects of the proposed USDA projects on social well-being are displayed in Table IX-6. The resultant increase in income and employment and the reduction of out-migration of people will influence the religious, economic, educational and governmental institutions of the basin. The rate of reduction in the farm population will be decreased. Increased agricultural production will create additional employment in the related trade service and processing industries. Recreation opportunities will increase as the approved and proposed development measures are completed.

C. Environmental Effects

Projects and programs proposed in this report will produce effects on the quality of the environment in the basin. These effects are summarized in the environmental quality account display (Table IX-2). Major areas of environmental consideration, as influenced by the recommended projects, include erosion and sediment, wildlife habitat, water quality and water supply, and water-based recreation.

Conservation treatment measures planned for 562,200 acres of land subject to erosion will reduce the soil loss in the basin by approximately 30 percent. Gully erosion will be controlled in large measure through the proposed installation of 299 grade stabilization structures. These structures will prevent land voiding of 2,145 acres and reduce sediment by 1,935 acre feet per year. This reduction in sediment will produce an improvement in the water quality of the streams in the basin. The recommended, improved and new sewage treatment plants will also reduce stream pollution and improve water quality.

Water based recreation opportunities will be increased by the installation of five multi-purpose structures. The reservoirs and associated recreation developments will provide opportunity for 165,100 annual recreation visits. Activities such as warm water fishing, swimming, picnicking and camping will be available. Recreation activity of this magnitude will also seasonally disrupt the tranquility of the rural environment.

Consideration of the improvement of wildlife habitat is included in the recommended conservation treatment practices. Steps will be taken to ensure that adequate mitigation is made for any loss of wildlife habitat during the construction of structural measures. The 107 reservoirs created by floodwater retarding structures will provide 4,950 acres of resting area for migratory waterfowl along with improved warm water fishery. Land area involved in the structural program is irreversibly committed to the project purposes.

Table IX-1 SELECTED PLAN, NATIONAL ECONOMIC DEVELOPMENT ACCOUNT
Nemaha River Basin, Nebraska

Components	Measures of Effects (Average Annual)	Components	Measures of Effects (Average Annual) 1/
Beneficial Effects:		Adverse Effects:	
A. The value to users of increased outputs of goods and services		A. The value of resources required for a plan	
1. Flood prevention	$1,437,520	1. Single and multi-purpose reservoirs	$ 930,000
2. Grade stabilization	947,100	2. Grade stabilization stuctures	576,000
3. Recreation	247,500	3. Recreation developments	70,000
4. Land treatment measures	792,000	4. Land treatment measures	730,000
5. Water quality	138,000	5. Sewage treatment systems	71,000
6. Water supply systems	81,000	6. Water supply systems	64,000
		7. OM&R	194,600
B. The value of output resulting from external economies.		B. Losses in output resulting from external diseconomies.	
1. Indirect and induced activities associated with increased net returns from flood prevention grade stabilization and recreation.	84,000	1. Indirect activities from project-take area.	20,000
Total beneficial effects:	$3,727,120	Total adverse effects:	2,655,600
		Net beneficial effects:	$1,071,520

1/ Cost of construction items amortized over 100 years @ 5 7/8 percent interest.

Table IX-2 SELECTED PLAN, ENVIRONMENTAL QUALITY ACCOUNT
Nemaha River Basin, Nebraska

Components	Measures of Effects
Beneficial and Adverse Effects:	
A. Areas of natural beauty.	1. Project output will make available regional funds and resources that can be used to enhance the physical appearance on 1,279,400 acres.
	2. Create 107 lakes with a total permanent surface area of 4,950 acres.
	3. Permanently inundate 4,950 acres of crop and pasture land.
	4. Disruption in tranquility of rural environment by 165,100 recreation visits per year.
	5. Develop 360 acres for recreation areas.
B. Quality consideration of water, land and air resources.	1. Prevent voiding by erosion on 2,145 acres.
	2. Reduce sediment by 1,935 acre feet per year.
	3. Reduce erosion on 562,200 acres.
	4. Improve water quailty in streamflow through reduction in sediment and installation of new or improved sewage treatment facilities for 19 communities.
C. Biological resources and selected ecosystems.	1. Provide 4,950 acres of resting area for migratory waterfowl.
	2. Create 5 lakes containing 26,290 acre feet of water for fish production.
	3. Enhance habitat and food supply for some game and nongame wildlife on 562,200 acres.
D. Irreversible or irretrievable commitments	1. Conversion of 4,950 acres of crop and pasture land to dams, spillways and reservoir pools.
	2. Periodic inundation of up to an additional 8,320 acres of crop and pasture land with floodwater storage.

Table IX-3 SELECTED PLAN, REGIONAL DEVELOPMENT ACCOUNT, INCOME EFFECTS
Nemaha River Basin, Nebraska

Components Income	Measures of Effects: Nemaha River Basin	Measures of Effects: Rest of Nation
	Average Annual	
Beneficial Effects:		
A. The value of increased output of goods and services to users 2/		
1. Flood prevention	$1,437,520	$ --
2. Grade stabilization	947,100	--
3. Recreation	247,500	--
4. Land treatment measures	915,000	792,000
5. Water quality	138,000	--
6. Water supply systems	81,000	--
B. The value of output to users residing in the region from external economies		
1. Indirect and induced activities associated with increased net returns from flood prevention, grade stabilization and recreation	1,477,325	-1,393,325
2. Indirect and induced activities associated with construction program in basin.		
a. Total structural program except land treatment measures	3/	3/
b. Land treatment measures	4/	4/
Total Beneficial Effects: 5/	$5,120,445	$-1,393,325

Components Income	Measures of Effects: Nemaha River Basin	Measures of Effects: Rest of Nation
	Average Annual 1/	
Adverse Effects:		
A. The value of resources contributed from within the region to achieve the outputs		
1. Single and multipurpose reservoirs	$ 127,200	$ 802,800
2. Grade stabilization structures	71,700	504,300
3. Recreation developments	35,000	35,000
4. Land treatment measures	365,000	365,000
5. Sewage treatment systems	35,500	35,500
6. Water supply systems	32,000	32,000
7. OM&R	194,600	0
B. Losses in output resulting from external diseconomies to users residing in the region		
1. Indirect activities from project-take area	398,000	- 378,000
Total Adverse Effects:	$1,259,000	$ 1,396,600
Net Beneficial Effect:	$3,861,445	$-2,789,925

1/ Cost of construction items amortized over 100 years @ 5-7/8 percent interest.
2/ During 100 year project life.
3/ Estimated secondary effects of nonregional funds expended in basin are $1,135,600 annually during 15 year installation period. A negative offset of identical amount applies to the rest of the nation.
4/ Estimated secondary effects of nonregional funds expended in basin are $110,000 annually during 50 year installation period. A negative offset of identical amount applies to the rest of the nation.
5/ Excludes secondary effects cited in 3/ and 4/ above.

Table IX-4 SELECTED PLAN, REGIONAL DEVELOPMENT ACCOUNT, EMPLOYMENT EFFECTS
Nemaha River Basin, Nebraska

Components Employment	Measures of Effects: Nemaha River Basin	Measures of Effects: Rest of Nation
Beneficial Effects:		
A. Increase in number and type of jobs.		
1. Agricultural Employment	44 man-years of permanent semi-skilled jobs in agr. production	--
2. Recreation Service	23 permament seasonal semi-skilled jobs	--
3. Project Construction	16 semiskilled jobs per year for 15 years	--
4. Land Treatment Installation	4 semiskilled jobs per year for 50 years	--
5. Indirect and Induced Employment from items above		
a. Agricultural Employment	39 permanent semiskilled jobs	--
b. Recreation Service	11 permanent seasonal jobs	--
c. Project Construction	14 full-time jobs for 15 years	--
d. Land Treatment Installation	1 full-time job for 50 years	--
Total Beneficial Effects:	83 permanent semiskilled jobs	--
	34 permanent seasonal semiskilled jobs	--
	30 semiskilled jobs per year for 15 years	--
	5 semiskilled jobs per year for 50 years	--

Components Employment	Measures of Effects: Nemaha River Basin	Measures of Effects: Rest of Nation
Adverse Effects:		
A. Decrease in number and type of jobs		
1. Project-take Area	14 man-years of permanent agr. jobs	--
2. Indirect and Induced Employment associated with Project-take Area	12 permanent semiskilled jobs	--
Total Adverse Effects:	26 permanent semiskilled jobs	--
Net Beneficial Effects:	57 permanent semiskilled	--
	34 permanent seasonal semiskilled	--
	30 semiskilled jobs per year for 15 years	--
	5 semiskilled jobs per year for 50 years	--

Table IX-5 SELECTED PLAN, REGIONAL DEVELOPMENT ACCOUNT, POPULATION DISTRIBUTION EFFECTS
Nemaha River Basin, Nebraska

Components	Measures of Effects
Population Distribution	
Beneficial Effects	Creates 83 permanent semiskilled jobs, 34 permanent seasonal semiskilled jobs, 30 semiskilled jobs for 15 years, and 5 semiskilled jobs per year for 50 years, primarily in a rural area which has experienced a 6% reduction in population between 1960 and 1970.
Adverse Effects	Project-take area annually displaces 14 man-years of agricultural employment and 12 permanent semiskilled jobs due to indirect and induced effects.
Regional Economic Base and Stability	
Beneficial Effects	Provides for storage of 108,820 acre-feet of floodwater, 34,420 acre-feet of sediment and 3,870 acre-feet for recreation. Provides a net average annual increase in total value of agricultural production of $1,781,000 in an area where agriculture is the economic mainstay. Creates 83 permanent semiskilled jobs, 34 permanent seasonal semiskilled jobs, 30 semiskilled jobs per year for 15 years, and 5 semiskilled jobs per year for 50 years.

Table IX-6 SELECTED PLAN, SOCIAL WELL-BEING ACCOUNT
Nemaha River Basin, Nebraska

Components	Measures of Effects
Beneficial and Adverse Effects:	
A. Income Distribution	1. Creates 83 low to medium income permanent jobs.
	2. Creates 34 low to medium income seasonal jobs.
	3. Creates 30 medium income jobs per year for 15 years.
	4. Creates 5 medium income jobs per year for 50 years.
	5. Distributes regional income benefits of $6,489,045 and regional costs of $1,262,600 to all income classes but estimated as lying dominantly in the $3,000-10,000 class.
B. Recreational Opportunities	1. Provides for activities for 165,100 recreation visits. See Component C (Life, Health and Safety) for possible adverse effects.
C. Life, Health and Safety	1. Provide varying levels of flood protection to 89,250 acres of agricultural land. Data base for developing meaningful estimates of effects not available.
	2. Adverse effects may surface as a function of water-based activities included in Component B (Recreational Opportunities). No feasible method is known and no data base is available for quantifying estimates of possible adverse effects on life and safety.
	3. Provide dependable water of good quality to 15 communities.
	4. Provide adequate sewage treatment facilities to 18 communities.

Table IX-7 CAPABILITY OF THE SELECTED PLAN TO SATISFY COMPONENT NEEDS
Nemaha River Basin, Nebraska

Description	Current Component Needs: Unit	Quantity	Recommended Plan: Provides	Remaining
Land Treatment	Acres	964,200	562,200	402,000
Flood Damage Reduction				
Watersheds Recommended for Project Action	Ave. Ann. $ Damage	$2,159,630	$1,437,520	$722,110
Watersheds Approved for Instal of Structural Measures	Residual Ave. Ann. $ Damage	257,650	0	257,650
Other Watersheds	Ave. Ann. $ Damage	683,930	0	683,930
Total Flood Damage Reduction		3,101,210	1,437,520	1,663,690
Erosion Control - Gully				
Watersheds Recommended for Project Action	Ave. Ann. $ Damage	947,100	947,100	0
Watersheds Approved for Instal. of Structural Measures	Residual Ave. Ann. $ Damage	45,380	0	45,380
Other Watersheds	Ave. Ann. $. Damage	114,550	0	114,550
Total Erosion Control - Gully		1,107,030	947,100	159,930
Impaired Drainage	Acres	6,000	0	6,000
M & I Water Supply	No. Systems	15	15	0
Municipal Sewage Treatment	No. Systems	33	18	15
Recreation	Recreation Visits	-482,500 1/	165,100	-647,600 1/
Water	Acres	15,690	3,480	12,210
Developed Land	Acres	580	360	220
Undeveloped Land	Acres	2,740	3,180	-440

1/ Recreation needs are projected to increase from a current over supply to a need for 5,327,500 recreation visits by 1980; 23,527,500 recreation visits by 2000; and 43,567,500 recreation visits by 2020.

CHAPTER X
COORDINATION AND PROGRAMS FOR FURTHER DEVELOPMENT

The implementation of an orderly and comprehensive program for the conservation and development of the basin's water and related land resources should be based on coordinated proposals of federal, state, and local agencies which are acceptable to the people in the basin. The Natural Resources Commission has the responsibility to coordinate the various proposals and plans from reports and data submitted to them by the cooperating federal and state agencies.

Development should be implemented as a result of the desire of local people and will be expedited when the local people are well-informed about alternative programs available to them and when they actively participate in the decision making process. Agencies which can be called upon to provide information on programs are, among others, the Natural Resources Commission, the Department of Environmental Control, the Cooperative Extension Service, University of Nebraska, and many local organizations.

Major resource development proposals for the basin may be installed under the programs of the U. S. Department of Agriculture, U. S. Army Corps of Engineers, and U. S. Department of the Interior. State and local entities of government, particularly the Natural Resources Districts and private interests, can implement other developments required to satisfy needs of the basin. Examples of other developments are the development of recreational areas by the State of Nebraska or appropriate political subdivisions within the basin, the continued improvement of the sewage treatment facilities by cities and villages, and the installation of private irrigation development by landowners.

A. Other Agency Programs

In addition to the USDA opportunities proposed in this report, other federal agencies have proposed or are making studies for the Nemaha River Basin. The U. S. Army Corps of Engineers has made an investigation and recommended a project for flood control on the Little Nemaha River.

The proposed structural measures included in this project consist of protective levees with necessary appurtenances along the Little Nemaha River and its tributary streams from the existing Missouri River Agricultural Levee Unit R-548 upstream to the vicinity of Brock, Nebraska. The levees would be designed to protect the lower basin flood plain against floods of approximately a 30-year magnitude. This project has been classified as inactive because of lack of local support.

Several other nonfederal agencies are active in developing various aspects of the basin's land and water resources. The Nebraska

Game and Parks Commission has prepared an outdoor recreation report for the state and has a continuing program of acquisition and management of land and water for recreation, fish, and wildlife purposes. The Department of Environmental Control provides funding for sewage treatment facilities. Local and county governments construct and operate needed developments for a variety of purposes.

The laws of the State of Nebraska provide for local flood plain zoning and land use regulation. The implementation of these zoning statutes will deter or limit the installation of developments in areas subject to flood damages. Although various agencies are able to assist in the preparation of needed reports, the implementation of zoning and land use programs is the responsibility of the state and local government.

B. Potential Developments Needing Further Coordination With Other Agencies

The projects proposed by the U. S. Bureau of Reclamation, U. S. Army Corps of Engineers, and other agencies should be coordinated with the U. S. Department of Agriculture in the administration and application of land treatment measures. Coordination is needed with the U. S. Fish and Wildlife Service and the Nebraska Game and Parks Commission to obtain maximum development of agricultural and wildlife resources.

C. Alternatives

A coordinated comprehensive program oriented toward a balance of economic, social, and environmental objectives would provide the most desirable development of the land and water resources of the basin. This program would have the combined effect of improving the economic and environmental condition of the basin by providing improved water supplies and enhancing or preserving the natural values of the environment. The quality of air, soil, and water resources would be improved as well as the plant and wildlife communities. Such a comprehensive program would most nearly achieve all objectives for water and related land resource development for the greatest good of the basin's residents.

Although this report endorses this type of comprehensive program, other alternatives need to be considered before implementing a final plan for the basin.

One such plan could be oriented toward environmental objectives as the primary consideration in determining the best use of the resources. The environmentally oriented plan would give emphasis to such items as public recreation, fish and wildlife development, preservation of wooded areas along streams and near centers of population, pollution abatement, water quality improvement, and beautifi-

cation. Secondary consideration would be given to the agricultural sector of the economy. This environmental type of plan would, in many instances, limit the potential for full economic development of the agricultural sector of the basin's economy. For example, water for low-flow augmentation needed to improve water quality and the fisheries resource might pre-empt a water supply for irrigation. On the other hand, the improved environmental condition made possible under this alternative approach might create new employment opportunities in recreational-oriented industries which would help to attract other industrial-oriented developments. Full implementation of this alternative approach is not possible under present USDA programs.

Another comprehensive plan could include considerations of structural measures, land use regulations, and zoning of flood plains to minimize flood damages. An alternative to this type of development would be to implement only the land use and zoning aspects of the plan which would reduce damages to future developments but would have little beneficial effect on current or projected damages to existing developments.

Yet another alternative would be to continue only the present programs of soil and water resource conservation development instead of the accelerated program proposed by this report. In general, present programs satisfy some basic individual and local needs but seldom provide for basinwide or statewide requirements. If present programs continue as in the past, federal cost-sharing and technical assistance will be needed at or near current rates.

D. New Programs or Modification of Existing Programs

Changes in technology will continue to occur which may result in new regional and national objectives. Existing programs have been and will continue to be modified to meet changing needs. The emphasis on conservation in the past has been largely focused on erosion control in order to maintain fertility and productive capability of the land. Now and in the future, emphasis on conservation will also include environmental concerns such as improvement of water quality, reduced eutrophication of lakes and impoundments, and overall landscape beautifications. Changing public demands and values will necessitate programs to provide more incentive for landowners to adequately participate in all phases of soil and water conservation programs and will increase the level of conservation treatment, improve and increase wildlife habitat and recreation opportunities, and provide for a general enhancement of the environment. Measures contributing to these objectives would include: for croplands--minimum tillage, terraces, diversions, and vegetated waterways; for pasture and range lands--proper grazing management, range revegetation with permanent grasses, and weed and brush control measures; and for forest and woodlands--improved forest management, tree planting for higher grade forest products, and elimination of damaging grazing.

A program is needed to provide incentive for basin landowners to properly manage existing woodlands and shelterbelts. An approach could be cost-sharing to manage forest lands for forest products and for recreation and environmental enhancement. Incentives could be provided to encourage establishment of markets for low grade forest products such as pallets, pulp material, and wood chips which would provide additional income to forest landowners and local processors.

USDA-SCS-LINCOLN, NEBR. 1975