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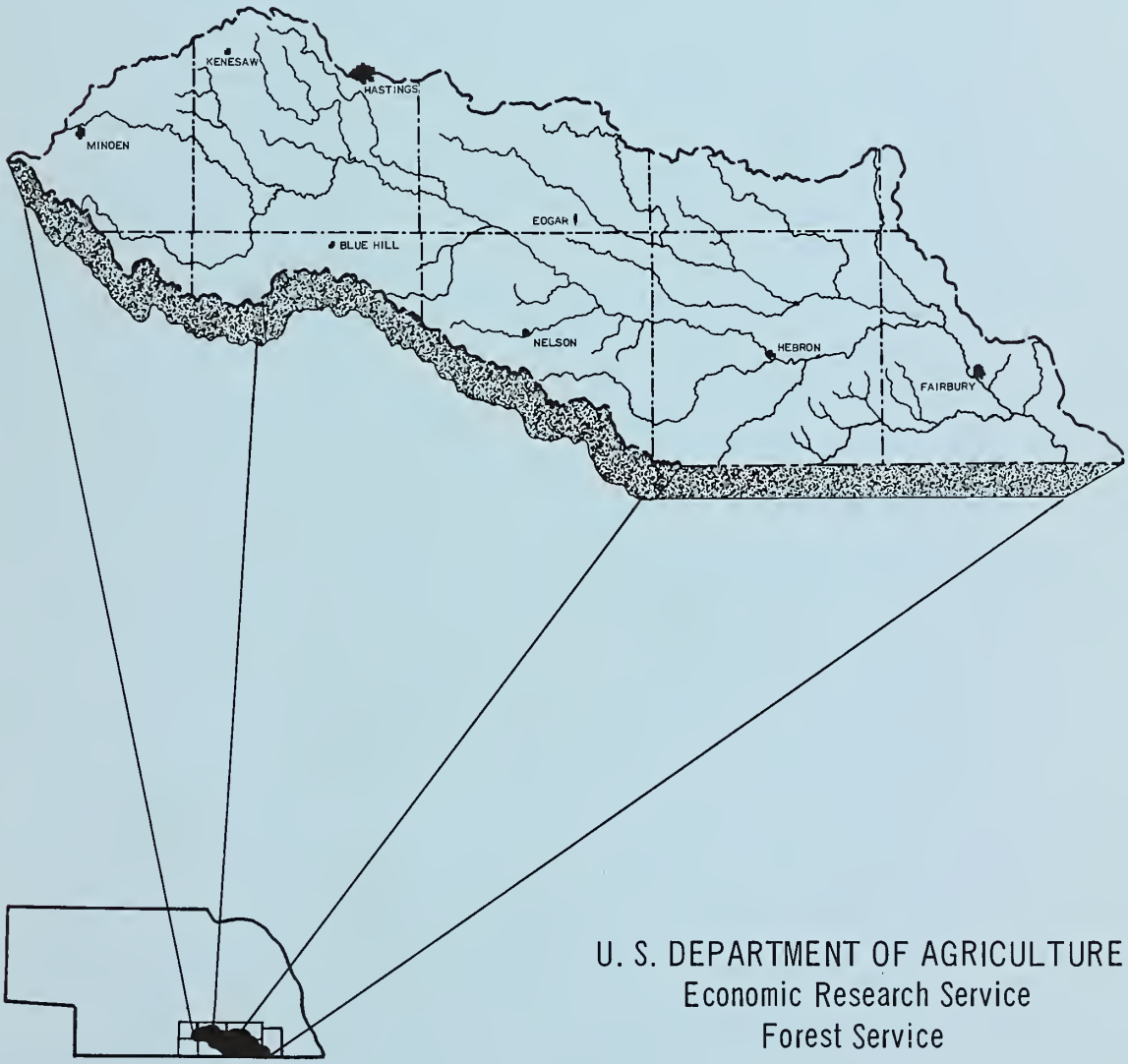
LITTLE BLUE RIVER BASIN
Nebraska

WATER AND RELATED LAND RESOURCES



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

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LITTLE BLUE RIVER BASIN REPORT

NEBRASKA

USDA WATER AND RELATED LAND RESOURCES REPORT

Prepared by

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ECONOMIC RESEARCH SERVICE

FOREST SERVICE

SOIL CONSERVATION SERVICE

Lincoln, Nebraska

Under Direction of

USDA FIELD ADVISORY COMMITTEE

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Bureau of Sport Fisheries and Wildlife

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Natural Resource Districts

Little Blue Flood Control and Conservation Association

Nebraska Game and Parks Commission

Nebraska Department of Water Resources

University of Nebraska:

- Agricultural Experiment Station
- Agricultural Extension Service
- Conservation and Survey Division

PHOTOGRAPHS

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

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U.S. DEPARTMENT OF AGRICULTURE
LITTLE BLUE RIVER BASIN, NEBRASKA

SUMMARY

General

The Little Blue River, a tributary of the Big Blue River, drains about 2,691 square miles or 1,722,200 acres in 11 south central Nebraska counties. This survey report prepared by 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 Little Blue River Basin. The report is based upon a study of upstream watershed needs and opportunities for flood prevention; agricultural, municipal, and industrial water supply; fish and wildlife habitat; recreation facilities; and water quality control.

The main objectives of the USDA 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 Bureau of Reclamation and the Corps of Engineers are each studying and planning a major flood control and irrigation project in the Little Blue River Basin. Their studies will be contained in their respective 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 deposited on lower lying lands or in channels smothers crops, reduces channel capacities, degrades water quality and disrupts irrigation. In the basin, 866,000 acres are subject to erosion damage. Of this total, nearly 296,000 acres have a gully erosion problem, with over 27,000 acres needing project action. The current average annual monetary damage for the area needing project action is estimated to be $37,530.

2. Floodwater and sediment damage are problems on the floodplains and in the upland depressional and flatland areas of the basin. It is estimated that 110,150 acres are subject to this type of damage, with 83,730 acres needing project action. Of this area, 31,750 acres are in the flat upland and shallow depressional areas and 51,980 acres are located on the floodplains along the tributary streams. The current average annual floodwater and sediment damages are estimated to be about $594,000.

3. About 41,700 acres of agricultural land has an excess water problem, with 25,500 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 fires during drought periods, severe over-grazing by livestock, inadequate management of natural tree resources, and Dutch elm disease causing the death of many trees. These problems also cause increased flood, sediment, and erosion 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 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 streams and ground water.

7. Some areas in the basin are experiencing lowering ground water levels. Such fluctuations of the water table are considered to be potentially serious. The development and proper use of the basin's ground water resources necessitates improved management and more study.

8. In order to satisfy the need for water-based recreational development by 1980, 12,900 acres of surface water, 150 acres of developed land, and 1,500 acres of undeveloped land will be needed. Present water areas and facilities are inadequate to meet the existing demands of basin residents for water skiing, sail boating, motor boating, and swimming. Fishing is limited to small farm ponds and to certain reaches of the Little Blue River; hunting is partially restricted by limited access to private lands. Projected recreational demands are expected to nearly double by 2020, increasing the needs for additional recreational facilities.

9. Livestock water requirements will increase from a current use of 7,900 acre feet to 18,690 acre feet by 2020. Ground water will continue to be the major source of supply, with surface sources supplying only an estimated 15 percent.

10. Municipal, industrial, and rural domestic water requirements will increase from an estimated current requirement of 9,020 acre feet to 12,900 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 decline. About 60 percent of today's farm units are expected to disappear, causing the average farm size to increase to over 750 acres by 2020.

The gross annual value of the total agricultural output is projected to increase about 180 percent by 2020. This will be accomplished by: changes in land use; increased yields due to improved technology,

management, and irrigation water management; increased installation of conservation land treatment measures; and reduced damages from floodwater, sediment, and impaired drainage.

Irrigation is projected to increase from a current normal use of 270,000 acres to approximately 375,000 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. It is recognized that structural measures often have adverse as well as beneficial effects on the total environment. Adverse effects need to be mitigated, as necessary, in order that the net effect on the environment will be good. 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 of this study are:

1. Two upstream watersheds, Balls Branch and Little Sandy Creek, are feasible for project action, and need to be installed in the next 10-15 years. These two watershed projects include: six floodwater retarding structures, including one with recreation and fish and wildlife features; 12 miles of multiple purpose channel work; and two grade stabilization structures. The total estimated installation cost of these structural measures is $1,989,000. The estimated federal share of this would be $1,341,000 and the nonfederal, $648,000, under current cost-sharing criteria. These measures are estimated to produce current average annual primary benefits of $210,900 at an average annual cost of $130,400.

   An additional eight watersheds were found to be potentially feasible for project action after 1980-1985. These potential watershed projects would include 28 floodwater retarding structures, including six with recreation or fish and wildlife features; 10 grade stabilization structures; and 76 miles of multiple purpose channel work. The channel work occurs in five watersheds in upland areas which are 75 percent cropland.

   Recreation or fish and wildlife developments were found feasible for seven of the ten potential watershed projects.

Additional storage is proposed for each of the seven sites, increasing the total water surface area at these reservoirs to about 2,200 acres. Recreational facilities have been included with an estimated annual use of 227,000 visitor days. Incidental recreational use of 204,000 visitor days is anticipated at the 27 additional reservoirs where no specific recreational developments are proposed.

Before implementation of any of the proposed project developments detailed investigations will be made of the possible adverse effects certain measures may have in regard to environmental values and existing wildlife habitat. Necessary mitigation measures will be included in the individual watershed work plans.

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. Land treatment measures should treat critical silt producing areas; improve natural water courses; improve range, pasture and forest land management; improve irrigation efficiencies; and provide necessary practices to control feedlot pollution.

   It has been projected in this study that an additional 525,700 acres of agricultural land will be treated by 2020. Of this area, 400,200 acres will require management, vegetative, and/or mechanical practices with 125,500 acres receiving management practices only. The total aggregate cost for all of the proposed treatment measures, using current prices, is estimated to be $17,797,600. This includes $477,000 for treatment of 7,200 acres of forest and woodland area.

3. Opportunities exist to assist in the installation of new or to improve existing water supply and sewage treatment facilities in a number of the urban and rural communities in the basin. Proposed facilities for this development are estimated to cost $1,830,600.

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

I. INTRODUCTION

This report on the Nebraska portion of the Little Blue 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, August, 1954). The Little Blue River Basin, a tributary to the Big Blue River, is a part of the Missouri River Basin. This cooperative Type IV river basin survey was authorized for study by the Administrator of the Soil Conservation Service, on November 9, 1962. The river basin study was requested by the Little Blue Flood Control and Conservation Association, through the state coordinating agency, the Nebraska Soil and Water Conservation Commission.

A Plan of Work for this basin study was developed by the Nebraska Soil and Water Conservation Commission. The Plan of Work outlined the assistance desired from a number of federal and state agencies: the Bureau of Reclamation; Corps of Engineers; Soil Conservation Service; Economic Research Service; Forest Service, in cooperation with the State Forester; Conservation and Survey Division (University of Nebraska); Extension Service (University of Nebraska); Nebraska Department of Water Resources; Nebraska Game and Parks Commission; and the Nebraska Department of Health.

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

1. Compile statistical material on the agricultural economy of the basin.

2. Inventory soil and water problems on a watershed basis.

3. Analyze projected improvements in agricultural technology, growth of markets, and the need for land and water resource development.

4. Evaluate the effects of water and related land resource development on the basin's economy.

5. Determine the economic feasibility of potential watershed projects.

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, the Economic Research Service, and the Forest Service. 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 Soil and Water Conservation Commission 1/ and other state and federal agencies.

USDA representatives analyzed each Soil and Water Conservation District's 2/ water and related land resource problems and needs by delineated watershed areas. This was done after consultation with the District Supervisors, local Soil Conservation Service Work Unit Staff, and local residents.

The Nebraska Soil and Water Conservation Commission (now NNRC) chaired the joint efforts of the various participating agencies. It held meetings to acquaint local people on the progress of planning activities and will continue such information meetings throughout the basin. The NNRC plans to consolidate the findings of each agency into a single state report for the basin. The information in this report will be furnished to all interested individuals and groups.

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. Development proposals of the various agencies are generally unilateral and present all potentials deemed desirable within the authorities and responsibilities of each concerned agency.

The development of comprehensive coordinated plan cannot be accomplished by combining all of the unilateral plans of each agency. This can be accomplished only by the joint efforts of all concerned, in coordinated plan formulation, such as in the Level B study 3/ for the Nebraska portion of the Platte River Basin or by some other coordinated federal-state planning effort.

1/ On July 1, 1972, the name was changed to the Nebraska Natural Resources Commission (NNRC).

2/ On July 1, 1972, the Local Districts were incorporated into the Natural Resource Districts.

3/ Level B and Type IV studies both deal with water resource problems of an area. Type IV is a cooperative study between a single federal agency and a state. Level B is a multiple federal agency study involving one or more states.

II. NATURAL RESOURCES OF THE BASIN

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

A. Location and Size

The Little Blue River is a tributary of the Big Blue River. It originates in the loess plains of south central Nebraska and flows in a south easterly direction to its junction with the Big Blue River near Waterville, Kansas.

The area of the Little Blue River Basin in Nebraska totals just under 2,691 square miles, or 1,722,200 acres. Principal tributaries include Big Sandy Creek, having a drainage area of 638 square miles; Rose Creek, 203 square miles; Spring Creek, 180 square miles; and Pawnee Creek, 126 square miles. The total length of the Little Blue River in Nebraska is approximately 200 miles.

The Little Blue River drains nearly all of Thayer County and parts of 10 other counties in Nebraska. Table II-1 lists these counties, their total areas, and the area of each within the basin.

B. Climate

The climate of the Little Blue Basin is typical of the plains region (Continental type), with wide and often abrupt variations in precipitation and temperature, both in time and location. Relatively warm summers and cold winters are typical, due to its location near the center of a large continent. The short period weather changes are brought about by the invasion of large masses of air of different characteristics, such as warm, moist air from the Gulf of Mexico; hot, dry air from the southwest and Mexico; cool, rather dry air from the Pacific northwest and cold dry air from the interior of Canada. The lower, southeastern portion lies within a belt of moist-subhumid climate. The upper, western portion lies in a parallel dry-subhumid belt, where in ordinary years the precipitation does not exceed evapo-transpiration losses.

Table II-1.—AREA BY COUNTIES
LITTLE BLUE RIVER BASIN, NEBRASKA

County	Total Area 1/	Area of County in Basin	
	(Acres)	(Acres)	(Percent)
Adams	359,680	296,800	82.5
Clay	364,800	197,100	54.0
Fillmore	369,280	111,700	30.2
Franklin	369,920	24,100	6.5
Gage	549,120	700	0.1
Jefferson	369,280	212,800	57.6
Kearney	327,680	166,700	50.9
Nuckolls	370,560	243,400	65.7
Saline	368,640	11,100	3.0
Thayer	369,280	368,500	99.8
Webster	368,000	89,300	24.3
TOTAL	4,186,240	1,722,200	--

1/ Source: U.S. Department of Commerce, Bureau of Census, Area Measurement Report, 1960.

The Little Blue Basin's weighted normal annual precipitation, based on the 1931-1960 period, is approximately 25 inches -- ranging from 23 inches in the headwaters to about 29 inches in the lower portion (Figure II-1).

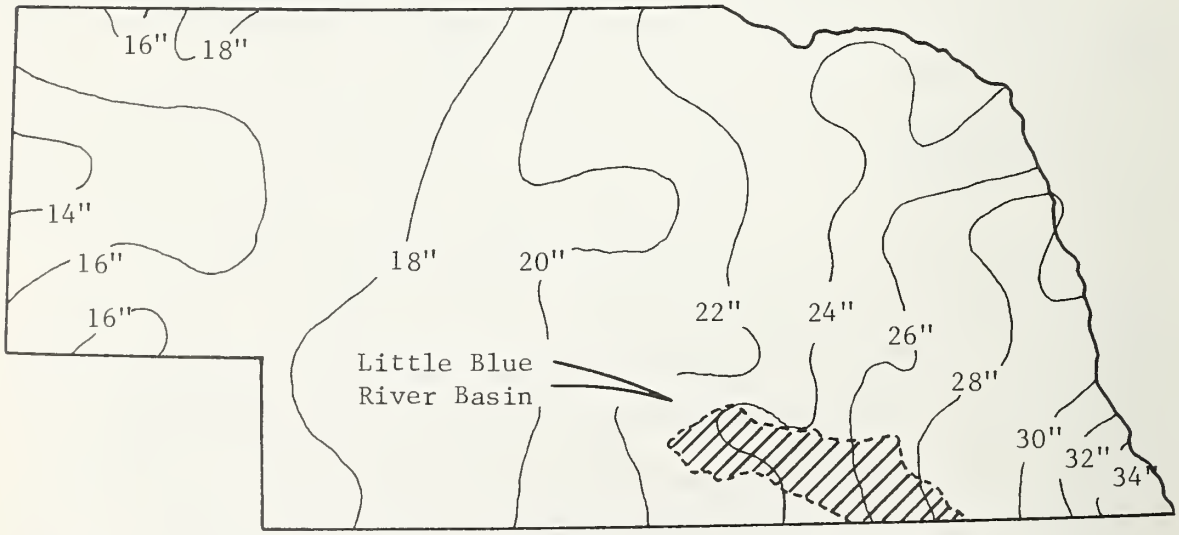

Figure II-1.—MEAN ANNUAL PRECIPITATION, IN INCHES. BASED ON THE PERIOD 1931-1960

Daily and monthly precipitation varies considerably at individual stations. Figure II-2 is a graphical presentation of normal monthly precipitation and extremes of record at four selected stations representative of the basin.

The highest one-day (24-hour) total precipitation recorded in the basin was 7.65 inches on July 9, 1950 at Fairbury. About 77 percent of the normal annual precipitation falls during the growing season. April through September.

Average annual snowfall ranges from 21 to 27 inches, averaging about 24 inches. Snowfall in individual years has varied considerably from this average. Several stations in and around the basin have reported annual totals ranging from less than 10 inches to over 50 inches.

Temperature patterns also vary throughout the basin. The average annual temperature (1931-1960 period) varies only slightly across the basin, being about 52°F. Sharp changes in daily temperatures are not uncommon in the spring and summer months, especially preceding thunderstorms. Normal monthly maximum, minimum, mean, and extreme temperatures at two stations are charted on Figure II-3.

There is only one station within the basin with evaporation records available (Rosemont 2S, discontinued March, 1968). The average annual Class A pan evaporation ranges from approximately 67 to 74 inches, being highest in the western portion. Annual lake evaporation is generally computed as approximately 70 percent of the Class A pan evaporation. Generally, the month of July has the highest loss, with a maximum of 17.4 inches and a minimum of 7.9 inches recorded at the Rosemont Station during the 23-year period of record. Evaporation data for the Rosemont station and from four near-by stations outside the basin are summarized in Table II-2.

Past climatological records indicate that the Great Plains area is subject to periodic droughts of rather extended durations. A recent weather bureau procedure, the Palmer Drought Index 4/ , was used to

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4/ The Palmer Drought Index provides monthly index values that permit the comparison of a particular period with the normal or average climatic conditions for the area in question. The procedure treats the variability of the moisture as a function of accumulated weighted differences between actual precipitation and the precipitation requirements, where the requirement depends on the carryover of previous rainfall as well as on the evapo-transpiration, soil moisture recharge, and runoff climatically appropriate for the particular time and area being analyzed. The procedure was computer programmed, and monthly analyses were run by the National Weather Service for each climatic division in the state.

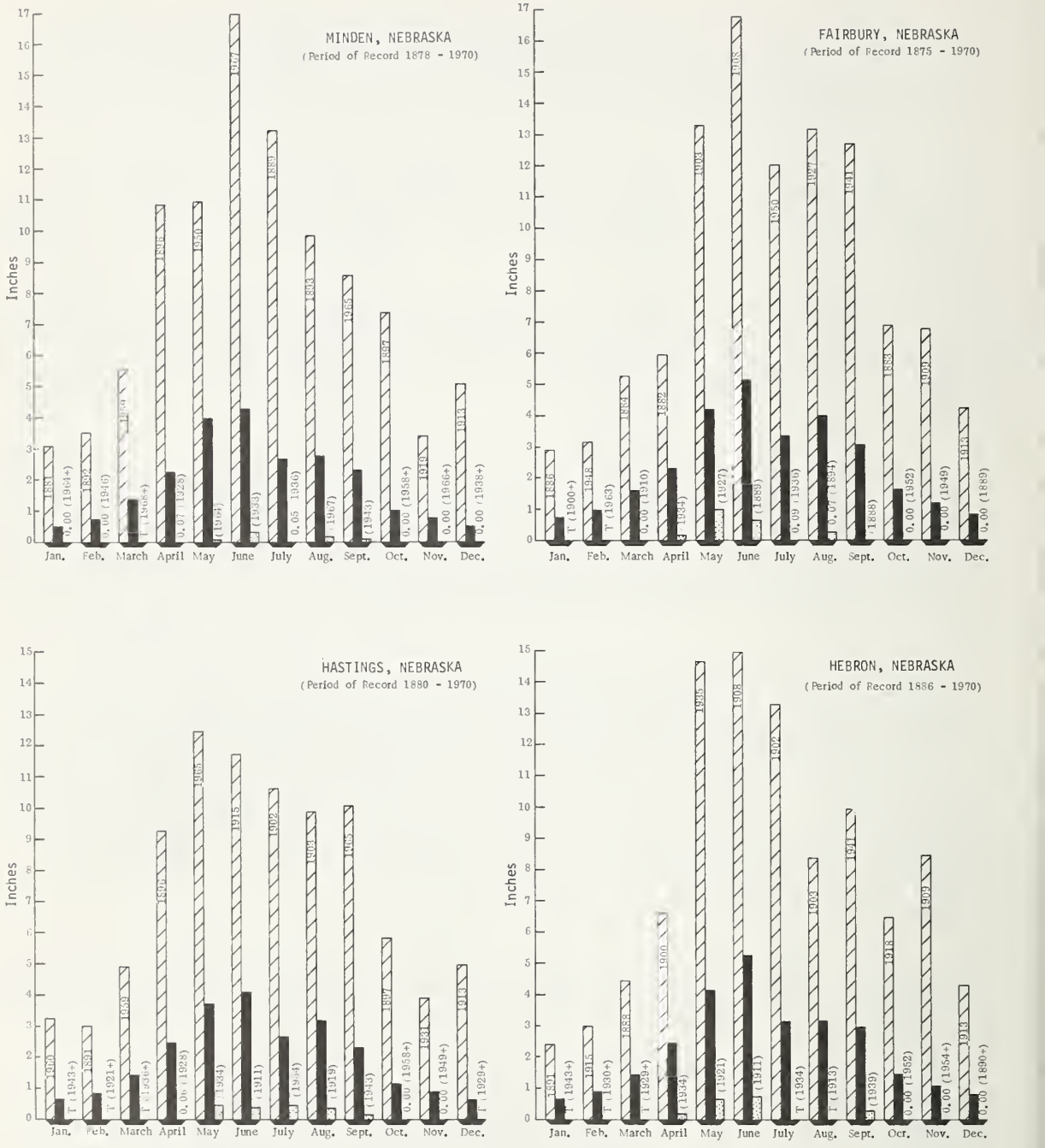
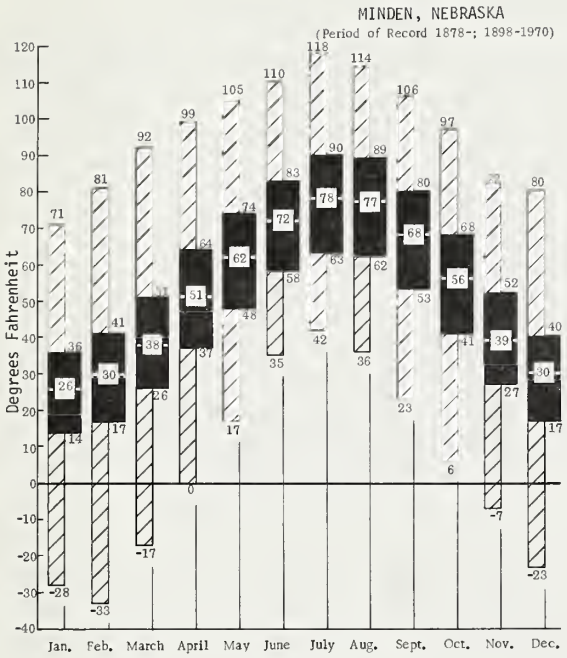
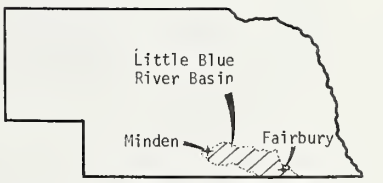
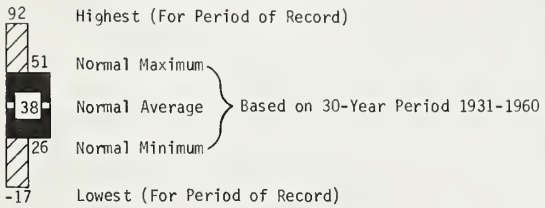


Figure II-2.—MONTHLY DISTRIBUTION OF PRECIPITATION





LOCATION OF MINDEN AND FAIRBURY IN THE BASIN



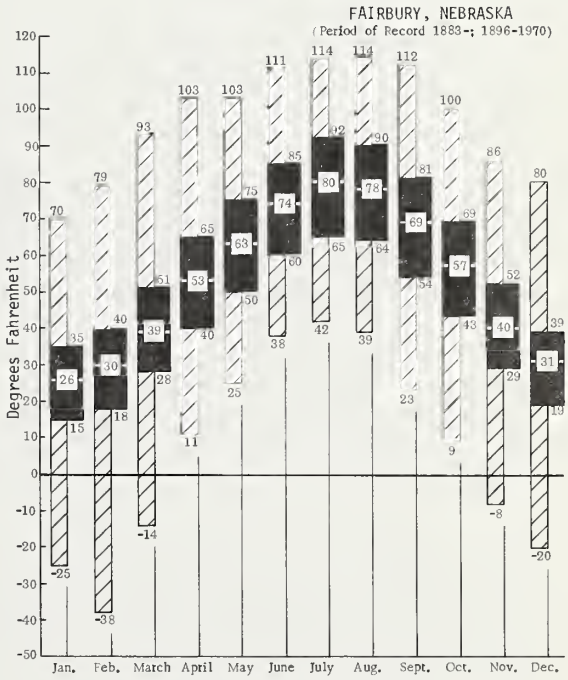


Figure II-3.—TEMPERATURE DISTRIBUTION BY MONTHS

Table II-2.—GROSS EVAPORATION IN INCHES AT STATIONS IN OR NEAR THE LITTLE BLUE RIVER BASIN, NEBRASKA

Station Name	Recorded Class A Pan Data					Est. Annual Lake or Reservoir
	Period	Avg.	Max.	Min.	Season	
Grand Island WB AP	'63-'70	44	48.8	38.8	May-Sept.	46
Harlan County Dam	'53-'70	54	69.8	44.4	May-Oct.	54
Holdrege 1E	'57-'70	36	39.9	32.5	May-Sept.	52
Lincoln Agronomy Farm	'31-'68	44	69.1	32.3	May-Oct.	44
Rosemont 2S	'45-'67	57	74.9	42.9	May-Oct.	51

Source: National Weather Service, NOAA, U.S. Department of Commerce.

analyze areas (climatic divisions) to determine moisture deficiencies and surpluses. Figure II-4 is a plot of annual indexes for the two climatic divisions encompassing the basin. The location of the basin in relation to these divisions is also shown on this figure.

Inspection of Figure II-4 indicates that serious droughts tend to occur cyclically in the central United States. However, no reliable method of forecasting moisture shortages or surpluses on a long-term basis is currently available.

The longest and most extreme recorded drought occurred during the 1930's. The peak monthly severities indexes of the south central and southeast divisions occurred during August, 1934. The longest "wet spell" occurred during the late 1950's and early 1960's.

Prevailing wind direction is north-northwesterly from November to February and south-southeasterly from March through October. Yearly average wind velocity is about 12 miles per hour. Average monthly velocity and distribution of direction for Grand Island, Nebraska, is shown on Figure II-5 and is considered as representative of the basin.

The average date of the last killing frost in the spring ranges from April 11 to 18 from east to west, while that of the first killing frost in fall ranges from October 20 to 26. This is based on the 1921-1950 period and a temperature threshold of 28°F. The average frost-free period ranges from 185 to 198 days.

Tornadoes, mostly in spring and early summer, occur infrequently but have caused extensive damage and loss of life. Damage from hail

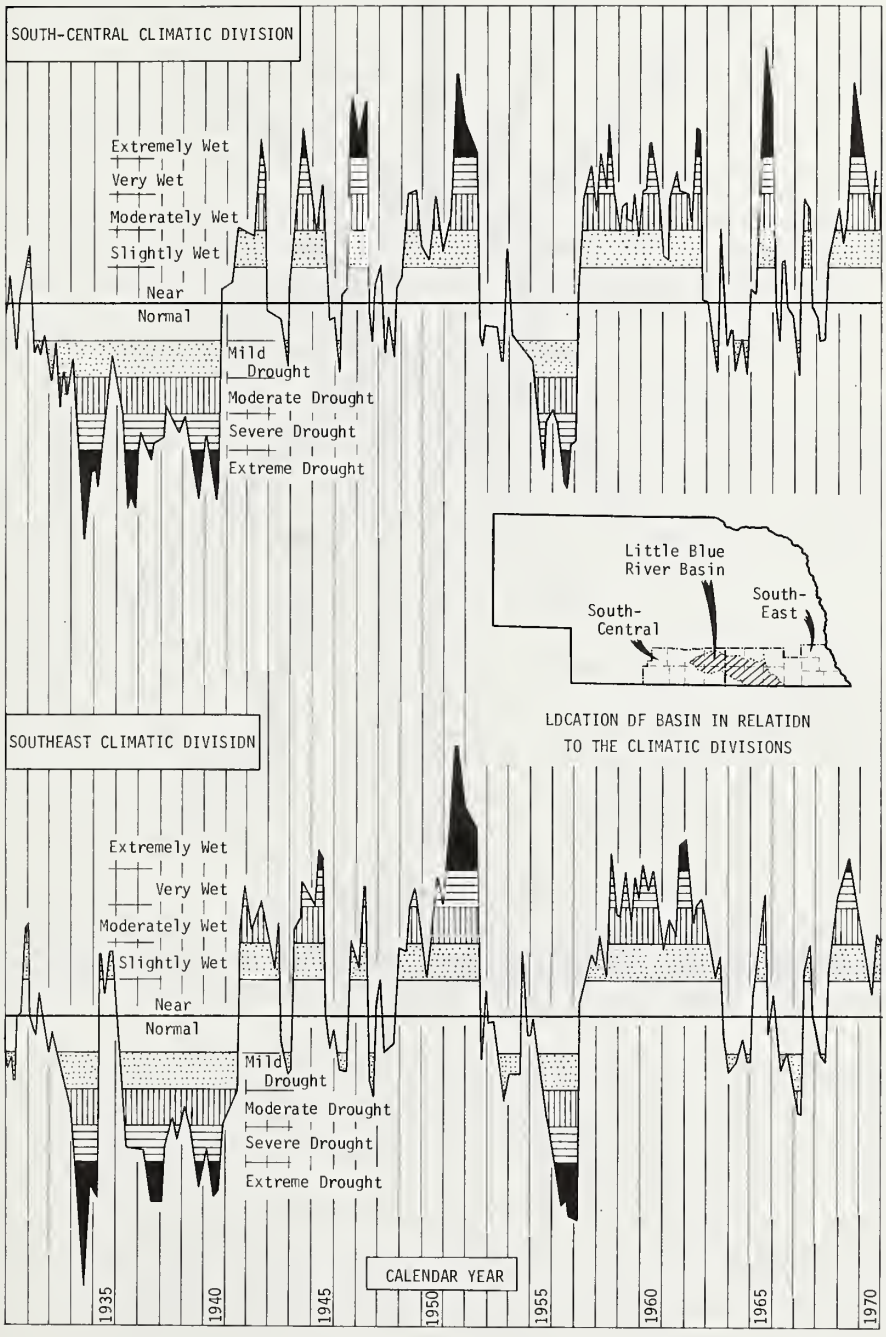
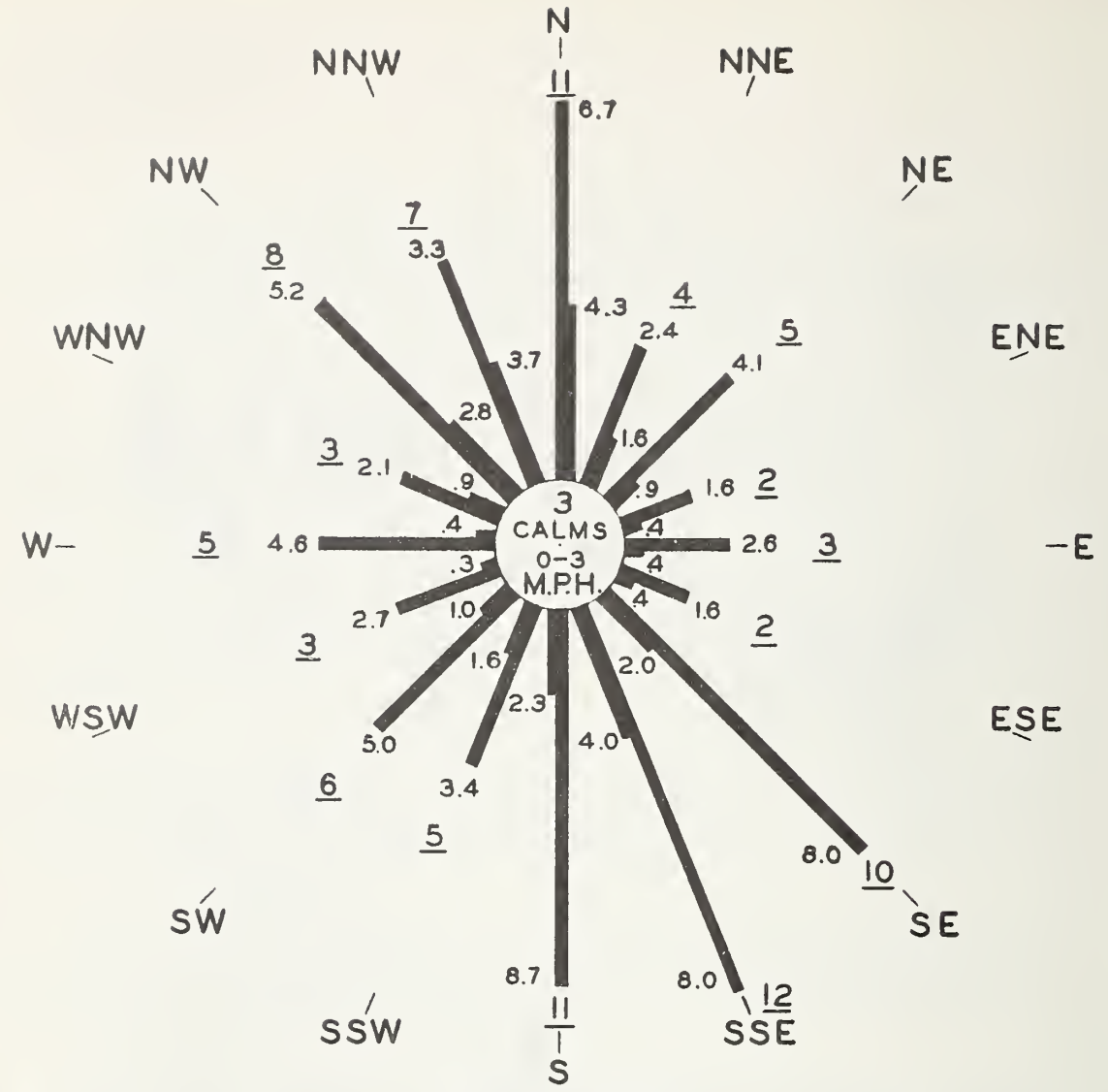


Figure II-4.—DROUGHT AND WET SPELL PERIODS FOR SOUTH-CENTRAL AND SOUTHEAST CLIMATIC DIVISIONS, NEBRASKA



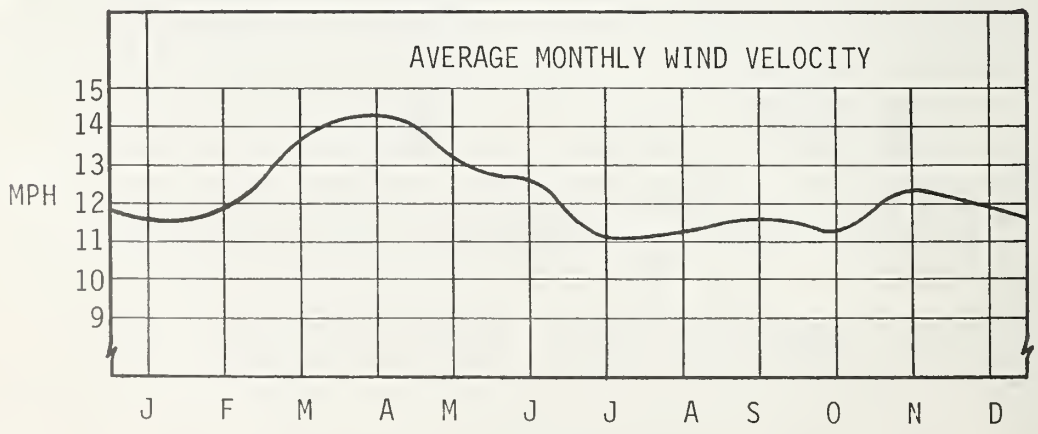


Figure II-5.—WIND ROSE AND MONTHLY DISTRIBUTION OF SURFACE WINDS FOR GRAND ISLAND, NEBRASKA

is not extensive but occurs over limited areas almost every year. Percent possible sunshine, on a mean annual basis, is estimated to be 64-67 percent.

C. Physiography and Geology

The drainage area of the Little Blue River lies almost wholly within the High Plains section of the Great Plains Province (as delineated by Fenneman), with the southern portion in the Plains Border section. In Nebraska usage, the basin is mostly within the Nebraska Loess Plains Physiographic area.

This area includes a major portion of the original constructional plain, especially north of Little Blue River. The plain slopes gently eastward at an average of eight to ten feet per mile and is characterized by many local depressions and intermittent lakes and marshes. Many of these occupy five to 100 acres with several covering 200 to 300 acres. In general, the plain becomes more dissected from west to east as drainageways approach their outlets.

The area south of the Little Blue River contains some fairly large remnamts of the plain but these become more dissected northward and eastward where major tributaries converge with the Little Blue. In southeastern Thayer and southwestern Jefferson counties, in the drainage area of Rose Creek, the upland is extensively eroded and only a few flat areas remain.

The total relief in the basin is about 1,000 feet. The altitude ranges from 2,205 feet above sea level in Kearney County southwest of Minden to about 1,200 feet in Jefferson County where the Little Blue River enters Kansas.

Geologic materials in the Little Blue River Basin occur as unconsolidated deposits of Pleistocene (Quaternary) Age overlying either semi-consolidated bedrock of the Ogallala formation of Tertiary Age or consolidated bedrock of Cretaceous and Permian Age.

The stratigraphic position of the various geologic formations, their general description, and their water-bearing properties are listed in Table II-3. The distribution of these geologic units within the basin are shown on two maps: Figure II-6 shows the Pleistocene sediments, and Figure II-7 is a Geological Bedrock Map showing the Tertiary, Cretaceous and Permian rocks.

Table II-3.—GEOLOGIC FORMATIONS AND THEIR WATER-BEARING PROPERTIES
LITTLE BLUE RIVER BASIN, NEBRASKA

System	Series	Stratigraphic Unit	Thickness (feet)	Texture and Areal Distribution	Water Supply
QUATERNARY	RECENT	Surficial alluvium, eolian silts and sands and soil.	0-20	Reworked silt, clay and sand in floodplains and terraces bordering stream channels; eolian silt and sand on slopes and upland; sand dunes in SE Adams and SW Kearney Counties; surface soils.	Generally above water table; significant only as transmitting medium for recharge to the ground-water reservoir.
	PLEISTOCENE	Loess and alluvial silts.	0-100	Principally wind-blown clayey silts of the Peoria and Loveland formations; locally the Peoria fm. may include a basal sand member (Todd Valley), and the Loveland fm. a basal sand and gravel member (Crete); also includes silts and clays of the Sappa formation with the Pearlette ash member.	The loesses are generally above the water table but may yield water to wells at a slow rate where saturated. The Todd Valley member yields water to wells at a moderate rate where saturated. The Crete sands and gravels may yield abundant supplies where coarse-textured and below the water table.
		Alluvial sands and gravels.	0-280	Stream-deposited sands and gravels containing lenses of silt and clay. Includes the Grand Island, Red Cloud, and Holdrege formations. Present in most counties but may be thin or absent in parts of Webster, Nuckolls, Thayer, and Jefferson Counties. Attains maximum thickness in broad pre-Pleistocene channels.	The principal source of water in the Basin; yields abundant supplies of water to wells where thick deposits are saturated.
		Alluvial and eolian silts and clays.	0-200	Mostly compact fine-textured sediments overlying the bedrock surface; contains lenses of sand and gravel.	Not an important source of water; may yield water to some domestic wells.
TERTIARY	PLIOCENE	Ogallala formation	0-120	Semi-indurated clayey to silty sands; occurs only in the few westernmost counties as buried ridges and knobs.	Saturated but not an important source of water supply; may yield water to a few wells.
CRETACEOUS	UPPER CRETACEOUS	Pierre Shale	0-390	Black and gray shale, chalky shale; underlies parts of Adams, Kearney, Webster, and Franklin Counties.	Not a known source of water supply.
		Niobrara Formation	0-380	Yellow and gray chalk, chalky shale, and chalky limestone. Exposed in Nuckolls County and underlies parts of Clay and Fillmore Counties and all of the counties to the west.	Extensively weathered in upper part; yields water to a few wells where fractured below the water table.
		Carlile Shale	0-280	Bluish-gray clayey shale. Exposed in Jefferson and Thayer Counties and underlies parts of Saline and Fillmore Counties and all of the counties to the west.	Not a known source of water supply.
		Greenhorn Limestone	0-35	Gray thin-bedded limestone and calcareous shale. Exposed in Thayer and Jefferson Counties and underlies parts of Saline and Fillmore Counties and all of the counties to the west.	Not a known source of water supply.
		Graneros Shale	0-75	Dark gray shale, calcareous in upper part. Exposed in southern Jefferson and Thayer Counties and underlies rest of Basin.	Not a known source of water supply.
	LOWER CRETACEOUS	Dakota Sandstone	0-600	Sandstone, silty to clayey sands, sandy to clayey shales. Extensively exposed in southern Jefferson and southeastern Thayer Counties, and underlies rest of Basin.	Sandstones yield water fairly readily to a few wells in the eastern part of the basin. Usually too deep for wells in the central and western part. Water may be moderately to highly mineralized.
PERMIAN	BIG BLUE	Chase Group	0-292+	Limestone and shale; underlies Little Blue River near Kansas line and at greater depth under rest of Basin.	Not a known source of water supply.

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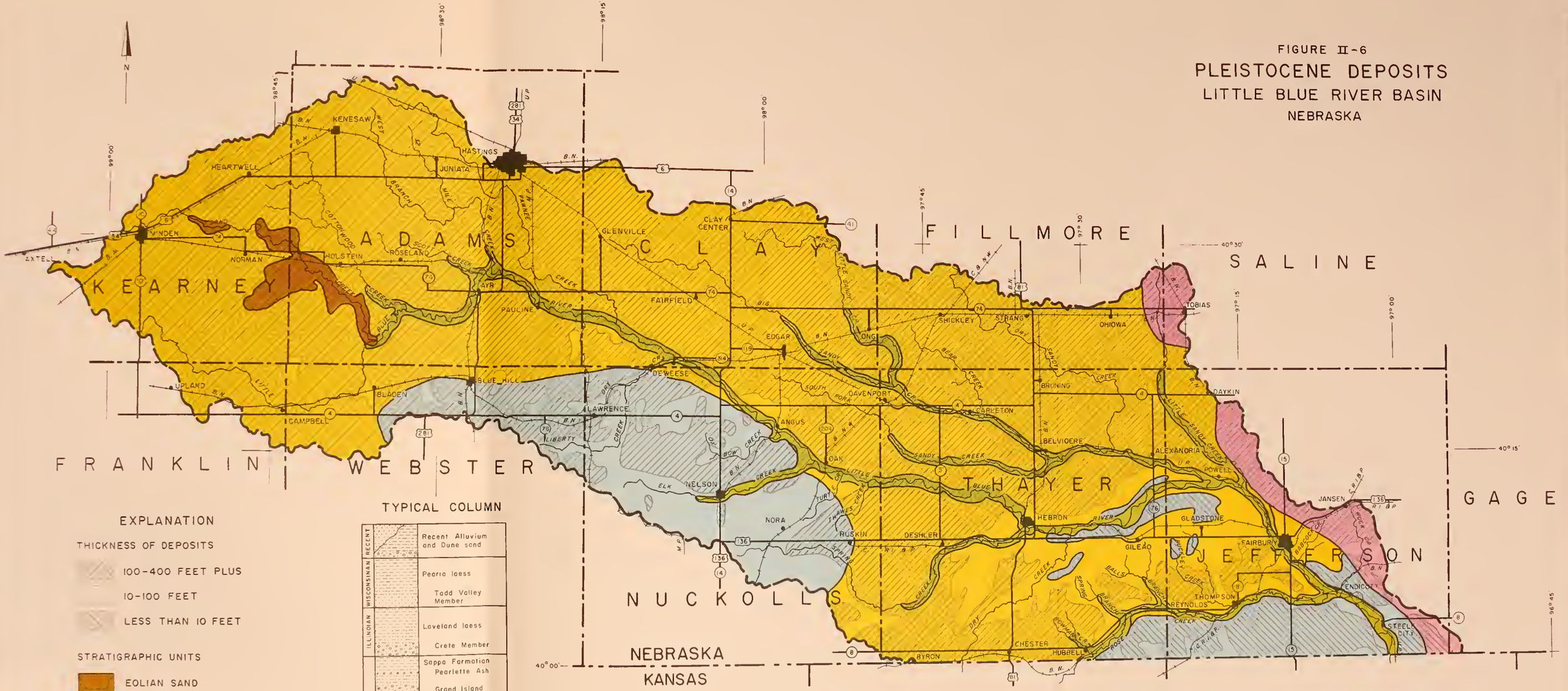
FIGURE II-6

PLEISTOCENE DEPOSITS

LITTLE BLUE RIVER BASIN

NEBRASKA



EXPLANATION

THICKNESS OF DEPOSITS

- 100-400 FEET PLUS
- 10-100 FEET
- LESS THAN 10 FEET

STRATIGRAPHIC UNITS

- EOLIAN SAND
- RECENT ALLUVIUM
- LOESS OVER SAND AND GRAVEL
- LOESS OVER GLACIAL TILL
- LOESS OVER BEDROCK

TYPICAL COLUMN

RECENT		Recent Alluvium and Dune sand
WISCONSINAN		Peoria loess
		Tadd Valley Member
ILLINOIAN		Loveland loess
		Crete Member
KANSAN		Sappa Formation
		Pearlette Ash
		Grand Island Member
		Kansan Till
		Red Cloud Formation
NEBRASKAN		Fullerton Formation
		Haldrege Member
		Seward Formation

SYMBOLS

- SILT AND CLAY
- SAND
- GRAVEL

SCALE 1/500,000

SCALE 5 0 5 10 15 20 MILES

NEBRASKA

SOURCE
SCS DRAWING 5 S 27418 AND UNPUBLISHED MATERIAL FURNISHED BY THE CONSERVATION AND SURVEY DIVISION, UNIVERSITY OF NEBRASKA(1955)

TRANSVERSE MERCATOR PROJECTION

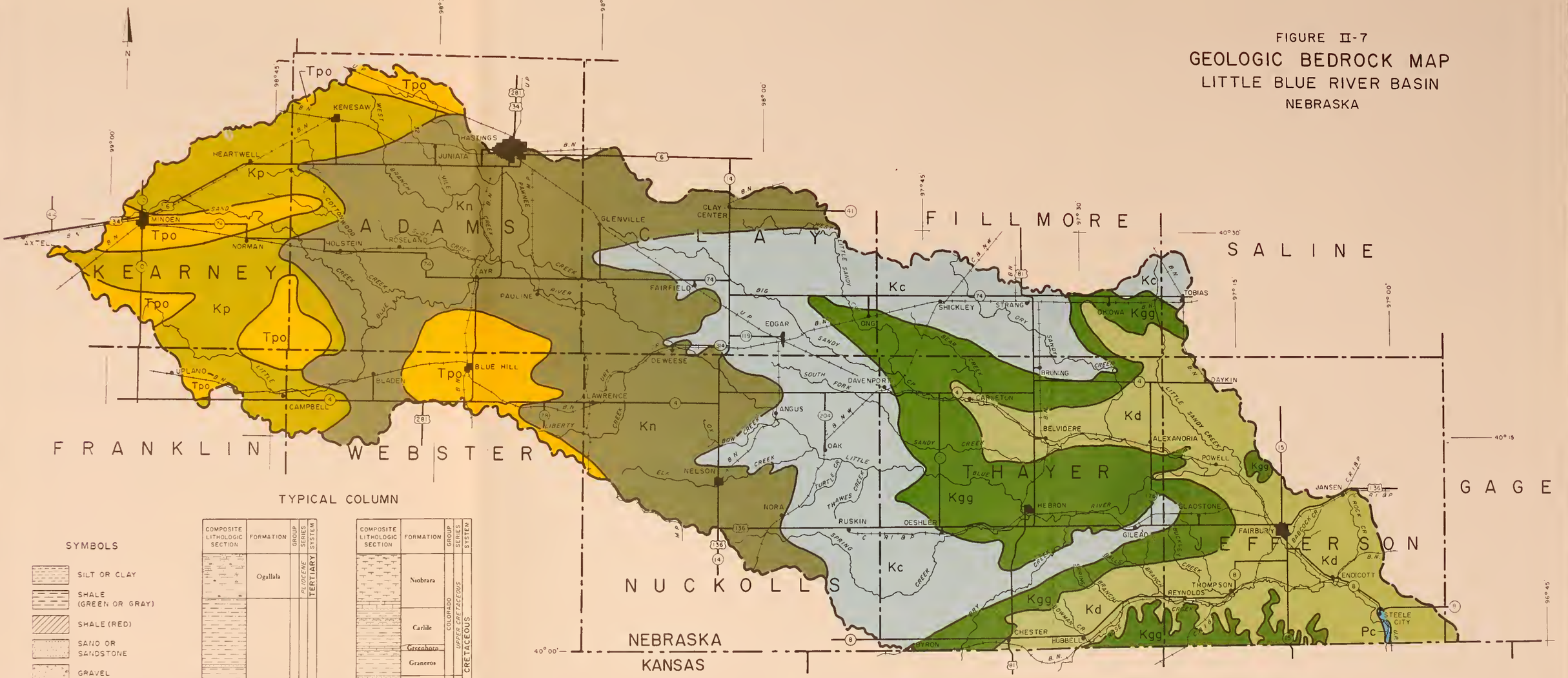
REVISED 5-5-71

5,S-28047

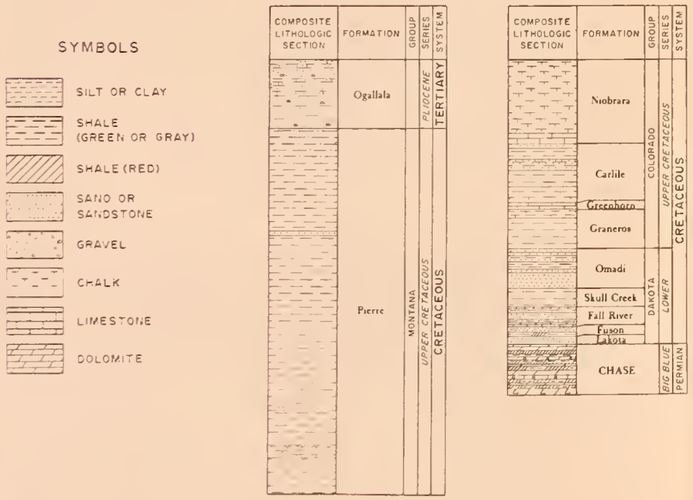
U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

FIGURE II-7
GEOLOGIC BEDROCK MAP
LITTLE BLUE RIVER BASIN
NEBRASKA



TYPICAL COLUMN



SYMBOLS

- SILT OR CLAY
- SHALE (GREEN OR GRAY)
- SHALE (RED)
- SAND OR SANDSTONE
- GRAVEL
- CHALK
- LIMESTONE
- DOLOMITE

LEGEND

- Tpo — OGALLALA FORMATION
- Kp — PIERRE FORMATION
- Kn — NIOBRARA FORMATION
- Kc — CARLILE FORMATION
- Kgg — GREENHORN-GRANEROS FORMATIONS
- Kd — DAKOTA GROUP
- Pc — CHASE GROUP

SCALE 1/500,000

SCALE 5 0 5 10 15 20 MILES

SOURCE

USGS SPRGNS. S.S-27483 ANS GEOLOGIC BEDROCK MAP OF NEBRASKA PREPARED BY THE CONSERVATION AND SURVEY DIVISION, UNIVERSITY OF NEBRASKA (1963).

TRANSVERSE MERCATOR PROJECTION

3-24-70
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The unconsolidated materials are principally windblown clayey silts called "loess", overlying sands and gravels of alluvial origin. The loess deposits and fine grained alluvial material range in thickness from a few feet to about 100 feet with the maximum thickness in Kearney and Adams Counties. The sands and gravels average over 200 feet thick throughout most of the basin and attain a maximum thickness of 250 to 280 feet in several east-trending buried channels. The continuity of the sands and gravels is commonly interrupted by lenses of silt and clay.

Some of the major tributaries to the Little Blue River have cut into the underlying sand and gravel. In a few places, especially in Adams and Kearney Counties near Holstein, sand has been reworked by the wind to form dune topography similar to that of the Sandhills.

Surficial materials along the nearly level floodplain of the Little Blue River are predominately silts and clays in the upper reaches, becoming progressively sandier eastward as the sand-carrying tributaries join from the north. Many of these materials are of the Recent Age, younger than the underlying Pleistocene sediments. Terraces adjacent to the river are generally finer textured.

A very small amount of glacial till, covered by a thin loess mantle, is present in the Saline County and Jefferson County portions of the drainage area east of Little Blue River.

The Ogallala formation consists of deposits of sand, silt and clay which are compact but poorly cemented. These beds probably covered much of the older bedrock throughout the basin, but now occur principally as older channel fill and buried hills and ridges.

The Cretaceous rocks consist of shale, limestone, chalk and sandstone. These beds dip gently northwestward so that rocks which are exposed in the eastern part of the basin become progressively deeper toward the west and are overlain by a thicker sequence of younger rocks.

The oldest rocks exposed in the basin are sandstones and interbedded shales of the Dakota group. They are found along the Little Blue River from northwest of Fairbury to the Kansas line, and along Rose Creek and its tributaries.

Limestone and shale of the Graneros, Greenhorn, and Carlile formations are exposed in Thayer County east of Hubbell and along the Little Blue River near Gilead. The Niobrara chalk outcrops near Nelson and Angus in Nuckolls County and is high throughout much of the upland in that area. Bedrock is not exposed in any of the other counties in the basin.

The principal mineral resources of the basin include sand and gravel, agricultural limestone, and shale and clay. Sand and gravel for aggregate are used in construction and are produced in five of the basin's counties. Production is usually from the alluvial deposits of the Little Blue River, Big Sandy Creek and Dry Sandy Creek.

Agricultural limestone is produced from the Niobrara formation in Nuckolls County and from the Greenhorn formation in Thayer and Jefferson Counties.

Shale and clay for the manufacture of brick and tile is quarried from the Dakota formation in Jefferson County.

Although there has been some exploratory drilling for petroleum, there are no producing wells in the basin.

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 significant characteristics of topography, soils, elevation, and precipitation with contrasts between land resource areas usually distinct and in some cases, very abrupt.

The Little Blue River Basin is located in the Central Great Plains Winter Wheat and Range Region and is entirely within the Central Loess Plain 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 14 soil associations that are located on the general soil map shown in Figure II-8. This soil association map was compiled by the State Soil Scientist of the Soil Conservation Service using data from county soil surveys. A description for each association is as follows:

Hobbs - Cass - Hord association: Deep, silty, nearly level, moderate or moderately rapidly permeable soils formed in alluvium on benches and bottomlands.

This association consists of well drained soils located in stream valleys where it occupies bottomlands, stream benches and footslopes. Some areas on bottomlands are flooded for short periods after heavy rains. Hobbs and Hord soils are moderately

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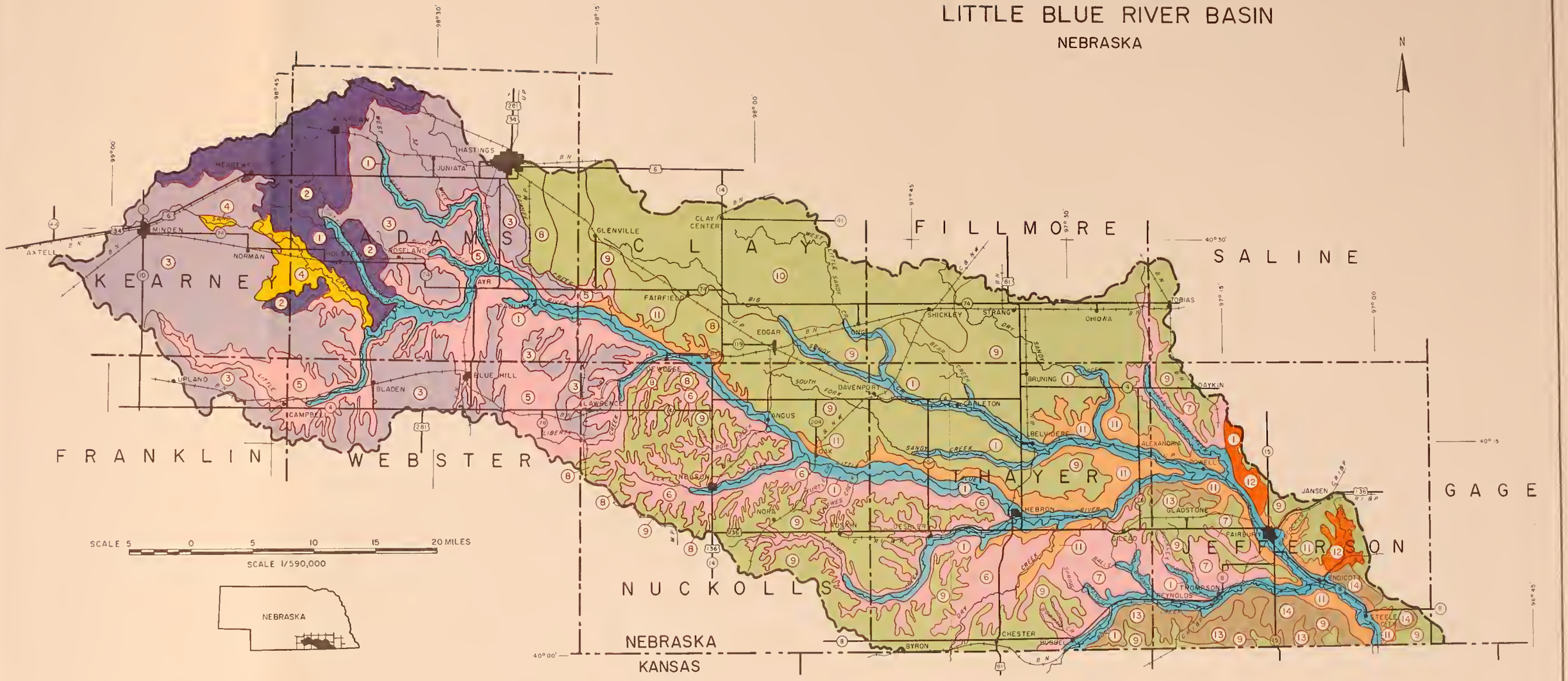
FIGURE II-8
GENERAL SOIL MAP
LITTLE BLUE RIVER BASIN
NEBRASKA



1 HOBBS - CASS - HORO ASSOCIATION. Deep, silty, nearly level, moderate or moderately rapidly permeable soils formed in alluvium on benches and bottom lands.

2 KENESAW - COLY ASSOCIATION: Deep, silty, nearly level to steep, moderately permeable soils formed in loess on uplands.

3 HASTINGS - HOLOREGE - HOLOER ASSOCIATION: Deep, silty, nearly level to moderately sloping, moderately slow or moderately permeable soils formed in loess on uplands.

4 VALENTINE - THURMAN ASSOCIATION: Deep, sandy, gently sloping to rolling rapidly permeable soils formed in wind deposited sands on uplands

5 DEEP GENTLY SLOPING TO STEEP SILTY SOILS FORMED IN LOESS ON UPLANDS.
HOLOER - HOLOREGE - GEARY ASSOCIATION: Deep, silty, moderately sloping to steep, moderately permeable soils formed in loess on uplands.

6 HASTINGS - GEARY ASSOCIATION: Deep, silty, strongly sloping, moderately slow or moderately permeable soils formed in loess on uplands.

7 GEARY - HASTINGS ASSOCIATION: Deep, silty, gently sloping to strongly sloping, moderate or moderately slowly permeable soils formed in loess on uplands.

8 DEEP, NEARLY LEVEL TO GENTLY SLOPING SILTY SOILS FORMED IN LOESS ON UPLANDS.
HASTINGS - CRETE ASSOCIATION: Deep, silty, nearly level to gently sloping, moderately slow or slowly permeable soils formed in loess on uplands.

9 CRETE - HASTINGS ASSOCIATION: Deep, silty, nearly level to very gently sloping, slow or moderately slowly permeable soils formed in loess on uplands.

10 CRETE - HASTINGS - FILLMORE ASSOCIATION: Deep, silty, nearly level to gently sloping, moderately slow to very slowly permeable soils formed in loess on uplands.

11 JANSEN - GEARY - MEADIN ASSOCIATION: Deep to shallow, loamy, moderately sloping to steep, moderate to very rapidly permeable soils formed in loamy material over sand and gravel or loess on uplands.

12 MORRILL - BURCHARD ASSOCIATION: Deep, loamy, moderately sloping to steep, moderately slowly permeable soils formed in glacial till on uplands.

13 SHALLOW AND MODERATELY DEEP, MODERATELY SLOPING TO STEEP, SILTY AND LOAMY SOILS FORMED IN LIMESTONE, SANDSTONE, AND SHALES ON UPLAND.
KIPSON - BENFIELD ASSOCIATION: Shallow and moderately deep, silty, strongly sloping to steep, moderate to slowly permeable soils formed in limestone and limy shale on uplands.

14 LANCASTER - HEDVILLE ASSOCIATION: Moderately deep and shallow, loamy, moderately sloping to steep, moderately permeable soils formed in sandstone and sandy shale on uplands.

SOURCE
SCS BASE 5,S-27,438 AND SOIL DATA
FURNISHED BY FIELD TECHNICIANS

TRANSVERSE MERCATOR PROJECTION

Border Rev. 2-1-73
5,S-29,856

permeable and have a silt loam surface layer and subsoil. Hobbs soils are on bottomlands and footslopes. Hord soils are on stream benches. Cass soils have a loam or silt loam surface layer and a fine sandy loam subsoil stratified with silty to sandy strata, are moderately rapidly permeable and are on bottomlands. Nearly all soils of this association are cultivated, although some areas adjacent to streams are in grassland or timber. Some areas are irrigated. Corn, grain sorghum, alfalfa and wheat are the most common crops grown. Control of flooding, maintenance of tilth, and maintenance of fertility are the primary concerns of management.

Kenesaw - Coly association: Deep, silty, nearly level to steep, moderately permeable soils formed in loess on uplands.

This association consists of well to somewhat excessively drained soils. The topography is often hummocky. These soils have a silt loam surface layer and calcareous silt loam underlying material. The well drained Kenesaw soils are nearly level to moderately sloping. The somewhat excessively drained Coly soils are strongly sloping to steep. The majority of the soils in this association are cultivated. Controlling water erosion, controlling soil blowing and maintaining fertility are the primary management concerns.

Hastings - Holdrege - Holder association: Deep, silty, nearly level to moderately sloping, moderately slow or moderately permeable soils formed in loess on uplands.

This association consists of well drained soils, having a silt loam surface layer and silty clay loam subsoil. Hastings soils are moderately slowly permeable and nearly level. Holdrege and Holder soils are moderately permeable and nearly level to moderately sloping. Most of this association is cultivated. Controlling erosion, maintaining soil fertility and conserving moisture are the main management concerns.

Valentine - Thurman association: Deep, sandy, gently sloping to rolling rapidly permeable soils formed in wind deposited sands on uplands.

This association consists of somewhat excessively to excessively drained soils located in areas commonly referred to as sandhills. Valentine soils have a thin, loamy fine sand surface layer and fine sand underlying material with a topography that

is rolling to dunelike. Thurman soils have a loamy fine sand surface layer and loamy fine sands underlying material. These are hummocky, gently to moderately sloping soils on uplands and stream benches. About half of this association is used as range and the remainder is cultivated. Preventing soil blowing, maintaining fertility and conserving moisture are management concerns in the cultivated areas.

Holder - Holdrege - Geary association: Deep, silty, moderately sloping to steep, moderately permeable soils formed in loess on uplands.

This association consists of well to somewhat excessively drained soils located on sideslopes of intermittent drainageways. These soils have a silt loam surface layer and silty clay loam subsoil. Holder and Holdrege soils are moderately sloping and strongly sloping. Geary soils are moderately sloping to steep. Also, included are some areas of steep Coly soils. This association is used for cultivated crops and native grass. Surface runoff, water erosion, and maintaining fertility are the main concerns in using these soils.

Hastings - Geary association: Deep, silty, strongly sloping, moderately slow or moderately permeable soils formed in loess on uplands.

This association consists of well drained soils on sideslopes along intermittent upland drainageways. Hastings soils have a silt loam surface layer and silty clay loam subsoil, are sloping and are moderately slowly permeable. Geary soils have a silty clay loam surface layer and subsoil, are moderately permeable, are more strongly sloping, and exist at lower elevations than Hastings soils. The soils in this association are used for cultivated crops and native range. The main concerns are water erosion and maintenance of fertility.

Geary - Hastings association: Deep, silty, gently sloping to strongly sloping, moderate or moderately slowly permeable soils formed in loess on uplands.

This association consists of well drained soils on sideslopes and ridgetops. Geary soils have a silty clay loam surface layer and silty clay loam subsoil, are moderately permeable and occur on strongly sloping sideslopes of intermittent drainageways.

Hastings soils have a silt loam surface layer, a silty clay loam subsoil, a moderatley slow permeability, and occur on gently sloping ridgetops. Most of this association is cultivated. The main concerns are the control of runoff and water erosion.

Hastings - Crete association: Deep, silty, nearly level to gently sloping, moderately slow or slowly permeable soils formed in loess on uplands.

This association consists of well and moderately well drained soils. Hastings soils have a silt loam surface layer with silty clay loam subsoil, and are nearly level to gently sloping. Crete soils have a silt loam surface layer with silty clay subsoil, and are nearly level. Most of the soils in this association are cultivated. Controlling erosion, maintaining fertility and conserving soil moisture are the main management concerns.

Crete - Hastings association: Deep, silty, nearly level to very gently sloping, slow or moderately slowly permeable soils formed in loess on uplands.

This association consists of broad areas. Crete soils have a silt loam surface layer and silty clay subsoil, are slowly permeable and nearly level. Because of the claypan subsoil these soils are somewhat droughty under dryland management. Hastings soils have a silt loam surface layer and silty clay loam subsoil, are moderately slowly permeable and very gently sloping or nearly level. Most of this association is cultivated. Moisture conservation and erosion control on the sloping areas are the main concerns of management.

Crete - Hastings - Fillmore association: Deep, silty, nearly level to gently sloping, moderately slow to very slowly permeable soils formed in loess on uplands.

This association consists of nearly level to gently sloping soils. Small shallow depressional basins are common. Crete and Fillmore soils have a silt loam surface layer and silty clay subsoil. The slowly permeable Crete soils are nearly level and the poorly drained, very slowly permeable Fillmore soils are in shallow depressions. The nearly level to gently sloping, moderately slowly permeable Hastings soils have a silt loam surface layer and a silty clay loam subsoil. Most of this association is cultivated. The sloping areas of Crete and Hastings soils are

susceptible to erosion, absorb water slowly, and are somewhat droughty during periods of low rainfall. Areas of Fillmore soils pond water for short to moderate periods of time following heavy rains.

Jansen - Geary - Meadin association: Deep to shallow, loamy, moderately sloping to steep, moderate to very rapidly permeable soils formed in loamy material over sand and gravel or loess on uplands.

This association consists of soils on ridges and valleysides of the Little Blue River and its tributaries. The topography is irregular within short distances. Jansen soils are moderately deep, having 20 to 40 inches of loamy surface material over mixed sand and gravel. Permeability is moderate in the upper part and very rapid in the sand and gravel. The deep moderately permeable Geary soils have a silty clay loam surface layer and subsoil. They are found on rolling ridgetops and some of the steeper sideslopes to drainageways. Meadin soils are shallow, having about 10 to 20 inches of a loam surface layer over mixed sand and gravel. They have rapid permeability in the upper part and very rapid in the sand and gravel. The soils in this association are used for cultivated crops and grassland. They are not particularly well suited to common crops. The main concerns of management are conservation of moisture and control of water erosion.

Morrill - Burchard association: Deep, loamy, moderately sloping to steep, moderately slowly permeable soils formed in glacial till on uplands.

This association consists of a dissected landscape in the eastern part of Jefferson County. Morrill soils are deep, loamy, and formed in reworked till. Burchard soils are deep, loamy and formed in limy glacial till. The strongly sloping to steep soils are used mainly for native grass; whereas the less sloping areas are cultivated. The main concerns of management are reducing runoff, controlling erosion and conserving moisture.

Kipson - Benfield association: Shallow and moderately deep, silty, strongly sloping to steep, moderate to slowly permeable soils formed in limestone and limy shale on uplands.

This association consists of soils on broken topography. Included are some areas of moderately deep Wakeen soils formed

of limestone and limy shale. Kipson soils are shallow, have moderate permeability and most of the acreage is steep. They have a silty clay loam surface layer over bedrock composed of interbedded limestone and limy shale. Benfield soils have slow permeability and are moderately deep. They have a silty clay loam surface layer and silty clay subsoil over limy shale bedrock. Most of this association is in native grassland. The main concerns are the conservation of moisture and the control of water erosion.

Lancaster - Hedville association: Moderately deep and shallow, loamy, moderately sloping to steep, moderately permeable soils formed in sandstone and sandy shale on uplands.

This association consists of soils having broken relief. The loamy Lancaster soils are moderately deep and generally occur in the landscape above the steeper associated shallow Hedville soils. Most of this association is in native grassland. Proper management of the grassland and control of erosion are the main concerns.

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 of agricultural lands. Permanent wildlife areas of over two acres are excluded from the classification system. The hazards and limitations on use increase as the class number increases. In other words, Class I land has few hazards or limitations, whereas Class VII has many. A brief description for each classification is 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, and woodland.

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

Class VII : Soils with very severe limitations that limit their use to range, woodland, wildlife or recreation. Reseeding to grasses 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 futher 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-4 shows the present major land use by Land Capability Classes in the Little Blue River Basin. About five 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 is usually necessary in order to obtain more uniform applications of water. Almost 7,000 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 48 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 and range, woodland, or wildlife habitat, if proper use and good management practices are followed. Presently, almost 69,000 acres of Class II land are used for pasture and forest land. Most of this land is suitable for the production of cultivated crops.

About 18 percent of the soils in the basin are Class III. Water erosion is the major hazard. Conservation cropping systems with minimum

Table II-4.—PRESENT MAJOR LAND USE BY LAND CAPABILITY CLASS
LITTLE BLUE RIVER BASIN, NEBRASKA

Land Capability Class	Cropland	Pasture and Range	Forest Land	Other	Total Ag. Land	1/ Nonagricultural	Total
	(Acres)						
I	77,250	6,990	0	2,600	86,840		
II	736,060	63,150	5,550	16,070	820,830		
III	241,610	56,670	1,540	5,980	305,800		
IV	104,990	51,290	410	3,320	160,010		
V			1,160	50	1,210		
VI	51,620	192,740	10,230	4,140	258,730		
VII	240	5,620	720		6,580		
Unclassified						82,200	
TOTAL	1,211,770	376,460	19,610	32,160	1,640,000	82,200	1,722,200
	(Percent)						
I	4.5	.4	0	.2	5.0		
II	42.7	3.7	.3	.9	47.7		
III	14.0	3.3	.1	.3	17.7		
IV	6.1	3.0	*	.2	9.3		
V	0	0	.1	*	.1		
VI	3.0	11.2	.6	.2	15.0		
VII	*	.3	*	0	.4		
Unclassified						4.8	
TOTAL 2/	70.3	21.9	1.1	1.9	95.2	4.8	100.0

* Less than 0.05 percent.

1/ Includes roads, urban areas, water areas over two acres, wildlife refuges, and miscellaneous uses.

2/ Discrepancies in totals due to rounding.

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 land, and wildlife habitat. Over 58,000 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 stream runoff.

Only nine 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 must 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 and range, forest land, and wildlife habitat are more desirable uses of these lands. Almost 105,000 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 forestry purposes and wildlife habitat.

About 15 percent of the agricultural land in the basin is in Land Capability Class VI. Most of the Class VI lands are on the steep slopes bordering the bottomlands. They contribute large amounts of sediment to floodplains and to stream channels. These steep areas should be used for pasture or range, or planted to trees and shrubs which, under proper management, will provide a permanent cover and materially reduce runoff and soil erosion. Almost 52,000 acres are being cropped and should be converted to permanent cover.

Class VII lands occupy less than one-half percent of the basin. These lands are unsuited to cultivation. Their use is largely restricted to pasture and range, forest land, or wildlife habitat. Most of the Class VII lands in the basin are now in pasture 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 be planted to trees for permanent cover.

Over 95 percent of the area in the basin is used for agricultural purposes. Of this, 70 percent is cropland; 22 percent is pasture, range, and native hay; and one percent is forest land. The balance of the basin consists of farmsteads, idle land, wildlife areas, water and miscellaneous areas not otherwise classified.

Over 1,200,000 acres of cropland exist in the basin. The principal crops grown in the basin are corn, grain sorghum, winter wheat and alfalfa hay. Minor acreages of oats and soybeans are also grown.

About 319,000 acres of the 376,000 acres in pasture and range are classified as rangeland. 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 and therefore fields are smaller than where grazing is the predominate land use.

The dominant climax vegetation is tall native grasses. From the eastern to the western part of the Little Blue Basin, there is a transition from the "true prairie" to the "mixed prairie" grasses. The true prairie grasses are the taller grasses -- such as big bluestem, indiangrass, and switchgrass -- which are important in the climax vegetation on deep upland soils. These true prairie grasses are typical in Thayer County, but there is a gradual transition in the 60 miles west from Thayer County, to the mixed prairie or shorter grasses -- such as blue grama, hairy grama, western wheatgrass, and sideoats grama.

About 19,600 acres is forest and woodland. At least 80 percent of this is located in the three southeastern counties of Jefferson, Thayer, and Nuckolls. The wooded areas occur mainly on bottomlands, in narrow fingers paralleling and adjacent to drainageways. The predominant species are elm, ash, and cottonwood, with some stands also including hackberry and boxelder. The species composition is more varied in the eastern part of the basin, and includes walnut and oak.

About 80 percent of the basin's forested area is classed as understocked woodland. Also included in the forest land acreage are 1,300 acres of shelterbelts (width of over 120 feet and a minimum area of one acre). In addition to species of trees native to the basin, shelterbelts include introduced species such as Russian olive, Russian mulberry, Siberian elm, ponderosa pine, and Austrian pine.

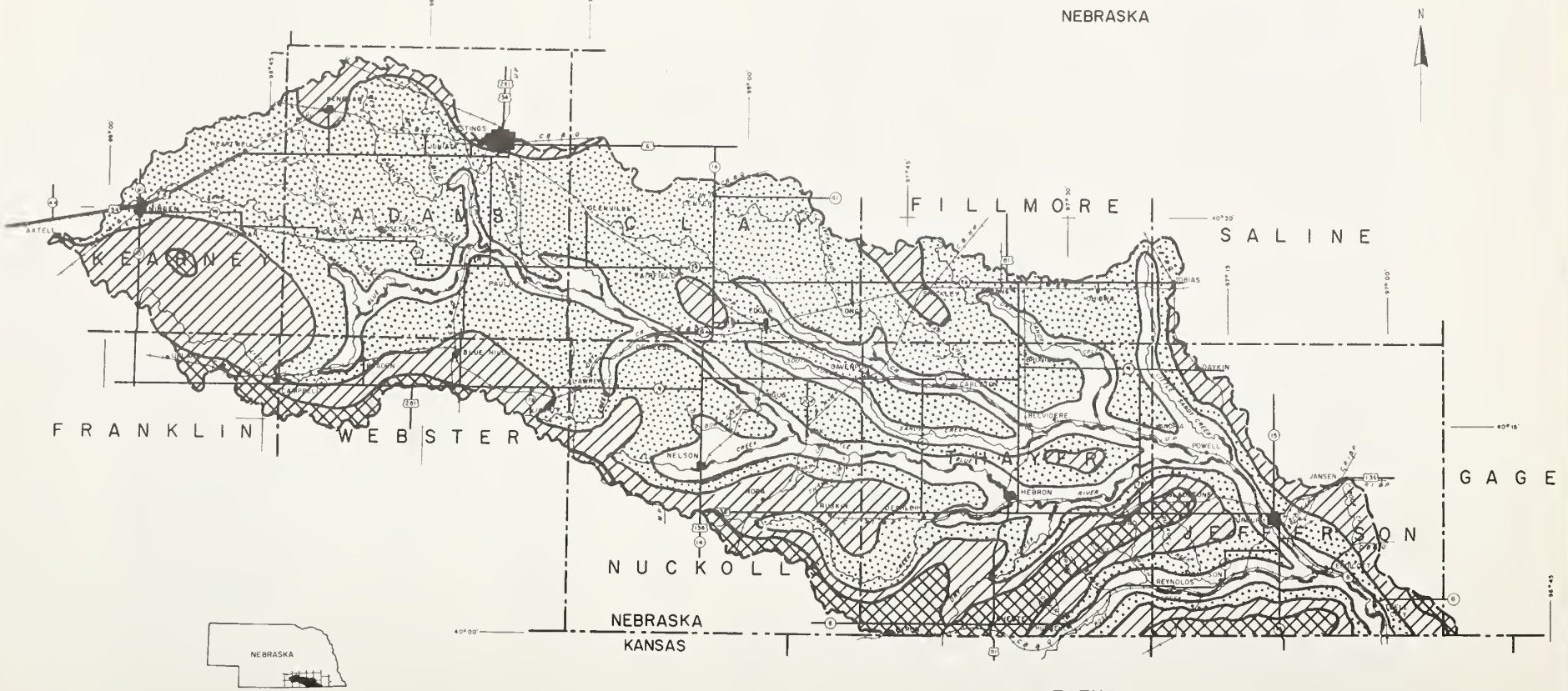
E. Water Resources

The basin's water supply is derived from both ground water and surface water. Currently, the basin's water-using functions rely heavily on ground water.

Ground water occurs throughout the basin under water table conditions. The water table slope generally parallels the surface topography, the flow direction being southeasterly. Depth to water is less than 100 feet over much of the basin (Figure II-9).

The water-bearing formations (aquifers) underlying the basin consist primarily of sands and gravels which are estimated to contain some 28 million acre feet of water. This vast underground reservoir is not, however, uniform, either in thickness or in location with respect to the basin's hydrologic boundary. The general location of the saturated thickness of the aquifers is shown on Figure II-10. Wells in areas having less than 25 feet of saturated sands and gravels are usually of low to moderate capacity (less than 500 gpm) and are

Figure II-9
DEPTH TO GROUND WATER
LITTLE BLUE RIVER BASIN
NEBRASKA

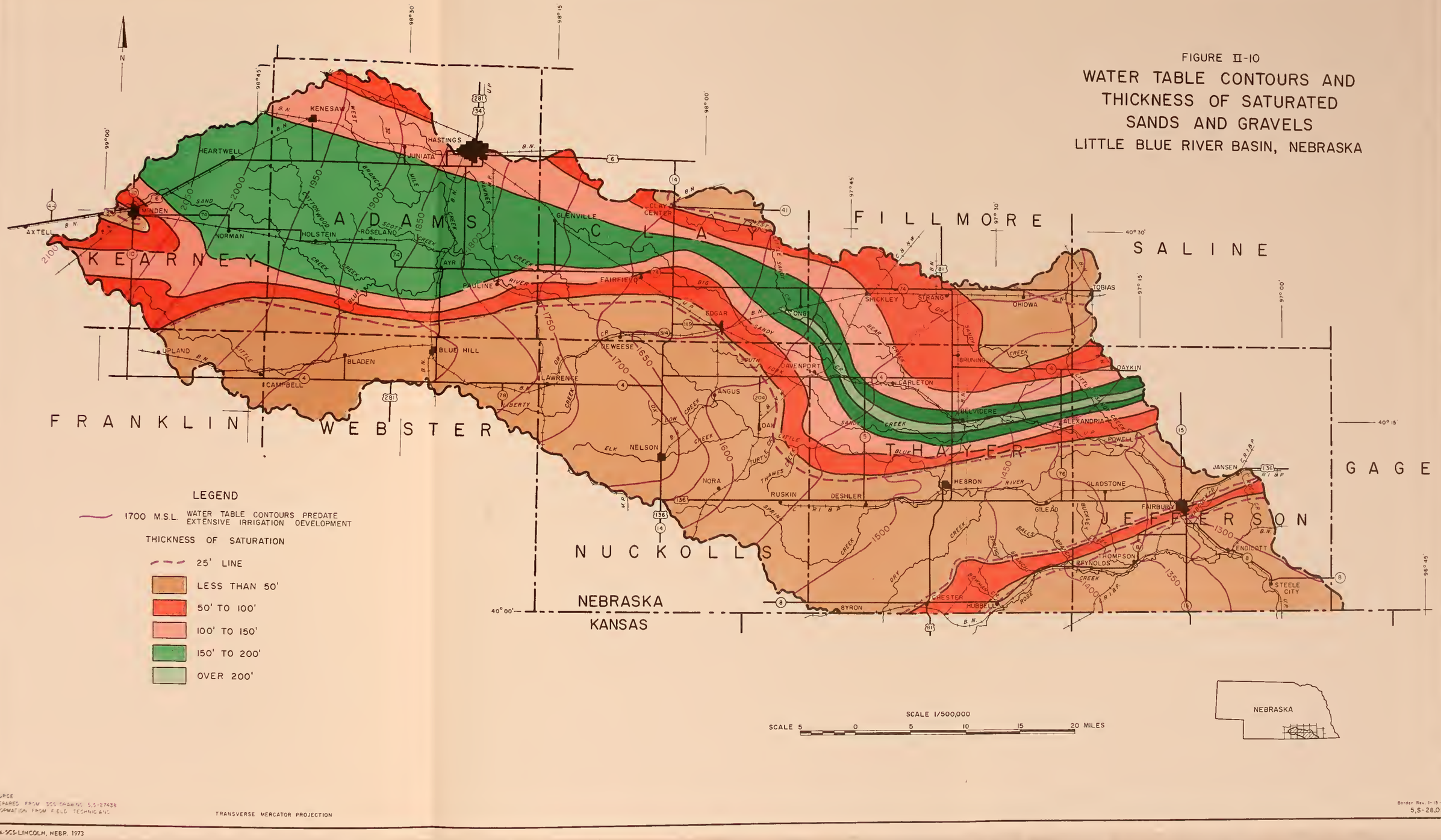


SOURCE
SCS DRAWING 5,S-27438 AND INFORMATION FROM FIELD TECHNICIANS.

FIGURE II-10

WATER TABLE CONTOURS AND THICKNESS OF SATURATED SANDS AND GRAVELS

LITTLE BLUE RIVER BASIN, NEBRASKA



SOURCE
PREPARED FROM SCS DRAWING S,S-27638
INFORMATION FROM F.E.O. TECHNICIANS

TRANSVERSE MERCATOR PROJECTION

Border Rev. 1-15-73
S,S-28,052

generally for other than irrigation use. General water table contours predating extensive irrigation development (pre-1940) are also shown on Figure II-10.

As stated above, ground water flows into the Little Blue Basin from the northwesterly direction. This natural method of replenishment is slow because water moves only a few feet per day through even the most permeable stratum. Principal recharge to the basin's aquifers is by infiltration from precipitation. Estimates of average annual recharge from precipitation vary from a few tenths of an inch in the rougher, tight-soil areas in the southern and eastern parts of the basin to one and one-half to two inches in the western part. An annual recharge of one inch, basin-wide, amounts to some 142,000 acre feet.

Irrigation developments within the past 25-30 years have caused some changes in the water table in some local areas. Seepage of water from the distribution canals of the Tri-County Irrigation Project has caused a steady rise in the water level in the western tip of the basin. A gradual lowering of the water table has occurred near the northern boundary of the basin, especially in Clay and Fillmore Counties. This decline coincides with the extensive development of pump irrigation and indicates withdrawal of ground water has exceeded replenishment on an annual basis. In 1970, an estimated 323,400 acre feet of ground water were utilized for irrigation. Figure II-11 shows the change in water levels since the development of irrigation.

Beginning near its junction with Sand Creek in southwestern Adams County, the channel of the Little Blue River is lower than the water table in the adjacent upland areas. From that point, ground water moves toward the river and discharges into the channel. In those stretches of stream valleys incised below the water table, the natural ground water discharge, by springs and seeps, is estimated to be some one to one and one-half cubic feet per second per stream mile. At the stream gaging station near Fairbury, ground water discharge averages almost one-half the total flow annually.

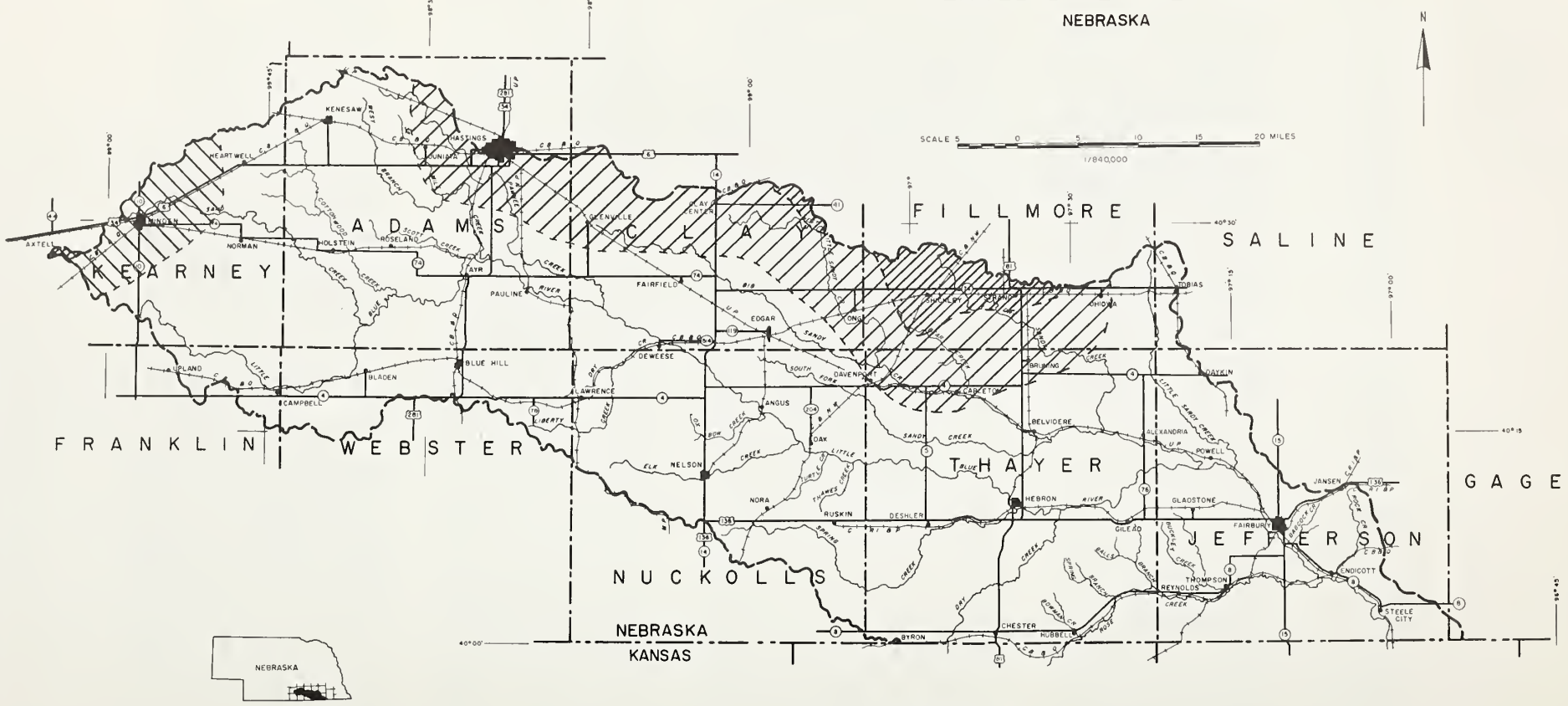
Records of streamflow are available from three active stream gaging stations on the main stem of the river. Table II-5 is a summary of the volume of runoff measured at the three active stations and from a station discontinued at the close of the 1968 water-year. (A water-year begins October 1 and ends September 30. The 1968 water-year ended September 30, 1968). Since all stations have different periods of record, varying from six to 48 years, mean annual unit runoffs for each station cannot readily be compared. For this reason, mean annual unit runoffs for each station and the three incremental drainage areas are computed for the common period of record (1963-1968).

Figure II-11

RISE OR DECLINE OF GROUND-WATER LEVEL DURING PERIOD OF RECORD

LITTLE BLUE RIVER BASIN

NEBRASKA



EXPLANATION

Rise, in feet

5 - 25

25 - 50

Decline, in feet

5 - 10

10 - 25

SOURCE
SCS DRAWING 5,S-27438 AND INFORMATION FROM FIELD TECHNICIANS.

USDA-SCS-LINCOLN, NEBR. 1973

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Table II-5.—HISTORIC RUNOFF VOLUMES
LITTLE BLUE RIVER BASIN, NEBRASKA

USGS Station No. and Name	Total Drainage Area	Period of Record	Median Annual 1/	Maximum Annual (& Yr.)	Minimum Annual (& Yr.)	Mean Annual 2/ & (Period of Record)
	Sq.Mi.	Water Year	Acre Feet	Acre Feet	Acre Feet	Ac.Ft. Per Sq.Mi.
#8829 Little Blue R. below Pawnee Cr. near Pauline 3/	881	1963-68	71,020	201,400 (1965)	60,270 (1964)	106 (106)
#8830-#8829	98	1963-68	10,960	23,900 (1965)	7,770 (1968)	128 (128)
#8830 Little Blue R. near Deweese	979	1954-70	95,680	237,800 (1969)	56,210 (1970)	109 (114)
#8835.7-#8830	573	1960-70	52,000	115,800 (1960)	31,170 (1970)	79 (101)
#8835.7 Little Blue R. near Gilead	1,552	1960-70	167,500	321,300 (1969)	87,380 (1970)	98 (115)
#8840-#8835.7	798	1960-70	78,900	179,600 (1969)	37,400 (1966)	83 (113)
#8840 Little Blue R. near Fairbury	2,350	1909-15 1929-70	233,000	740,000 (1949)	77,760 (1940)	86 (112)

Source: Water Supply Papers published by Water Resources Division, U.S. Geological Survey.

1/ Tabular values for the period of record shown - equalled or exceeded approximately one-half of the years.

2/ Mean annual unit runoffs are shown for the 6-year concurrent period (1963-1968 water-years). The entire period of record is shown in parentheses.

3/ Discontinued September 1968.

As of September 30, 1970, 339 separate water right claims and applications were on record with the Nebraska Department of Water Resources. Irrigation appropriations accounted for 265 of the total for an average of 0.88 cfs per claim (approximately 400 gpm). Table II-6 presents a summary of the water claims, and the locations in relation to the stream gages. Currently, surface water is not used for domestic purposes. Most of the water right claims are for water in the Little Blue River. Claims are also on file for water from such tributaries as Bear, Rose, Big Sandy, Little Sandy, Dry Sandy, Spring, and Thirty-Two Mile Creeks.

Table II-6.—NATURE OF WATER RIGHT CLAIMS AND APPLICATIONS 1/
LITTLE BLUE RIVER BASIN, NEBRASKA

Location of Claims In Relation To Stream Gages	Use To Which Claim Is Applied						
	Storage	Resort	Stock	Storage Only 2/	Irrigation	Power	Manufacturing
	Acre Feet			No. of Claims	cfs		
Above #8829 (nr. Pauline)	1,155.54	128.0	66.59	4	15.09	1.50	0
Above #8830 (nr. Deweese)	1,247.75	128.0	66.59	4	22.77	1.50	0
Above #8835.7 (nr. Gilead)	2,175.86	128.0	115.59	12	92.44	1.50	0
Above #8840 (nr. Fairbury)	2,303.26	499.0	115.59	14	199.99	18.20	.90
@ State Line	3,589.54 3/	499.0 4/	115.59	16	234.20	18.20	.90
TOTAL	4,204.13 AF			--	253.30 cfs		

1/ On file with the Nebraska Department of Water Resources as of September 30, 1970.

2/ Land does not have a direct flow appropriation.

3/ Includes 2,060.57 AF in the three PL-566 watershed projects and 32 AF in Crystal Lake.

4/ Includes 371 AF appropriated by Nebraska Game and Parks Commission in Jefferson County.

Table II-7 is a tabulation of the extremes and selected frequencies (chance of occurrence) of the lowest mean discharges for 7- and 30-consecutive-day periods at the gaging stations. The period of record is given by climatic-years. The climatic-year, beginning April 1, is

Table II-7.—LOWEST MEAN DISCHARGE
FOR CONSECUTIVE PERIODS OF 7 AND 30 DAYS
LITTLE BLUE RIVER BASIN, NEBRASKA

Item	USGS Gaging-Station Identification Numbers			
	06-8829	06-8830	06-8835.7	06-8840
Period of Record -	1963-67	1953-69	1960-69	1910-14 & 1929-69
	Cubic Feet Per Second			
7-Day (Consecutive) Duration:				
Maximum	48.3	63.3	76.9	149.0
(& Year)	(1965)	(1969)	(1965)	(1951)
Median	29.1	38.1	56.9	84.5
10% Chance	1/	21.0	21.0	49.0
Minimum	17.4	17.3	14.0	36.1
(& Year)	(1964)	(1964)	(1964)	(1955)
30-Day (Consecutive) Duration:				
Maximum	55.0	70.2	94.4	165.0
(& Year)	(1965)	(1959)	(1961)	(1951)
Median	33.1	47.4	71.8	102.0
10% Chance	1/	31.0	35.0	62.0
Minimum	21.4	23.7	21.2	42.3
(& Year)	(1964)	(1964)	(1964)	(1934)

1/ Record too short for meaningful analysis.

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

Note: See Table II-5, "Historic Runoff", for name, location and drainage area of above gaging stations.

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 1967 climatic-year began April 1, 1967 and ended March 31, 1968.

Chemical analysis of municipal raw water supplies in 1969 indicates samples from thirteen communities contain excessive amounts of either iron or manganese or both. These samples were obtained from the source well before any treatment. These source wells are located in or near the towns of Ohiowa, Endicott, Glenville, Hastings,

Holstein, Campbell, Minden, Blue Hill, Clay Center, Davenport, Hubbell, Milligan and Steele City. 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. In southern Jefferson County, the total dissolved solids concentration is higher than the limit recommended for drinking water. However, acclimatization to this mineralized water is not difficult and only newcomers and casual visitors may find it objectionable.

Currently (1970), the estimated gross annual withdrawal and/or diversion of water is some 359 thousand acre feet. Irrigation demands the largest percentage of the total. Beneficial consumption varies by use and by source. Table II-8 is a summary of the current demands and consumption of the basin's water resources by selected uses.

Table II-8.—SUMMARY OF CURRENT ANNUAL SURFACE AND GROUND WATER WITHDRAWAL AND CONSUMPTION LITTLE BLUE RIVER BASIN, NEBRASKA

Item	Diversion or Withdrawal	Consumption
	Acre Feet	
Surface Water		
Industrial 1/	-	-
Irrigation	12,800	9,600
Livestock	700	700
Watershed Protection Measures	3,400	3,400
Pond Evaporation	5,900	5,900
TOTAL SURFACE	22,800	19,600
Ground Water		
Municipal, Industrial & Rural Domestic	7,320	2,930
Irrigation	323,400	258,700
Livestock	4,100	4,100
Industrial	1,410	560
TOTAL GROUND	336,230	266,290
TOTAL SURFACE & GROUND	359,030	285,890

1/ Power and gravel pit use unknown.

F. Fish and Wildlife

The Little Blue Basin has a varied wildlife resource. This wildlife resource is enhanced by generally good soil and moisture conditions. The pheasant, an introduced species, is the most important upland game bird. The conditions for pheasant reproduction are good in the western two-thirds of the basin. Prairie grouse are present in significant numbers in the southeast part of Jefferson County. White-tailed deer range principally along the Little Blue River. Rabbits and squirrels are abundant throughout the basin. The basin has a moderate to low quail population. The forested river bottoms, drainageways and adjoining cropland are essential habitat components of these wildlife types.

The Little Blue River provides excellent habitat for channel catfish, many of this species are caught annually. This habitat extends into the lower reaches of the tributaries of the Little Blue wherever there is a sustained stream flow throughout the year. The ameliorating influence of the forest along the streams is an important factor in maintaining favorable water temperatures and low turbidity. Other fish found in these waters are carp and bullhead. Farm ponds have been constructed in the basin, and many of these have been stocked with bass and bluegill. Floodwater retarding structures have been built, some of which provide water areas for the production of catfish, bass, and bluegill.

The rainwater basins in the upper reaches of the Little Blue Basin are important waterfowl production areas, particularly during years of abundant rainfall and in years when northern production areas are stricken by drought. Waterfowl use includes nesting, feeding, and resting during the spring and fall migrations.

G. Quality of the Natural Environment

The quality of the natural environment in this basin is closely related to agriculture. The environmental beauty of the landscape is that of a productive agricultural area with its well kept farms and farmsteads which gives a pleasing appearance to the countryside.

The topography in the upland area is flat and nearly all the land is cropped. This area is covered with fields of wheat, corn and grain sorghum, with the productive ability of the soils playing a major role in the quality of the environment for those engaged in the farming enterprise. In many areas this productivity is further enhanced by irrigation development.

Nebraska Game & Parks Commission

Rainwater Basins Provide Habitat for Migratory Waterfowl

Downstream from the flat upland areas, the topography is moderately rolling with the valleys lined with trees and the sloping hillsides covered with intermittent areas of pasture and cropland. Since the basin has no unique scenic attractions, the diversity provided by these agricultural features are the major ingredients of the natural, aesthetic environment of the basin.

The basin has a temperate climate with distinct winter and summer seasons. Generally, the rainfall is sufficient to maintain a green plant cover during the growing season. There are massive movements of air, relatively free of pollutants. There are sufficient quantities of good ground water for domestic uses in nearly all parts of the basin with surface water flows in the main stem of the Little Blue River adequate except during periods of drought. In general, the natural environment is conducive to good health with the residents enjoying a high average longevity.

III. ECONOMIC DEVELOPMENT

Opportunities for development are influenced by the resources and economic conditions existing in the study area and surrounding region. Knowledge of current and projected economic conditions is necessary for successful resource planning. An examination of factors such as size and characteristics of the population, labor force, employment and sources of personal income must be made to get an indication of growth. Along with this growth, there are increased demands for the use of resources. Only by balancing our future needs with available resources can we hope to foster continued economic growth and a higher level of living. The future economy will be influenced by the historical trends, but the direction and extent of changes will be modified by influences outside the basin and the desires of people within the basin.

A. Historical Development

Before 1850, the non-Indian population of the Little Blue River Basin was limited to a few cattle ranchers. The first settlers began establishing homes along wooded streams where feed, water, and timber were readily available. By the late 1850's, many permanent settlements had been established. County boundary designation was started by the 1855 Territorial Legislature. By 1871 county governments had been established over the entire area and the settlement pattern was fairly well established. The Oregon Trail, from St. Joseph, Missouri to Fort Laramie, Wyoming, passed through the basin. Many of the early settlers were families who dropped out of wagon trains and remained to establish permanent homes.

Much of the land was settled under the Preemption Act of 1841, whereby a settler could establish a home on a 160-acre plot of land and purchase it for $1.25 per acre. The Homestead Act of 1862 furnished added impetus to settlement by providing a means of acquiring title to 160 acres of land merely by living on it five years and paying a nominal fee.

Most of the early settlers came from Missouri, Iowa, Illinois, and other midwestern states while later immigrants came directly from Europe. The 160 acre farm size prescribed by the settlement laws of the time and the eastern Corn Belt ownership heritage both had significant influences on land use patterns.

Settlement during the late 1870's and early 1880's was stimulated by an economic "boom" and excellent weather. The adaptation of the windmill made settlement between the streams possible. Barbed wire fences made it possible to establish permanent boundaries and protect cropland from range cattle. This period was characterized by rapid population expansion.

Economic depression, drought and blizzards in 1887 and 1888 gave forewarning of the variability of the basin's weather and the hazards of an agriculture based on eastern Corn Belt traditions. The 1890 to 1900 decade ended many settler's hopes. Farms were too small and farming practices were not adapted to this climate. The corn lister, wheat and grain sorghums were brought in and farm consolidation and extensive farming practices designed to cope with the more variable climate were instituted. Population growth rate declined, farm numbers decreased, and the agriculture industry adjusted to the environment of the area. Subsequent booms, depressions, droughts, and war years have alternately slowed and accelerated the process of consolidation and the reorganization of the agricultural industry in the basin.

B. General Description

Population

The total population of the Little Blue River Basin reached 70,000 people by 1890. The population remained in the 70,000-75,000 range until 1940 when the population count was down to 65,000. The population of the basin has continued to decline to a 1970 population of 55,500 (Table III-1).

Table III-1.—POPULATION 1890-1970
LITTLE BLUE RIVER BASIN, NEBRASKA

Census Year	Total	Urban	Total Rural	Rural Farm	Rural Nonfarm
	(Numbers)				
1890	70,357	12,818	57,539		
1900	70,580	8,531	62,049		
1910	74,981	12,298	62,683		
1920	72,896	14,189	58,707		
1930	74,223	17,810	56,413		
1940	64,918	17,663	47,255	26,667	20,588
1950	62,260	21,553	40,707	20,476	20,231
1960	58,179	21,631	36,548	15,922	20,626
1970	55,500	25,619	29,881	12,700 1/	17,181 1/

Source: U.S. Department of Commerce, Bureau of Census.
1/ Preliminary. Rural farm and rural nonfarm not available in the preliminary 1970 Bureau of Census data.

In 1960, 37 percent of the basin's population resided in urban areas. Over 27 percent lived on farms, and the remaining population lived in rural nonfarm areas or in rural communities of less than 2,500 people (Figure III-1). Movement of people from rural to urban areas was evident during the decade of the 60's. By 1970, nearly 46 percent of the people lived in Hastings and Fairbury.

The loss of rural farm population has been a major factor in the decline of the basin's population. Comparison with state population trends, however, shows that a slower growth in the urban sector is the greatest deviation from the state trends.

Incorporated places were stratified into the size groups shown in Table III-2, to determine if off-setting changes by size groups were being obscured in the overall change of this broad category.

Table III-2.—CITIES AND VILLAGES GROUPED BY POPULATION IN 1950, 1960, 1970: LITTLE BLUE RIVER BASIN, NEBRASKA

Category	Number	1950 Pop.	1960 Pop.	1970 Pop.	Change 1950-1970 Numbers	Change 1950-1970 Percent
< 250	22	3,439	3,029	2,984	- 455	-13
250-500	11	3,626	3,460	3,413	- 213	- 6
500-1,000	7	4,554	4,461	5,280	+ 726	+16
1,000-2,500	3	5,183	5,259	5,273	+ 90	+ 2
Other 1/		3,077	3,940	2/		
> 2,500 (Urban)	2	21,553	21,631	22,950	+1,397	+ 6

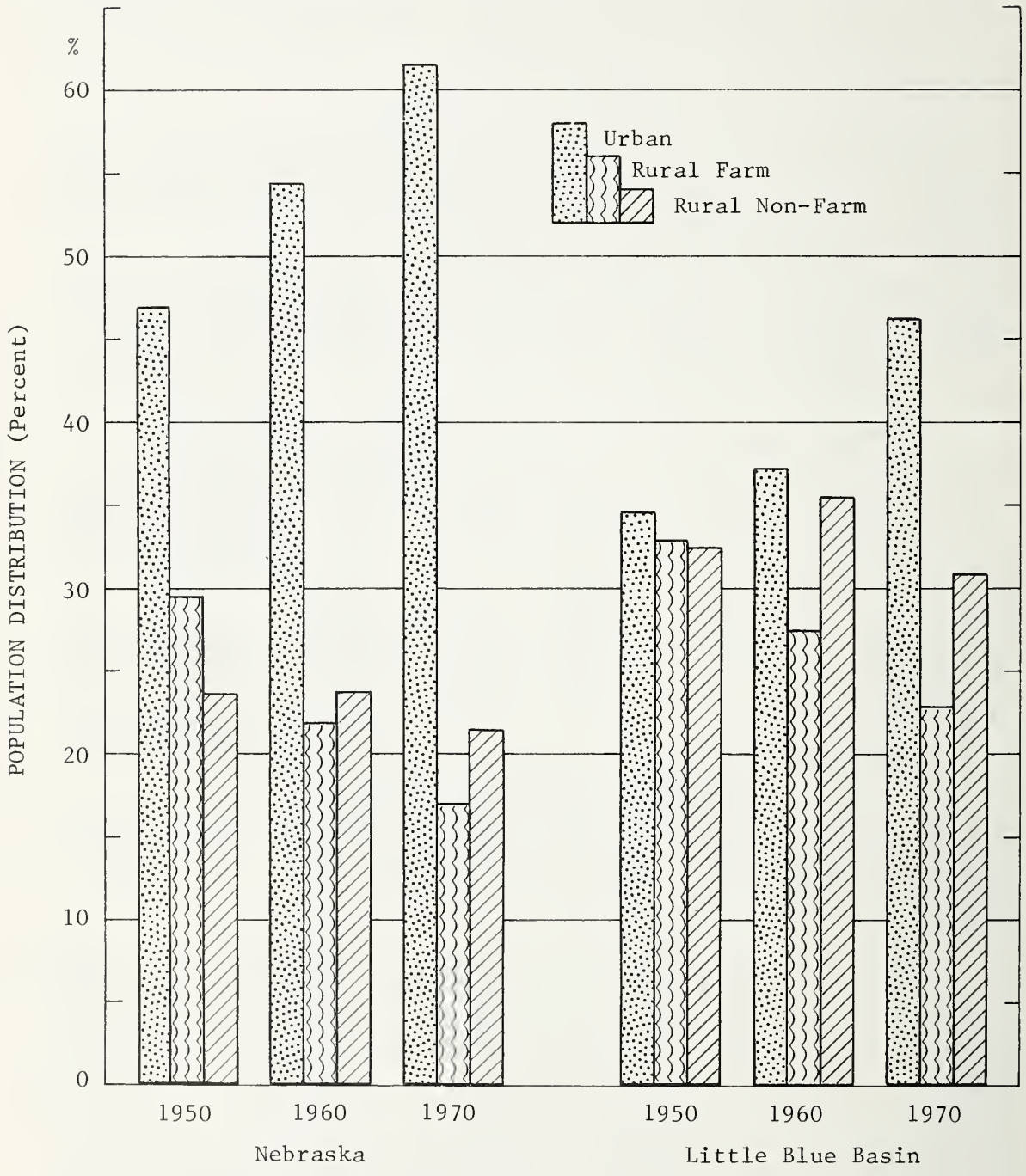
Source: U.S. Department of Commerce, Bureau of Census.

1/ This category is the rural nonfarm population living outside the corporate limits of cities and villages.

2/ Not available in the preliminary 1970 census.

Three of the population categories listed in Table III-2 exhibited growth during the 1950-1970 time period. In the nonurban categories, towns of 500 to 1,000 gained 16 percent, while towns of less than 250 lost 13 percent. The population loss by towns less than 500 indicates trends in small villages closely parallel to the adjustments occurring on farms. The urban population increased six percent in the same time period. The remaining category exhibiting growth is the "other" category which represents the residual of rural nonfarm people living outside the corporate limits of cities and villages but are not classified as farmers. The growth of this "other" category is probably closely related to forces outside of agriculture.

Figure III-1.—POPULATION DISTRIBUTION BY CLASSES, 1950, 1960, 1970: NEBRASKA AND LITTLE BLUE RIVER BASIN, NEBRASKA



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

When enumerated individually, it was found that only 16 of the 43 incorporated places with a population of less than 2,500 increased in size between 1950 and 1970. Of the 33 towns and villages with a population of 500 or less, 21 lost an average of 57 people per town. Three of the towns in the 500-1,000 category gained population while the remaining four towns lost an average of 43 per town. Towns between 1,000 and 2,500 appear to be fairly stable but show little growth. It seems apparent that the same technological change which has occurred in agriculture has affected the smaller villages and towns (Table III-3).

Table III-3.—ENUMERATION OF GROWTH AND DECLINE IN POPULATION OF CITIES AND VILLAGES, 1950-1970, LITTLE BLUE RIVER BASIN, NEBRASKA

Category	Total Number	Number That Gained	Gain	Number That Declined	Decline
< 250	22	7	252	15	- 707
250-500	11	5	281	6	- 494
500-1,000	7	3	899	4	- 173
1,000-2,500	3	1	549	2	- 459
Subtotal	43	16	2,129	27	-1,833
Urban	2	1	2,527	1	-1,130
TOTAL	45	17	4,656	28	-2,963

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

Employment

Trends in employment are highly correlated to population changes and show that growth has occurred only in counties where alternative basic employment has taken up losses in agricultural employment. Adams is the only county which shows a population gain from 1960 to 1970, increasing 5.6 percent.

Total 1968 employment was approximately 20,500, as shown in Table III-4. Agriculture furnished about 23 percent of the total as opposed to about 27 percent in 1960. Mining, construction, and manufacturing employed about 15 percent of the total, while the remaining 63 percent worked in the retail and service sectors.

Table III-4.—EMPLOYMENT, 1960 & 1968 AND BASIC CHANGE
LITTLE BLUE RIVER BASIN, NEBRASKA

Category	1960	1968 1/	Basic Change 1960-1968
Agriculture & Forestry	5,929	4,850	-1,079
Contract Construction & Mining	1,179	1,110	- 69
Manufacturing	1,959	1,950	- 9
Transportation, Communications, and Public Utilities	1,453	1,310	- 143
Wholesale & Retail Trade	4,232	4,400	168
Finance, Insurance, and Real Estate	570	530	- 40
Services & Others	6,178	6,350	172
TOTAL	21,500	20,500	-1,000

Source: U.S. Department of Commerce, Bureau of Census, and Office of Business Economics.

1/ Estimate.

Comparisons of change in employment between 1960 and 1968 (Table III-4) show a 13 percent decline in agricultural employment. This is consistent with state and national trends. The sectors gaining in employment were wholesale and retail trade, and services. The gains were four and 13 percent respectively. Total employment in the basin was reduced by 1,000.

Projected Employment and Population

Employment was projected by modifying the national trends in employment to fit the local area. To provide consistency with overall projections from other areas, employment projections for agriculture were taken from the Missouri River Comprehensive Study. The total employment for the basin is projected to remain very close to the 1960 total employment level. However, the downward trend in agricultural employment is expected to continue. Agricultural employment in 2020 is expected to be 2,900 compared to 5,900 in 1960. Offsetting the declining agricultural employment is a growth in the nonagriculture employment of a nearly equal absolute magnitude (Table III-5).

The projections of employment were then translated into population by using projected labor efficiency from the Missouri River Comprehensive Study. Total population in the basin is projected to continue

Table III-5.—HISTORICAL AND PROJECTED EMPLOYMENT
LITTLE BLUE RIVER BASIN, NEBRASKA

Year	Agriculture Employment	Nonagriculture Employment	Total Employment
	(Thousands)		
1950	8.2	15.4	23.6
1960	5.9	15.6	21.5
1968	4.9	15.6	20.5
1980	4.2	16.2	20.4
2020	2.9	17.4	20.3

the declining trend which began in 1930. The total population is projected to decline from 55,500 in 1970 to 53,700 in 1980 and to 53,400 in 2020. The urban population is projected to continue growing while the rural farm population continues its downward trend. Rural nonfarm has remained almost constant through the last three decades (Figure III-2).

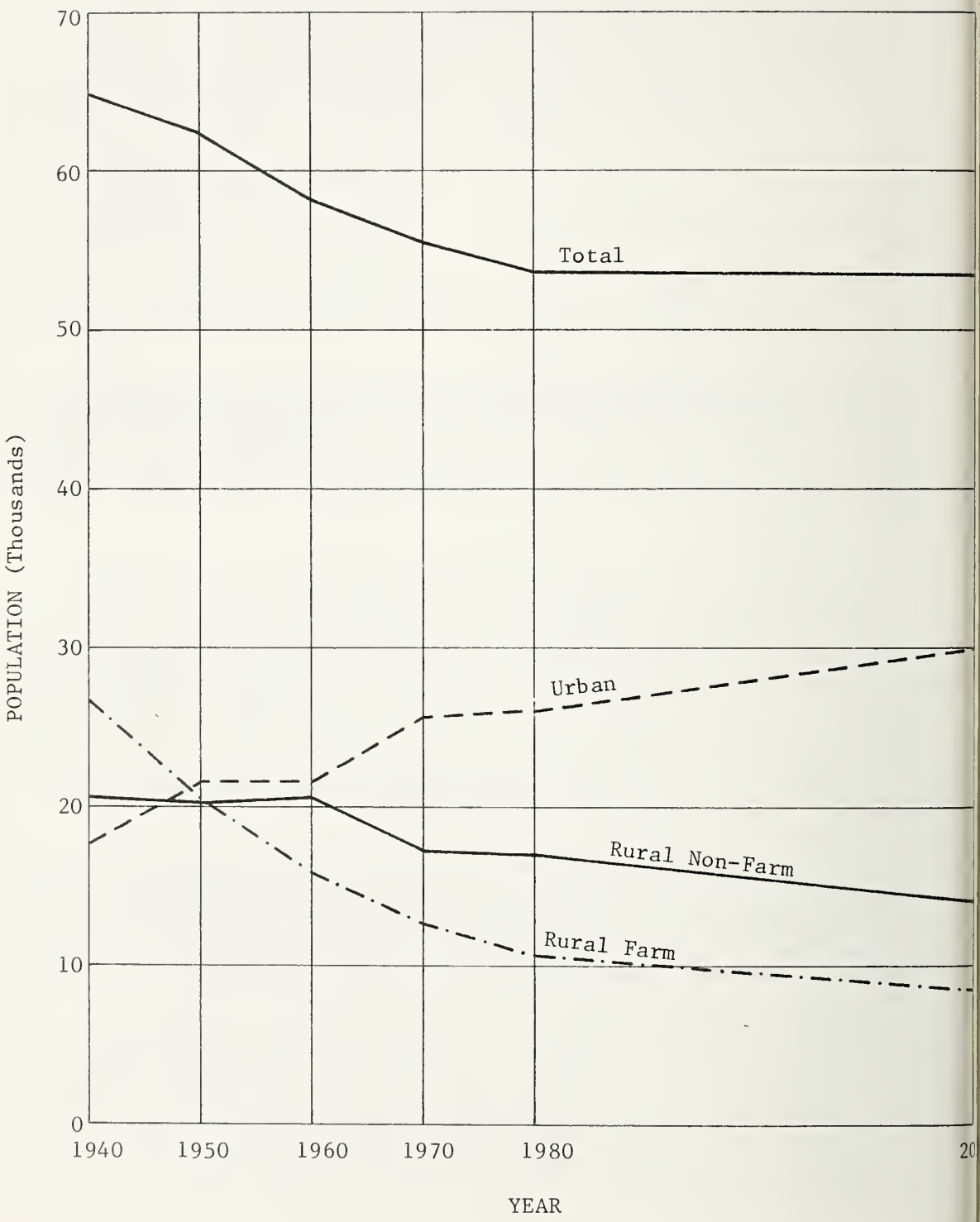
Other Economic Activity

The 1963 Census of Manufacturing listed approximately 75 manufacturing plants in the basin. Three of these employed 100 or more people. Of the 25 plants which appear to be linked closely to agriculture, only two plants employ more than 100 people. There are five meat slaughtering plants, three milk and milk product processing plants, five animal feed processors, two fertilizer mixer plants, and four farm machinery plants in the basin.

The transportation system of the Little Blue River Basin is well developed with highways and railroads. Railroads no longer provide passenger service to the basin but they do play an important role in the moving of agricultural products to market. The basin is served by the Chicago, Rock Island, and Pacific; Burlington Northern; Missouri Pacific; Chicago and Northwestern; and Union Pacific railroads.

There are about 350 miles of hard-surfaced federal and state highways and many more miles of gravel and rock-surfaced county roads traversing all portions of the basin. The major north-south highways are U.S. 81 and 281 and state highways 14 and 15. U.S. highway 6-34 on the northern boundary and U.S. 136 on the southern boundary are the major east-west routes.

Figure III-2.—POPULATION TRENDS
AND PROJECTIONS, LITTLE BLUE RIVER BASIN, NEBRASKA



Commercial bus and truck transportation routes serve much of the area. A number of cities have municipal airports and commercial air transportation is available at Hastings and several points adjacent to the basin.

Livestock is the major item of export from the basin. The basin is located within economical shipping distance of three central markets and has many local buying stations and auction sales rings.

Grain elevators are located in most towns and market facilities for grain are adequate. The estimated capacity in state and federally licensed private grain storage is 65,000,000 bushels and in USDA bin sites it is 3,850,000 bushels. Marketing facilities are generally adequate although the box car shortage in recent years has created some grain marketing problems.

Mineral resources contribute a small but significant amount to the economy of the basin. In 1969, the value of sand and gravel produced was over $650,000. The production of shale and clay, together with agricultural lime added another $100,000 or more.

C. Agriculture and Related Economic Activity

Agriculture

The Little Blue River Basin lies in a transitional zone between the Corn Belt on the east and the Central Great Plains on the west. It is typical of neither, but possesses many characteristics of both. Most farms are diversified family-size units. Production is influenced greatly by a climate more humid than typical of the Central Great Plains but restrictive enough to modify traditional Corn Belt culture. Corn, because of the extensive irrigation development, is the most important crop. Sorghum acreage has increased on both dry and irrigated lands. Wheat is a cash crop of major importance.

Livestock enterprises are important and contribute nearly half of the gross farm sales in the basin. Trends indicate that the increase in the livestock industry has not kept pace with the increased feed grain production from irrigated land. The basin has depended upon feed grains in the past as a partial cash crop and projections indicate that if present relationships continue, the amount of surplus feed grain in the area will increase.

The steady decline in farm numbers and the resulting increase in farm size is one of the most significant aspects of the basin's agriculture, (Table III-6). In 1969, there were 4,100 farms in the basin,

Table III-6.—DISTRIBUTION OF FARMS BY SIZE GROUPS, 1949-1969
LITTLE BLUE RIVER BASIN, NEBRASKA

Category	1949	1954	1959	1964	1969
Number of Farms	6,114	5,802	5,161	4,530	4,100
Average Size (Acres)	270	290	327	366	402
	----------	----------	(Percent)	----------	----------
< 100 acres	15.3	13.9	12.4	12.6	13.4
100 to 179 acres	20.6	18.2	16.3	13.7	11.8
180 to 259 acres	20.5	19.7	16.5	12.6	11.7
260 to 499 acres	35.4	38.7	40.9	39.1	37.2
> 500 acres	8.2	9.5	13.9	22.0	25.9

Source: U.S. Department of Commerce, Bureau of Census, U.S. Census of Agriculture, 1950, 1959, 1964.

2,014 less than in 1949. The basin, with its heritage of the 160-acre homestead, has had a large number of farm consolidations. The average farm size in 1969 was 402 acres, 132 acres larger than in 1949. Twenty-six percent of the farms were larger than 500 acres and 13 percent were less than 100 acres. The largest group -- 37 percent -- was in the 260 to 499 acre category.

Agricultural technology, typified by the substitution of large machines for labor, coupled with drought and low prices in the 1930's and again in the 1950's is primarily responsible for this dynamic change. These are the same trends as were found in the population and employment data. Though fewer in numbers, individual farmers are producing much more. In accomplishing this, they are becoming more dependent on service communities for larger amounts of purchased inputs.

Agriculture in the basin represents a capital investment of over 500 million dollars. The largest capital value is in land and buildings. The 1969 Agricultural Census listed the average value of land and buildings at $103,800 per farm. This means that the asset value of agricultural land and buildings is about 425 million dollars (Table III-7), a 56 percent increase from 1964. This large increase in values is due largely to the increase in land value, especially in irrigated land, and the large capital investment in private irrigation development.

Tenancy in the basin is substantially higher than the national average and slightly higher than the state average. The percent of farms operated by tenants dropped from 41 percent in 1949 to 25 percent

Table III-7.—CAPITAL INVESTMENT IN FARM REAL ESTATE, 1949-1969
LITTLE BLUE RIVER BASIN, NEBRASKA

Item	1949	1954	1959	1964	1969
	(Dollars)				
Value of Land and Buildings:					
Per Farm	21,631	30,116	42,651	60,200	103,800
Per Acre	78.00	101.00	128.00	164.00	258.00

Source: U.S. Department of Commerce, Bureau of Census, U.S. Census of Agriculture, 1950, 1959 and 1964.

in 1969. Decreases in total farm numbers have come mainly from the tenant category. Farms operated by full owners have also decreased by over 350 farms. One deterrent to full ownership of farms has been the rapid expansion of irrigation which requires a high investment for family farms. The larger farm sizes, the increasing land values, and the high cost of machinery is and will continue to be a deterrent to full ownership of farms by the farm operator (Table III-8).

Table III-8.—OWNERSHIP OF FARMS, 1949-1969
LITTLE BLUE RIVER BASIN, NEBRASKA

Category	1949		1954		1959		1964		1969	
	No.	%	No.	%	No.	%	No.	%	No.	%
Full Owners	1,809	30	1,750	30	1,597	31	1,451	32	1,460	35
Part Owners	1,779	29	1,710	30	1,696	33	1,686	37	1,624	40
Tenants	2,516	41	2,337	40	1,860	36	1,385	31	1,016	25

Source: U.S. Department of Commerce, Bureau of Census, U.S. Census of Agriculture, 1950, 1959 and 1964.

In 1969, cash receipts from livestock and crop sales were $102 million, 212 percent greater than in 1949 (Table III-9). Livestock receipts have accounted for about 50 percent of total receipts but have ranged as high as 58 percent in 1969 and as low as 43 percent in 1954. Purchases of livestock were over $24 million or 41 percent of the value of livestock and livestock products sold in 1969. Total receipts averaged $24,954 per farm in 1969. However, there is some

Table III-9.—VALUE OF FARM PRODUCTS SOLD, 1949-1969
LITTLE BLUE RIVER BASIN, NEBRASKA

Product	1949	1954	1959	1964	1969
	(Thousand Dollars)				
Dairy Products	1,788.9	1,726.6	1,970.1	2,315.4	3,234.9
Poultry & Poultry Products	2,887.2	1,850.2	1,703.2	1,373.1	1,291.5
Other Livestock & Livestock Products	12,106.8	14,598.5	22,648.6	35,813.2	54,771.9
Forest Products	0.8	1.4	6.9	102.1	3.0
Other Crops	15,997.4	23,772.6	31,774.8	29,755.6	43,010.1
Total Sales	32,781.1	41,949.3	58,103.6	69,359.4	102,311.4
Livestock Purchased 1/	3,322.3		9,583.8	15,187.9	24,054.7
Sales Less Purchases	13,640.6		16,738.2	24,313.8	35,243.6

Source: U.S. Department of Commerce, Bureau of Census, U.S. Census of Agriculture, 1950, 1959 and 1964.

1/ Not available in the 1954 Census of Agriculture.

double counting in the "other livestock and livestock products" category. If livestock purchases are netted out, the average falls to $19,087 per farm.

Another general indicator of the relative position of agriculture in the basin as compared to agriculture in Nebraska and the United States is the farm operator "Level-of-Living Index" 5/ (Table III-10). This indicator reveals that the farm operator's "level-of-living" in the basin was slightly below the state average but considerably above the average for the nation. The rate of increase in this index, however, has been about equal to Nebraska's increase and considerably less than for the United States.

5/ This index is based upon five variables which are believed to reflect levels of living. These variables are: (1) average value of products sold per farm; (2) average value of land and buildings per farm; (3) percentage of farms with telephones; (4) percentage of farms with home freezers, and (5) percentage of farms with automobiles.

Table III-10.—LEVEL OF LIVING INDEX, 1950-1964
LITTLE BLUE RIVER BASIN, NEBRASKA

Area	1950	1959	1964	Percent Change 1950-1959	Percent Change 1959-1964
Little Blue	78	115	133	47	16
Nebraska	82	123	142	50	15
United States	59	100	122	69	22

Source: Farm Operator Level of Living Indexes, for Counties of the United States, 1950, 1959 and 1964, Stat. Bul. #406, Economic Research Service, U.S. Department of Agriculture.

Resource Use

There are 1,640,000 acres presently available for agricultural uses in the Little Blue Basin. Nonagricultural uses, such as roads and urban and water areas, presently account for 82,200 acres. By 2020, the land available for agricultural uses is projected to decrease to 1,632,200 acres as a result of increased nonagricultural land use.

About 74 percent of the agricultural land is presently devoted to cropland. Presently, 23 percent is in pasture and rangeland, one percent in woodland and two percent in other agriculture land uses. These percentages are projected to remain essentially unchanged through 2020.

Current normal 6/ and projected cropping patterns were developed for the basin (Table III-11). The major dryland crops in the basin are wheat, sorghum, alfalfa hay and corn. The soybean crop is a relatively new crop to the basin, but the acreage planted is expected to expand rapidly. The two major irrigated crops are corn and sorghum. The irrigated corn acreage is projected to expand from 166,000 acres in current normal to 282,400 acres in 2020. The acreage of irrigated cropland is projected to increase from a current normal acreage of 270,000 acres to 315,000 acres by 1980. An additional 60,000 acres of private irrigation development is projected by 2020. About 11 percent of the pasture and range land consists largely of pasture or introduced grasses. Eighty percent of the woodland is grazed.

6/ Current normal represents land use and production in an average year with current production technology. In this report, current normal is based upon the five year period of 1959-1963. The normalization process removes abnormalities caused by weather, other hazards and farm programs which make a single year unreliable as a land use and production base.

Table III-11.—CURRENT NORMAL AND PROJECTED LAND USE
LITTLE BLUE RIVER BASIN, NEBRASKA

Land Use	Current Normal	1980	2020
	(Thousand Acres)		
CROPLAND	1,211.8	1,205.6	1,198.7
Nonirrigated:	941.8	890.6	823.7
Corn	58.5	50.0	35.0
Sorghum	158.6	175.0	190.0
Wheat	290.4	295.0	300.0
Oats	10.8	7.5	3.5
Soybeans	2.3	10.0	25.0
Alfalfa Hay	82.0	84.0	90.0
Other Tame Hay	3.4	3.5	3.5
Cropland Pasture	12.7	15.3	20.0
Other Crops	11.2	11.5	12.0
Summer Fallow	54.6	55.0	56.0
Idle Cropland	257.3	183.8	88.7
Irrigated:	270.0	315.0	375.0
Corn	166.0	220.1	282.4
Sorghum	59.5	53.5	45.0
Soybeans	1.7	3.5	7.5
Potatoes	.3	.4	.6
Alfalfa Hay	16.6	17.5	19.5
Other Crops	1.6	2.5	4.0
Idle Cropland	24.3	17.5	16.0
PASTURE, TOTAL	376.5	381.3	384.2
Pasture	42.2	43.0	45.0
Range	319.4	323.3	323.7
Native Hay	14.9	15.0	15.5
FOREST, TOTAL	19.6	19.5	19.3
Grazed	16.0	15.1	12.7
Not Grazed	3.6	3.4	6.6
OTHER AGRICULTURAL LAND	32.2	31.8	30.0
TOTAL AGRICULTURAL LAND	1,640.0	1,638.2	1,632.2
NONAGRICULTURAL LAND	82.2	84.0	90.0
TOTAL AREA	1,722.2	1,722.2	1,722.2

Current normal and projected yields for the Little Blue Basin are shown in Table III-12. These estimates of yield increases assume continued improvements in management, conservation and utilization of the soil resource, improved varieties of field crops, increased use of fertilizer and greater acceptance and application of new technology. the yields for corn, sorghum, wheat and oats are projected to be about double the current normal yields by 2020.

Table III-12.—CURRENT NORMAL AND PROJECTED YIELDS
LITTLE BLUE RIVER BASIN, NEBRASKA

Crop	Unit	Current Normal	1980	2020
Nonirrigated:				
Corn	Bu.	38	53	80
Sorghum	Bu.	48	63	88
Wheat	Bu.	24	36	53
Oats	Bu.	25	35	49
Soybeans	Bu.	17	20	25
Alfalfa Hay	Ton	2.1	2.4	2.8
Other Hay	Ton	1.1	1.5	1.9
Cropland Pasture	AUM	3.7	5.1	6.6
Irrigated:				
Corn	Bu.	89	130	197
Sorghum	Bu.	93	132	198
Soybeans	Bu.	28	33	44
Potatoes	Cwt.	147	208	297
Alfalfa Hay	Ton	3.8	4.9	6.8
Pasture	AUM	2.7	3.6	4.6
Range	AUM	1.3	1.5	1.8
Native Hay	Ton	1.2	1.3	1.6

The projections of land use were combined with yield projections to compute a projected level of total production for the basin for 1980 and 2020. Production totals are shown in Table III-13. Feed grain production is projected to be 64 percent greater than current normal by 1980 and 180 percent greater than current normal by 2020. Wheat production will more than double by 2020. Soybean production is projected to increase rapidly reaching to a total 11 times greater than current normal.

Baseline projections for major farm products in the Little Blue Basin were developed for 1980 and 2020. These baseline projections

Table III-13.—CURRENT NORMAL AND PROJECTED PRODUCTION 1/
LITTLE BLUE RIVER BASIN, NEBRASKA

Commodity	Unit	Current Normal	1980	2020
		(Thousands)		
Feed Grains	Bu. 2/	29,559	48,517	82,779
Wheat	Bu.	6,970	10,620	15,900
Soybeans	Bu.	87	316	955
Potatoes	Cwt.	44	83	178
Hay	Tons	257	312	416
Pasture	AUM	576	718	922
Beef & Veal	# Live Wt.	123,715	175,000	275,000
Pork	# Live Wt.	35,960	41,500	74,500
Lamb & Mutton	# Live Wt.	3,015	3,250	3,750
Chickens	# Live Wt.	1,115	985	2,400
Milk	Pounds	77,400	94,000	180,000
Eggs	Dozen	5,625	8,217	15,833

1/ The estimated production shown assumes the projected level of private irrigation development and existing trends of resource development.

2/ Corn equivalents.

represent production levels that are essentially consistent with the basin retaining its historical share of national food and fiber output. The national projections from which basin baseline production levels are derived include consideration of population growth; shifts in consumer demands; industrial and other uses of agricultural commodities; livestock feeding efficiencies and feed ration composition; foreign demand for agricultural projects; and the advance of technology in the production of crops and livestock.

The baseline level of projected livestock output is assumed also to be the level of projected livestock production (Table III-13). Beef and veal production is projected to increase 41 percent by 1980 and double current normal production by 2020. Pork production is projected to increase 15 percent by 1980 and 107 percent by 2020. Chicken production is projected to decrease slightly from current normal by 1980 but to increase significantly by 2020. Egg production shows a large gain of 181 percent by 2020.

The production of feed grains, hay, and pasture was converted to feed units and compared with feed unit requirements of the projected livestock production. This method also gives some measure of the duplication present in the table of total projected production, i.e.,

most of the pasture and hay, and a large portion of the feed grains listed in this table are fed to livestock and therefore, are duplicate production requirements.

Table III-14 shows feed unit requirements for projected livestock production. Projected exports were based upon current levels of production in excess of feed requirements. Thus, this level of projected exports assumes that the basin will continue to furnish the same relative share of the national feed grain requirements. The basin will need little resource development to maintain its historical share of projected national production. If actual production in the basin were to be significantly higher than that projected for the basin, it would be at the expense of other feed producing areas in Nebraska or elsewhere in the United States.

Table III-14.—CURRENT NORMAL AND PROJECTED FEED UNIT PRODUCTION LITTLE BLUE RIVER BASIN, NEBRASKA

Item	Current Normal	1980	2020
	(Thousand Feed Units 1/)		
Feed Grains	1,656,416	2,716,952	4,635,600
Hay	261,800	320,285	428,380
Pasture	259,200	323,100	414,900
Total Feed Units	2,176,416	3,360,337	5,478,880
Feed Unit Needs 2/	1,879,358	2,335,262	2,368,425
Exports	297,058	458,619	747,758
Total Demand	2,176,416	2,793,881	3,116,183
Surplus		566,456	2,362,697

1/ A feed unit equals one pound of corn or its equivalent.

2/ Assumes a slight increase in the relative share of projected national output than has been produced historically.

The value of feed grain exports plus wheat and other cash crops approximates the direct cash income of crop production in the basin. The large excess of feed grains over livestock needs presently and in projection years shows the heavy reliance on feed grains as a cash crop. A relative increase in value of livestock products may occur over time as the factors affecting the livestock industry change. Labor forces, population centers, markets, processing plant location,

and transportation rates for feed and livestock all determine regional prices which, in turn, create regional advantages or disadvantages and influence levels of livestock production.

The basin possesses resources which could be utilized to increase economic growth. For example, the meat processing industry is engaged in a period of readjustment to decentralized plants. The basin has surplus labor and feed. Many other elements conducive to agricultural product processing development are present. The basin is on the western fringe of the Corn Belt and should be in an excellent position to capitalize on the population growth in the west, where projected needs for livestock products surpass its expected ability to meet them.

The gross value of current normal and projected production is given in Table III-15. The gross value of all crop and livestock production is estimated to be $90 million in the current normal time period. The gross value is projected to increase to $133 million by 1980 and $217 million by 2020. The projected increases in value are the result of increased production alone since current normal prices are used for the three time periods.

Table III-15.—GROSS VALUE OF CURRENT NORMAL AND PROJECTED PRODUCTION LITTLE BLUE RIVER BASIN, NEBRASKA

Commodity	Price 1/	Current Normal	1980	2020
		(Thousand Dollars)		
Feed Grains	1.07	31,628	51,913	88,573
Wheat	1.78	12,407	18,904	28,302
Soybeans	2.30	200	727	2,197
Potatoes	1.38	61	115	246
Hay	17.82	4,580	5,560	7,413
Pasture	5.00	2,880	3,590	4,610
Beef and Veal	.2317	28,665	40,548	63,718
Pork	.1505	5,412	6,396	11,212
Lamb & Mutton	.1516	457	493	569
Chickens	.1544	172	152	371
Milk	.0295	2,283	2,773	5,310
Eggs	.0210	1,418	2,071	3,990

1/ Current normalized price, Interim Price Standards for Planning and Evaluating Water and Land Resources, Water Resource Council, April 1966.

The current normal gross value of crop production is $52 million, or 57 percent of the total crop and livestock value. Feed grains account for 61 percent and wheat 24 percent of the gross crop value. The projected value of soybean and potato production increases rapidly by 2020 but still accounts for only two percent of the gross crop value in 2020. The current normal value of livestock production is $38 million, or 43 percent of the total crop and livestock value. Beef and veal production is the dominant livestock activity accounting for 75 percent of the current normal gross value of livestock production.

The feed grains, hay and pasture and range production serve as inputs to the basin's livestock industry. Table III-16 presents gross farm income estimates which represent the value of livestock, wheat, soybeans and net feed grain exports. Gross farm income is projected to increase from $57 million in current normal to $81 million by 1980. The 2020 projected gross farm income is nearly two and one-third times the current normal value.

Table III-16.—ECONOMIC TRENDS AND IMPLICATIONS
LITTLE BLUE RIVER BASIN, NEBRASKA

Gross Income	Unit	Current Normal	1980	2020
Gross Farm Income	Th. Dol.	56,751	80,942	130,203
Gross Income Per Farm Worker	Dollars	9,900	16,500	36,200

The current normal gross income per farm worker is $9,900 (Table III-16). The two factors, gross value of production and agricultural workers, move in opposite directions to create a relatively large income per farm worker in 1980 and 2020. In 1980, gross income per farm worker is projected to be $16,500 and is projected to increase to $36,200 by 2020.

The level of projected agricultural production may be considered as that which might be expected if past trends continue. Since projections of yields based on historical trends were used, a certain amount of resource development is "built-in" to the system. Better management techniques, such as higher levels of fertility and soil conservation practices, are inherent factors in the projections. Resource development practices that will be applied in the future, such as land treatment and water conservation measures which sustain the quality of the

resource are implicit in the projections of agricultural production. In addition, major projects enhancing the capability of the resources, accelerating existing programs, or changing traditional patterns will tend to create a source of added production.

Realization of the projected agricultural production will require additional inputs -- especially seed, herbicides and fertilizer. The costs of seed and herbicides and insecticides are a significant percentage of the crop budget but are not likely to increase greatly in the future. Fertilizer use per acre has been increasing. The additional quantity of nutrients needed to replace that taken from the soil was calculated. The calculations assume that 50 percent of the nitrogen applied will be used by the crops as will 25 percent of the phosphate. Using $.045 and $.087 respectively, as the cost per pound of nutrient, the quantities and values of nutrients needed are shown in Table III-17.

Table III-17.—PROJECTED ADDITIONAL FERTILIZER USE
LITTLE BLUE RIVER BASIN, NEBRASKA

Item	1980		2020	
	Tons	Value	Tons	Value
Nitrogen (N)	20,775	$1,869,750	56,290	$5,066,100
Phosphate (P_2O_5)	8,345	$1,452,030	22,935	$3,990,690
Total Value	--	$3,321,780	--	$9,056,790

Newly established fertilizer plants near the basin will be capable of furnishing the additional nutrients needed. The current number of fertilizer dealers will probably handle the increased quantity of plant nutrients.

D. Forest Resources and Related Economic Activities

There are 19,600 acres of commercial forest land in the basin. This includes land which is at least 10 percent stocked by trees of any size and producing, or physically capable of producing, commercially usable wood, or other forest products. Most of the timber resources are in the bottomland and are hardwood forest type, including cottonwood, elm, ash, oak, maple and walnut. The predominant species is cottonwood, while black walnut has become quite scarce. The average value is $5

to $45 per thousand board feet for the lower-value species of cottonwood, oak, ash, and maple, and $100 to $1,500 per thousand board feet for the more valuable and scarce black walnut.

Nebraska Extension Forestry

Walnut Trees Provide an Added Source of Income

The basin should not be thought of as a timber-products producing area; however, the forest land provides a supplemental income to the landowner, and contributes to meeting the basin's and region's needs for forest products. There are eight sawmills within or adjacent to the basin which produce rough lumber, wood pallets and special-order dimension material. Most of these mills are presently operating part-time during the winter. The annual production from these mills varies from 100 to 1,500 thousand board feet, with a timber-products mill output value of $10,000 to $150,000.

Nebraska Extension Forestry
Typical Small Sawmill in the Basin

Several landowners are growing Christmas trees commercially. They sell on a "choose and cut basis". In 1970, production totaled more than 2,000 trees. The income to the landowners amounted to more than $15,000. Production and marketing of Christmas trees is a relatively new enterprise in the basin and is expected to increase.

Generally, the existing forest and woodland areas are in a depleted condition. 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 forest and woodlands made up largely of defective trees of low-value species. Under existing conditions there is insufficient reproduction of desirable species.

Timber products output is expected to continue at about the same rate in the future. To accomplish this it will be necessary to develop markets for products which can be made from low-value timber, such as wood chips and wood shavings. It will also be necessary to stock the

basin's forests with more desirable species, to eliminate or reduce grazing, and to improve forest management in the near future so that present outputs can be maintained in later time periods.

E. Outdoor Recreation and Related Economic Activity

Outdoor recreation and fish and wildlife activities make limited contributions to the economy of the Little Blue Basin. Various segments of the economy do benefit from the recreation activity. Income is created from expenditures for lodging, groceries, auto fuel and parts, and meals, especially from visitors to the basin. Duck, pheasant, quail, and deer hunting create economic activity through the sale of hunting licenses, shells, guns, archery equipment and other related hunting equipment and clothes.

Nebraska Game & Parks Commission
Pheasant Hunting Increases Basin's Income

Fishing also creates economic activity in the basin through the purchase of equipment and supplies. Bait sales provide some seasonal supplemental income to private individuals. Fishing on public lands is provided at two lake areas totaling 62 surface acres. The warm water streams are fished wherever access is allowed by private owners.

Most of the larger towns have municipal swimming pools, and these meet much of the needs of the basin for swimming. Nearly all of the towns have parks for public use; these meet picnicking needs and provide opportunities for various other outdoor activities.

Farmers in the basin obtain some supplemental income from recreation activities. The recreational income includes gross cash receipts obtained from fees for the privilege of hunting and fishing. However, the recreational income is still insignificant. In the 1964 Census of Agriculture only about ten farms reported receiving recreational income. The dollar values could not be published due to disclosure problems. However, this amount represents only a small fraction of the agricultural contribution to recreation. Most farmers do not charge any fees and ask only that permission be obtained to hunt or fish on their property.

The "Comprehensive Plan for Outdoor Recreation" (Nebraska Game Forestation and Parks Commission) divides Nebraska into socio-economic areas for study. The Hastings and Beatrice socio-economic areas are those in which the bulk of the Little Blue Basin is located. The population characteristics of the Little Blue are assumed to be those of these two socio-economic areas. The population outside the basin, but in the area of influence which is expected to be served by basin resources, is projected to increase 21 percent from 1970 to 1980. However, the basins population is expected to decrease four percent during the same time period (Table III-18).

More significant than the quantitative population trend in determining recreation demands are the characteristics of that population. A rural to urban realignment of the population is occurring. Projections indicate that the farm population will continue to decrease and the urban population will continue to increase. The median age of the people in the basin is 34.4 years in all except Adams and Nuckolls Counties. The percent of people 65 and older has consistently increased for the 70 years of the census periods. The 65 and older category consists mostly of retired people who have considerable leisure time but are not physically active. This is countered by a significant increase in numbers of those 14 and under who require specialized facilities and relatively close supervision. Those under 14 and over 65 make up 41 percent of Nebraska's population.

Table III-18.—POPULATION (1970 AND PROJECTED) AFFECTING RECREATION DEMAND, LITTLE BLUE RIVER BASIN, NEBRASKA

Item	1970	1980	2020
	(Thousands)		
	In Basin		
Farm	12.7	10.7	8.4
Rural Nonfarm	17.2	17.0	15.0
Urban	25.6	26.0	30.0
Total Basin	55.5	53.7	53.4
	Outside Basin		
Area of Influence	19 1/	23 1/	51 2/
GRAND TOTAL	74.5	76.7	104.4

1/ Based on data from Nebraska Game and Parks Commission (1966).
2/ Projected by USDA River Basin Staff.

Other factors which may lead to an increased future economic activity in recreation include increasing educational and family income levels. The population is also becoming more mobile. Mechanization and improved technology along with a shorter work week will result in more leisure time.

F. Relationship of Economic Development and Water Resource Development

Water resource development has played a major role in the economic development of the Little Blue Basin. Private irrigation has been the major water resource development. During and immediately after the drought of 1954-56, many irrigation wells were drilled. Total acres irrigated in the five county area 7/ approximating the basin increased as follows: 1950 - 21,700; 1959 - 217,100; and 1968 - 340,600.

The increase in irrigation has tended to dampen the decrease in farm numbers in those areas where the acreage of irrigation has increased rapidly. As farmers shifted from dryland to irrigated crop production, a shift from wheat, oats and alfalfa to corn and sorghum

7/ Adams, Clay, Jefferson, Nuckolls, and Thayer Counties.

has occurred. Accompanying the increase in irrigated acreages is an increased use of fertilizer and a need for more grain storage capacity.

Irrigation From Wells Continues to Increase

Urban and rural communities provide services for the agriculture industry. Agriculture related businesses may need to expand in volume either by increasing the number of firms or by expanding the size of present firms. Local elevators may need to increase the capacity to handle increased volumes of grains. Fertilizer and commercial feed requirements will increase thus providing the need for dealers to handle these products. It is likely that the demand for agriculture related products will be met by an expansion of existing firms.

IV. WATER AND RELATED LAND RESOURCE PROBLEMS

Water and land resource problems are identified which adversely affect the basin. Analyses of problems describe causes, extents and 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. Erosion Damages

The basin is located in the Central Loess Plains Land Resource Area. Nearly all of the land is in farms and about two-thirds is cropland. The area is a nearly level to gently rolling loess-mantled plain with stream valleys that are mostly narrow and are not deeply incised.

Sheet and wind erosion is causing the gradual removal of the cap of highly productive loess over a part of the basin and in places has exposed undeveloped and less productive parent materials. This erosion is particularly evident on steeper slopes. The loss of valuable top soil results in reduced productivity.

Sheet Erosion Caused by Inadequate Land Treatment

Poor irrigation water management has caused excessive erosion in some fields. Excessive amounts of irrigation water have caused gullying in some roadside ditches and waterways. Irrigation guidelines relative to such items as gradient, side slope and length of run are not adequately followed by some irrigators, thereby increasing the hazard of erosion. In addition, lands on which irrigation guidelines are not followed become vulnerable to damage by runoff from high intensity rainstorms and snowmelt events.

Much of the acreage devoted to introduced grasses is in small pastures near farmsteads. The general practices of over-grazing of these pastures and lack of care and maintenance makes these areas vulnerable to severe erosion. A considerable acreage planted to introduced grasses has not been given the extra care and maintenance follow-up needed. Severe erosion has taken place on some of these areas.

Much of the native grassland has been, and is overstocked. Overstocking causes suppression and killing out of the taller and more desirable grasses, permitting the increase of weeds and less desirable species of native grasses. When stands deteriorate, native grassland decreases in productive capacity and is subject to increased soil erosion, both by wind and water.

It is estimated that about 80 percent of the woodland is grazed. In some situations, grazing of woodlands has destroyed the ground cover, resulting in excessive erosion.

The Nebraska Conservation Needs Inventory, 1967, USDA (CNI) shows some 866,000 acres of land having an erosion problem in the basin. It is estimated that 586,100 acres of erosion problem are on cropland, 50,100 acres of which is irrigated. There are 259,000 acres of pasture and range with varying degrees of erosion, with an additional 6,200 acres of forest and 14,700 acres of other agricultural land having erosion problems. Table IV-1 is an inventory of the erosion problem, by land capability units.

About 470 miles of streambank are affected by streambank erosion in the basin. Damage is considered serious on only about one percent of the total streambank mileage, and moderate on about five percent. The current average annual damages from streambank erosion are estimated to be $15,000. These damages include loss of land, deposition of infertile sediment and damage to bridges.

Gully erosion accounts for the major share of land damage in the basin. The gully erosion is accelerated by the lack of vegetative cover and is ordinarily most severe in cultivated areas on rolling topography. Land damage from gullying on irrigated lands is usually

Table IV-1.—INVENTORY OF AGRICULTURAL LAND WITH EROSION PROBLEMS BY LAND CAPABILITY UNITS, LITTLE BLUE RIVER BASIN, NEBRASKA 1/

Item	Land Capability Unit					Total
	II E	III E	IV E	VI E	VII E	
Cropland	231.4	188.4	115.7	50.6	-	586.1
Irrigated	(22.3)	(22.2)	(5.4)	(0.2)	(-)	(50.1)
Nonirrigated	(209.1)	(166.2)	(110.3)	(50.4)	(-)	(536.0)
Pasture & Range	16.8	34.4	67.6	136.2	4.0	259.0
Forest	1.9	1.3	0.4	2.0	0.6	6.2
Other	6.0	3.1	2.6	3.0	-	14.7
TOTAL	256.1	227.2	186.3	191.8	4.6	866.0

1/ From Nebraska Conservation Needs Inventory, 1967, USDA (CNI).

associated with and accelerated by excessive irrigation water runoff. The CNI reports 296,000 acres have gully erosion problems. Not all of this area has gullies that are of the size and nature requiring treatment by project type action. In this study, it was estimated that nearly 269,000 acres could be treated by individual landowners and operators, while over 27,000 acres required project action. The problem area and that portion needing project action for each delineated watershed is shown in Table IV-2. A map showing the location of each delineated watershed is shown on Figure IV-1.

Table IV-2.—SUMMARY OF WATER AND RELATED LAND RESOURCES PROBLEMS AND NEEDS LITTLE BLUE RIVER BASIN, NEBRASKA

Delineated Watershed Identification		Flood Prevention					Agric. Water Mgmt.	
		Floodwater & Sediment		Gully Erosion			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)						
41c3- 1	Little Blue (Upper)	233,100	7,200	7,200	34,500	0	5,800	4,000
41c3- 2	Cottonwood-Scott Crs.	98,800	3,050	3,050	23,000	0	1,400	1,000
41c3- 3	Thirty-Two Mile Cr. 1/	67,100	2,810	2,810	13,500	0	200	0
41c3- 4	Pawnee Creek	80,700	3,950	3,950	13,200	0	1,000	1,000
41c3- 5	ACNW Tribs.	199,500	13,150	13,150	29,400	0	1,500	1,000
41c3- 6	Angus-Hebron Tribs.	144,300	11,950	500	30,000	0	500	0
41c3- 7	Spring Creek	115,200	3,450	3,450	22,500	9,000	200	0
41c3- 8	Dry (Thayer)	80,900	6,500	2,600	16,000	0	1,500	0
41c3- 9	Big Sandy (Upper)	212,300	2/	2/	18,000	0	10,700	7,500
41c3-10	Big Sandy (Lower)	195,700	32,950	30,180	36,500	500	14,100	8,000
41c3-11	Little Sandy	67,300	6,450	6,450	11,100	1,500	3,200	3,000
41c3-12	Bowman-Spring Branch 1/	22,100	490	490	1,500	300	200	0
41c3-13	Buckley 1/	25,300	1,050	1,050	3,200	0	0	0
41c3-14	Rose Creek 3/	82,300	8,000	8,000	13,000	4,000	400	0
41c3-15	Fairbury Tribs.	93,000	9,150	850	30,000	12,000	1,000	0
41c3-16	Little Blue (Hollenberg)	4,600	0	0	250	0	0	0
	TOTAL	1,722,200	110,150	83,730	295,650	27,300	41,700	25,500

1/ Watersheds approved for installation of structural measures.
2/ Area included with 41c3-10.
3/ Balls Branch is a tributary of Rose Creek.

Monetary damages from gully erosion have been estimated for only the area needing project action. Since this area is by definition the drainage area contributing to the problem area, the actual area subject to damage is less than the total area needing project action. It is estimated that 4,180 acres, mostly Class IV land, will be damaged by voiding and depreciation in a 50-year period, averaging some 83 acres per year. The current average annual damage from this loss is estimated to be $37,530. Of this total, $33,730 is land damage, $1,840 is other agricultural damage, and the remaining $1,960 is nonagricultural damage. Table IV-3 lists the current gully erosion damage necessitating project action for each delineated watershed.

Gully Erosion Damages Land

B. 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. Differences in climate and precipitation have a lesser effect than do the differences in land use, soil and topographic characteristics. It is estimated that slightly over 110,000 acres in the basin are subject to flooding. This area is located on the floodplains and in upland depressional and flatland areas. A general location of the area subject to damage is shown in Figure IV-2.

U.S. DEPARTMENT OF AGRICULTURE

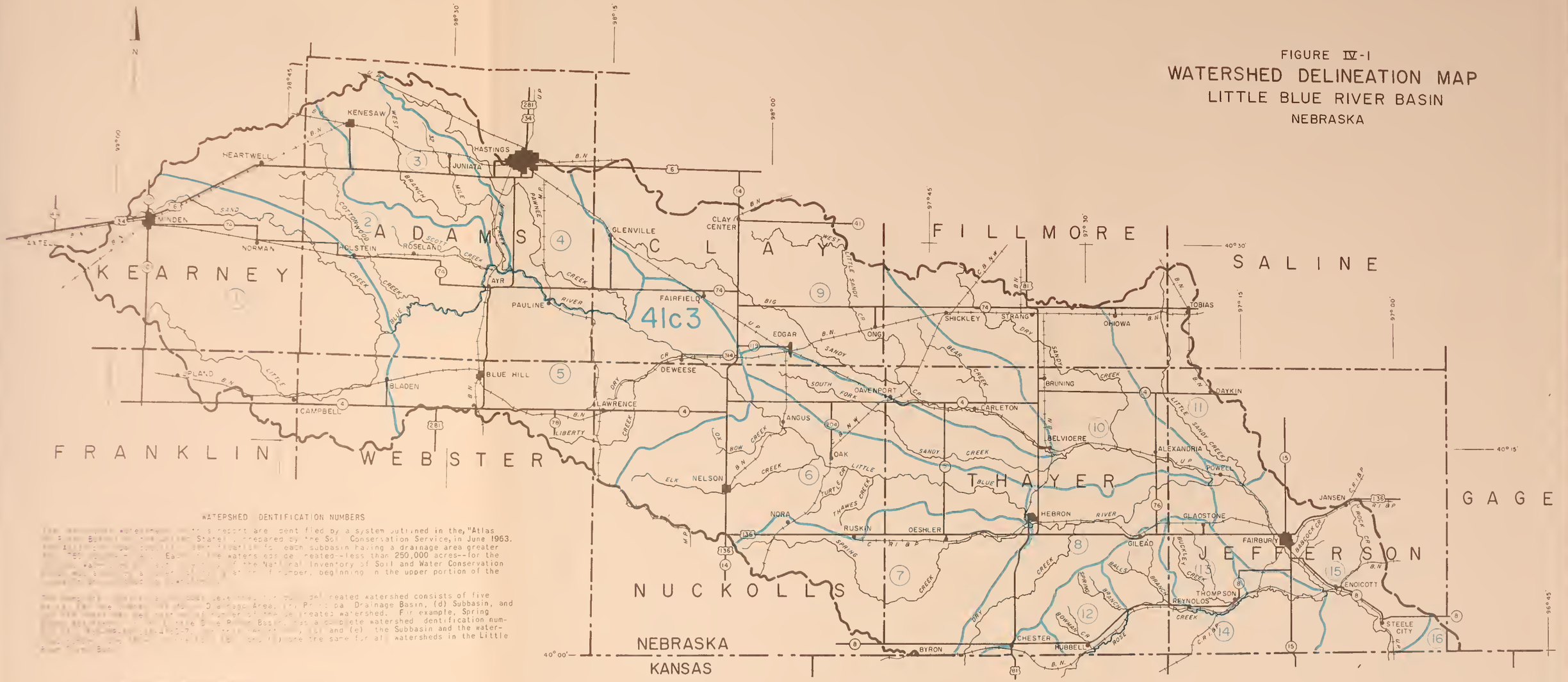
SOIL CONSERVATION SERVICE

FIGURE IV-1

WATERSHED DELINEATION MAP

LITTLE BLUE RIVER BASIN

NEBRASKA



WATERSHED IDENTIFICATION NUMBERS

[illegible] is a report area identified by a system outlined in the, "Atlas [illegible] State", prepared by the Soil Conservation Service, in June 1963. [illegible] for each subbasin having a drainage area greater [illegible] Each of the waters established--less than 250,000 acres--for the [illegible] of the National Inventory of Soil and Water Conservation [illegible] number, beginning in the upper portion of the [illegible]

[illegible] watershed consists of five [illegible] Drainage Area, (c) Principal Drainage Basin, (d) Subbasin, and [illegible] of the delineated watershed. For example, Spring [illegible] Basin, has a complete watershed identification number [illegible], (c) and (e) the Subbasin and the watershed [illegible] (b) and (d) are the same for all watersheds in the Little [illegible]

[illegible]	Name	Drainage Area (Acres)
[illegible]	[illegible]	233,100
[illegible]	[illegible]	98,800
[illegible]	[illegible]	67,100
[illegible]	[illegible]	80,700
[illegible]	[illegible]	199,500
[illegible]	[illegible]	44,300
[illegible]	[illegible]	5,200
[illegible]	[illegible]	89,900
[illegible]	[illegible]	212,300
[illegible]	[illegible]	135,700
[illegible]	[illegible]	67,300
[illegible]	[illegible]	22,100
[illegible]	[illegible]	25,300
[illegible]	[illegible]	82,300
[illegible]	[illegible]	93,000
[illegible]	[illegible]	4,600

LEGEND

41c3 SUBBASIN IDENTIFICATION NUMBER (ATLAS OF RIVER BASINS, JUNE 1963)

WATERSHED AREAS OF LESS THAN 250,000 ACRES

(2) WATERSHED NUMBER WITHIN SUBBASIN

SCALE 1/500,000

SCALE 5 0 5 10 15 20 MILES

NEBRASKA

HENDERSON MERCATOR PROJECTION

REV. 2-1-73

5,S-28050

U. S. DEPARTMENT OF AGRICULTURE

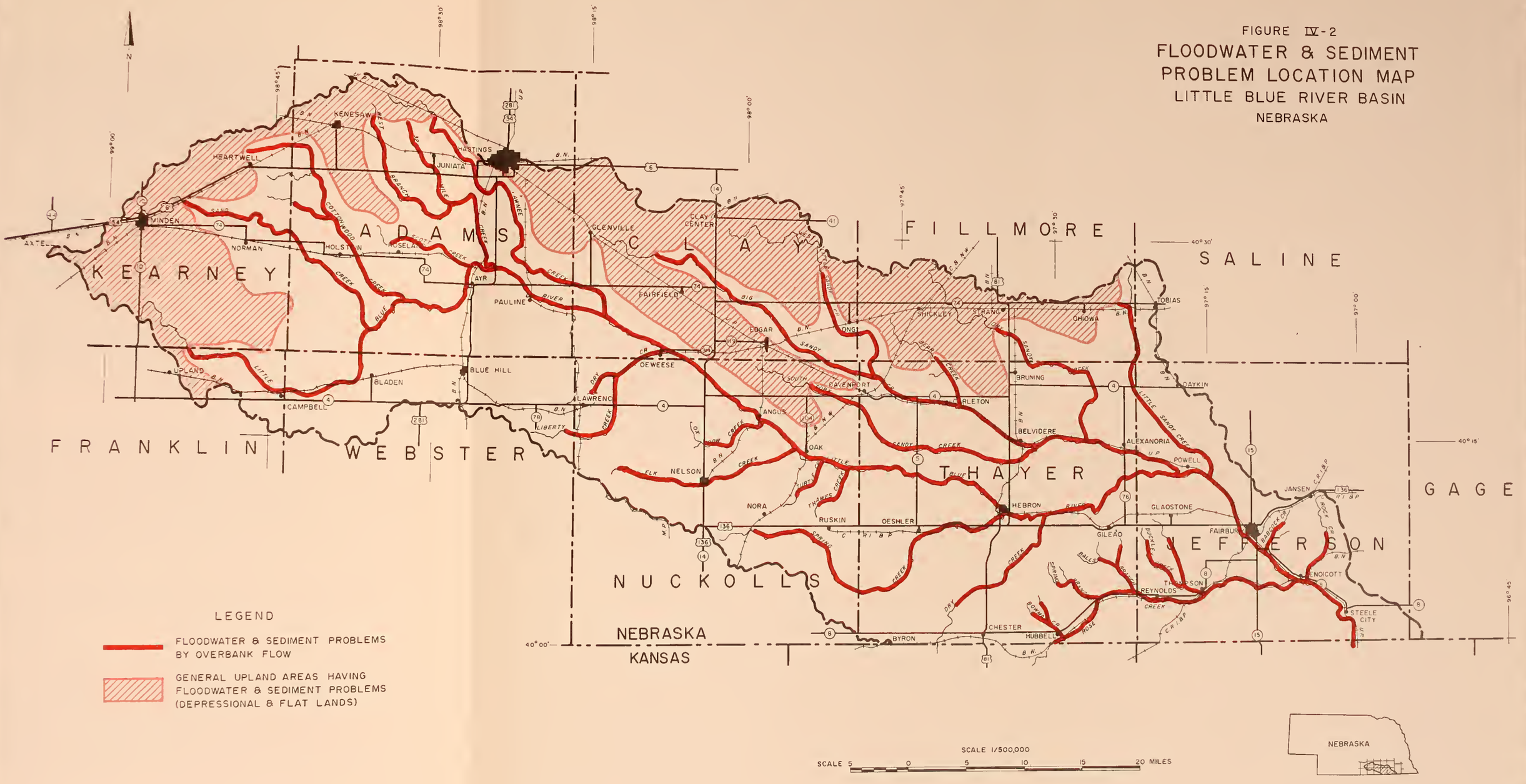
SOIL CONSERVATION SERVICE

FIGURE IV-2

FLOODWATER & SEDIMENT PROBLEM LOCATION MAP

LITTLE BLUE RIVER BASIN

NEBRASKA



LEGEND

FLOODWATER & SEDIMENT PROBLEMS BY OVERBANK FLOW

GENERAL UPLAND AREAS HAVING FLOODWATER & SEDIMENT PROBLEMS (DEPRESSIONAL & FLAT LANDS)

SCALE 1/500,000

SCALE 5 0 5 10 15 20 MILES

TRANSVERSE MERCATOR PROJECTION

3-20-70

5,S-28049

Table IV-3.—SUMMARY OF CURRENT GULLY EROSION DAMAGES NEEDING PROJECT ACTION, LITTLE BLUE RIVER BASIN, NEBRASKA 1/

Delineated Watershed Identification		Drainage Area	Area Needing Project Action	Area Subject To Damage: 50-Year Period	Area Subject To Damage: Average Annual	Average Annual Damage Under Current Economic Development: Agricultural Land	Agricultural Other	Non-Agri.	Total Direct
Number	Name	(Acres)				(Dollars)			
41c3- 1	Little Blue (Upper)	233,100	0	0	0	0	0	0	0
41c3- 2	Cottonwood-Scott Crs.	98,800	0	0	0	0	0	0	0
41c3- 3	Thirty-Two Mile Creek	67,100	0	0	0	0	0	0	0
41c3- 4	Pawnee Creek	80,700	0	0	0	0	0	0	0
41c3- 5	ACNW Tribs.	199,500	0	0	0	0	0	0	0
41c3- 6	Angus-Hebron Tribs.	144,300	0	0	0	0	0	0	0
41c3- 7	Spring Creek	115,200	9,000	360	7	3,810	130	250	4,190
41c3- 8	Dry (Thayer)	80,900	0	0	0	0	0	0	0
41c3- 9	Big Sandy (Upper)	212,300	0	0	0	0	0	0	0
41c3-10	Big Sandy (Lower)	195,700	500	150	3	1,020	60	60	1,140
41c3-11	Little Sandy	67,300	1,500	390	8	3,180	190	190	3,560
41c3-12	Bowman-Spring Branch	22,100	300	70	1	570	30	30	630
41c3-13	Buckley	25,300	0	0	0	0	0	0	0
41c3-14	Rose Creek	82,300	4,000	960	19	6,860	410	410	7,680
41c3-15	Fairbury Tribs.	93,000	12,000	2,250	45	18,290	1,020	1,020	20,330
41c3-16	Little Blue (Hollenberg)	4,600	0	0	0	0	0	0	0
	TOTAL	1,722,200	27,300	4,180	83	33,730	1,840	1,960	37,530

1/ Adjusted normalized prices were used for all watersheds.

Sediment deposition on cultivated floodplains in some areas causes loss of crops with moderate to severe limitations for future crop use. Generally this sediment comes from erosion of agricultural land. Another source is from sand and gravel pumping operations. The deposition of sediment lowers the capacity of reservoirs to store water planned for other purposes. Excessive deposition of sediment also forms levees along streambanks and subsequently disrupts the functioning and maintenance of natural 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 roads and 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.

Road and Bridge Flooding

32 Mile Creek 1968

Urban Flooding

Fairbury 1960

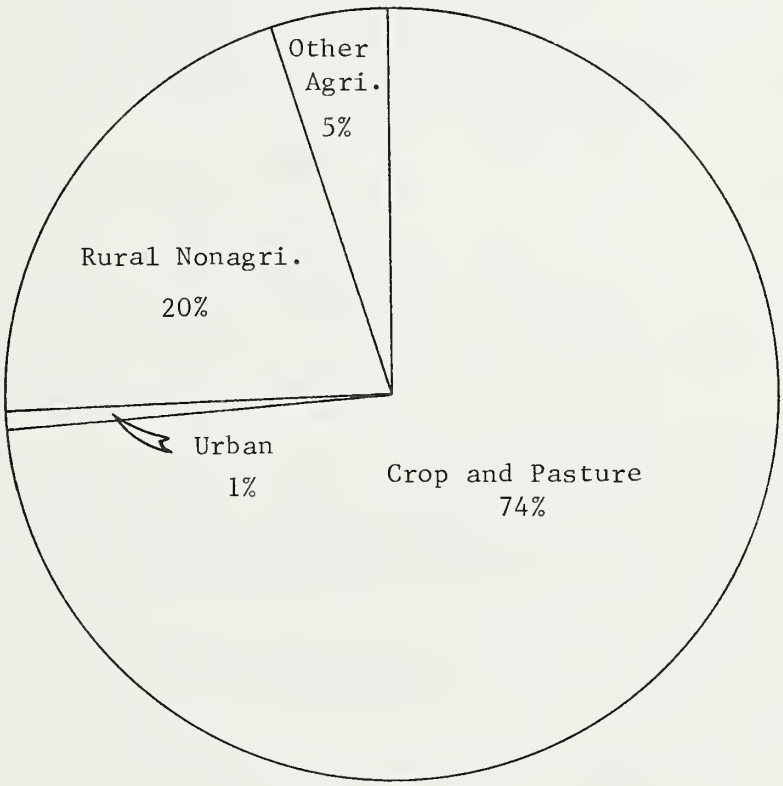
Losses occur in urban areas as a result of inundation of, and sediment and debris damage to, homes, public buildings, utilities and commercial and industrial businesses located on the floodplain. Some urban floodwater damage is also caused by storm water disposal systems which have inadequate capacity.

The flooding hazard is often increased as a result of growth of 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 lodges at bridges, causing increased bridge damage and increased flood stages. Currently an additional source of dead trees and snags are trees lost to the Dutch Elm disease.

Monetary damages were not estimated for all areas subject to flooding. It was assumed that the floodplain area along the main stem of the Little Blue River, below the proposed Angus Reservoir, was beyond the scope of this study. Hence, this area is not included in the 83,730 acres in need of upstream project action. It is estimated that 31,750 acres of this upstream damage area is in upland depressional

and flatland areas. The remaining 51,980 acres are located on the floodplains along tributary streams. The current average annual damages for the upstream area is estimated to be $594,000. Of this total, $401,400 occurs on the upstream floodplains and $192,600 on the upland depressional areas. Crop and pasture damages are estimated to be $438,600 and other agricultural damages $29,400. Rural nonagricultural damages are $122,300; urban damages are estimated at $3,600. The percentage distribution of damages is shown in Figure IV-3. Table IV-4 lists the current residual damage for each delineated watershed.

Figure IV-3.—AVERAGE ANNUAL FLOODWATER AND SEDIMENT DAMAGE
LITTLE BLUE RIVER BASIN, NEBRASKA



In addition to the direct damages, there are other losses which stem from flooding even though the area or property may not have been flooded. Examples include interruptions to travel and 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-4.—SUMMARY OF CURRENT RESIDUAL FLOODWATER AND SEDIMENT DAMAGES BY WATERSHEDS 1/
LITTLE BLUE RIVER BASIN, NEBRASKA

Delineated Watershed Identification		Drainage Area	Location	Area Needing Project Action 2/	Floodwater and Sediment - Average Annual Damage Under Current Economic Development				
Number	Name				Crop and Pasture	Other Agri.	Rural Non-Ag.	Urban	Total Direct
		(Acres)		(Acres)	(Dollars)				
41c3- 1	Little Blue (Upper)	233,100		7,200	35,500	2,000	11,200	0	48,700
			(Upland)	(4,000)	(21,100)	(400)	(1,500)	0	(23,000)
			(Floodplain)	(3,200)	(14,400)	(1,600)	(9,700)	0	(25,700)
41c3- 2	Cottonwood-Scott Crs.	98,800		3,050	11,600	1,200	6,000	0	18,800
			(Upland)	(1,000)	(4,660)	(100)	(400)	0	(5,160)
			(Floodplain)	(2,050)	(6,940)	(1,100)	(5,600)	0	(13,640)
41c3- 3	Thirty-Two Mile Cr. 3/	67,100	Floodplain	2,810	8,600	1,500	23,000	0	33,100
41c3- 4	Pawnee Creek	80,700		3,950	23,300	1,800	5,600	0	30,700
			(Upland)	(1,000)	(6,200)	(200)	(500)	0	(6,900)
			(Floodplain)	(2,950)	(17,100)	(1,600)	(5,100)	0	(23,800)
41c3- 5	ACNW Tribs.	199,500		13,150	77,410	6,970	21,700	1,000	107,080
			(Upland)	(1,000)	(6,760)	(120)	(200)	0	(7,080)
			(Floodplain)	(12,150)	(70,650)	(6,850)	(21,500)	(1,000)	(100,000)
41c3- 6	Angus-Hebron Tribs.	144,300	Floodplain	500	1,750	330	3,200	0	5,280
41c3- 7	Spring Creek	115,200	Floodplain	3,450	14,860	1,640	7,700	100	24,300
41c3- 8	Dry (Thayer)	80,900	Floodplain	2,600	6,760	330	2,000	0	9,090
41c3- 9	Big Sandy (Upper)	212,300	Data Included With 41c3-10						
41c3-10	Big Sandy (Lower)	195,700		30,180	150,910	3,960	14,300	0	169,170
			(Upland)	(21,750)	(124,900)	(1,480)	(4,500)	0	(130,880)
			(Floodplain)	(8,430)	(26,010)	(2,480)	(9,800)	0	(38,290)
41c3-11	Little Sandy	67,300		6,450	40,400	2,500	7,100	0	50,000
			(Upland)	(3,000)	(18,200)	(400)	(1,000)	0	(19,600)
			(Floodplain)	(3,450)	(22,200)	(2,100)	(6,100)	0	(30,400)
41c3-12	Bowman-Spring Branch 3/	22,100	Floodplain	490	4,600	400	2,000	0	7,000
41c3-13	Buckley 3/	25,300	Floodplain	1,050	4,500	800	200	0	5,500
41c3-14	Rose Creek	82,300	Floodplain	8,000	53,330	5,450	16,800	2,500	78,080
41c3-15	Fairbury Tribs.	93,000	Floodplain	850	5,120	550	1,500	0	7,170
41c3-16	Little Blue (Hollenburg)	4,600		0	0	0	0	0	0
	TOTAL	1,722,200		83,730	438,640	29,430	122,300	3,600	593,970
			(Upland)	(31,750)	(181,820)	(2,700)	(8,100)	0	(192,620)
			(Floodplain)	(51,980)	(256,820)	(26,730)	(114,200)	(3,600)	(401,350)

1/ Only remaining damages listed for watersheds approved for installation of structural measures.
2/ Does not include main stem area below proposed Angus Peservoir.
3/ Watersheds approved for installation of structural measures.

Price Base: Long-term projected prices current at the time of planning were used for the watershed projects approved for installation. Adjusted normalized prices were used for the remainder of the watersheds.

C. Impaired Drainage

An analysis of the Conservation Needs Inventory shows that over 41,700 acres, or about two percent of the basin, are designated as having excess water for agricultural production. Approximately 33 percent of this area is currently in cropland with 52 percent in pasture and range. The remaining area is in forest and other lands.

A major portion of the problem area is located on the flat uplands and shallow depressions where the existing surface drainage outlets are inadequate to remove runoff from precipitation and irrigation waste water in time to prevent damage to crops. This problem is magnified when precipitation falls on recently irrigated fields that are still at or near field moisture capacity. Excess water on the surface or in the root zone has a detrimental effect on agricultural production. Crops normally grown in the area are subjected to delayed plantings, additional farming operations, and untimely harvests which reduce yields, lower quality, and increase production costs. In many cases, if the impaired drainage conditions are not corrected, crops must be limited to those species tolerant to wetness conditions.

In addition to the upland drainage problem there are areas on the floodplains of the Little Blue River and its tributaries having an excess water problem. Heavy 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.

D. Water Shortages

The basin is primarily dependent on rainfall for its supply of water. Frequent periods of drought occur which result in reduced supplies of water. When moisture deficiencies are greatly below normal some water-dependent functions may severely suffer.

Agricultural crops are often affected by periods of low rainfall during the growing season. Unless supplemental water is provided reduction in yield results. Loss of income occurs to the landowner and the community. Current investment costs in producing food and fiber are relatively insensitive to local moisture conditions.

The livestock industry is directly related to crop production. Much of the grain fed to the livestock in the basin is grown by the feeders on nearby fields. Low crop yields adversely affect the feed supply and may often result in reduced feeding operations. Where surface water is the principal source of supply for livestock, drought periods produce critical situations which may force either development of ground water for supply, hauling or piping of water, or relocation of pasture and feeding operations. Presently, one-fourth of the range and pasture lands have inadequate water supplies to meet efficient spacing, quantity, and quality criteria.

Municipal, industrial and rural domestic water supply functions are not as severely influenced as agriculture in periods of below normal precipitation. Since these functions depend almost entirely on

ground water, water shortages are limited to very short durations when capacities of distribution systems are inadequate. The vast ground water reservoirs tend to delay the adverse affect of low recharge years.

Periods of low rainfall and streamflow have a most damaging effect on the basin's fish and wildlife population and propagation since they rely solely on surface water. The limited water-based recreation activities are also curtailed due to a resultant decline in the quantity and quality of water available.

E. Range and Forest

An average of about 50 range and forest fires occur each year in the basin, burning an average of about 5,000 acres. Fires destroy the ground cover of litter and humus; kill young trees and shrubs; and damage, but rarely kill large pole and sawtimber trees. 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 retardation in tree growth; the reduction in timber quality; and the reduction in resistance of trees to disease and insect infestation.

One of the greatest damages to trees and woodlands has been caused by livestock. Grazing and use of the woodlands for shade and shelter of livestock is practiced in much of the woodlands. 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 retard erosion and reduce peak runoff.

Insects and diseases cause losses in timber production through reduction in growth, lower quality, deformities, rot and death of trees. The occurrence of the Dutch Elm disease is killing most of the American elm. The loss of these trees leaves a 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, they 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.

Nebraska Extension Forestry

Forest Area Invaded by Seedlings

F. Pollution

The major sources of pollution are from agricultural lands and associated livestock enterprises; and from municipalities and industrial plants. When measured volumetrically, the major agricultural pollutant in the basin is sediment. Land treatment is inadequate on much of the land in the basin. As a result, excessive runoff and erosion continue. Sediment from erosion causes such harmful effects as the clogging of stream channels, the destruction of fish and wildlife habitat and the reduction of recreational value of surface waters. Runoff from agricultural areas may transport residues of agricultural chemical from the soil. These residues are from herbicides and pesticides which may adversely affect the biota of the receiving streams.

Generally, streams have been historically used to carry away wastes. When adequate amounts of surface water are available for dilution of wastes, problems of stream pollution are minor. In the Little Blue River Basin surface water quality problems due to pollutants are generally local in scope. One important reason that surface water quality is not a major problem is the great dependence of the basin on ground water sources for water.

Forty-four incorporated communities in the Little Blue River Basin are included in this waste treatment study (not including Hastings which discharges its waste into the Big Blue River). Thirty-three of the 44 communities have municipal sewage treatment facilities, out of which 15 (serving 8,821 people) do not presently provide adequate treatment of sewage. The 15 communities, by population class, which do not meet present standards of the Nebraska Environmental Control Council are: (1) Blue Hill and Hebron (in the 1,000-2,500 class); (2) Clay Center, Edgar, Kenesaw and Nelson (in the 500-1,000 class); (3) Bruning, Fairfield, Glenville, Juniata, Lawrence and Shickley (in the 250-500 class); (4) Roseland and Ruskin (in the 100-250 class); and (5) Deweese (in the under 100 class).

Eleven out of the 44 incorporated villages do not presently have public sewage treatment facilities. The seven of these 11 communities with a total population of 929 people which need new public treatment systems are Belvidere, Heartwell, Oak, Reynolds, Steele City and Nora. The other four incorporated communities can meet their treatment needs by private disposal systems. There are at least five unincorporated communities which can meet their treatment needs by private systems. 8/

Feedlots Near Water Courses are Sources of Pollution

8/ From Interim Plan for Water Quality Management in the Little Blue River Basin (April 1972 - Adjusted to December 1972).

Livestock fattening in feedlots has increased greatly in recent years. Also, there is some increase in confined feeding operations (feeding in minimum space situation under roof and probably in a building with at least partially controlled environment). Paralleling the increase of livestock feeding has been the increased efficiency of commercial fertilizers for crops which has reduced the economic value of manure for fertilizer.

Current studies indicate that the quantity of sediment produced by the confined feeding of livestock is largely a function of area of feedlots rather than the numbers of livestock. The runoff from a sloping feedlot one-acre in size lacking runoff controls will produce a quantity of sediment roughly equivalent to that from an acre of cropland which lacks conservation treatment. Carrying the analogy further, at a density of 100 steers per acre, the sediment production from that area of feedlot is roughly equivalent to that from an acre of untreated cropland. However, the runoff and sediment from feedlots has a greater pollutional effect than from cropland because of the higher coliform count and the higher biological oxygen demand (BOD).

Not enough research has been done to permit much general quantification of pollution from confined feeding of livestock. Many variable factors, such as location of feedlots relative to water courses, management practices of individual operators, slope and soil characteristics make quantification difficult.

Odors from the evaporation of liquid wastes and the anerobic decomposition of liquid and solid waste is disagreeable to residents living in proximity to feedlots. In addition, airborne ammonia from evaporation of liquid wastes contributes nitrogen to nearby bodies of water, thus accelerating the eutrophication of these waters.

In the past a somewhat common practice has also been to locate feeding operations near water courses in order to facilitate waste disposal. One damaging effect of feedlots (without treatment facilities) in close proximity to streams is to "slug" local reaches during times of large runoff and fish kills can result in localized stream reaches.

In 1957, the Nebraska legislature passed the Water Pollution Control Act, the general purpose of which was to reduce and control the pollution of waters of the state. Under the act, a state Water Pollution Control Council was created, the duties of which were to administer the Control Act. An important duty of this Council was to inventory agricultural and related wastes. On March of 1968, the Council adopted a regulation requiring that feedlots in certain categories of size and location be registered.

A total of over 83,000 beef-animal equivalent units (B.E. units) (A beef-animal equivalent is the BOD demand in the fecal production of a 1,000 pound beef animal.) were inventoried in the basin. 9/ Of this number, 5,000 or six percent are located within 500 feet and 30,000 or 36 percent are located within one-half mile of a watercourse or stream. Over 47,000 B.E. units or 57 percent are being fed within 500 feet of water supply wells. Over 54,000 B.E. units or over 65 percent are fed in feedlots which have no waste treatment facilities (Table IV-5).

Table IV-5.--FEEDLOT DATA REFLECTING DISTANCE FROM STREAMS AND WELLS AND EXISTENCE OF TREATMENT FACILITIES 1/
LITTLE BLUE BASIN, NEBRASKA

Distance To A Watercourse Or Stream	Percent of Total	Number of Animal Units and Distance From Water Supply Well					Total	Waste Treatment Facility	
		100	101-500	501-1,000	1,001-2,680	2,681-5,280		With	Without
	(Beef Animal Equivalents)								
Within 500'	6	2,800	2,100	0	100	0	5,000	500	4,500
500' to ¼ mi.	9	4,600	1,900	1,000	100	0	7,600	2,200	5,400
¼ mi. to ½ mi.	21	9,800	4,900	1,900	800	0	17,400	9,000	8,400
½ mi. to 1 mi.	6	2,200	2,100	700	0	0	5,000	900	4,100
Over 1 mile	58	28,000	14,000	2,600	700	3,000	48,300	15,900	32,400
TOTAL	100	47,400	25,000	6,200	1,700	3,000	83,300	28,500	54,800
Percent of Total		57	30	7	2	4	100	33	67

1/ From a mid-1969 inventory of feedlots registered by the Nebraska Water Pollution Control Council.

G. Water Table Fluctuations

Problems caused by a declining water table consist primarily of well redevelopment and increased costs of pumping. In the area of the general decline (Figure II-11) lifts have increased up to approximately 10 percent. By contrast, the rising water table in the western tip of the basin has decreased lifts by as much as 20 percent. Direct monetary investments or savings from water table fluctuations occur, but quantification is difficult.

9/ Inventory of Feedlots Registered, a study by the Nebraska Water Pollution Control Council, (1969).

These fluctuations have only incidental adverse effects on all water-using functions except irrigation. Any water-using function withdrawing ground water at a rate much higher than the recharge rate will experience an increase in operating costs from increasing pumping lifts.

H. Impairment of Natural Beauty

The natural beauty of the Little Blue Basin is agriculturally oriented. The basin lacks any large or spectacular scenic attractions which will attract tourists from outside the basin. The rolling terrain has valleys lined with trees and sloping hillsides covered with intermittent areas of pasture and cropland. In summer, the basin has fields of wheat, corn and milo that are attractive to people, especially those closely associated with agriculture.

The attractiveness and beauty of the basin are often impaired by the forces of man and nature. Periods of drought diminish or destroy much of the beauty of the vegetative cover. Although there has been significiant progress in the application of conservation treatment measures and management of the agricultural land in the basin, much remains to be done. An excessive amount of sheet and gully erosion occurs that reduces productivity and scars the landscape. Soil erosion from misused or inadequately treated areas results in excessive sedimentation of streams and rivers and increases the turbidity of streams, ponds and lakes. This contributes to lowered aesthetic values by impairing the natural beauty of the area. Over-bank flooding caused by high intensity rain storms, common to the basin, causes permanent damages to agricultural land and facilities and reduces the aesthetic and environmental value of the area.

Relatively small areas, especially in the upper part of the basin, are marshy or wetlands. The wetland areas which present problems are the marginally wet areas which are excessively wet during part of the year and are dry part of the year. Such areas are often under cultivation and are thus neither completely suited for agricultural production nor for wildlife areas.

Some channel alignment has been done in the past. Channelization, while it alleviates flooding in some areas, results in vertical banks, sluffing of banks and destruction of fishing habitat. Also the degradation of main stream channels results in overfalls in tributary channels and increases gullying.

Shelterbelts, after a number of years, tend to develop into scrubby growth areas. Certain species of trees in the belts die out to be replaced by less desirable species. Often times, the deposition of snow in the shelterbelts causes limb breakage.

Much of the natural woodland has been managed with the objective of maximizing grazing, rather than to improve the production or use of the forest resources. This has reduced or impaired the beauty associated with the forest environment. Currently, the scourge of the Dutch elm disease is killing, or has killed many native American elm trees. The bare and bleached limbs of the dead trees mar the landscape and impair the beauty of the forested areas.

The disposal of solid waste such as old car bodies, worn-out machinery, tin cans and bottles has resulted in unsightly dump grounds in or near urban and rural communities and along main highways and county roads. Many junkyards and auto graveyards are not adequately screened with trees, shrubs or fences or are not adequately maintained. Many abandoned farmsteads, buildings and other manifestations of our past impair the natural beauty of the basin.

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

The application of measures that provide protection and management, including all types of conservation treatment and practices, is a basic need in the conservation, development and utilization of land and water resources. Protection and management measures are needed for crop, pasture and forest lands throughout the basin. Land should be treated according to its needs and used in accordance with its capabilities. Structural measures will be required to protect lands subject to flooding, dispose of excess water from agricultural lands, reduce erosion and provide storage for water supplies and other beneficial uses. Application of nonstructural measures are needed to limit or reduce future flood damages.

A. Land Treatment

There is need to provide adequate conservation treatment to about 60 percent or 983,600 acres of the 1,640,000 acres of agricultural land in the basin to reduce soil losses to acceptable limits. Mechanical and vegetative practices -- such as contour farming, terraces and waterways; the establishment of permanent vegetation on critical sediment producing areas; forestry practices such as thinning, weeding and planting understocked stands with desirable species; management of crop residue to provide protection of the surface from wind and water; and the maintenance or improvement of soil fertility -- are needed to provide adequate land treatment.

Currently, some 656,000 acres of agricultural land in the basin are adequately treated. Of the remaining 60 percent still needing treatment, 496,200 acres have been classed as needing management, vegetative and mechanical practices, with the remaining 487,400 acres needing only management type practices.

Presently, there are 1,211,800 acres of cropland in the basin. About 47 percent or about 570,000 acres are considered to be adequately treated. Sixteen percent or 188,600 acres need only proper management in order to be adequately treated. Thirty-seven percent or about 453,000 acres need more intensive land treatment, including management, vegetative and mechanical practices.

Out of 941,800 acres of nonirrigated cropland about 43 percent or 409,000 acres are adequately treated. About 384,000 acres or 41 percent of the nonirrigated cropland require intensive conservation

A Conservation Cropping System Conserves Soil

treatment to reduce soil losses to acceptable limits. Mechanical practices such as grassed waterways, terraces and diversions are needed to provide the intensive treatment necessary. In addition, about 149,000 acres or 16 percent of the nonirrigated cropland need only proper management practices such as proper management of crop residues and conservation cropping systems.

Of the current normal 270,000 acres of irrigated cropland 60 percent or about 162,000 acres is adequately treated. About 69,000 acres or 25 percent of the irrigated land needs vegetative and mechanical practices in order to provide adequate treatment, including land leveling, land smoothing and improved irrigation systems. About 39,000 acres needs only proper management, including management of residues, maintenance of fertility lands and improved irrigation water application.

There are 376,500 acres of pasture in the basin, constituting about 23 percent of the agricultural land. Only 17 percent or about

A Native Pasture in Excellent Condition

66,000 acres are adequately treated. Seventy-six percent or about 285,000 acres need proper management only. Seven percent or about 25,000 acres need more intensive vegetative and mechanical practices.

Only about 19,600 acres of forest and woodland are in the basin, which is a little over one percent of the total agricultural land. Only 12 percent or 2,400 acres are adequately treated. About 13,300 acres or around 68 percent need proper management, with an additional 3,900 acres needing both management and vegetative and/or mechanical practices (see Table V-1).

In addition to the needed land treatment, land needs to be used in accordance with its capabilities. Over 7,000 acres of Class I land and 69,000 acres of Class II land are presently devoted to pasture and could be converted to cropland. Over 52,000 acres of Class VI land is being cropped, and this land should be converted to pasture and range.

Table V-1.--CONSERVATION TREATMENT OF AGRICULTURAL LAND
LITTLE BLUE RIVER BASIN, NEBRASKA 1/

Item	Total	Land Adequately Treated		Land Needing Treatment: Proper Management Practices Only		Land Needing Treatment: Proper Management & Vegetative and/or Mechanical Practices	
	Acres (000)	Acres (000)	Percent	Acres (000)	Percent	Acres (000)	Percent
Cropland							
Nonirrigated	941.8	408.5	43	149.2	16	384.1	41
Irrigated	270.0	161.7	60	39.4	15	68.9	25
Total Cropland	(1,211.8)	(570.2)	(47)	(188.6)	(16)	(453.0)	(37)
Pasture & Range	376.5	65.6	17	285.5	76	25.4	7
Forest Land	19.6	2.4	12	13.3	68	3.9	20
Other Ag. Land	32.2	18.3	57	-	-	13.9	43
TOTAL	1,640.1	656.5	40	487.4	30	496.2	30

1/ Nebraska Conservation Needs Inventory, 1967, USDA.

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 1980, 2000 and 2020. In this study damages were determined for the 83,730 acres of upstream area needing project action. This does not include the main stem of the Little Blue River below the proposed Angus Reservoir.

The current average annual flood damage for the upstream area is estimated to be $593,970. Under projected economic development this damage is expected to increase to $921,450 by 1980, $1,286,200 by 2000 and $1,700,050 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 floodplain land use regulation before project type structural measures are applied. Structural solutions to flood problems include floodwater-retarding structures, channel

Table V-2.--SUMMARY OF CURRENT AND PROJECTED RESIDUAL FLOODWATER AND SEDIMENT DAMAGES BY WATERSHEDS 1/
LITTLE BLUE RIVER BASIN, NEBRASKA

Delineated Watershed Identification		Drainage Area	Location	Area Needing Project Action 2/	Average Annual Damage			
					Current Flood Damages	Under Projected Economic Development		
Number	Name					1980	2000	2020
		(Acres)		(Acres)	(Dollars)			
41c3- 1	Little Blue (Upper)	233,100		7,200	48,700	74,470	103,800	137,660
			(Upland)	(4,000)	(23,000)	(33,350)	(46,230)	(62,100)
			(Floodplain)	(3,200)	(25,700)	(41,120)	(57,570)	(75,560)
41c3- 2	Cottonwood-Scott Crs.	98,000		3,050	18,800	29,300	40,920	54,030
			(Upland)	(1,000)	(5,160)	(7,480)	(10,370)	(13,930)
			(Floodplain)	(2,050)	(13,640)	(21,820)	(30,550)	(40,100)
41c3- 3	Thirty-Two Mile Cr. 3/	67,100	Floodplain	2,810	33,100	52,960	74,140	97,310
41c3- 4	Pawnee Creek	80,700		3,950	30,700	48,080	67,180	88,600
			(Upland)	(1,000)	(6,900)	(10,000)	(13,870)	(18,630)
			(Floodplain)	(2,950)	(23,800)	(38,080)	(53,310)	(69,970)
41c3- 5	ACNW Tribs.	199,500		13,150	107,080	170,270	238,230	313,120
			(Upland)	(1,000)	(7,080)	(10,270)	(14,230)	(19,120)
			(Floodplain)	(12,150)	(100,000)	(160,000)	(224,000)	(294,000)
41c3- 6	Angus-Hebron Tribs.	144,300	Floodplain	500	5,280	8,450	11,830	15,520
41c3- 7	Spring Creek	115,200	Floodplain	3,450	24,300	38,880	54,430	71,440
41c3- 8	Dry (Thayer)	80,900	Floodplain	2,600	9,090	14,540	20,360	26,720
41c3- 9	Big Sandy (Upper)	212,300	Data Included With 41c3-10					
41c3-10	Big Sandy (Lower)	195,700		30,180	169,170	251,040	348,850	465,960
			(Upland)	(21,750)	(130,880)	(189,770)	(263,070)	(353,380)
			(Floodplain)	(8,430)	(38,290)	(61,270)	(85,780)	(112,580)
41c3-11	Little Sandy	67,300		6,450	50,000	77,060	107,500	142,300
			(Upland)	(3,000)	(19,600)	(28,420)	(39,400)	(52,920)
			(Floodplain)	(3,450)	(30,400)	(48,640)	(68,100)	(89,380)
41c3-12	Bowman-Spring Branch 3/	22,100	Floodplain	490	7,000	11,200	15,680	20,580
41c3-13	Buckley 3/	25,300	Floodplain	1,050	5,500	8,800	12,320	16,170
41c3-14	Rose Creek	82,300	Floodplain	8,000	78,080	124,930	174,900	229,560
41c3-15	Fairbury Tribs.	93,000	Floodplain	850	7,170	11,470	16,060	21,080
41c3-16	Little Blue (Hollenberg)	4,600		0	0	0	0	0
	TOTAL	1,722,200		83,730	593,970	921,450	1,286,200	1,700,050
			(Upland)	(31,750)	(192,620)	(279,290)	(387,170)	(520,080)
			(Floodplain)	(51,980)	(401,350)	(642,160)	(899,030)	(1,179,970)

1/ Only remaining damages listed for watersheds approved for installation of structural measures.
2/ Does not include main stem area below proposed Angus Reservoir and damages.
3/ Watersheds approved for installation of structural measures.

Price Base: Long-term projected prices current at the time of planning were used for the watershed projects approved for installation. Adjusted normalized prices were used for the remainder of the watersheds.

modifications and 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.

Reservoir control of 40 to 60 percent of the total drainage area is usually the minimum needed for effective reduction of flood damages. Under watershed project-type development, minimum floodwater storage

capacity for a 25-year frequency runoff event without operation of the emergency spillway was provided. Reservoir storage was also provided for at least 50 years accumulation of sediment.

Channel modifications, levees and dikes are needed where adequate reservoir sites are not available or where reservoirs alone will not provide an adequate level of protection. Channel capacity sufficient to contain at least a two-year frequency runoff is usually provided. In some situations flow characteristics of streams can be improved by channel realignment and by the removal of constricting log jams, debris and trees. In some flatland areas where there is little potential for reservoir sites, excavated channels need to be designed to remove the excess water from excessive precipitation events within a time that will hold crop and pasture damage to an acceptable minimum. Care must be exercised to preserve beauty of the basin which includes mitigation for areas damaged. These multiple purpose channels will also convey irrigation waste water.

Application of nonstructural measures (in lieu of and/or in addition to land treatment and structural measures) is needed to reduce future flood damage increases. Review of historical flood data indicates that total flood damages continue to increase, even though flood control measures have been implemented. Nonstructural measures that could be used to reduce future flood damages include: land management, flood forecasting, emergency floodfighting, floodway regulation, floodplain planning and zoning and flood-proofing of buildings. The applicability and implementation of managerial programs in lieu of structural measures will be subject to legal and institutional arrangements. Flood insurance is desirable. Although it will not reduce flood damages, it provides a means of spreading the cost of flood losses and achieving better regulation of floodplain land use.

C. Gully and Streambank Stabilization

There is need for a wide variety of gully stabilization measures on the 296,000 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 269,000 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 27,300 acres needing project

Grade Stabilization Structure at Head of Gully

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 $37,530. This damage is projected to increase to $55,910 in 1980, $79,570 by 2000 and $115,210 by 2020. A detailed evaluation for each watershed is shown in Table V-3.

About ten 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.

Table V-3.—SUMMARY OF CURRENT AND PROJECTED GULLY EROSION DAMAGES NEEDING PROJECT ACTION, LITTLE BLUE RIVER BASIN, NEBRASKA 1/

Delineated Watershed Identification		Drainage Area	Area Needing Project Action	Average Annual Damage			
				Current Gully Damages	Under Projected Economic Development		
Number	Name				1980	2000	2020
		(Acres)		(Dollars)			
41c3- 1	Little Blue (Upper)	233,100	0	0	---	---	---
41c3- 2	Cottonwood-Scott Crs.	98,800	0	0	---	---	---
41c3- 3	Thirty-Two Mile Creek	67,100	0	0	---	---	---
41c3- 4	Pawnee Creek	80,700	0	0	---	---	---
41c3- 5	ACNW Tribs.	199,500	0	0	---	---	---
41c3- 6	Angus-Hebron Tribs.	144,300	0	0	---	---	---
41c3- 7	Spring Creek	115,200	9,000	4,190	6,240	8,880	12,860
41c3- 8	Dry (Thayer)	80,900	0	0	---	---	---
41c3- 9	Big Sandy (Upper)	212,300	0	0	---	---	---
41c3-10	Big Sandy (Lower)	195,700	500	1,140	1,700	2,420	3,500
41c3-11	Little Sandy	67,300	1,500	3,560	5,300	7,550	10,930
41c3-12	Bowman-Spring Branch	22,100	300	630	940	1,340	1,930
41c3-13	Buckley	25,300	0	0	---	---	---
41c3-14	Rose Creek	82,300	4,000	7,680	11,440	16,280	23,580
41c3-15	Fairbury Tribs.	93,000	12,000	20,330	30,290	43,100	62,410
41c3-16	Little Blue (Hollenberg)	4,600	0	0	---	---	---
	TOTAL	1,722,200	27,300	37,530	55,910	79,570	115,210

1/ Adjusted normalized prices were used for all watersheds.

Generally, agricultural land in land capability classes IIw, IIIw and some IVw soils are feasible to treat. There are presently 68,300 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 41,700 acres having impaired drainage problems, 25,500 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

Drought is a deterrent to a sustained high level of agricultural production. Therefore, a need exists for irrigation development to stabilize production for the individual landowner.

Considerable amounts of land have been developed for irrigation, all of which is private development. The major source of water is ground water but some developments use surface water from the Little Blue River and its major tributaries.

The irrigation development in this area is dependent on the availability of suitable land having an adequate water supply. An estimated one million acres in the basin have soils suitable for irrigation. About 270,000 acres are presently irrigated, and over 700,000 more acres could be irrigated if adequate water supplies were available. Many areas in the basin do not have adequate water supplies for irrigation so future developments must be limited to areas having both suitable land and an adequate water supply.

It is anticipated that future irrigation development will utilize both ground water and surface water supplies. Generally, irrigation is accomplished either by private means or by major project-type developments. Usually ground water supplies are used in conjunction with private development and surface water supplies are used in project development. The planning of major public irrigation projects is not the responsibility of the USDA and therefore the projections of future needs in this report pertain only to private irrigation development. It is estimated that approximately 375,000 acres of private irrigation development will be installed by 2020.

It is important that irrigation water be applied efficiently in order to reduce environmental pollution through runoff or deep percolation of irrigated water. Irrigators need to become better informed on operation of irrigation systems to obtain optimum efficiency in water use and to prevent damages both within the systems and to areas downstream. To obtain efficient irrigation, land should be properly prepared as needed to meet the needs of the specific method of water application to be used. In addition, improved irrigation water management techniques should be used, including timing, application rate and gross amount applied. The Nebraska Irrigation Guide and State Standards and Specifications provide information that can be used to meet these goals.

Field efficiency, the ratio of the quantity of water effectively put into the crop root zone and utilized by growing crops to the quantity delivered to the field, varies considerably throughout the basin. These variations are caused by many different factors, including the capability of the soils irrigated and the degree of conservation treatment or management.

Of the present 270,000 acres of irrigation, approximately 60 percent or 162,000 acres has had adequate land preparation and satisfactory water management is being practiced. The field efficiency of the land properly treated is about 61 percent with the range varying from 65 percent on Class I land to a low of 55 percent on Class IV land (Table V-4). The remaining 108,000 acres and any new development need proper land forming to obtain proper gradients, length of run and provision for reuse of waste water.

Table V-4.—CURRENT FIELD EFFICIENCY OF IRRIGATED LAND
BY LAND CLASS
LITTLE BLUE BASIN, NEBRASKA

Land Class	Total		Adequately Treated		Residual Needs			
					Proper Mgmt Only		Mgmt,Veg,&/or Mech	
	1,000 Ac.	Field Eff. Percent	1,000 Ac.	Field Eff. Percent	1,000 Ac.	Field Eff. Percent	1,000 Ac.	Field Eff. Percent
I	73	58	36	65	25	55	12	45
II	158	56	118	60	13	50	27	40
III	28	43	4	60	0	50	24	40
IV	11	46	4	55	1	45	6	40
Total	270	(55)	162	(61)	39	(53)	69	(41)

The field efficiency of the 39,000 acres needing proper management practices only is about 53 percent. The 69,000 acres that need proper management practices plus intensive practices, such as land forming, improved systems and the like, are being irrigated with a field efficiency of about 41 percent. As a whole, it is estimated that the field efficiency amounts to about 55 percent at the present time.

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 need. The present consumption requirements were estimated using livestock numbers of January 1, 1966. Consumption rates used were 30 gallons per day (gpd) for milk cows, 12 gpd for beef cattle and calves, four gpd for hogs, 1.8 gpd for sheep and 0.06 gpd for chickens. The current daily requirement for the basin was estimated to be 4.3 million gallons per day (4,800 acre feet per year).

Ground water is the most important source of livestock water in the basin. Currently, about 85 percent of the 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 widespread availability of ground water has helped to stabilize the livestock industry in the basin.

However, even in areas with adequate ground water supplies, some of the livestock water requirements are met from surface sources. Ground water developments require a well and pump with some source of power such as a windmill. 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 construct livestock ponds or rely on rivers and streams to furnish the remaining 15 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. These losses are sizable in comparison to consumptive use and need to be included to obtain the total livestock water requirement. The current annual evaporation loss of 3,100 acre feet was determined by a study of pond numbers and surface areas.

Erosion Control and Livestock Water Supply by Structure

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

4,800 acre feet to 13,790 acre feet by 2020. It is expected that ground water will continue to be the principal source of livestock water and will furnish most of the additional requirements.

In estimating the future evaporation losses, it was assumed that effective livestock pond numbers would 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 have a more dependable supply for both the existing and a-ditional livestock water requirements. Since the new livestock ponds will have a greater total surface area, the projected evaporation losses will increase from the existing 3,100 acre feet to 4,900 acre feet by 2020.

Total livestock water requirements, including both consumption and stockwater pond evaporation are estimated to increase from the current 7,900 acre feet to 18,690 acre feet by 2020. A detailed analysis for all time periods is shown in Table V-5.

Table V-5.--LIVESTOCK WATER REQUIREMENTS 1/
LITTLE BLUE RIVER BASIN, NEBRASKA

Item	Current 2/	1980	2000	2020
Water Consumption				
Annual Use-Ac.Ft.	4,800	7,100	9,870	13,790
Ground Water (85%)	(4,100)	(6,000)	(8,370)	(11,700)
Surface Water (15%)	(700)	(1,100)	(1,500)	(2,090)
Evaporation				
Livestock Ponds-No.	1,800	-	-	-
Surface Area-Acres	1,440	1,630	1,950	2,280
Annual Use-Ac.Ft.	3,100	3,500	4,200	4,900
Total Water Requirement				
Annual Use-Ac.Ft.	7,900	10,600	14,070	18,690

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

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 1980, 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 requirement for the urban area was estimated to be 4,590 acre feet. The projected increase in population and the projected increased water use rate will increase this requirement to 6,050 acre feet by 2020. The 1970 requirement for the rural nonfarm population grouping was estimated to be 2,370 acre feet with the 2020 requirement 2,240 acre feet. In this basin the increased use rate is offset by the projected decreasing population. A slight increase is projected in the rural farm requirements from 780 acre feet in 1970 to 790 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 7,740 acre feet in 1970 to 9,080 acre feet by 2020. Table V-6 shows these requirements for all projection periods for each population grouping.

Table V-6.—ESTIMATED 1970 AND PROJECTED MUNICIPAL, INDUSTRIAL AND RURAL DOMESTIC WATER SUPPLY REQUIREMENTS LITTLE BLUE RIVER BASIN, NEBRASKA

Item	1970	1980	2000	2020
Urban 1/				
Population	25,600	26,000	28,000	30,000
Rate/Capita (gpcd)	170	185	195	200
Ac.Ft./Yr.	4,880	5,390	6,120	6,730
Rural Nonfarm				
Population	17,200	17,000	16,000	15,000
Rate/Capita (gpcd)	105	110	115	120
Ac.Ft./Yr.	2,020	2,100	2,060	2,020
Rural Farm				
Population	12,700	10,700	9,550	8,400
Rate/Capita (gpcd)	50	60	70	80
Ac.Ft./Yr.	710	710	740	750
Subtotal				
Population	55,500	53,700	53,550	53,400
Ac.Ft./Yr.	7,610	8,200	8,920	9,500
Industrial 2/				
Ac.Ft./Yr.	1,410	2,130	2,960	3,400
TOTAL				
Ac.Ft./Yr.	9,020	10,330	11,880	12,900

1/ Includes the part of Hastings in Little Blue River Basin.
2/ From Nebraska State Water Plan.

Water requirements for industrial use not supplied by municipal systems was estimated to be 1,410 acre feet in 1960 and is projected to increase to 3,400 acre feet by 2020. This use added to the municipal and rural domestic requirements gives a combined 1970 estimated use of 9,510 acre feet. The total requirement will increase to 10,260 acre feet in 1980, 11,640 acre feet by 2000 and 12,480 acre feet by 2020.

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 45 incorporated cities and villages in the basin, 34 presently have an adequate water system. One village needs to improve its existing system and nine of the ten communities not having a public water supply need new systems. The remaining village does not have a large enough population to justify a public water supply. Details of the existing municipal water supply needs are shown in Table V-7.

Table V-7.—MUNICIPAL WATER SUPPLY NEEDS, 1970
LITTLE BLUE RIVER BASIN, NEBRASKA

Category	System Adequate		Improved Existing System		New System Needed		No System Needed	
	Places	Pop. 1/	Places	Pop. 1/	Places	Pop. 1/	Places	Pop. 1/
Incorporated Communities								
Over 2,500 2/	3	25,619						
1,000-2,500	2	2,868						
500-1,000	5	4,070						
250-500	9	3,653	1	315				
100-250	14	2,431			4	556		
Under 100	1	83			5	288	1	17
TOTAL	34	38,724	1	315	9	844	1	17

1/ Preliminary 1970 census data.
2/ Includes part of Hastings (17,685) located in the Little Blue River Basin.

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 individual pressure systems of adequate quantity and quality. Sufficient water is available to develop individual systems for those not presently

having pressurized water systems. Currently, there is little need for rural water systems in this basin due to the large supply of ground water.

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 some cases rural water systems may be a needed alternative.

H. Recreation, Fish and Wildlife

Present and future demand for recreation and fish and wildlife 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 total population for this area has already been presented in Chapter III of this report. The population affecting the recreation demand for 1970 was 75,000. This population is projected to increase to 77,000 by 1980 and 104,000 by 2020.

Private Recreation Development

In projecting future outdoor recreation demand, factors other than population must also be considered. The shift in population from rural to urban and the expected increase in latent demand as people become more aware of the opportunities for recreation will increase future demands. An example is the projected increase in water skiing which indicates that the projected increase in demand is greater than just the population effect.

The "Comprehensive Plan for Outdoor Recreation" by the Nebraska Game, Forestation and Park Commission was used to determine the activities that should be considered in this basin. The data shown in Table V-8 for 1960 and 1980 is from the Commission's report.

Table V-8.—1960 AND PROJECTED RECREATIONAL DEMAND
LITTLE BLUE RIVER BASIN, NEBRASKA

Activities	1960 1/	1980 1/	2000 1/	2020 2/
	(Thousand Activity Days)			
Swimming	286			
Boating	88			
Water Skiing	12			
Subtotal	(386)	(585)	(743)	(862)
Driving & Sightseeing	476			
Walking for Pleasure	220			
Picnicking	131			
Bicycling	132			
Nature Walks	48			
Camping	26			
Horseback Riding	37			
Subtotal	(1,070)	(1,479)	(1,818)	(2,064)
Ice Skating	62			
Sledding	16			
Subtotal	(78)	(179)	(258)	(317)
Playing Outdoor Games	267			
Viewing Outdoor Sports	102			
Attending Outdoor Concerts	15			
Subtotal	(384)	(577)	(630)	(745)
Fishing	335	369	396	416
Hunting	146	161	172	180
Total Activity Days	2,399	3,350	4,017	4,584

1/ From Nebraska Game, Forestation and Parks Commission, Dec. 1966.
2/ Projections by River Basin Survey Staff.

The projection of recreation demands are expressed by the number of activity-days required to supply recreationists with appropriate opportunities. These activity-day projections are then converted to visitor days from the assumption that on the average, 2.5 activities occur for each daily visit to a recreational area.

The estimated demand in 1960 was about 2,399 thousand activity-days, with the amounts projected to increase to 4,584 thousand activity-days by 2020. Table V-8 lists the activities considered and the projections for 1980, 2000 and 2020.

The 1960 demand for hunting was 146,018 activity-days. A moderate increase in hunting demand is anticipated in the future. The diversity of hunting and the fact that most of it will be on private lands makes unrealistic any suggested acre figure 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.

The demand for fishing was 335,249 activity-days in 1960 and is projected to increase to 369,000, 396,000 and 416,000 activity-days respectively for the target years of 1980, 2000 and 2020.

Data contained in the Nebraska Outdoor Recreation Plan were used to indicate current supply, demand and unmet demands of the basin. The Hastings socio-economic area was selected to be typical of the Little Blue Basin, the population being similar with much of the area in each being common to both. It is projected that 114 acres of developed land is needed to supply the unmet demands for camping and picnicking. Some 2,632 surface acres of water are needed to supply the unmet demands for boating and skiing (Table V-9).

Table V-9.--CURRENT SUPPLY, DEMANDS AND UNMET DEMANDS
HASTINGS SOCIO-ECONOMIC AREA, NEBRASKA

Item	Current Capacity or Supply	Current Demands	Unmet Demand
Fishing (Fisherman Days)	51,465	242,239	190,594
Boating & Water Skiing Waters (Surface Acres)	102	2,734	2,632
Swimming Beaches (Acres)	0	3	3
Trails (Miles)	0	18	18
Ice Skating (Acres)	17	19	2
Camping (Developed Acres)	11	86	75
Picnicking (Developed Acres)	83	122	39

Source: Nebraska Comprehensive Outdoor Recreation Plan.

Projected needs of land and water can be supplied by surface acres of water and by acres of developed and undeveloped lands. In 1980 the projected need for water is 12,900 acres of surface water; the projected need for developed land is 150 acres; and the projected need for total recreational land is 1,500 acres (Table V-10).

Table V-10.--PROJECTED NEED FOR LAND AND WATER AREAS FOR SPECIFIED RECREATION ACTIVITIES HASTINGS SOCIO-ECONOMIC AREA, NEBRASKA

Year	Total Land	Developed Land	Total Water
		(Thousand Acres)	
1980	1.5	0.15	12.9
2000	2.8	0.28	19.5
2020	3.4	0.34	22.1

Source: Nebraska Comprehensive Outdoor Recreation Plan (1966).

I. Water Quality Control

Ground water quality is generally good throughout the basin. In the southeastern portion, glacial deposits underlie the loess soils and deep wells tap the Dakota sandstones. Water from this formation tends to be highly mineralized or "hard". Chemical analysis of this area's ground water classifies it as at least permissible for drinking water. The remainder of the basin area has ample supplies of "desirable" drinking water.

Future demands on ground water as drinking water are expected to be generally met from sources within the basin boundaries. The quality of this water is expected to be comparable to current quality.

The confined feeding of livestock is projected to increase substantially with a resultant increase in feedlot wastes. An increase in conservation practices such as diversion terraces, catch basins and manure management are needed to reduce feedlot runoff which will reduce sediment and organic waste discharge into streams.

Irrigation return flows will tend to increase as irrigation increases. Proper water management practices are needed to hold return flows to a minimum. The degree of pollution that comes from the use

of fertilizers, insecticides and herbicides has not been accurately determined. However, proper use of fertilizers, insecticides and herbicides is needed to reduce the pollution potential from them.

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. 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.

The other major sources of stream pollution in this basin are municipal and industrial. 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. There is need to reduce the quantities of nitrates and phosphates that enter surface waters and result in over-enrichment of water.

Forty-four incorporated communities have been studied relative to the sewage disposal systems. Of these 44 communities 33 presently provide and 11 do not provide municipal treatment facilities. Of the 33 providing municipal treatment, 15 need improvement and are Blue Hill, Hebron, Clay Center, Edgar, Kenesaw, Nelson, Bruning, Fairfield, Glenville, Juniata, Lawrence, Shickley, Roseland, Ruskin and Deweese. Of the 11 which do not provide municipal facilities, seven need to build new municipal plants and include Belvidere, Heartwell, Oak, Ohiowa, Reynolds, Steele City and Nora.

Individual waste treatment facilities will adequately meet the needs in the remaining eight communities. A grouping of the municipal sewage treatment needs is shown for all of the incorporated communities in the basin in Table V-11.

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 individual 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 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,

Table V-11.—MUNICIPAL SEWAGE TREATMENT NEEDS, 1970
LITTLE BLUE RIVER BASIN, NEBRASKA

Category	System Adequate		Improve System		New System		No System	
	Places	Pop. 1/	Places	Pop. 1/	Places	Pop. 1/	Places	Pop. 1/
Incorporated Communities								
Over 2,500 2/	2	7,934						
1,000-2,500			2	2,868				
500-1,000	1	937	4	3,133				
250-500	4	1,626	6	2,342				
100-250	10	1,776	2	392	6	886		
Under 100	1	83	1	86	1	43	4	272
TOTAL	18	12,356	15	8,821	7	929	4	272

1/ Preliminary 1970 census data.
2/ Does not include Hastings.

industries such as sand and gravel processors, brick and tile manufactures 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 dog food often need to provide their own waste treatment systems in order that municipal systems not be overtaxed. There also is need to provide temporary measures to areas under construction such as industries and residential sites, highways and county roads that will control the erosion during the period there is no vegetative cover.

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 a 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 action 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. Guidance is provided for maintaining the measures and practices after they have been applied.

Over 4,500 landowners or operators of over 1,000,000 acres of land in the basin are cooperators with local soil and water conservation districts. About 3,000 conservation plans have been prepared on 700,000 acres.

Nearly 800,000 acres of land have adequate land treatment measures applied. Cumulative land treatment in the

basin includes (1) over 6,000 miles of terraces, (2) nearly 11,000 acres of grassed waterways and outlets for terrace systems, (3) about 12,000 grade stabilization structures control gullying, (4) the seeding of over 60,000 acres of range seeding, (5) nearly 25,000 acres of pasture and hayland planting, (6) the conversion of 46,000 acres of cropland to grassland, and (7) the conversion of nearly 600 acres of cropland to woodland.

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 designing to reduce water pollution, and is now actively involved with urban construction to reduce on-site erosion. Through the Resource Conservation and Development Projects the SCS is involved in resource conservation.

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 and landscape; flood hazard; and in improved design of highways, parks, and housing. Detailed soil surveys have been completed on approximately 1,200,000 acres in the basin.

Small Watershed Program - PL-566

The SCS has the leadership for Department of Agriculture activities under the Watershed Protection and Flood Prevention Act. The SCS works with local organizations that sponsor watershed projects and with individual landusers in the project area. Federal assistance includes helping in the preparation of a watershed work plan, the design and supervision of construction of the proposed measures, and 100 percent cost-share of construction costs. This may include measures for flood prevention, watershed protection, irrigation, drainage, water supply, public recreation areas, fish and wildlife habitat, and land treatment.

Three small watershed projects under construction are Thirty-Two Mile Creek - 67,100 acres; Bowman-Spring Branch -

22,100 acres; and Buckley - 25,300 acres. The total structural program in these projects includes 20 floodwater retarding structures, controlling some 53,400 acres of drainage area and having a total capacity of 2,650 acre feet. In addition, one mile of channel improvement is planned. These measures will provide flood protection for 4,350 acres of floodplain. The total installation cost of all planned structural measures amounts to $1,316,000. These projects will result in an average annual primary benefit of some $90,200, at an average cost of $55,300 annually.

An application for planning was submitted for the Balls Branch Watershed. The Nebraska Soil and Water Conservation Commission Planning Staff prepared a Preliminary Investigation Report and presented alternate plans to the local sponsors for their consideration. None of the alternative plans were acceptable to the local people and planning has been suspended.

Great Plains Conservation Program: PL-84-1021

The Great Plains Conservation Program, administered through the Soil Conservation Service, provides landowners the opportunity to plan conservation over a long period of time and to schedule and install permanent land treatment practices on their entire farm units. Through this Great Plains Program, the federal government also provides cost-sharing assistance in the application of approved practices. Adams, Clay, Franklin, Kearney, Nuckolls, Thayer and Webster Counties are the counties in the basin having the Great Plains Program at this time. Nearly 500 Great Plains contracts have been signed with 145,000 acres under contract.

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. Develop the land and water resources for agriculture, municipal or industrial use.

2. Provide land and water information to other planning agencies for agricultural and nonagricultural uses.

3. Carry out conservation measures for watershed protection and flood prevention.

4. Accelerate soil surveys.

5. Reduce pollution of air and water.

6. Speed up conservation work on individual farms, ranches and other private holdings.

7. Make needed adjustments in land use.

8. Improve or expand recreational facilities.

9. Promote historical and scenic attractions.

10. Encourage existing industries to expand and new ones to locate in areas in order to create jobs.

11. Train or retrain residents in needed job skills.

12. Encourage construction of needed community facilities such as hospitals, roads and sewer 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:

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

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

3. The Watershed Protection and Flood Prevention Act, PL-83-566 provides for application of watershed protection and erosion control treatment measures on forest lands.

4. The Cooperative Forest Management Act of 1950, 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.

5. Section 2 of the Clark-McNary Act of 1924 provides authority for cooperative fire control. Under this act, the states 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.

These cooperative programs are well established and represent continuing progress in the basin. For example, during 1971: (1) 50,000 trees were distributed for planting on small woodland areas; (2) 100 landowners received forest management assistance involving 2,000 acres; (3) assistance was given in planning and implementing the forest improvement and fire control phases on three PL-566 small watersheds totaling 105,000 acres; (4) technical assistance was provided in harvesting and marketing forest products to 125 landowners; and (5) assistance was given in organizing and equipping 24 fire control districts.

The Forest Service cooperates in the Rural and Environmental Assistance Program with the Agricultural Stabilization and Conservation Service, and gives technical assistance in forestry measures to private landowners, following the usual policy of working through the State Forester.

The Forest Service does research in tree improvement by means of genetics, tree selection and breeding, tree windbreak management, tree diseases, and works cooperatively in tree planting and shelterbelt research with the State Experiment Stations.

3. Agricultural Stabilization and Conservation Service

The Agricultural Stabilization and Conservation Service, through their Rural Environmental Assistance Program, provides cost-sharing to landowners and operators for carrying out conservation practices on farm and range land that is in agricultural production. This includes practices contributing to conservation and development of soil, water, plant, wildlife, and other resources as well as those effective in reducing or controlling sediment, chemical, and animal waste pollutants. The cost-sharing program is available to individual farmers and ranchers as well as to groups of landowners who have common problems too large or complex to be handled individually. The program also provides cost-sharing for installing emergency conservation practices needed as a result of a natural disaster. The Soil Conservation Service is responsible for most technical phases of the program.

The Agricultural Stabilization and Conservation Service administers the USDA Agriculture Farm Program, relating to agriculture production control. It administers specified commodity and related land use programs designed for voluntary production adjustment, resource protection, and also administers price, market, and farm income stabilization programs.

During the period of 1966 through 1970, nearly 2,800 farms in the basin participated in the agricultural conservation program at least one time. Over 600 farms participated in calendar year 1970. Other assistance provided during 1970 included the following:

$206,000 cost-shares paid
5,800 acres in cropland adjustment program
1,500 acres of establishment of permanent cover
230 agricultural water reservoirs
480 storage bins

4. Farmers Home Administration

The Farmers Home Administration makes loans to eligible individual farmers, rural residents, and to groups of farmers and rural communities for water development and soil conservation. These loans are for the purposes of developing water supply systems for domestic, livestock and irrigation use, and for carrying out soil conservation practices. Each loan is scheduled for repayment in accordance with the borrowers ability to repay over a period not exceeding 40 years.

Loans are also made to local organizations to help finance projects and develop land and water resources in watersheds planned under authority of Public Law 566. Eligible local organizations include soil conservation districts, irrigation districts, drainage districts, and similar organizations which have authority under state law to construct, maintain, and operate works of improvement. These watershed loans are repayable over periods up to 50 years.

Grants are available for comprehensive area-wide water and sewer planning; loans and grants are available for water and sewer systems; loans are available for grazing associations; and loans and grants are available for solid waste disposal.

5. 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 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.

A tabulation for the 11 counties, portions of which make up the Little Blue Basin, shows the following conservation activities: (1) 534 people in personal consultation; (2) 30 public meetings which involved 296 in

attendance; (3) 601 4-H Club members with conservation projects; and (4) 24 releases to various news media.

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 finding better ways of storing, saving, transporting and using water. It continually carries on research both on the physical requirements for, and the physical effects of soil and water conservation. The research program in oriented primarily to the needs of farmers and conservationists for scientific determination of the effectiveness and feasibility of conservation practices. A few examples of the many studies being made are: water management, including requirements and consumptive use of agricultural crops; sediment yield and delivery rates; conservation cropping systems and residue management; and the hydraulic characteristics of surface methods of irrigation.

B. Little Blue Natural Resource District

The application of conservation practices to the land by individual landowners and operators is the largest single activity in the develop-

ment 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 Soil and Water Conservation Districts were incorporated into the Little Blue Natural Resource District.

The boundaries of the Little Blue Natural Resource District generally parallel the hydrologic boundaries of the Little Blue River Basin. In accordance with a memorandum of understanding, the Soil Conservation Service provides technical and planning assistance to individual farmers, and groups of farmers in applying conservation practices to accomplish proper land use and management.

C. Reservoirs and Local Protection Projects

The only authorized local flood protection project in the basin is the 5.4 mile levee and appurtenant structures installed by the Corps of Engineers around low-lying areas in the city of Fairbury, where the municipal power-plant and waterworks, the city park, a grade school, four business concerns and some 170 residences are subject to flooding from the Little Blue River.

The Corps of Engineers recently completed a Floodplain Information Report for the city of Fairbury. This report makes specific information on floods and potential flood hazards readily available to state and local governments and other interested agencies and citizens for their use in planning and regulating the use of the floodplains.

No major flood control reservoirs are located in the basin. A feasibility report has been completed by the Bureau of Reclamation for the proposed Angus Reservoir on the Little Blue River. The project is presently under consideration for authorization.

D. Irrigation Development

To date there are no existing project-type irrigation developments in the basin. However, an irrigation district has been organized and is working with the Bureau of Reclamation to seek authorization for the proposed Angus Reservoir project.

All existing irrigation in the basin has been privately developed. The current normal acreage is estimated to be 270,000 acres. Nearly all of the water used for irrigation comes from ground water supplies.

However, over 320 surface water right claims are on record with the Nebraska Department of Water Resources. There are nearly 4,000 irrigation wells located in the basin. Over 140,000 acres are under irrigation water management, with nearly 130,000 acres of land leveling for irrigation having been completed.

E. Drainage Improvement

Numerous small drainage developments have been installed by landowners to reduce crop and pasture damages on flatland and depressional areas. In many cases, the installed practices have provided adequate protection while in others only partial drainage has been accomplished. In some situations the installed practices are adequate for normal precipitation events but are totally inadequate for the larger storms.

F. Recreation, Fish and Wildlife

There are a number of existing recreation and fish and wildlife developments in the basin. These developments are owned by federal, state and local entities of government. Many private owners also provide recreational facilities. This is especially true of hunting where the supply is primarily supplied by the private sector.

At the present time, about 3,900 acres of rainwater basins have been acquired by the Bureau of Sport Fisheries and Wildlife under the Wetlands Loan Act. This acreage, which is federally managed for the purpose of waterfowl production, is located in 14 lagoon areas in Clay, Fillmore and Kearney Counties. These areas range from 35 to 670 acres in size and are open to public hunting except when posted.

The State of Nebraska owns 543 acres of land and water in three recreational developments. These developments are the Alexandria, Crystal Lake and Smartweed Marsh State Recreational Areas (SRA). These areas contain 467 acres of land and 76 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 three state owned areas.

Other recreational lands include 461 acres owned or administered by municipalities, which consist primarily of parks and playgrounds. Eight municipalities have public swimming pools. Rock Creek Site three miles northeast of Endicott, the site of a Pony Express station along the Oregon Trail, is now mostly owned by the State Game Commission.

Nebraska Game and Parks Commission

Alexandria Lake - State Recreation Area

Table VI-1.—CLASSIFICATION OF STATE OWNED RECREATIONAL LANDS
LITTLE BLUE RIVER BASIN, NEBRASKA

Areas	Class 1/			Type		
	I	II	III	Land	Wetland	Water
	(Acres)					
Alexandria SRA		95	345	394		46
Crystal Lake SRA		63		33		30
Smartweed Marsh SRA			40	6	34	
Total Acres		158	385	433	34	76

1/ Class I Areas -- High Density Recreation.
Class II Areas -- General Outdoor Recreation.
Class III Areas -- Natural Environment.

Nearly 800 acres of cropland have been coverted to wildlife-recreation uses. Also, about 2,700 acres of farmstead and feedlot windbreaks and nearly 600,000 feet of field windbreaks have been established which could be used for the above purposes.

In addition to the developed recreation areas the three small watershed projects under construction -- Buckley Creek, Bowman Spring Creek and Thirty-Two Mile Creek -- will provide some incidental recreation use. These three watersheds will have an aggregate sediment pool surface area of 730 acres. There are an estimated 2,200 farm ponds with an estimated surface area of 1,600 acres which also provide incidental recreation, fishing and hunting benefits. Also in Thirty-Two Mile Creek an alternative plan has been presented to the people which consists of a multiple purpose structure having 96 acres in a recreation pool and a minimum of 388 acres of land for development.

G. Rural and Urban Electrification

The major portion of the wholesale electrical energy requirements needed in the Little Blue River Basin is produced by the Nebraska Public Power District (NPPD). About 50 percent of the power requirements of the eastern two-thirds of Nebraska is generated by the NPPD by six steam plants, 14 hydro plants and six internal combustion plants within the state. A sizable portion of the remaining balance of needed power requirements is supplied to a grid system under contract from the U.S. Bureau of Reclamation.

Nebraska is unique in that it has the only overall Public Power System in the nation. "Public power" in Nebraska means that rural electric systems and municipal systems are publicly owned. The major public power generation and transmission systems in Nebraska are financed by the sale of revenue bonds which are retired on a regular schedule from earnings. In Nebraska, except for three Cooperative Membership Associations, all rural electric systems are political subdivisions of the state, the directors being elected by public ballot. The directors of the three cooperative member corporations on the otherhand are elected by vote of the membership.

Electrical power to rural areas, including the farms and many small towns, is supplied by four rural electric systems. These local retail systems purchase their power directly from the Nebraska Public Power District, or through Nebraska G&T which acts as purchasing agents for several rural electric systems.

Some towns have their own generating plants which serve as the main source of their power, or as emergency standby equipment. For example, Fairbury, Hastings and Minden own generation plants as well as their own distribution systems. Fairbury has a hydro-generating plant as well as a steam plant. Most of the incorporated towns buy power from the Nebraska Public Power District and distribute the power through their own systems.

The power picture in the Little Blue Basin is typical of that of the state. In 1934 only 7.1 percent of Nebraska's farms had electric service. By 1969 98.3 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 lines, the replacement of substations, and the finding of new sources of power.

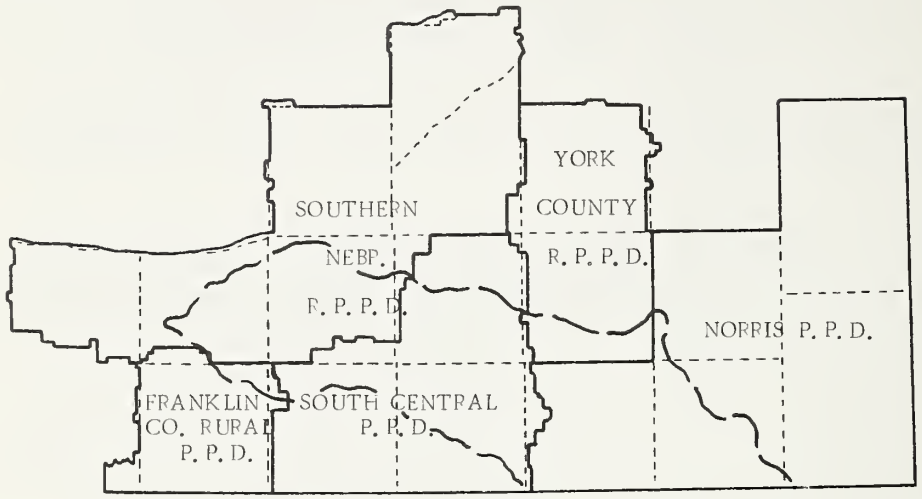
It is estimated that funds, necessary to meet the increaseing power demands, will be double the amount of REA loan funds that have been used in the entire 30-year history of the REA.

The rural distribution systems, of which there are 36 in Nebraska (Figure VI-1) were 100 percent financed by the borrowing of funds from the Rural Electrification Administration. Supplemental financing is now available through the National Rural Utilities Cooperative Financing Corporation. The present supplemental financing can be 90 percent REA (federal) funds and 10 percent private funds. It appears that the federal financing will gradually phase out, and Congress is being asked to enable the use of private investment funds to permit needed expansion of rural power distribution.

H. Municipal and Rural Domestic Water Supply Developments

Thirty-five of the 45 incorporated communities in the basin are supplied by a public water system. The 1970 census shows that there are 39,039 people living in these communities, some 25,619 of which are located in the three cities with populations greater than 2,500. The remaining 13,420 residents live in 32 incorporated rural communities under 2,500 in population. The remaining ten communities, with a total of 861 inhabitants, have individual water systems. Living in rural households are 15,600 people 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

Figure VI-1.--RURAL ELECTRIC SYSTEMS
LITTLE BLUE RIVER BASIN



households. A grouping of the existing water supply developments, using 1970 population data, is shown in Table VI-2.

Table VI-2.--MUNICIPAL & RURAL DOMESTIC WATER SUPPLY DEVELOPMENTS, 1970, LITTLE BLUE RIVER BASIN, NEBRASKA

Category	Public Water Systems		Individual Water Systems		Total	
	Places	Pop.1/	Places	Pop.1/	Places	Pop.1/
Incorporated Communities						
Over 2,500 2/	3	25,619			3	25,619
1,000-2,500	2	2,868			2	2,868
500-1,000	5	4,070			5	4,070
250-500	10	3,968			10	3,968
100-250	14	2,431	4	566	18	2,987
Under 100	1	83	6	305	7	388
Subtotal	(35)	(39,039)	(10)	(861)	(45)	(39,900)
Rural 3/ Households				15,600		15,600
TOTAL	35	39,039	10	16,461	45	55,500

1/ Preliminary 1970 census data.

2/ Includes part of Hastings (17,685) located in the Little Blue River Basin.

3/ Includes farm, nonfarm, and unincorporated communities.

I. Municipal and Rural Domestic Sewage Treatment Developments

Twenty-nine of the 44 incorporated urban and rural communities in the basin have municipal waste treatment systems. These sewage treatment facilities provide a central waste disposal service to 20,677 residents. This does not include any of the population of Hastings, as their treatment plant outlets into the Big Blue River. The remaining 15 incorporated communities and the rural households, with a total population of 17,138, are supplied by individual 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, 1970 LITTLE BLUE RIVER BASIN, NEBRASKA

Category	Municipal Waste Treatment Systems		Individual Waste Treatment Facilities		Total	
	Places	Pop. 1/	Places	Pop. 1/	Places	Pop. 1/
Incorporated Communities						
Over 2,500 2/	2	7,934			2	7,934
1,000-2,500	2	2,868			2	2,868
500-1,000	5	4,070			5	4,070
250-500	10	3,968			10	3,968
100-250	9	1,744	9	1,233	18	2,987
Under 100	1	83	6	305	7	388
Subtotal	(29)	(20,677)	(15)	(1,538)	(44)	(22,215)
Rural 3/ Households				15,600		15,600
TOTAL	29	20,677	15	17,138	44	37,815

1/ Preliminary 1970 census data.
2/ Does not include Hastings.
3/ Includes farm, nonfarm, and unincorporated communities.

J. Other Resource Projects and Programs

There are no other known existing water and related land resource projects and programs in the Little Blue Basin. However, there are some federal and state owned lands other than those already discussed that could be a factor in future development.

The former Naval Annunition Depot in Adams and Clay Counties covers an area of over 47,000 acres. This area is no longer being used by the federal government as an ammunition depot. The General Services Administration has been disposing of this area for other uses. The Agricultural Research Service now controls over 35,000 acres of this area for the U.S. Meat Animal Research Center. Some 3,200 acres is now devoted to the use of the Army National Guard, with the balance of the area to be sold for private uses.

Until recent years, the Board of Educational Lands and Funds managed over 95,000 acres of state lands in the basin. However, the state has decided to dispose of these lands as existing leases expire. At the present time, there are only about 5,600 acres of educational lands remaining under state ownership. These lands, scattered in small tracts throughout the basin, are to be sold by about 1978.

VII. WATER AND RELATED LAND 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 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. However, there is a serious deficiency of choice recreational areas.

About 52,000 acres of land in Land Capability Classes VI and VII are presently cropped. This acreage should be established to a permanent cover of grass or trees. Over 125,000 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 upstream reservoirs. Sites with adequate storage potential exist throughout the basin except in the upland areas at the western end and in the upper reaches of Big and Little Sandy Creeks. In the latter areas, there are limited sites with physical potential but whose locations are unfavorable for development. Estimated upstream reservoir storage potential are shown in Table VII-1 for each delineated watershed.

Many of the potential upstream impoundment sites could be efficiently developed for multiple purpose uses. These sites could provide flood prevention, irrigation, recreation, fish and wildlife, ground water recharge and water quality control functions.

The total upstream reservoir storage potential is estimated to be about 400,000 acre feet. Of this amount, 79,000 acre feet is sediment

Table VII-1.--UPSTREAM RESERVOIR STORAGE POTENTIAL, LITTLE BLUE RIVER BASIN, NEBRASKA

Delineated Watershed Identification		Watershed Drainage Area	Potential Reservoirs	Area Controlled	Storage Capacity			
Number	Name	Acres	Number	Acres	Sediment	Other 1/	Floodwater	Total
					(Acre-Feet)			
41c3- 1	Little Blue (Upper)	233,100	9	96,000	12,000	16,400	24,000	52,400
41c3- 2	Cottonwood-Scott Crs.	98,800	3	48,000	6,000	7,600	12,000	25,600
41c3- 3	Thirty-Two Mile Cr. 2/	67,100	6	29,820	1,810	5,550	5,760	13,120
41c3- 4	Pawnee Cr.	80,700	3	32,000	4,000	4,800	8,000	16,800
41c3- 5	ACNW Tribs.	199,500	12	51,200	6,400	8,100	12,800	27,300
41c3- 6	Angus-Hebron Tribs.	144,300	6	38,400	4,800	4,050	9,600	18,450
41c3- 7	Spring Creek	115,200	8	48,000	6,000	5,100	12,000	23,100
41c3- 8	Dry (Thayer)	80,900	5	32,000	4,000	3,100	8,000	15,100
41c3- 9	Big Sandy (Upper)	212,300	(Included with 41c3-10)					
41c3-10	Big Sandy (Lower)	195,700	7	317,380	19,640	48,400	77,780	145,820
41c3-11	Little Sandy	67,300	3	34,040	3,240	4,300	8,930	16,470
41c3-12	Bowman-Spring Branch 2/	22,100	8	12,740	1,200	1,800	3,100	6,100
41c3-13	Buckley 2/	25,300	6	10,820	1,100	1,500	2,520	5,120
41c3-14	Rose Cr.	82,300	8	42,900	5,300	6,800	8,900	21,000
41c3-15	Fairbury Tribs.	93,000	8	26,900	3,360	4,200	5,600	13,160
41c3-16	Little Blue(Hollenburg)	4,600	0	0	0	0	0	0
	TOTAL	1,722,200	92	820,200	78,880	121,700	198,990	399,540

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

A Multiple Purpose Impoundment

storage, 199,000 acre feet is flood prevention storage and the remaining 122,000 acre feet is additional storage 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 reservoirs, a potential exists for many smaller impoundments that will satisfy onfarm and local needs for

livestock water, grade stabilization, irrigation and flood prevention. These smaller reservoirs would also have incidental benefits for recreation, fish and wildlife, or ground water recharge. No estimate has been made of the potential storage involved in these developments.

The land rights required to permit construction of the potential upstream multiple purpose reservoirs must be acquired either by easement or by acquiring title to the land. Nearly all of these sites are located on highly productive agricultural land. Many include farmsteads located on or near the bottomland areas which would be subject to inundation. Some existing roads and railroads would also 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 to the total installation costs. At some locations the high cost of removing or relocating improvements makes otherwise desirable sites impractical. Where it was evident the cost of land rights would be prohibitive, alternate sites were considered.

Potential reservoir site locations were not made for any areas in the basin. The small watershed projects were initially evaluated by estimating the amount of drainage area that would be desirable and physically possible to control for the flood prevention function. It was then assumed that sites would be available for needed storage on the basis of general topographic relief. The number of reservoirs needed and the total storage required was estimated. It was assumed that these sites would have the potential to supply the other functional needs of the area without designating the actual location. Detailed studies during project formulation will be needed to best determine which sites will best satisfy multiple purpose needs.

The above mentioned potential small watershed reservoirs will require coordinated planning. Coordination with other federal and state agency proposals cannot be over emphasized. For instance, the Bureau of Reclamation has proposed a large dam and reservoir project to be located on the main stem of the Little Blue River near Angus, Nebraska. Should this project become a reality, a coordinated effort in all phases of planning will need to be initiated. One item to consider in coordination would certainly include sediment trap efficiency of upstream reservoirs and their influence on the larger reservoir with respect to sediment and the general hydrology of the area. Another item would consider the effects of land treatment measures. Evaluation of various proposals according to clearly defined objectives will likely require the greatest coordination.

C. Ground Water Developments

Future development of ground water will be related to such considerations 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 areal extent and saturated thickness of the water-bearing strata.

One important aspect of deep well development is the ability of the water-bearing material to transmit or conduct water. This "ability" is termed transmissivity (Figure VII-1) and is measured in Meinzer units (gallons per day per foot of width). It is the product of the aquifer's coefficient of permeability and its thickness. A generalized delineation of ranges of transmissivity is useful when determining a safe or sustained yield of the water-bearing strata. Safe yield is generally defined as the point at which withdrawal equals recharge on an annual basis. However, it may also be more liberally defined as a sustained withdrawal that does not result in substantial increases in drawdown, pumpage costs and competition with surface water rights. An approximation of well yields in gallons per minute can be determined by dividing Meinzer units by 100. Therefore, an aquifer with a transmissivity of 50,000 gpd/ft. could be expected to produce well yields of 500 gpm.

Future demands on ground water will likely be made by the same functions that exist currently. Future developments demanding volumes over 500 gpm on a sustained basis will be limited geographically to approximately 60 percent of the area due to a simple lack of ground water in the other 40 percent.

The physical potential exists to stabilize the water level in the area currently experiencing a declining water table. This may be accomplished by developing a recharge system or it may come about indirectly by conjunctively using surface water. Either method will rely on the capture and careful disposition of excess surface waters which may or may not originate in the basin.

No specific research has been undertaken on recharge potential in the basin. Unless more significant tangible losses result to enough people from possible lack of supply, research methods and projects are not expected to gain much support.

Topics of researching recharge potential for this basin would certainly include (1) increasing natural recharge; (2) including specific recharge storage in reservoirs; (3) recharge systems of pits, dugouts, bordered plots or wells; and (4) diverting and purchasing excess surface water from sources outside the basin.

D. Channel Modifications and Levees

A potential exists to install multiple purpose flood prevention and drainage channels in many of the upland and depressional areas in

U S DEPARTMENT OF AGRICULTURE

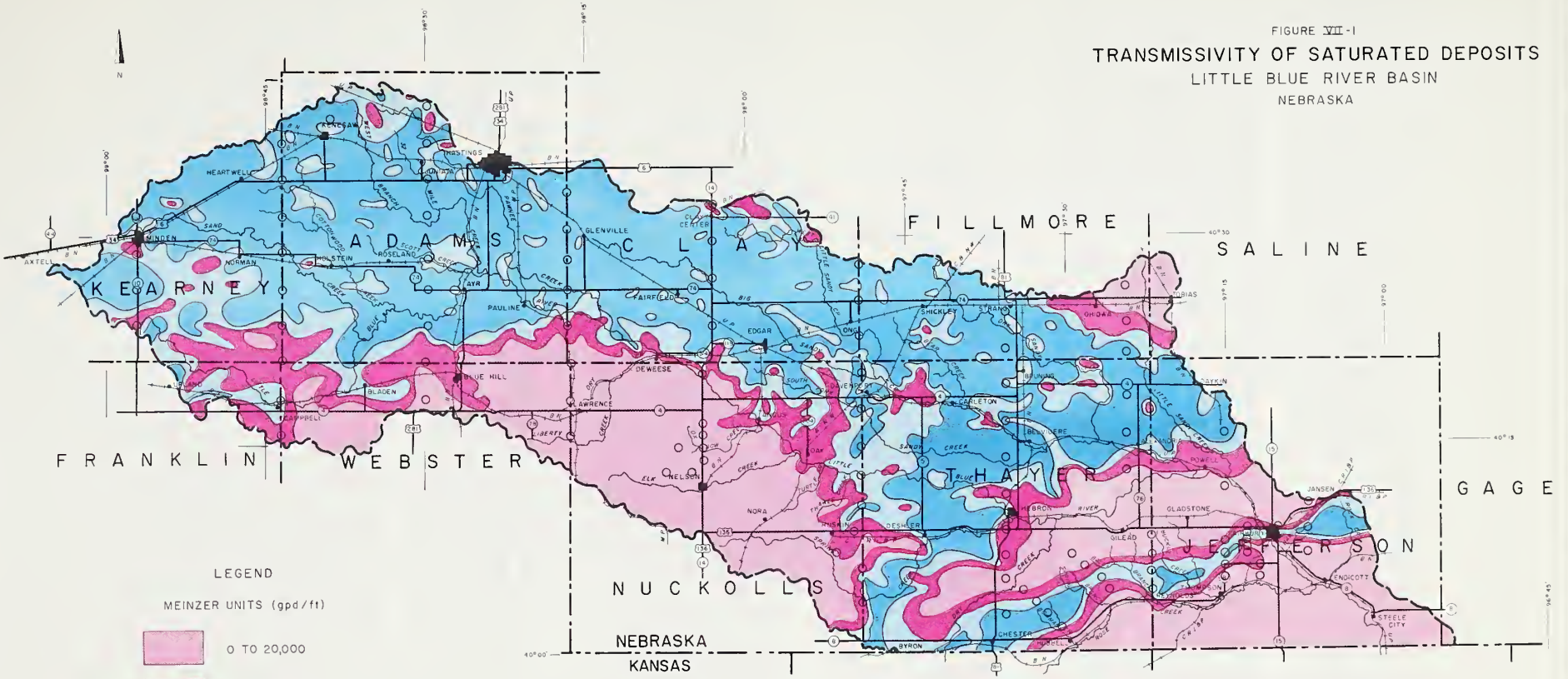
SOIL CONSERVATION SERVICE

FIGURE VII-1

TRANSMISSIVITY OF SATURATED DEPOSITS

LITTLE BLUE RIVER BASIN

NEBRASKA



LEGEND

MEINZER UNITS (gpd/ft)

- 0 TO 20,000
- 20,000 TO 50,000
- 50,000 TO 100,000
- OVER 100,000
- ○ TEST HOLE

SCALE
SCS DRAWING 5,S-27,439 AND INFORMATION FROM E.C. REED, CONSERVATION SURVEY DIVISION, UNIVERSITY OF NEBRASKA

TRANSVERSE MERCATOR PROJECTION

Border Rev 1-15-73
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the nearly level upper reaches of the basin and on the flat divides between the major drainages. These channels would remove excess surface water and flood runoff resulting from abnormally high precipitation events within a time that would minimize crop damage. In many locations, these channels would also convey irrigation waste water.

A potential exists for channel modifications or levees to provide flood protection to areas where reservoirs alone would not provide an adequate level of protection or where the existing conditions do not justify the installation of reservoirs. There is a potential to achieve an acceptable level of flood protection in some areas by improving the flow characteristics of the stream. This can be accomplished by removing constricting logs, trees and other debris. In some cases, minor realignment will be adequate but in other cases, major channel work may be helpful.

The installation of the potential channel modifications will require both project action and onfarm development. Project action is necessary when the problem involves a group of landowners.

E. Gully and Streambank Stabilization

The potential for gully and streambank stabilization measures exists in nearly all areas of the basin. The minimum level of stabilization is necessary to prevent further deterioration of the land resource located in the path of advancing gullies or streambank erosion. In many locations there is also a potential to reclaim areas already gullied to the degree that they are no longer productive. A potential exists for project-type actions to solve the more serious gully erosion problems.

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

Potentially a major portion of the gully erosion problem can be controlled 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 diversion; grassed waterways; the sloping of channel banks and vegetative stabilization by planting trees; the installation of channel lining; and the use of jetties, deflectors and riprap.

F. Irrigation

Relatively large amounts of land in this basin are suitable for irrigation. The limiting physical factor for future development is the lack of an adequate water supply.

Presently both ground and surface water supplies are available in the basin for additional irrigation development. In addition a potential exists to import surface waters from outside the basin. However, many legal restraints in Nebraska obstruct trans-basin diversion of water and it should be considered only as a long-range potential.

Considering the water available, the total irrigation potential including existing development is estimated to be over 460,000 acres. The potential is shown in Table VII-2 for each delineated watershed. To develop this potential both private and project-type development may be required using both ground and surface water supplies. These water supplies must be integrated into a system that will best utilize the total water supply available. Improved onfarm irrigation efficiencies will be required on both existing and new irrigated areas.

Table VII-2.--SUMMARY OF POTENTIALLY IRRIGABLE LAND
LITTLE BLUE RIVER BASIN, NEBRASKA

Delineated Watershed Identification		Drainage Area	Potentially Irrigable 1/
Number	Name	(Acres)	
41c3- 1	Little Blue (Upper)	233,100	78,500
41c3- 2	Cottonwood-Scott Crs.	98,800	38,000
41c3- 3	Thirty-Two Mile Cr.	67,100	26,000
41c3- 4	Pawnee Creek	80,700	27,000
41c3- 5	ACNW Tribs	199,500	38,000
41c3- 6	Angus-Hebron Tribs	144,300	14,500
41c3- 7	Spring Creek	115,200	17,000
41c3- 8	Dry (Thayer)	80,900	9,000
41c3- 9	Big Sandy (Upper)	212,300	107,500
41c3-10	Big Sandy (Lower)	195,700	83,500
41c3-11	Little Sandy	67,300	7,500
41c3-12	Bowman-Spring Branch	22,100	2,500
41c3-13	Buckley	25,300	2,400
41c3-14	Rose Creek	82,300	4,500
41c3-15	Fairbury Tribs	93,000	7,000
41c3-16	Little Blue (Hollenberg)	4,600	0
TOTAL		1,722,200	462,900

1/ Includes some 270,000 acres of presently irrigated land.

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 270,000 acres to 375,000 acres by 2020. 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. Field efficiencies associated with future irrigation are estimated to increase five percent for all land capability units (LCU's). Each LCU will still have irrigated land requiring either proper management or vegetative and/or mechanical practices or both (Table VII-3). The estimated increase in field efficiencies is assumed to be applied equally to all current and all new irrigated acres.

Table VII-3.—ESTIMATED FIELD EFFICIENCY
BY LAND CAPABILITY UNIT OF IRRIGATED LAND IN 2020
LITTLE BLUE BASIN

Item	Land Capability Unit				
	I	II	III	IV	Total
Total 1/					
1,000 Acres	102	220	39	14	375
Field Eff. Percent 2/	68	62	58	51	(63)
Adequately Treated					
1,000 Acres	88	180	25	7	300
Field Eff. Percent	70	65	65	60	(66)
Residual Needs					
Proper Mgmt. Only					
1,000 Acres	9	13	2	1	25
Field Eff. Percent	60	55	55	50	(57)
Mgmt., Veg. &/or Mech.					
1,000 Acres	5	27	12	6	50
Field Eff. Percent	50	45	45	40	(45)

1/ Includes existing irrigation.
2/ Weighted according to degree of treatment.

Nearly all the new irrigation development will use ground water as its source with development limited to areas where ground water is available. The Ground Water Development section of this chapter discusses in greater detail the location of this potential.

There is little potential remaining for private surface water development from existing stream flows because the dependable base flows

have been appropriated. 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 and fish and wildlife development. Such reservoirs can provide surface areas for the 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.

Water-Based Recreation at Reservoir

An excellent potential exists for the development of water resources for fishing. The reservoirs will provide some augmentation of low flows to help 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.

Most of the hunting potential is on privately owned land. To improve this potential, some type of incentive will be required to motivate private 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.

There also is potential for improving hunting in the upland areas of the basin by more public acquisition or lease of privately owned rainwater basins. The more permanent of these "rainwater" basins would provide additional public hunting areas and habitat needed for wildlife production.

H. Water Quality Control

Considerable potential exists for improving the quality of the basin's surface waters. Application of the needed land treatment and the proper use and management of agricultural lands can achieve a significant decrease in the rate of erosion. This will reduce sediment production and lessen the delivery of sediment to downstream lands, channels, streams and reservoirs. The potential floodwater retarding and grade stabilization structures would also be effective in reducing damages by decreasing sediment deposition. Storage of water for quality control would be incorporated into multiple purpose reservoirs to augment low flows by controlled releases.

Stream pollution from municipal, industrial and rural domestic waste disposal systems can be held to an acceptable minimum if adequate improvements and enlargements to these systems are made as the need arises.

Proper selection and use of agricultural chemicals, including pesticides, herbicides and fertilizers, will insure that the potential pollution of the ground and surface waters from these sources will be minimal.

I. Associated Land Treatment and Adjustments

All land can be used within its capability and could be treated according to its needs. However, it is not reasonable to expect this to occur due to such factors as land ownership changes, normal depreciation of mechanical practices and unavoidable lag in reapplication of conservation practices. Droughts, storms and "acts of God" also cause desired land treatment to be less than the total treatment needed. The current and projected status of land treatment of agricultural land in the basin through 2020 is shown in Table VII-4.

Table VII-4.—CURRENT & PROJECTED STATUS OF AGRICULTURAL LAND TREATMENT LITTLE BLUE RIVER BASIN, NEBRASKA

Land Use	Projected Basin Acreage 2020	Current Adequate Treatment	Projected Land Treatment: Proper Mgmt.	Proper Mgmt & Veg. or Mech. Prac.	Sub-total	Proj. Adequate Treatment By 2020: Total	Percent
	(1,000 Acres)						%
Cropland							
Nonirr.	823.7	408.5	47.0	121.1	168.1	576.6	70
Irr.	375.0	161.7	55.0	83.3	138.3	300.0	80
Subtotal	(1,198.7)	(570.2)	(102.0)	(204.4)	(306.4)	(876.6)	(73)
Pasture & Range	384.2	65.6	17.0	186.3	203.3	268.9	70
Forest & Woodland	19.3	2.4	3.7	3.5	7.2	9.6	50
Other Ag. Land	30.0	18.2	2.8	6.0	8.8	27.0	90
TOTAL AG. LAND	1,632.2	656.4	125.5	400.2	525.7	1,182.1	72

It is projected that over 525,000 additional acres of agricultural land will be adequately treated by 2020, bringing the total land with adequate treatment to over 1,182,000 acres which is over 72 percent of the agricultural land. Of this, some 194,000 acres need only management practices and about 255,000 acres need more intensive treatment in order to be adequately treated.

Projections indicate that substantial improvements in treatment status will take place on cropland and on pasture and range. Over

306,000 more acres of cropland will attain adequate treatment status by 2020, bringing the total percent of cropland adequately treated to 73 percent. Over 203,000 acres of pasture and range will attain adequate status, bringing the total to 70 percent with adequate treatment by 2020.

In making projections for the area to be adequately treated for forest and woodland, it is necessary to consider the cost of treatment in relation to benefits individual landowners will receive. In many instances it may not be economically feasible for private landowners to treat forest and woodland areas and it is estimated that only 50 percent of this land use will be treated by 2020. The projected treatment includes the planting and development of windbreaks to provide protection for agricultural croplands, farmsteads, feedlots and wildlife. It also includes the development of limited areas for commercial production of forest products. Suitable areas include those with shallow soils not suitable for cultivation. Other areas are in the floodplains where walnut production has a potential.

The projected land treatment of other agricultural land estimates that 90 percent of this area will be adequately treated by 2020. The greatest treatment potential for this category will be for the control of pollution from livestock feedlot areas.

Generally, farm operators can make needed adjustments in land use without reducing the acreages of cropland, grassland or woodland. If the national demand for grain or livestock increases the basin has over 180,000 acres of land presently in grassland and woodland that has a capability of producing crops.

J. Nonstructural Measures

Nonstructural measures provide additional potential for reducing flood damages and achieving proper land use in the Little Blue Basin. Floodplain management and zoning of the floodplain is one important alternative 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. Floodplain zoning regulations are usually necessary to realize the maximum benefits from floodplain management.

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 nor structural as usually defined. Among these are relocation of buildings out of area susceptible to flooding or floodproofing 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.

VIII. OPPORTUNITIES FOR DEVELOPMENT OF 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 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. Small Watershed Projects

It is recommended that project action be initiated in two small watershed projects in the Little Blue Basin by 1980. These watersheds are physically and economically feasible and ready for project development. The location of the two watersheds to be initiated by 1980 and those that appear to be potentially feasible at some later time period are shown in Figure VIII-1.

The Balls Branch Watershed, 13,200 acres, is a small left bank tributary of Rose Creek. It is located in southeastern Thayer County between the existing Buckley and Bowman-Spring Branch Watersheds. All of these watersheds are subwatersheds of Rose Creek. The primary objective in the Balls Branch Watershed is the reduction of floodwater, sediment and gully erosion damages. An application for planning assistance has been submitted for this watershed.

Little Sandy Creek is a 67,300 acre watershed located in Fillmore, Jefferson, Saline and Thayer Counties. The primary objective for development of this watershed will be the reduction of floodwater, sediment and gully erosion damages. Included are some upland water desposal measures with additional benefits from drainage.

The project structural measures studied for the above two watersheds consist of six reservoirs, two grade stabilization structures and 12 miles of multiple purpose channels. The total storage in the proposed reservoirs is estimated to be 15,520 acre feet with 3,770

acre feet allocated for sediment, 930 acre feet for recreation and the remaining 10,820 acre feet for flood prevention. The total permanent water surface area for the six proposed reservoirs would be 530 acres. Recreation and fish and wildlife developments have been proposed at one reservoir with a water surface area of 230 acres. Details of the proposed developments in each feasible watershed are shown in Tables VIII-1 and VIII-2.

The total installation cost of the structural measures amounts to $1,989,000. This consists of $1,343,000 for flood prevention measures, $495,000 for recreation and wildlife developments and $151,000 for project drainage measures. It is estimated that $1,341,000 of the total installation cost would be federal expenditure and $648,000 non-federal expense. Table VIII-3 gives the cost-sharing and functional costs for each feasible watershed.

The average annual total cost for the two early action watersheds is estimated to be $130,400. This includes $117,500 for amortization of the installation cost and $12,900 for operation and maintenance. The average annual primary benefits from these two watersheds are estimated to be $210,900. Waterflow control benefits are estimated to be $126,800 with recreation benefits of $57,900. Other benefits for these projects are drainage - $12,600; grade stabilization - $2,400; and indirect benefits of $11,200. The benefit-cost ratio for these two projects is 1.6 to 1. The details of the benefit-cost analyses for the feasible watersheds are shown on Table VIII-4. An alternative system of structural measures may prove feasible upon detailed analyses of the watersheds.

Eight additional delineated watersheds (see Table VIII-5) appear to be potentially feasible for development at more distant time periods. These watersheds have a total drainage area of 1,228,300 acres. Their development is primarily needed for the reduction of floodwater, sediment and gully erosion damages. In six of the watersheds recreation and fish and wildlife development have been included as primary functions; drainage having some incidental benefits is included in five watersheds.

The structural measures studied in the eight potentially feasible watersheds consist of 28 reservoirs, ten grade stabilization structures and 76 miles of multiple purpose channels. The 28 reservoirs would have a total storage capacity of 146,570 acre feet with a permanent water surface area of 4,275 acres. These reservoirs would control 429,380 acres of the 1,228,300 acres of drainage area of the above mentioned watersheds. The ten grade stabilization structures would control erosion in 4,000 acres of drainage area and the 76 miles of multiple purpose channels would require 920 acres of right-of-ways to develop as shown in Table VIII-5.

FIGURE VIII-1

WATERSHEDS FEASIBLE FOR PROJECT ACTION

-FEASIBILITY PURPOSE & STATUS-

LITTLE BLUE RIVER BASIN

NEBRASKA

LEGEND

- WATERSHED APPROVED FOR INSTALLATION (COMPLETED OR UNDER CONSTRUCTION)
- WATERSHEDS REQUESTING WATERSHED PLANNING ASSISTANCE
- POTENTIALLY FEASIBLE WATERSHED PROJECTS NOT NOW UNDER APPLICATION
- WATERSHEDS IN WHICH PROJECT ACTION SHOULD BE INITIATED BY 1980

FEASIBILITY PURPOSES

- (WC) -WATERFLOW CONTROL MEASURES (FLOODWATER RETARDING RESERVOIRS & CHANNEL MODIFICATION)
- (LS) -LAND STABILIZATION-GULLY EROSION (GRADE STABILIZATION STRUCTURES)
- (D) -DRAINAGE MEASURES
- (R) -RECREATION

SCALE 1/500,000

SCALE 5 0 5 10 15 20 MILES

TRANSVERSE MERCATOR PROJECTION

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Table VIII-1.--SUMMARY OF STRUCTURAL MEASURE DATA--QUANTITIES AND COSTS FOR THOSE WATERSHEDS ECONOMICALLY FEASIBLE
LITTLE BLUE RIVER BASIN, NEBRASKA

Delineated Watershed Identification		Reservoir Data												Grade Stabilization Structure			Multi-Purp. Chan.		Total Structural Installation Costs
		Drainage Area		Storage Capacity				Water Sur. Ar. (Top of Pool)		Reservoir Install. Cost									
Number	Name		No.	Drainage Area Controlled	Sediment	Recreation	Flood-water	Total	Permanent	Flood	Sediment & Flood-water	Recreation and Facilities	Total	No.	Drainage Area Controlled	Installation Cost	Length	Rights of Way	Installation Cost
		Acres		Acres	Ac.Ft.	Ac.Ft.	Ac.Ft.	Ac.Ft.	Acres	Acres	$1,000	$1,000	$1,000		Acres	$1,000	Miles	Acres	$1,000	$1,000
41c3-11	Little Sandy	67,300	3	34,040	3,240	930	8,930	13,100	445	1,130	655	495	1,150	2	600	42	12	140	301	1,493
41c3-14	Rose 1/	13,200	3	6,820	528	-	1,891	2,419	86	283	496	-	496	-	-	-	-	-	-	496
	GRAND TOTAL	80,500	6	40,860	3,768	930	10,821	15,519	531	1,413	1,151	495	1,646	2	600	42	12	140	301	1,989

1/ Balls Branch Subwatershed only. Preliminary work plan data.

1968 installation costs, projected to 1980.

Table VIII-2.--RECREATION AND FISH AND WILDLIFE OPPORTUNITIES FOR WATERSHEDS HAVING PROJECT FEASIBILITY
LITTLE BLUE RIVER BASIN, NEBRASKA

Watershed		Developed Areas	Permanent Storage		Water Surface		Additional Land	Developed Land	Visitor Days	Additional Installation Cost
Number	Name		Additional	Total	Additional	Total				
		No.	Ac.Ft.	Ac.Ft.	Acres	Acres	Acres	Acres		Dollars
					WATERSHEDS IN WHICH PROJECT ACTION APPEARS FEASIBLE (Within next 10 years)					
41c3-11	Little Sandy	1	930	1,996	90	230	450	38	23,000	495,000
41c3-14	Rose 1/	0	-	-	-	-	-	-	-	-
	GRAND TOTAL	1	930	1,996	90	230	450	38	23,000	495,000

1/ Balls Branch Subwatershed only. Preliminary work plan data does not include recreation.

Table VIII-3.--COST SHARE SUMMARY OF WATERSHEDS FOUND ECONOMICALLY FEASIBLE
LITTLE BLUE RIVER BASIN, NEBRASKA

Delineated Watershed Identification		Functional Allocation									Total Installation Cost		
		Flood Prevention 1/			Drainage			Recreation					
Number	Name	Federal	Non-Federal	Total	Federal	Non-Federal	Total	Federal	Non-Federal	Total	Federal	Non-Federal	Total
		(1,000 Dollars)											
41c3-11	Little Sandy	677	170	847	68	83	151	199	296	495	944	549	1,493
41c3-14	Rose 2/	397	99	496	-	-	-	-	-	-	397	99	496
	GRAND TOTAL	1,074	269	1,343	68	83	151	199	296	495	1,341	648	1,989

1/ Includes waterflow control measures (floodwater retarding structures and channel improvement) and grade stabilization structures.
2/ Balls Branch Subwatershed only.

Table VIII-4.--AVERAGE ANNUAL BENEFITS AND COSTS OF STRUCTURAL MEASURES
FOR WATERSHEDS FOUND ECONOMICALLY FEASIBLE
LITTLE BLUE RIVER BASIN, NEBRASKA

Delineated Watershed Identification		Average Annual Primary Benefits						Average Annual Costs		
Number	Name	Waterflow Control	Grade Stabilization	Drainage	Recreation	Indirect	Total	Amortization of Installation Cost 1/	Operation and Maintenance Cost	Total
		(Thousand Dollars)								
41c3-11	Little Sandy	66.7	2.4	12.6	57.9	5.2	144.8	88.2	11.4	99.6
41c3-14	Rose 2/	60.1	-	-	-	6.0	66.1	29.3	1.5	30.8
	GRAND TOTAL	126.8	2.4	12.6	57.9	11.2	210.9	117.5	12.9	130.4

1/ Amortized @ 5⅛ percent interest. Installation costs projected to 1980.
2/ Balls Branch Subwatershed only. Preliminary work plan data.

Price Base: Adjusted normalized prices.

Table VIII-5.--SUMMARY OF STRUCTURAL MEASURE DATA FOR WATERSHEDS
IN WHICH PROJECT ACTION APPEARS POTENTIALLY FEASIBLE
LITTLE BLUE RIVER BASIN, NEBRASKA

Delineated Watershed Identification	Drainage Area	Reservoir Data								Grade Stabilization Structure		Multi-Purpose Channels	
				Storage Capacity				Water Surface Area (Top of Pool)					
Number & Name		No.	Drainage Area Controlled	Sediment	Recreation	Floodwater	Total	Permanent	Floodwater	No.	Drainage Area Controlled	Length	Right-of-Ways
	Acres		Acres	Ac.Ft.	Ac.Ft.	Ac.Ft.	Ac.Ft.	Acres	Acres		Acres	Miles	Acres
41c3- 1													
Little Blue (Upper)	233,100	-	-	-	-	-	-	-	-	-	-	20	250
41c3- 2													
Cottonwood-Scott Crs.	98,800	-	-	-	-	-	-	-	-	-	-	6	70
41c3- 4													
Pawnee Creek	80,700	3	32,000	4,000	1,250	8,000	13,250	625	1,575	-	-	-	-
41c3- 5													
ACNW Tribs	199,500	6	19,200	2,400	1,000	4,800	8,200	340	890	-	-	5	60
41c3- 7													
Spring Creek	115,200	8	48,000	6,000	1,000	12,000	19,000	850	2,200	-	-	-	-
41c3- 9													
Big Sandy (Upper)	212,300	(Included with 41c3-10)											
41c3-10													
Big Sandy (Lower)	195,700	7	317,380	19,640	3,600	77,780	101,020	2,230	7,240	-	-	45	540
41c3-15													
Fairbury Tribs	93,000	4	12,800	1,600	300	3,200	5,100	230	630	10	4,000	-	-
GRAND TOTAL	1,228,300	28	429,380	33,640	7,150	105,780	146,570	4,275	12,535	10	4,000	76	920

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B. Land Treatment and Land Use Programs

Application of needed land treatment measures is essential for full resource development in the basin and should be applied at an accelerated rate. It is estimated that about 1,182,000 acres or 72 percent of all agricultural land could be adequately treated by 2020 if adequate funding and technical assistance are made available.

Financial assistance for the application of land treatment measures is furnished by government cost-sharing through the Rural Environmental Assistance Program administered by the Agricultural Stabilization and Conservation Service. USDA long term cost-sharing assistance is also available in seven counties of the basin through the Great Plains Conservation Program administered by the Soil Conservation Service. Credit to finance conservation measures is available from the Farmers Home Administration.

No attempt has been made to estimate future federal expenditures for land treatment. The areas projected for treatment in Chapter VII are the amounts proposed for development by 2020. The areas in each land use to receive adequate treatment during this period are as follows: (1) nonirrigated cropland - 168,000 acres; (2) irrigated cropland - 138,000 acres; (3) pasture and range - 203,000 acres; (4) forest and woodland - 7,200 acres; and (5) other agricultural land - 8,800 acres.

The total cost of the basin's needed land treatment program is estimated to be $17,797,600 including technical assistance (see Table VIII-6). Irrigated cropland including the cost to develop the new proposed area will require $9,224,500 of this cost. The proposed expenditure on nonirrigated cropland is $5,267,000 with pasture and range estimated at $2,501,000. Costs for forest and woodland treatment is $477,000; those for other agricultural land are estimated at $328,000. The major treatment on other agricultural land is control of feedlot pollution.

About 12 percent of the agricultural land in the basin is in the five feasible watershed projects currently under construction or proposed for installation by 1980. Land treatment in these watersheds will be accelerated to meet the 75 percent requirement of the small watershed program. Some 75,300 acres at a total cost of $2,674,500 need treatment in these five watersheds. It is estimated that $2,137,700 will be accomplished by the going program and $536,800 by the accelerated program.

Land treatment expenditures in the potential long-range watersheds are estimated to total $12,204,800. Additional costs of $2,918,300

are necessary for land treatment in areas where there are no feasible watersheds. A detailed analysis of the needed land treatment program is shown in Table VIII-6.

Table VIII-6--ESTIMATED COST OF PROPOSED LAND TREATMENT
LITTLE BLUE RIVER BASIN, NEBRASKA

Item	Watershed Projects Currently Approved and Proposed for 1980				Watershed Projects Potentially Feasible By 2020		Area Not In Proposed Watershed Projects		Total	
	Going Program		Accelerated							
	Acres	Dollars	Acres	Dollars	Acres	Dollars	Acres	Dollars	Acres	Dollars
NONIRRIGATED CROPLAND										
Management Only	5,600	50,400	1,400	12,600	32,200	289,800	7,800	70,200	47,000	423,000
Management, Vegetative & Mechanical	14,500	580,000	3,500	140,000	83,100	3,324,000	20,000	800,000	121,000	4,844,000
Subtotal	(20,100)	(630,400)	(4,900)	(152,600)	(115,304)	(3,613,800)	(27,800)	(870,200)	(168,100)	(5,267,000)
IRRIGATED CROPLAND										
Management Only	6,600	52,800	1,800	14,400	37,600	300,800	9,000	72,000	55,000	440,000
Management, Vegetative & Mechanical	10,000	1,053,600	2,700	284,300	57,000	6,011,500	13,600	1,435,100	83,300	8,784,500
Subtotal	(16,600)	(1,106,400)	(4,500)	(298,700)	(94,600)	(6,312,300)	(22,600)	(1,507,100)	(138,300)	(9,224,500)
PASTURE AND RANGE										
Management Only	2,000	6,000	200	600	11,900	35,700	2,900	8,700	17,000	51,000
Management, Vegetative & Mechanical	22,300	292,900	2,100	27,400	130,400	1,718,000	31,500	411,800	186,300	2,450,100
Subtotal	(24,300)	(298,900)	(2,300)	(28,000)	(142,300)	(1,753,700)	(34,400)	(420,500)	(203,300)	(2,501,100)
FOREST AND WOODLAND										
Management Only	400	4,000	300	3,000	2,400	24,000	600	6,000	3,700	37,000
Management, Vegetative & Mechanical	600	76,000	300	38,500	2,100	266,000	500	59,500	3,500	440,000
Subtotal	(1,000)	(80,000)	(600)	(41,500)	(4,500)	(290,000)	(1,100)	(65,500)	(7,200)	(477,000)
OTHER AGRICULTURAL LAND										
Management Only	200	2,000	100	1,000	2,000	20,000	500	5,000	2,800	28,000
Management, Vegetative & Mechanical	400	20,000	300	15,000	4,300	215,000	1,000	50,000	6,000	300,000
Subtotal	(600)	(22,000)	(400)	(16,000)	(6,300)	(235,000)	(1,500)	(55,000)	(8,800)	(328,000)
TOTAL	62,600	2,137,700	12,700	536,800	363,000	12,204,800	87,400	2,918,300	525,700	17,797,600

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; furnish trees for planting areas best adapted to forest production; to thin and improve timber stands; and to provide fire protection.

Funds to assist landowners with the installation of the proposed practices are supplied by both state and federal agencies. No attempt has been made in this study to determine what amounts might be furnished by any given agency. Instead the total cost of the needed forestry improvements have been included in the overall land treatment program.

Table VIII-6 shows an additional 7,200 acres of forest and woodland needs to be treated by 2020. The estimated cost for this treatment is $477,000.

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 and promoting conservation planning; by developing and managing water resources for recreation, wildlife, agriculture, industry and municipalities; and by encouraging new industries to locate in the area to process and market products of the area. At the present time no Resource Conservation and Development project is anticipated for this basin. However, if a need for this type of program develops the opportunity for such a program remains.

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 (FHA) 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 FHA assistance for water supply developments in ten communities in the basin. Nine 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 $333,000. A portion of this amount could be eligible for assistance from FHA. Table VIII-7 groups the proposed developments using 1970 census data.

The Nebraska Water Pollution Control Council has classified the need for upgrading sewage treatment facilities according to the urgency. One group of towns is on the Council's 1-year needs list and/or has an approved project and includes Hebron and Lawrence with an estimated cost of $140,000.

Table VIII-7.—MUNICIPAL WATER SUPPLY AND SEWAGE TREATMENT OPPORTUNITIES, LITTLE BLUE RIVER BASIN, NEBRASKA

Category of Incorporated Communities 1/	Improve Existing Systems		New Systems		Total	
	Places No.	Inst. Costs Dollars	Places No.	Inst. Costs Dollars	Places No.	Inst. Costs Dollars
Water Supply						
2,500-5,500						
1,000-2,500						
500-1,000						
250-500	1	28,000			1	28,000
100-250			4	156,000	4	156,000
Under 100			5	149,000	5	149,000
Subtotal	(1)	(28,000)	(9)	(305,000)	(10)	(333,000)
Sewage Treatment						
2,500-5,500						
1,000-2,500	2	280,000			2	280,000
500-1,000	4	355,000			4	355,000
250-500	6	372,000			6	372,000
100-250	2	31,000	6	351,000	8	382,000
Under 100	1	55,600	1	53,000	2	108,600
Subtotal	(15)	(1,093,600)	(7)	(404,000)	(22)	(1,497,600)
TOTAL COSTS	-	1,121,600	-	709,000	-	1,830,600

1/ Grouping using 1970 census data.

A second group of communities are on a 5-year needs list and includes the 13 communities of Blue Hill, Clay Center, Kenesaw, Bruning, Chester, Glenville, Juniata, Shickley, Belvidere, Heartwell, Ohiowa, Reynolds and Steele City. The estimated cost for this group is $1,031,000.

A third group is a group of communities which is on the Farmers Home Administration needs estimate and may include sewer collection needs as well as treatment needs. This group includes the following eight towns at an estimated cost of $326,600: Edgar, Nelson, Fairfield, Oak, Roseland, Ruskin, Deweese and Nora.

Another breakdown of communities shows the estimated cost for (1) improvement of existing systems and (2) the building of new systems. The cost for improving existing systems is $1,093,600 for the following 15 communities: Blue Hill, Hebron, Clay Center, Edgar, Kenesaw, Nelson, Bruning, Fairfield, Glenville, Juniata, Lawrence, Shickley,

Roseland, Ruskin and Deweese. The estimated cost for building new systems is $404,600 and includes the following seven towns: Belvidere, Heartwell, Oak, Ohiowa, Reynolds, Steel City and Nora (Table VIII-7).

The total cost for water supply and sewage treatment facilities is estimated to be $1,132,600. Current estimates, using existing policies and procedures, show that FHA assistance could provide funds for approximately 50 percent of this amount.

IX. IMPACTS OF PROPOSED USDA PROJECTS AND PROGRAMS

The proposed 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 (which will also provide storage for sediment). 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 and assist in the maintenance of soil fertility.

Hydrology

Installation of floodwater retarding reservoirs and channel modification measures will reduce flood crests on the tributary floodplains and improve runoff conditions in upland areas. Detention structures will temporarily detain flood runoffs, trapping much of the debris and sediment. It is not anticipated that the upstream watershed and land treatment measures will reduce the basin's average annual runoff at the state line.

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. The prolonged streamflows will permit more intensive utilization of surface water for livestock, fishing, irrigation, recreation and other environmental uses.

The proposed drainage measures will allow removal of excess water from upland crop areas subject to periodic indundation and will facilitate internal drainage in the root zone. Increased yields on the crop and pasture lands will result.

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 and delivery. 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 recommended measures and projects which can be installed through the USDA programs will have a significant impact in supplying the needed recreation and fish and wildlife resources in this basin. There are six water impounding reservoirs proposed in the two new watershed projects recommended in this report which will increase the water surface.

Table VIII-2 lists the watershed where recreation and fish and wildlife purposes have been included. A total of one reservoir is feasible for recreational development. An additional 930 acre feet of permanent storage has been added to this reservoir. The water surface area for the proposed multiple purpose reservoir totals 230 acres. In addition to the normal flood pool areas 450 acres of additional land has been proposed for recreation and wildlife use. Adequate facilities needed to accommodate the anticipated use have been included in the $495,000 installation cost.

The projected recreational use for the proposed developed area associated with the multiple purpose impoundment is estimated to be 23,000 visitor-days. This is equivalent to 57,500 activity-days. The major activities to be supplied by this development include camping, swimming, boating, picnicking, fishing and hunting.

The six reservoirs and their surrounding land areas will make a significant net contribution to both wildlife habitat and recreational use. These impoundments will be used by migrating waterfowl and a limited amount of productive nesting will take place in the cover around the reservoirs. The impoundment shore lines 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.

The beneficial effects of structures on wildlife may outweigh the adverse effects but the adverse effects should be noted. For example (1) reservoirs do inundate areas which harbor wildlife, making them unsuitable for existing species of wildlife and (2) there may be a vector problem because of increased areas for mosquito propagation.

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. Detailed evaluations were not made because specific sites for the proposed improvements have not been located. 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

Economic growth in the Little Blue River Basin will continue although at a somewhat lower rate than anticipated for the nation as a whole.

The economic impact of the proposed USDA projects and programs can be divided into two categories. First is the impact of many technical assistance programs that provide information, education and planning assistance for many aspects of land and water resource conservation and development. It is impossible to measure the economic effects of these programs. However, they have had a significant impact in our existing economy and it is expected to continue. Second is the impact of financial assistance furnished by USDA programs. This assistance is in the form of grants, loans or cost-sharing to assist individual landowners or organized groups of landowners and municipalities in land conservation and water resource developments.

It is extremely difficult to evaluate the economic effects of many of the financial assistance programs of the USDA. In this study the proposed land treatment to be installed by 2020 is estimated to cost nearly $18 million. These practices will reduce soil loss and preserve the productivity on the basin's crop, pasture and forest lands; they will reduce sedimentation in streams and reservoirs; they will reduce flood damages; and they will help control feedlot pollution.

A number of USDA programs, including the Rural Environmental Assistance Program, the Great Plains Conservation Program, Cooperative State-Federal Forestry Programs and programs of the Farmers Home Administration, assist with the financing and installation of land treatment measures. No attempt has been made in this study to determine the economic effects of land treatment programs.

The Farmers Home Administration also has grant and loan programs that assist municipalities with the installation of water supply and sewage treatment facilities. The proposed community facilities are estimated to cost over a million dollars. Although no attempt was made to determine the 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.

A detailed analysis of the economic effects of the proposed small watershed program was made in this study. The planned structural measures will reduce floodwater, sediment and gully erosion damages. Gully erosion structures will prevent land destruction and production of damaging sediment. Reduction of the floodwater damage hazard will result in increased crop yields and beneficial cropping and land use adjustments will occur. More intensive land use benefits will accrue from increased use of fertilizer, improved varieties and improved cultivation practices. Floodwater damage reduction will also result from less frequent flooding of highways and bridges, reduced debris cleanup and reduced loss of livestock and farm equipment.

The total average annual floodwater, sediment and gully erosion damage in the basin is $631,500. Of the total $503,600 is to agriculture, $124,300 to rural nonagriculture and $3,600 to urban damage. There are significant losses to the operators farming the 31,750 acres of upland areas and 51,980 acres of floodplain lands affected, as well as the 4,180 acres subject to gully erosion. Installation of the proposed structural measures will provide average annual damage reduction of about $239,400, leaving residual damages of about $392,100. Recreation development measures are expected to add an additional $57,900 average annual benefits.

Further benefits will be in the form of increased stability of family farms through an increased volume of business, cheaper production of higher quality products and more efficient use of machinery and labor. Benefits will result from taking steep, marginal uplands out of crop production and shifting crop production to floodplain areas now in hay or pasture. Flood protection will enable current inputs to produce crop yields approaching 100 percent of flood free yields.

The installation of works of improvement provide a stimulus toward economic growth and development. Because of the relationships that exist between various sectors of the local economy and how they relate to the region and the nation it is extremely difficult, if not impossible, to measure all effects likely to occur. An initial change in one of the basic sectors will in turn encourage changes in other sectors which will induce further changes and so on. The total package of changes can be expressed terms of employment, population and income.

Employment will be generated as the proposed resource conservation and development becomes operative. One way to estimate this impact is through the use of an employment multiplier. This approach involves a division of total employment into two segments: (1) the basic or nonservice segment contains those people employed in agriculture, forestry, mining and manufacturing which produce goods and services locally for consumption mainly outside the basin; and (2) the derivative or service-oriented segment whose goods and services are mainly consumed locally. Total employment and income rise and fall with the basic industries.

A ratio of derivative activity to basic activity is then computed from employment data as shown in Table IX-1. In 1960, 21,500 persons were employed in the basin. Of this total 7,916 were in the basic group and the remaining 13,583 in the derived group. The basic-derivative ratio is thus 1:1.72. Further extension of this concept reveals a ratio of 1:2.28 in 1980 for each additional person employed in agriculture by 1980, and an additional 2.28 persons will be needed to service the basic employee.

Table IX-1.--OCCUPATIONAL CLASSIFICATION OF EMPLOYED PERSONS
LITTLE BLUE RIVER BASIN 1950-60

Item	1950	1960
Basic Industries:		
Agriculture	8,213	5,929
Forestry & Mining	53	28
Manufacturing	1,817	1,959
Subtotal	(10,083)	(7,916)
Derivative Industries:		
Construction	1,411	1,151
Transportation, Communication & Utilities	1,585	1,453
Wholesale Trade	885	769
Retail Trade	3,598	3,463
Finance, Insurance & Real Estate	478	570
Services	4,973	5,736
Other	627	441
Subtotal	(13,557)	(13,583)
Total Employment:	23,640	21,500
Basic/Derivative Ratio:	1:1.34 - 1950	
	1:1.72 - 1960	

In 1980, with the works of improvement in place and operative the value of agricultural production can be increased about $186,600 annually. The projects will result in increased crop yields and adjustments in cropping and land use. More intensive land use benefits will accrue from increased use of fertilizer and improved cultivation practices. Flood prevention measures will permit the inputs to produce yields nearer to those produced on similar soils without flood damages. The value of production per farm worker is projected at $16,500 as shown in Table III-22. If it is assumed that agricultural labor resources will be fully employed without the plan the additional agricultural production will result in 11 additional basic employees. Further, an additional 2.28 persons will be needed to service each basic employee. The total impact on employment, resulting from the increase in agricultural production associated with the programs, is estimated to be 36 employees.

Conversely, it can be assumed that underemployment of farm workers will be of such magnitude that the additional agricultural production

($186,600) will affect per worker income but will leave employment unchanged. The basinwide effect amounts to an average annual income of an additional $38 per farm worker. However, farmers in the area benefited by the projects will realize more significant effects than the basinwide effect.

The increase in personal income is available for successive rounds of consumer spending. This additional income generates further expenditures which are a multiple of the original increase in income. A portion of this increase is spent in the basin and in turn respent within the area until its marginal effect becomes zero. A summation of these successive rounds of spending is commonly called the income multiplier.

Recent studies in areas with an economy similar to the Little Blue River Basin indicate that as an initial increment of personal income is respent in the trade area, the total effect is approximately two times greater.

If the entire $186,600 were dispersed in the basin the total income effect would be at least $373,200 annually. No attempt was made to project the income multiplier for 2020. However, as the basic-derivative employment ratio increased the income multiplier will react in a similar fashion.

The federal share of installation costs for watershed developments recommended plus the already approved PL-566 watersheds totals $2,394,000. If a ten-year period is allowed for project installation and federal funds distributed equally over the period, this is equivalent to an annual investment of approximately $239,400. All (or a part) of this amount can represent new income to the basin provided that a local contractor is selected and he purchases labor, machinery and supplies within the basin. This added increment of income will be quickly dispersed and short-lived. The impact of this investment on the local economy is again influenced by the income multiplier for a total of about $478,800 annually during the construction period.

The projected economic effects will be realized in the basin and will contribute to basin economic development objectives. To the extent that additional agricultural production and associated economic activity merely displaces production and activity in other areas or affects market prices, the benefits may not truly be national gains. The output increasing effects of the proposed development are so small however that any displacement or price effects would be insignificant.

C. Land Use and Availability

Generally, sufficient lands are available for the proposed water

resource developments. Construction of the proposed small watershed projects, including those already approved for installation, would require the removal of 16,940 acres of land formerly available for agriculture use. About 5,540 acres is needed for the permanent pools, 6,750 acres for the floodwater pools, 3,580 acres for recreation and fish and wildlife, and 1,070 acres for right-of-ways for upland multiple purpose channels. The benefits from the proposed projects will greatly exceed the reduction in income from the acreage taken out of agriculture production.

Over 462,000 acres of land in the basin are estimated to be potentially irrigable. The current normal acreage is 270,000 acres or 58 percent of the total potential. Since nearly all of the potential irrigation evaluated will be private, land availability is no problem. The total crop production from the potentially irrigable land would more than double the total dryland production. Yields for irrigated corn and sorghum, for example, are about two and one-half times and two times the respective yields for nonirrigated land.

D. Social and Institutional Effects

Development of the water, land, wildlife and related resources of the Little Blue Basin will improve the social environment of the rural and urban areas. 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.

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 acceptable to the people in the basin. The Nebraska Natural Resources Commission has the responsibility to coordinate the various proposals and plans from reports and data submitted by the cooperating federal and state agencies.

Implementation of resource development programs can occur only with the support of the local people. Acceptance of programs will be expedited when the local people are well informed about the programs and actively participate in the decision making process. Agencies that will assist in the task of informing the public are the Nebraska Natural Resources Commission, the Extension Service-University of Nebraska and many local organizations and news media.

The major development proposals for the basin can be installed under the programs of the U.S. Department of Agriculture, U.S. Army Corps of Engineers and the U.S. Department of the Interior. State and local entities of government 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 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 Little Blue River Basin. The Bureau of Reclamation, U.S. Department of the Interior, has made a reconnaissance investigation and has completed a report. The key feature of this study is the proposed Angus Dam and Reservoir on the Little Blue River which would provide storage for irrigation, flood control, recreation and fish and wildlife purposes. The proposed reservoir would provide irrigation water for 20,000 acres of land south and east of the proposed dam. It would provide 337,000 acre feet of storage for flood control with the 5,100 acre conservation pool available for recreation and fishery uses.

The U.S. Army Corps of Engineers has evaluated the proposed Angus Reservoir for flood control benefits and has made studies at a number

of urban areas for local protection projects and floodplain information reports.

Several state 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 basin and has a continuing program of acquisition and management of land and water for recreation and fish and wildlife purposes. Local and county governments construct and operate needed developments for a variety of purposes. In many cases special purpose districts have been established to install specified improvements.

The laws of the State of Nebraska provide for floodplain 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 irrigation project proposed by the Bureau of Reclamation and the upstream watershed projects proposed by the U.S. Department of Agriculture should be coordinated in planning. Locations of upstream structural measures should be advantageous to both programs. The benefits of coordinated locations should be considered in the economic evaluation of the watershed developments.

There is need for further coordination of the proposed upstream watershed projects with the Nebraska Game and Parks Commission in the detailed planning of proposed recreation developments. Additional coordination is also needed with the Bureau of Sport Fisheries and Wildlife to obtain efficient joint development of agricultural and wildlife resources.

C. Alternatives

A coordinated comprehensive program oriented toward a balance of the economic, social and environmental objectives would provide the most desirable development of the land and water resources of the basin. This would have a combined effect of improving the economic and environmental condition of the basin by reducing flood losses and enhancing

agriculture generally; 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. The 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 the USDA report endorses this type of comprehensive program other alternatives may need to be considered before implementing a final plan for the basin. One alternative for water resource development would be unilateral installation of projects without regard to the relationships to or effects on other projects. This would in some cases result in overlapping development, competition for structure sites and installation of projects to benefit an area or property that might later be involved in other projects. Installation of the features of any one program without coordination with other programs could result in providing substantial benefits to some of the floodplains of the basin while flood damages would continue uncontrolled in other parts of the basin. For instance, the USDA plan would be effective in the upstream areas but main stem damages would not be significantly reduced. Conversely, the downstream developments proposed by other agencies would provide protection to the main stem and major tributary properties but would not benefit the upstream portion of the basin.

A 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 beautification. 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 preempt 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 may not be possible under present USDA programs but careful planning and correlation of available program resources can provide many of the benefits of both alternatives through a multiple purpose, ecologically oriented agriculture.

A comprehensive plan would probably include consideration of both structural measures, zoning of floodplains and land use regulations to

minimize flood damages. An alternative to this type of development would be to implement only the zoning and land use aspects of the plan. This would reduce the damages to future developments but would have little beneficial effect on current or projected damages to existing developments.

Another alternative would be to continue only the present programs of soil and water resource conservation development and utilization instead of adding the accelerated program proposed by this report. In general, present programs satisfy some basic individual and local needs but seldom provide for basinwide or state-wide requirements. If present programs continue as in the past federal cost-sharing and technical assistance will be needed at or above 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 the fertility and productive capability of the land. 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 beautification. 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 that 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; for forest and woodlands -- improved forest management, tree planting for higher grade forest products and elimination of damaging grazing.

Changes in present programs and addition of new programs are also needed to fully develop the water and related land and to enhance the environmental resources of the basin. A basinwide land treatment program is needed to assist farm and ranch operators to plan and contract for the installation of complete conservation programs according to agreed schedules. The Great Plains Conservation Program provides this type of assistance in seven counties of the basin. A similar type of program should be made available in the remaining counties with the features of contracting and scheduling the installation of conservation treatment.

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.

In order to provide for the optimum water and related land resource development in the Little Blue Basin it is suggested that consideration be given to providing storage for water necessary for low flow augmentation. The Rural Development Act of 1972 permits cost-sharing under the Watershed Protection and Flood Prevention Act (PL 566) to provide such low flow augmentation. Cost-sharing will be provided when benefits contribute primarily to public welfare such as improvement of aesthetic aspects of environment; enhancement of fish and wildlife habitat; and the increase of assimilative capacity of streams.

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