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**UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY**

**A PLAN FOR STUDY OF WATER RESOURCES IN THE
PLATTE RIVER BASIN, NEBRASKA —
WITH SPECIAL EMPHASIS ON THE STREAM-AQUIFER
RELATIONS**

By

C. F. Keech, J. E. Moore, and P. A. Emery

Principal cooperating agencies:

CONSERVATION AND SURVEY DIVISION, UNIVERSITY OF NEBRASKA

U.S. BUREAU OF RECLAMATION,

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U.S. ARMY CORPS OF ENGINEERS

OPEN FILE REPORT



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NEBRASKA DISTRICT
Water Resources Division
Lincoln, Nebraska 68508

January 1973

CONTENTS

	Page
Abstract	3
Introduction	4
Hydrogeology	9
Water-resource developments and related problems	16
Legal constraints on water-resource developments	23
Description of plan for study.	24
Work outline.	27
Available data.	30
Selected bibliography.	31

ILLUSTRATIONS

Figure 1. Platte River subbasins and principal topographic regions	8
2. Locations of stream-gaging stations and principal areas irrigated with surface water	12
3. Principal areas irrigated with ground water	17

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ABSTRACT

A "Level B" study is being made of the Platte River basin in Nebraska. The basin (approximately 40,800 square miles) extends the full length of the State, a distance of nearly 470 miles. The study is a Federal and State interagency effort to formulate a comprehensive plan for the conservation, development, and management of the water and related land resources of the Platte River basin. The technical information for the study will be provided by 14 task forces. This report describes the work of the Level B Stream-Aquifer Hydrology Task Force (Task Force 13). The U.S. Geological Survey is the lead agency for this task force.

Task Force 13 will provide the agencies participating in the Level B study with a quantitative description of the operation of the hydrologic system with emphasis on the relation of ground water to surface water. A digital model will be developed to simulate the physical character and operation of the stream-aquifer system. After the model has been calibrated with field data, it will be used to evaluate the effect of proposed projects. Some of the uses of the model are evaluation of effects of proposed conjunctive use projects, effects of changes in water use, and study of future water problems such as water-logged areas, groundwater mining, and streamflow depletion.

INTRODUCTION

Water resources of the Platte River basin in Nebraska far exceed those of any comparable area in the Missouri River basin. Much development of the water resources of the Platte River basin already has taken place, and more is contemplated for the future. Some problems associated with water development have already occurred, and others are anticipated. Near the completion of the Type I Comprehensive Framework Study of the Missouri River basin, it became apparent to those involved in that study that the Platte River basin in Nebraska would require a more detailed study to investigate complex problems before further project or program implementation studies could be initiated. As a result, a detailed "Level B" study of the Platte River basin in Nebraska was begun.

The Level B study is a Federal and State interagency effort to formulate a comprehensive plan for the conservation, development, and management of the water and related land resources of the Platte River basin of Nebraska. The technical information for the Level B study will be provided by 14 task forces. This report describes the work of the Stream-Aquifer Hydrology Task Force, designated as Task Force 13.

This task force will provide those Federal and State agencies participating in the Level B study with a quantitative description of the operation of the hydrologic system in the Platte River basin. In order to make this description, a digital model will be developed to simulate the physical character and operation of the stream-aquifer system. After the model has been tested and calibrated with field data, it will be used to evaluate the effect of proposed water projects on the ground-water and surface-water system.

The approach for this study is summarized as follows:

1. Assemble and analyze all available hydrologic data needed to define the stream-aquifer system.
2. Develop a preliminary digital model of the basin.
3. Collect data to refine the model.
4. Develop and calibrate a digital simulation model of the entire basin in Nebraska, including tributaries.
5. Use model to evaluate proposed water development and management plans.

The Stream-Aquifer Hydrology Task Force is composed of representatives from the U.S. Geological Survey; Conservation and Survey Division and Department of Agricultural Engineering, University of Nebraska; Nebraska Department of Water Resources; Bureau of Reclamation; Soil Conservation Service; Corps of Engineers; and Environmental Protection Agency.

The plan of study for the task force as given in this report was reviewed and approved by these agencies at a meeting in Lincoln on July 7, 1972. The Geological Survey is the lead agency for Task Force 13 and has the major responsibility for completing the study. The Conservation and Survey Division of the University of Nebraska and the Bureau of Reclamation (Grand Island, Nebraska, office) will be relied on to make major contributions.

The contribution to be made by the Conservation and Survey Division is summarized as follows:

1. Compile and plot the following data on preliminary maps--
scale 1:250,000:
 - a. Thickness of water-bearing deposits.
 - b. Transmissivity of saturated zone, as determined from test-hole logs and irrigation-well performance tests.
 - c. Storage coefficient of water-bearing deposits.
 - d. Depth to water table.
 - e. Configuration of water table.
 - f. Well-yield map.
2. Verify data by fieldwork, as necessary.
3. Collect additional field data in areas selected for detailed modeling.
4. Prepare detailed maps for specific areas of interest.
5. Provide consultation services regarding application of data to the model.

The contribution to be made by the U.S. Bureau of Reclamation is summarized as follows:

1. Supply basic hydrologic data.
2. Update existing hydrologic studies for proposed USBR projects.
3. Update and modify computer programs.
4. Participate in the design, calibration, and use of the digital model of the Platte River basin.

Other major phases of the investigation will be accomplished by the U.S. Geological Survey in collaboration with other agencies and task forces on items of mutual concern.

The Level B study area is the part of the Platte River drainage basin that is within Nebraska (fig. 1). It extends the full length of

Figure 1 (caption on next page) belongs near here.

the State, a distance of nearly 470 miles, and its greatest width is about 153 miles. The altitude of the Platte River at the Wyoming-Nebraska line is 4,025 feet, and at the mouth it is 945 feet. The highest point in the study area, 5,424 feet, is at the southwest corner of the Nebraska panhandle.

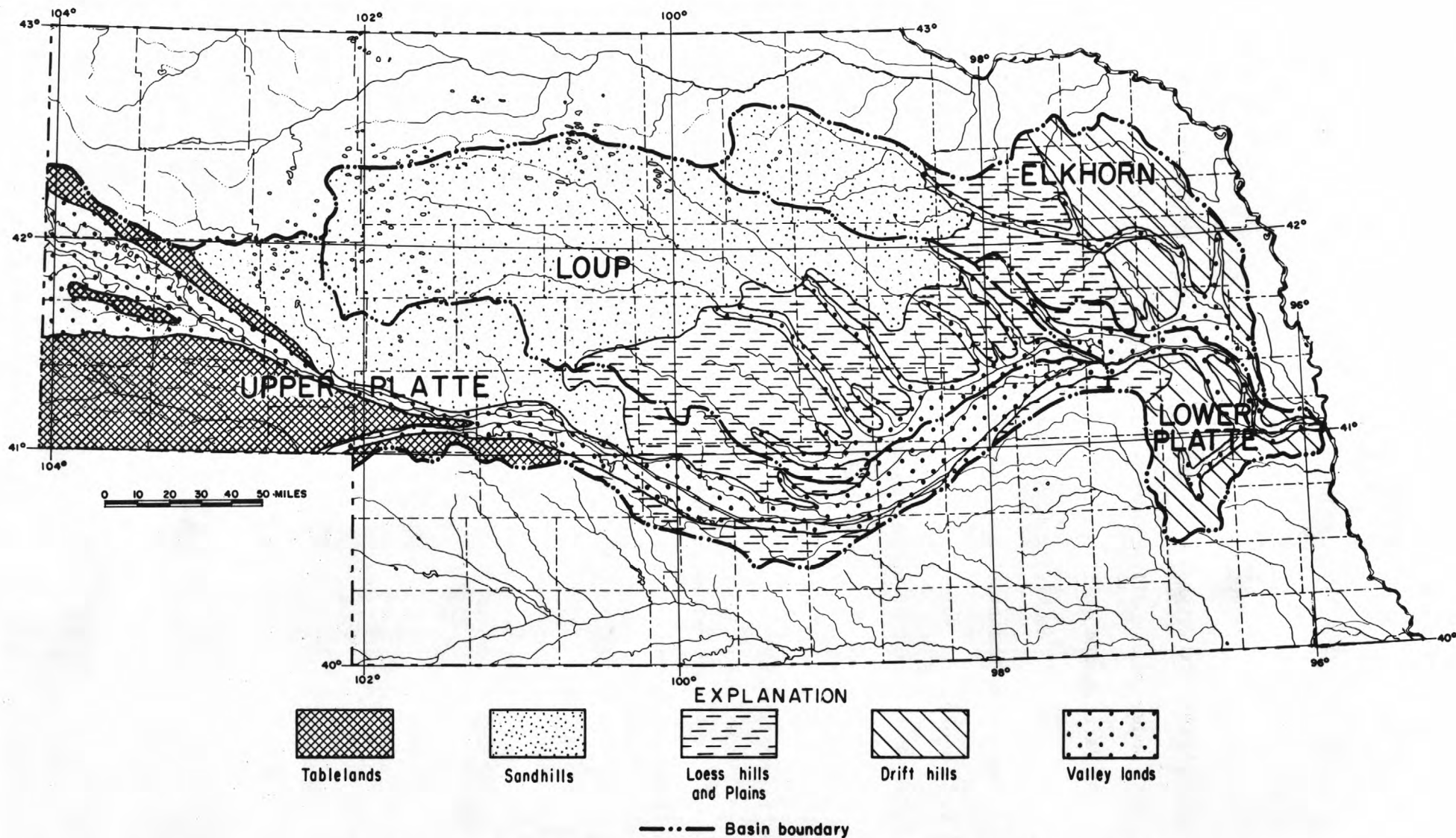


Figure 1.--Platte River subbasins and principal topographic regions, Nebraska.

As shown in figure 1, the basin is conveniently divisible into the following subbasins:

<u>Subbasin</u>	<u>Area, square miles</u>
Elkhorn	6,989
Loup	15,213
Upper Platte	15,461
Lower Platte.	<u>3,043</u>
Total. . .	40,706

HYDROGEOLOGY

The Platte River basin in Nebraska comprises a variety of terrains, the larger of which are tablelands formed by rocks of Tertiary age, a vast region of sandhills, loess hills and plains, drift hills, and valley lands. (See fig. 1.)

The Tertiary rocks are as much as 1,300 feet thick at the west end of the State, and they thin eastward to extinction about two-thirds the distance across the State. Extensive exposures of these rocks are limited to the upland parts of the North and South Platte River drainage basins. Throughout the remainder of the Platte River basin, the Tertiary rocks and the uppermost consolidated rocks in the eastern third of the State are mantled almost everywhere by unconsolidated deposits of Quaternary age. Where they fill valleys in the underlying rock, these deposits are as much as 300-400 feet thick; but where they mantle hills, they are somewhat thinner and in a few places are very thin or absent. Possibly as much as a third of the volume of Quaternary deposits consists of coarse-textured alluvium, and the remainder consists of fine-textured alluvium, dune sand, loess, and glacial drift. In the Platte River valley and other principal valleys, coarse-textured alluvium is either exposed or thinly covered by loess; but in upland areas, it generally is more thickly covered by fine-textured alluvium, loess, or glacial drift.

The Ogallala Formation, which is the uppermost of the Tertiary stratigraphic units, and the alluvium of Quaternary age are the principal aquifers. Where the alluvium directly overlies the Ogallala, the two constitute a single aquifer. Throughout a large part of the Platte River basin, these aquifers supply large amounts of ground water for irrigation, municipal supply, and industrial use. Shaffer (1972, p. 43, 51, 55) estimated that pumpage from these aquifers for irrigation, urban, and rural domestic and livestock use in 1970 amounted to about 1.5 million acre-feet.

The sandhills region is hydrologically important because the sand so readily absorbs precipitation that virtually no overland runoff occurs. Furthermore, the thickness of saturated materials beneath the sandhills region is greater than in any other part of the basin. As withdrawals by pumping there are small, most of the absorbed water eventually moves to areas where it is discharged to the atmosphere by evapotranspiration or by seepage to streams. Streams originating in the sandhills region are noted for their steady rate of flow and are an important source of water for irrigation and the generation of electric power.

Streamflow in the basin is derived from three sources: Surface-water inflow from Wyoming and Colorado, precipitation on the basin, and ground water. Each is a variable quantity, and this variability constitutes a principal problem in managing the water supplies of the basin. The locations of stream-gaging stations in the Platte River drainage basin in Nebraska are shown on figure 2.

Figure 2 (caption on next page) belongs near here.

Construction and operation of reservoirs in the Wyoming part of the North Platte River drainage basin have done much to regulate the inflow of surface water to Nebraska and meet the seasonal variations in water demands. As surface-water inflow from Colorado generally is least when water demands in Nebraska are the greatest, the usefulness of this inflow is limited.

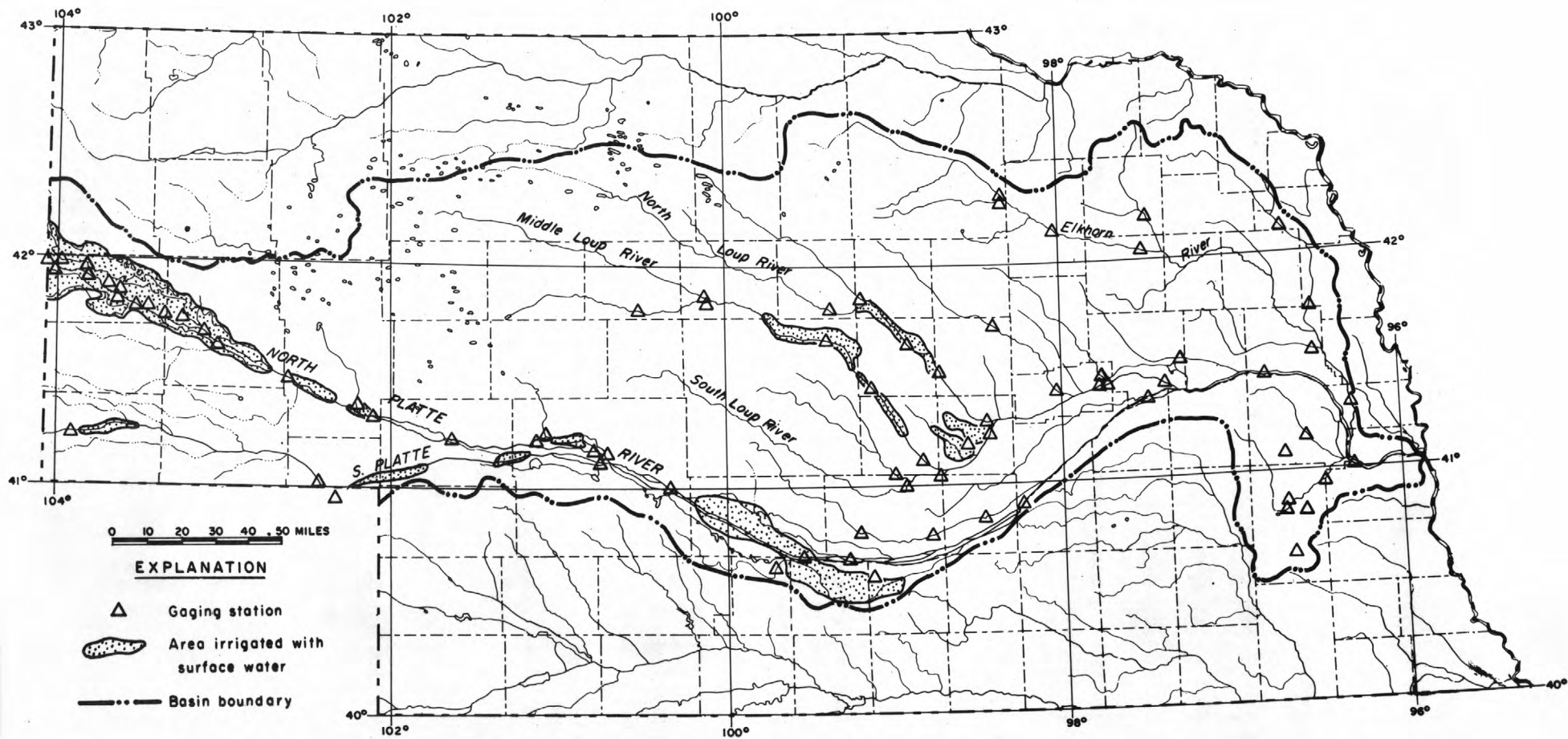


Figure 2.-- Locations of stream-gaging stations and principal areas irrigated with surface water, Nebraska.

Precipitation is highly variable in amount, in geographic distribution, and in time. Average annual precipitation ranges from 15 inches at the western end of the State to 29 inches at the eastern end, or about 50 million acre-feet per year on the Platte River basin. Except for some of the snowmelt and spring rains that produce surface-water outflow from the basin, virtually all of the precipitation evaporates, is consumed by vegetation, or is added to ground-water storage. It is estimated that less than 1 percent of the precipitation on the basin in 1970 produced direct runoff from the basin. Somewhat greater values would characterize those years when large discharges resulted from rain on a rapidly melting snow cover. How large a percentage of the precipitation on the basin in 1970 was consumed through evapotranspiration or was added to ground-water storage cannot be estimated from the available data. Large variations in the percentage that is added to ground-water storage occur from year to year; but over the long term, it is estimated to be at least 7 percent. Geographically the percentage differs greatly. For example, as much or more than 25 percent of the precipitation in the sandhills region may be added to storage, but only a fraction of 1 percent of the precipitation percolates into the western tablelands. A fairly large percentage of the precipitation on valley lands also is added to ground-water storage. Although not measured, evapotranspiration probably ranges from less than 75 to more than 99 percent of the average annual precipitation. However, the total quantity of water consumed in some years by evapotranspiration is considerably greater because some of the water thus consumed is from holdover storage in surface reservoirs or as soil moisture.

The water supply of the Platte River basin in Nebraska in water year 1970 (data from Shaffer, 1972, p. 25-30; ground-water inflow and outflow not included) is summarized below:

	Thousands of <u>acre-feet</u>
Inflow:	
North Platte River, Wyoming-Nebraska line	519
Interstate Canal, Wyoming-Nebraska line	304
Fort Laramie Canal, Wyoming-Nebraska line	131
Mitchell and Gering Canals, Wyoming-Nebraska line	67
Lodgepole Creek at Bushnell, Nebr	6
South Platte River at Julesburg, Colo	<u>814</u>
Total	1,841
Precipitation:	
Elkhorn subbasin	8,749
Loup subbasin	15,938
Upper Platte subbasin	14,621
Lower Platte subbasin	<u>4,137</u>
Total	43,445
Decrease in reservoir storage	13
Outflow:	
Lodgepole Creek at Ralston.	6
Platte River near South Bend	3,269
Ungaged below South Bend	27
Effluent from Allied Chemical Corporation Plant	25
Pumpage into Omaha water system	<u>31</u>
Total	3,358

The difference, 42 million acre-feet, between outflow and the sum of inflow, precipitation, and decrease in reservoir storage is assumed to be that part of the 1970 precipitation that was returned to the atmosphere by evapotranspiration, was incorporated into plant and animal tissue, or was added to soil-moisture or ground-water storage. Of these, evapotranspiration was the greatest by far.

Some water that is lost from the basin could be retained for beneficial use through construction of additional surface reservoirs and by increased use of water-conservation practices on the land. The largest existing surface reservoir in the basin is Lake McConaughy, which has a usable storage capacity of nearly 2 million acre-feet. Usable storage in other reservoirs totals about 0.3 million acre-feet. Some additional storage is proposed. The principal purposes of water-conservation practices are to reduce nonbeneficial overland runoff and to increase soil-moisture storage.

WATER-RESOURCE DEVELOPMENTS AND RELATED PROBLEMS

Development of surface-water supplies, particularly for irrigation, began in the 1880's and has continued to the present time. (See fig. 3.)

Figure 3 (caption on next page) belongs near here.

Most of the earlier development took place in the more arid western part of the basin, and rights to appropriate streamflow commonly exceed the supply during the latter part of the irrigation season. Most of the later project-type developments divert from the Loup River and its tributaries. Prospective irrigation developments range in size from small individually owned acreages to irrigation projects that are many thousand acres in extent; both direct-flow diversions and complex storage developments that vary widely in magnitude are involved. Much of the earlier development of surface-water supplies resulted from local initiative and funding by private interests with the irrigation limited largely to valley lands. However, most of the later developments involved planning, financing, and construction by Federal agencies and State Irrigation and Reclamation Districts. These later developments have extended irrigation to the upland areas as well as to additional valley lands.

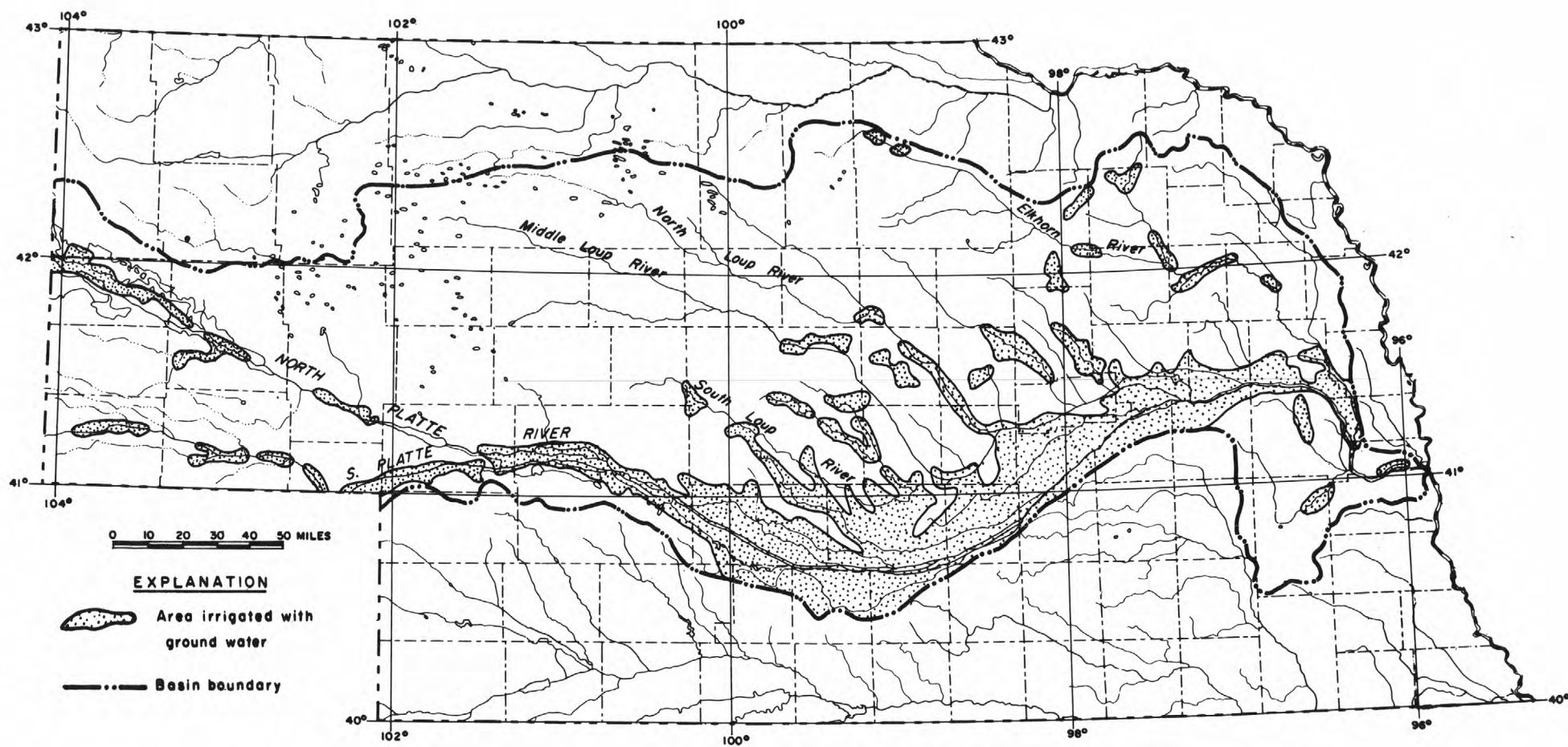


Figure 3.-- Principal areas irrigated with ground water, Nebraska.

As shown in figure 3, development of ground water for irrigation is extensive in both valley and upland areas, particularly in the eastern two-thirds of the basin. A few ground-water developments adjacent to the Platte River, specifically for municipal use at Grand Island, Fremont, Lincoln, and Omaha, were designed to insure a perennial water supply by inducing surface water to recharge the aquifer. Other developments in valley areas have accomplished this inadvertently. In some areas, particularly in upland parts of the basin, ground-water developments have caused water levels in wells to decline progressively. In such areas, water is being withdrawn from storage. Some water users in those areas are considering the importation of surface water to augment their water supplies.

Irrigated acreages and estimated amounts of water used for irrigation in 1970 (Shaffer, 1972, p. 40, 43) are as follows:

Surface-water irrigation

<u>Subbasin</u>	<u>Area irrigated (acres)</u>	<u>Amount of water diverted (thousands of acre-feet)</u>
Elkhorn	20,400	20
Loup	121,200	230
Upper Platte	689,300	1,675
Lower Platte	<u>9,600</u>	<u>10</u>
Total ...	840,500	1,935

Ground-water irrigation

<u>Subbasin</u>	<u>Area irrigated (acres)</u>	<u>Amount of water pumped (thousands of acre-feet)</u>
Elkhorn	129,585	130
Loup	237,935	238
Upper Platte	948,290	948
Lower Platte	<u>130,040</u>	<u>130</u>
Total ...	1,445,850	1,446

Even though development of irrigation has done much to increase crop production, stabilize agriculture, and promote agricultural-support business, it has caused some detrimental effects. In some places where surface water is used, agricultural land has become waterlogged because the water table has been raised to, or nearly to, the land surface. Problems of soil salinity have developed in some such waterlogged areas. Furthermore, irrigation return flows contribute to increased mineralization of the receiving streams. Use of ground water in some upland areas has caused a lowering of the water table below the depth reached by shallow wells and has necessitated deepening of those wells. Any such lowering of water levels also has prompted concern that ground-water supplies are being depleted. Although significant depletion of streamflow by pumping from wells has not been demonstrated, many users of streamflow are fearful that low flows that are maintained by ground-water seepage will diminish and eventually cease. A benefit of pumping in areas of shallow water table is the salvaging of water that would otherwise be lost to evaporation or be used by nonbeneficial vegetation.

Other consumptive uses of water in the basin are for urban, rural domestic and livestock, and industrial supplies. Nonconsumptive uses are for cooling at fuel-electric power plants, the generation of hydroelectric power, and recreation.

The quantities in the following statements are from Shaffer (1972, p. 54-58).

Urban supplies in 1970 totaled 93,300 acre-feet, or 83.3 mgd (million gallons per day). All were obtained from ground-water sources, and the total includes 40 percent of the supply for Omaha, which is located outside the Platte River basin.

The amount of water for rural domestic and livestock use in 1970 was estimated at 70,000 acre-feet, or 62.6 mgd. All domestic and most livestock supplies are obtained from wells.

Industrial use included 5.3 mgd injected for secondary recovery of oil (Upper Platte subbasin), 16.0 mgd for processing of sugar beets (Upper Platte subbasin), 1.7 mgd for State institutions (mostly Upper and Lower Platte subbasins), and an unknown amount for small self-supplied industries. All water for these uses was obtained from wells.

Water used for cooling at fuel-electric plants amounted to 352.4 acre-feet, or 311.1 mgd. All but 82.9 acre-feet (74 mgd) was pumped from wells.

A total of 6.9 million acre-feet of water was used for the generation of hydroelectric power. Considerable reuse of water is involved as water passing through an upstream hydroelectric plant may pass through one or more other plants downstream. Furthermore, the water that has passed through several plants is still available for downstream consumptive use.

Much recreational use is made of surface reservoirs constructed and operated primarily for irrigation, flood control, or power generation. Similar use is made of water in borrow pits along Interstate 80 west of Grand Island and in abandoned gravel pits at numerous valley locations. Several of the gravel-pit lakes are surrounded by summer homes.

Planning of water-resource developments should take into account all the foreseeable impacts of those developments. Stream-aquifer relations are sure to be affected by some of the developments, and the magnitude of attendant problems can only be surmised at the present time. Simulation of the existing stream-aquifer relations will provide a valuable tool for the evaluation of the effect of the potential changes. Stream-aquifer relations are of particular interest in the reach of the Platte River in Buffalo, Hall, and Merrick Counties because water-level contours indicate near-equilibrium conditions exist there. They also are of interest in the reach between the mouth of the Loup River and the mouth of the Platte River as that reach is near the State's two largest metropolitan areas and has a significant potential for industrial development of ground-water supplies dependent on induced recharge from the river.

LEGAL CONSTRAINTS ON WATER-RESOURCE DEVELOPMENTS

Existing interstate water compacts and a United States court decree apportion the flows of the South and North Platte Rivers. The South Platte River Compact between Colorado and Nebraska provides that from April 1 to October 15, Colorado shall not allow diversions from the river below the Washington County line near Balzac for Colorado appropriations with priority dates after June 1897, if such diversions would deplete the flow at the State line below a mean daily flow of 120 cfs (cubic feet per second). Each State is allowed full use of Lodgepole Creek within its respective boundaries.

The decree in Nebraska v. Wyoming affecting use of natural flow of the North Platte River limits irrigation acreage, irrigation storage, and export of water to other basins in Colorado and Wyoming. It fixes the relative storage rights for Pathfinder, Guernsey, Seminoe, and Alcova Reservoirs, and the water rights of certain Nebraska canals diverting near the Wyoming-Nebraska State line as against the storage rights of the named reservoirs and the natural-flow right of the Kendrick project. It allots 25 percent of the natural flow available in the Guernsey Dam-Tri-State Dam section to Wyoming and 75 percent to Nebraska during the period of May 1 to September 30. The decree permits any of the parties to apply for an amendment or extension of the decree. Such an amendment was consummated by a stipulation approved by the Supreme Court in January 1953, relating to the Glendo Unit.

Much more use of water could be made in Nebraska if water in excess to needs within the Platte River basin could be transported to an adjacent basin where a water shortage exists. The newly developed water plan for the State envisions transfer of water from one basin to another; but because transbasin diversions have been restricted by a Nebraska Supreme Court Decision (*Osterman v. Central Nebraska Public Power and Irrigation District*, 131 Neb. 356, 268 N.W. 334, 1936), it is probable that no such developments could be implemented without legislative action to clarify the law and state policy on this issue. Some environmental impacts of proposed transbasin diversions could be evaluated by simulation modeling.

DESCRIPTION OF PLAN FOR STUDY

The objective of Stream-Aquifer Hydrology Task Force 13 is to provide a quantitative description of the operation of the hydrologic system in the Platte River basin with emphasis on the relation of ground water to surface water. As pointed out earlier, stream-aquifer relations are of concern because many stream appropriators fear that pumping from wells will deplete low flow significantly. Where a good hydraulic connection exists between a stream and aquifer, pumping from wells adjacent to or very near the stream induces recharge from the stream and thus has a depletionary effect on natural streamflow. Pumping from wells that are farther from the streams may intercept ground water that would otherwise have discharged, either by evapotranspiration or by seepage, into the stream.

There has been considerable speculation regarding estimates of the relative effects of pumping on streamflow and on water loss by evapotranspiration. Some believe that streamflow already has been depleted appreciably by pumping from wells, others are convinced that the depletionary effects now are small but will become increasingly significant with time, and a few seem sure that the depletionary effects never will be a cause for concern. The stream-aquifer models proposed for construction by this task force should be so designed that all tangible factors are evaluated and the depletionary effects caused by pumping from wells and by surface-water manipulations are defined convincingly. Only then can planning for additional water-resource developments proceed with confidence.

Some of the assumptions for the stream-aquifer models are:

The ground-water system is considered as a single unconfined aquifer consisting of Pleistocene and Pliocene rocks. Underlying bedrock is relatively impermeable.

The aquifer is hydraulically connected to the Platte River and other major tributaries.

Ground-water recharge is from applied irrigation water, precipitation, and canal and tributary leakage.

Ground-water discharge is by underflow, pumpage, evapotranspiration, and seepage to streams.

Water can be salvaged from evapotranspiration by lowering the water table.

Ground-water recharge is not increased significantly by lowering the water table.

Evapotranspiration from the water table is mainly a function of depth to water.

Transmissivity is not affected appreciably by changes in saturated thickness caused by lowering of the water table.

Possible uses that can be made of the models are:

Evaluation of the effects of proposed water-resource projects (including transfer of water from one part of the basin to another or to other basins) on the stream-aquifer system.

Evaluation of the effects of changes in water use--for example, the effect of lowering the water table to salvage nonbeneficial evapotranspiration.

Evaluation of the effects of legal, economic, and social constraints on the available water supplies.

Identification of future water problems such as waterlogged areas, ground-water mining, conflict of water rights, stream-flow depletion, degradation of water quality due to reuse and depletion of the water, and the effect of changes in upriver developments on surface-water inflows to the basin.

Provision of input information for a basic transport model suitable for water-quality modeling.

The work outline for Task Force 13 is detailed on the following pages. Items under A in the outline are scheduled for completion in fiscal year 1972; those under B, C, and D in fiscal year 1973; those under E and F in fiscal years 1973 and 1974; and those under G and H in fiscal years 1974 and 1975. The total cost of the work of Task Force 13 is approximately \$260,000. Of this amount \$40,000 is budgeted for the Conservation and Survey Division, University of Nebraska; 30,000 for the U.S. Bureau of Reclamation; and the remainder for the U.S. Geological Survey.

Work outline

- A. (Fiscal Year 1972) Preparation of a plan of study and preliminary assembly of data for modeling.
 - 1. Preparation of planning report.
 - 2. Construct model of Mid-State reach of Platte River valley, Odessa to Grand Island.
 - 3. Evaluate ground-water withdrawals.
 - 4. Prepare water budget.
- B. (Fiscal Year 1973) Assembly of hydrologic and hydrogeologic data to define the physical character of the stream-aquifer system.
 - 1. Subdivide the basin into hydrologic units.
 - a. Gaged sites.
 - b. Diversion points.
 - c. Sites of proposed or potential reservoirs or streamflow augmentation plans.

2. Prepare maps needed for construction of stream-aquifer model.
 - a. Stream-aquifer hydraulic connection.
 - b. Aquifer transmissivity and specific yield.
 - c. Aquifer boundaries.
- C. (Fiscal Year 1973) Assembly of hydrologic data to define the operation of the stream-aquifer system.
 1. Select historical study period and time interval.
 - *2. Compile and analyze streamflow records on monthly basis for study period.
 3. Compile and analyze tributary and return-flow records.
 4. Compile and analyze canal diversion and reservoir records.
 5. Compile and analyze data on ground-water withdrawals.
 6. Compile surface-water applications.
 - *7. Compile and analyze precipitation records.
 - *8. Compile and analyze evapotranspiration data (maps and rate of use and evapotranspiration salvage function).
 9. Synthesize and review all hydrologic data.
 - *10. Compile data needed for water-quality study.
 11. Compile data on ground-water inflow and outflow to basin.
- D. (Fiscal Year 1973) Preparation of technical progress report (for the use of other task forces and to satisfy general requirements for the information).

- E. (Fiscal Year 1973-74) Continuation of digital-model studies. Calibration of digital model to simulate the historical operation of the stream-aquifer system. Work consists of programing input to the model, comparing model results with water-level-change maps, well hydrographs, and streamflow records.
1. Prepare preliminary design.
 2. Make simulation studies.
 3. Make calibration studies (calibrate model results with field data).
 4. Refine model and exchange data and results with State and Federal planning agencies.
- F. (Fiscal Year 1973-74) Use digital model to evaluate water-management schemes and to assist in water-resource planning.
1. Conjunctive use of ground water and surface water.
 2. Improved water development and delivery.
 3. Other uses--modification of model to fit special planning or special constraints on water development and to permit evaluations in multiobjective planning.
- G. (Fiscal Year 1974-75) Preparation of a plan for continuing studies. These studies are necessary to complete the model in a current status so that it will be available for use in evaluating new plans or modifications of plans. The continuing study should also consider the need for evaluation of the quality of both ground water and surface water. A constraint on future management plans will probably be the effect of development on water quality. It may be necessary to model the quality of both the ground water and surface water and couple this model with the hydrologic or transport model.

H. (Fiscal Year 1974-75) Preparation of technical report.

*Coordinate with Task Force 3 "Hydrology and Hydraulics."

Available data

The quality and quantity of available data describing the hydrologic framework of the study area varies considerably from one location to another throughout the study area. The same is true of information regarding natural hydrologic processes as well as man's use of the water resources.

All data, unpublished and published, relating to the hydrology of the study area will be evaluated. In addition, other Level B task forces will provide new data as input to this study.

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