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Groundwater Levels in Nebraska, 1984

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By Michael J. Ellis, U.S. Geological Survey, and Darryll T. Pederson, Conservation and Survey Division/Nebraska Water Survey Paper Number 59/Prepared in cooperation with U.S. Geological Survey/Conservation and Survey Division, Institute of Agriculture and Natural Resources, The University of Nebraska–Lincoln

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Conservation and Survey Division
Institute of Agriculture and Natural Resources
The University of Nebraska–Lincoln

The Conservation and Survey Division of the University of Nebraska is the agency designated by statute to investigate and interpret the geologically related natural resources of the state, to make available to the public the results of these investigations, and to assist in the development and conservation of these resources.

The division is authorized to enter into agreements with federal agencies to engage in cooperative surveys and investigations in the state. Publications of the division and the cooperating agencies are available from the Conservation and Survey Division, University of Nebraska, Lincoln, Nebraska 68588-0517.

Publication and price lists are furnished upon request.

June 1985

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LIST OF HYDROGRAPHS FOR KEY OBSERVATION WELLS

FACTORS FOR CONVERTING ENGLISH UNITS TO THE INTERNATIONAL SYSTEM OF UNITS (SI)

Multiply English Units	By	To obtain SI units
	Length	
inches (in)	25.4	millimeters (mm)
feet or foot (ft)	.3048	meters (m)
miles (mi)	1.609	kilometers (km)
	Area	
acres	4047	square meters (m^2)
square miles (mi^2)	2.590	square kilometers (km^2)
	Volume	
acre-feet (acre-ft)	1233	cubic meters (m^3)
	Flow	
gallons per minute (gpm)	.00006309	cubic meters per second (m^3/s)

This report on Nebraska's groundwater levels summarizes the water-level changes in 1984 on a statewide basis and by major areas.

INTRODUCTION

In 1930, the Conservation and Survey Division of the University of Nebraska and the U.S. Geological Survey began a cooperative water-level measurement program to observe and document on a continuing basis the fluctuations in groundwater levels throughout Nebraska.

This report, the thirty-first annual report on Nebraska's groundwater levels, summarizes the water-level changes from 1983 to 1984 and shows, through the use of maps of the entire state and of the major areas of the state, where significant changes from estimated predevelopment levels have occurred. It describes the availability of data on water levels, provides information on changes in the water-level measurement program during the year, and summarizes data on the two major causes of water-level changes—precipitation and groundwater use. The maps showing areas where water levels have risen or declined are based on point data. Because data points on which the maps are based are not evenly distributed, some areas may not be delineated as precisely as others.

The primary objective of most water-level measurement programs is to monitor groundwater-level fluctuations in wells in order to detect significant water-level changes. For maximum effectiveness, a water-level measurement program should include evaluation of the adequacy and accuracy of water-level information collected and should provide a means for its storage, retrieval, and dissemination in a readily understandable format.

Data on groundwater levels are important when used with other data to:

1. Determine the amount of groundwater in storage and its availability for use.

2. Assess the water-supply outlook by determining changes in the amount of groundwater in storage.

3. Identify areas where rising groundwater levels might cause waterlogging and areas where water levels are declining toward limits of economic groundwater use.

4. Provide long-term records useful for evaluating the effectiveness of land-management and water-conservation programs, for correlating and evaluating the shorter records from project studies, and for assessing the validity of the project findings.

5. Provide data for use in estimating or determining rate and direction of groundwater movement, water loss by evapotranspiration, specific yield of aquifers, base flow of streams, sources and amounts of recharge, and locations and amounts of discharge.

6. Supply long-term records needed for testing hydrologic simulation models and for assessing the validity of model assumptions and approximations.

Nebraska's water-level measurement program includes the collection of many more data than are presented in this report. These additional data are available, upon request, from the Conservation and Survey Division.

CHANGES IN WATER LEVELS, 1984

Water levels were higher in fall 1984 than in fall 1983 in over 70 percent of the observation wells measured in Nebraska. Higher water levels in 1984 are a continuation of a general statewide trend since 1980-1981. In 1984, levels were less than 3 ft higher in most wells but were 4 to more than 10 ft higher in some. The greatest water-level rises were in the east-central and northeastern parts of the state where precipitation was normal to above-normal during the growing season. Levels mostly declined in the south central, southwest, and Panhandle, reflecting large irrigation withdrawals necessitated by below-normal precipitation. Declines in these areas mostly were less than 2 ft, except in Box Butte, Chase, Cheyenne, and Perkins counties, where declines of more than 3 ft occurred.

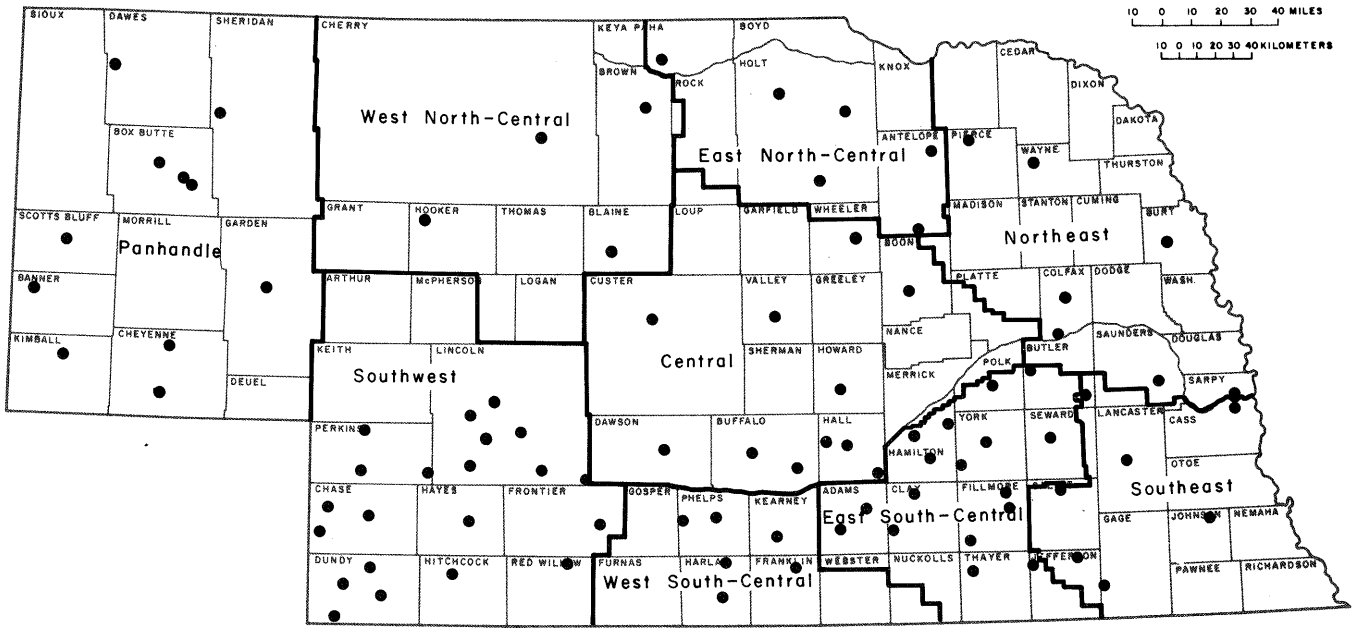
Water levels rose in more than half of Nebraska's observation wells in 1984.

Comparison of fall 1984 water levels with estimated predevelopment water levels allowed delineation of most areas of significant decline or rise in water levels that resulted from development of water resources. Water-level data collected by Natural Resources Districts in 1984 permitted the delineation of some areas of water-level change that otherwise might not have been detected. Data are sufficient to describe the water-level rises and declines that have occurred in most areas of the state. To facilitate description of water-level changes, the state has been subdivided into nine parts, each of which is described separately: Southeast Division, Northeast Division, East South-Central Division, West South-Central Division, Central Division, East North-Central Division, Southwest Division, West North-Central Division, and Panhandle Division. Hydrographs of key observation wells within each division are included in the section for that division to illustrate the seasonal and long-term fluctuations that have occurred in water levels at different locations in the division. The key observation wells in each area include those equipped with continuous recorders and other wells measured periodically that are representative of the hydrologic conditions in the areas. Hydrographs of wells measured periodically usually do not show the extremes in water-level fluctuations as accurately as recorder-well hydrographs, but are useful for showing long-term trends.

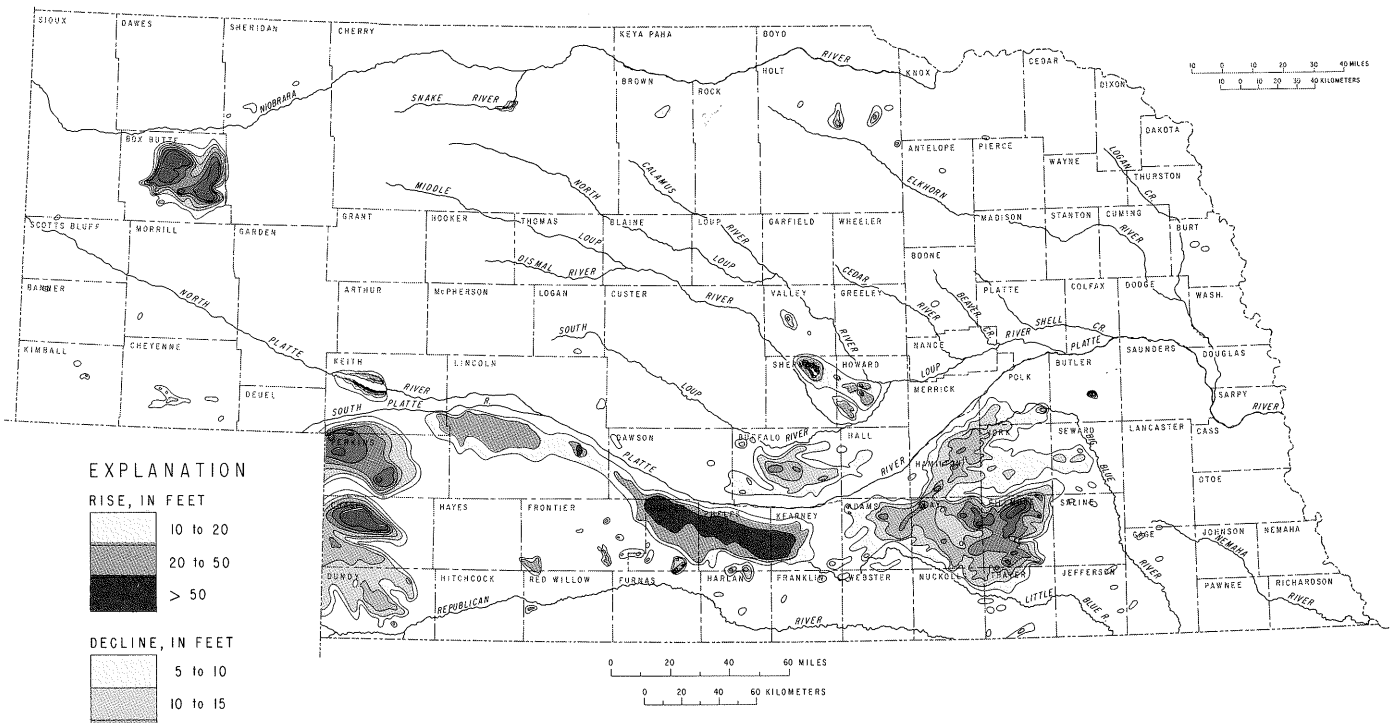
A hydrograph is a chart showing changes in the level of the water over a period of time in a well, stream, lake, or reservoir. In this report, all hydrographs show the changing level of the water in wells in relation to two reference points. On the left side of the hydrograph, the depth to water is shown in feet below land surface. On the right side of the hydrograph, the elevation of the water level in the well is shown in feet above mean sea level. The bottom of the hydrograph is marked off in intervals of time—the major divisions representing either one-year periods or five-year periods. To determine the position of the water level at any given time, locate that time on the bottom scale, move up to the plotted line, and then move either left scale for depth to water or right scale for elevation of the water level.

The period of record for many observation wells is too short to provide a satisfactory basis for determining long-term water-level changes. However, where possible, an individual comparison is made between the 1984 water level and the estimated predevelopment water level. The estimated predevelopment water level is the approximate average water level that existed in a well prior to any man-made development that significantly affected water levels in the vicinity of the well. All available water-level data collected prior to, or during, the early stages of development are used to estimate predevelopment water levels.

Before development by mankind, most groundwater systems are in a state of near equilibrium—that is, long-term recharge is approximately equal to long-term discharge. In Nebraska, natural equilibrium of groundwater systems has been altered by (1) increased discharge from irrigation wells, (2) recharge from infiltration of surface water applied to irrigated crops, (3) recharge resulting from deep percolation of seepage from irrigation storage and distribution systems, (4) discharge to man-made drains, and (5) changes in land use that affect the amount of recharge an aquifer receives. In many parts of the state, water-level fluctuations resulting from natural conditions may be either masked or accentuated by water-level fluctuations resulting from human activities.



Location of key observation wells and boundaries of divisions



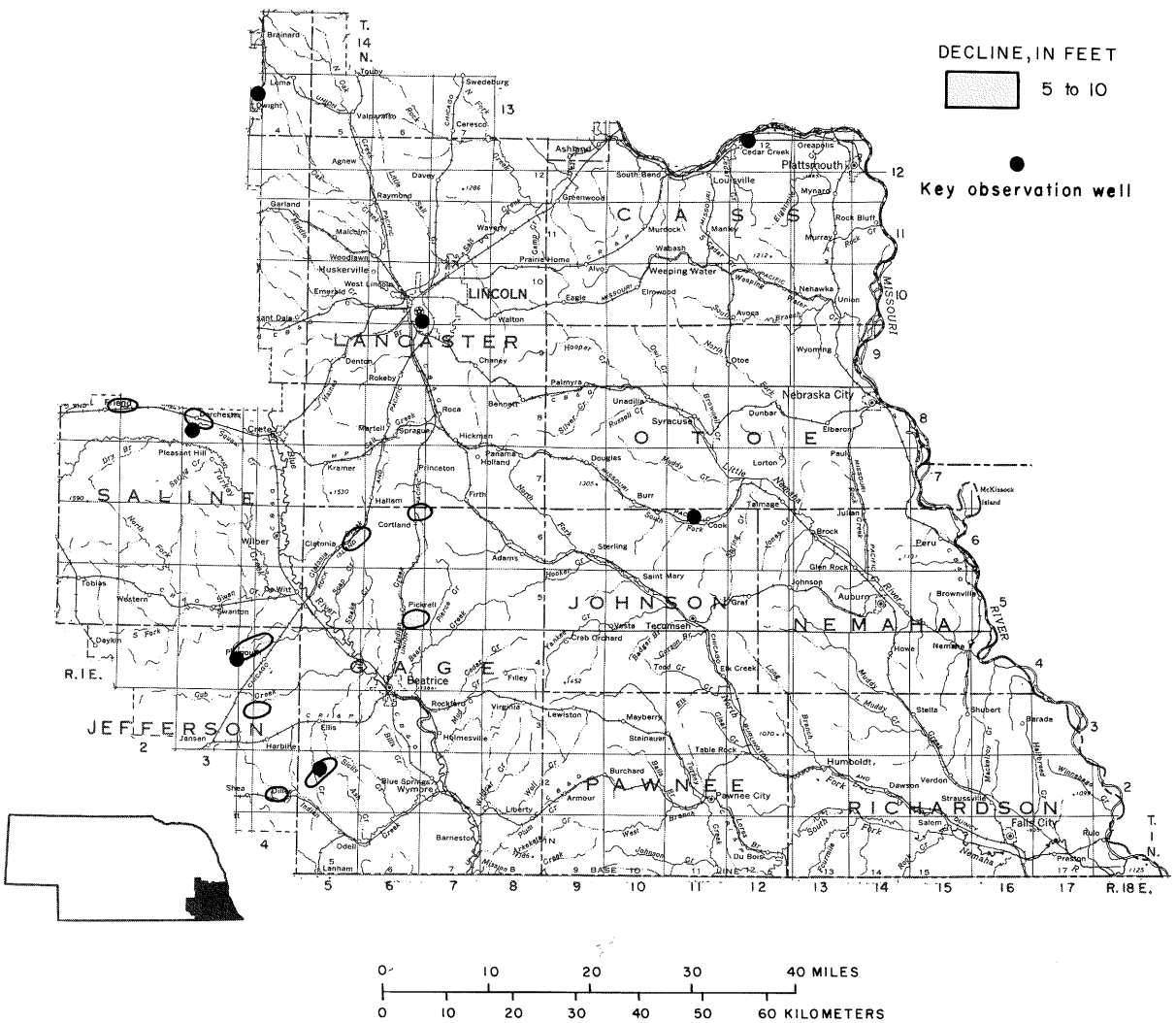
Significant rises and declines in groundwater levels from predevelopment to fall 1984

Southeast Division

Water levels in the Southeast Division averaged 0.1 ft higher in fall 1984 than in fall 1983. Most water-level rises were less than 2 ft, except in Gage and Saline counties where levels rose as much as 7.4 ft.

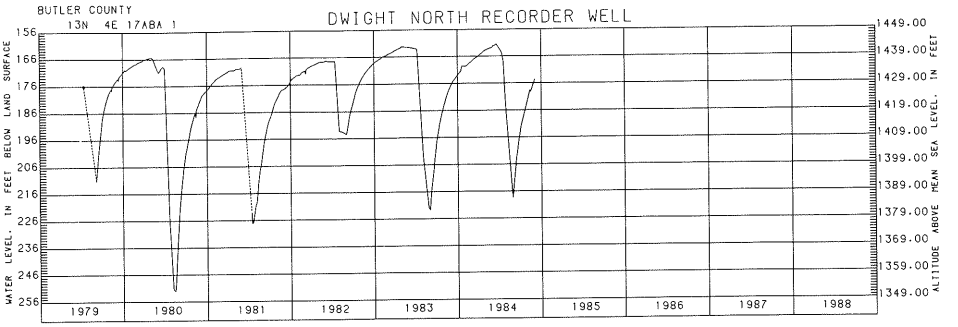
Intensive development of groundwater resources for irrigation has been limited mostly to the western part of the division and has resulted in declines of 5 ft or more from estimated predevelopment levels in an area of approximately 16,500 acres. A maximum decline of 10.7 ft occurred in a well in northeastern Jefferson County.

Estimated predevelopment water levels are based on water levels measured prior to the early 1950s. Data needed to determine predevelopment levels are sufficient only in the western part of the area. However, well-measurement programs of the Lower Big Blue and Nemaha Natural Resources Districts along with the state-federal cooperative well-measurement program provide sufficient data for good determination of current water-level changes in nearly all the area.

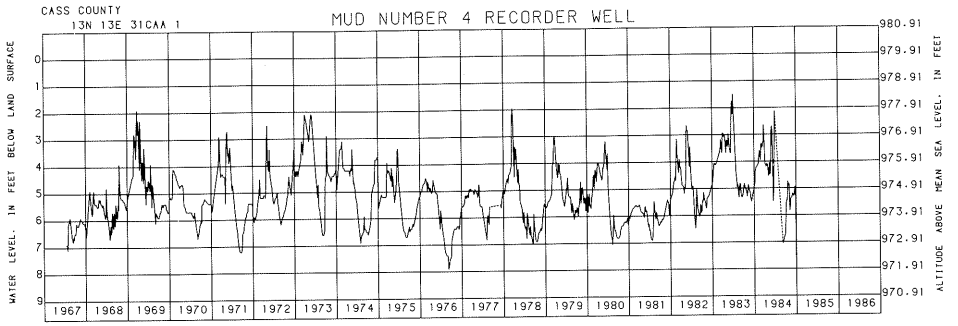


Areas of significant water-level change in the Southeast Division from 1950 to fall 1984

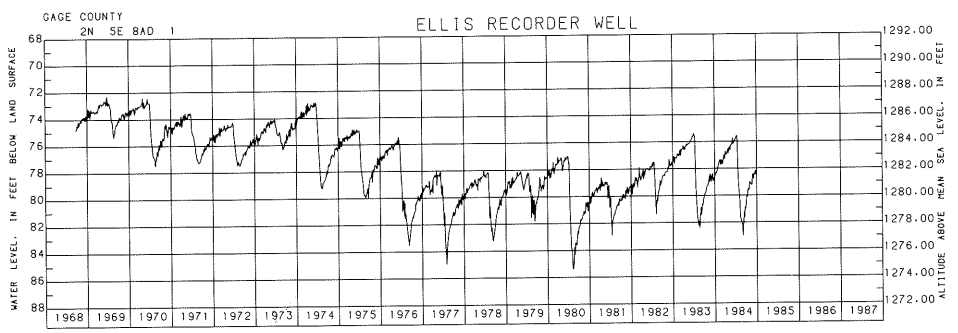
Butler County: Dwight North
Estimated predevelopment water level: 163 ft
Net water-level change in 1984 +4.58 ft
Net water-level change since 1979: +0.73 ft



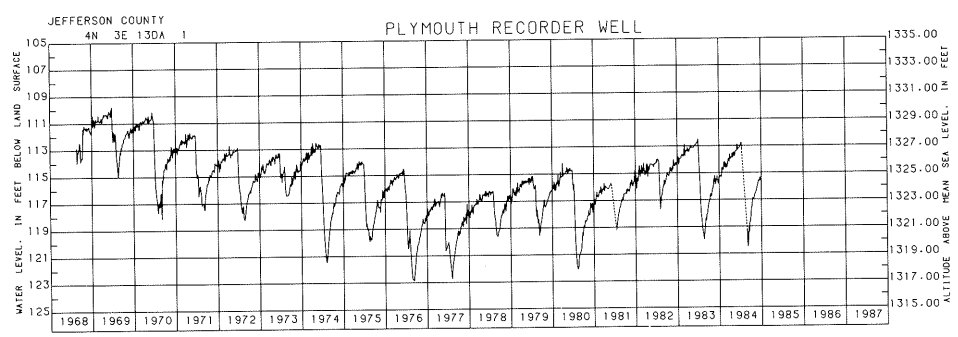
Cass County: MUD No. 4
Estimated predevelopment water level: 4.5 ft
Net water-level change in 1984: +0.15 ft
Net water-level change since 1967: +1.16 ft



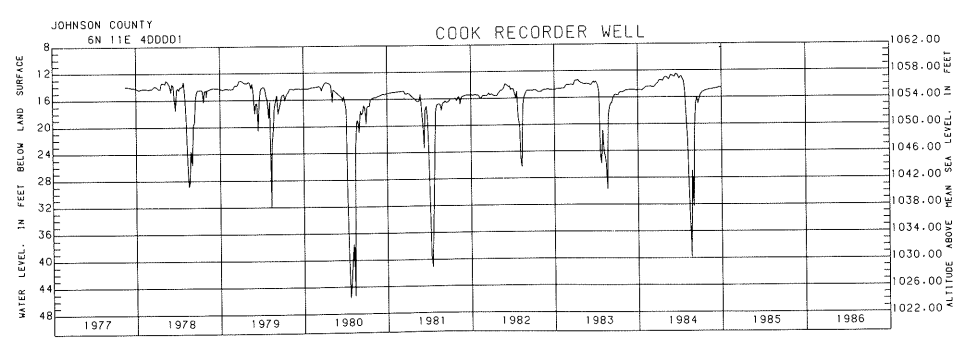
Gage County: Ellis
Estimated predevelopment water level: 73 ft
Net water-level change in 1984: +0.49 ft
Net water-level change since 1968: −4.10 ft



Jefferson County: Plymouth
Estimated predevelopment water level: 107 ft
Net water-level change in 1984: −0.11 ft
Net water-level change since 1968: −3.85 ft



Johnson County: Cook
Estimated predevelopment water level: 13 ft
Net water-level change in 1984: +0.38 ft
Net water-level change since 1977: −0.30 ft

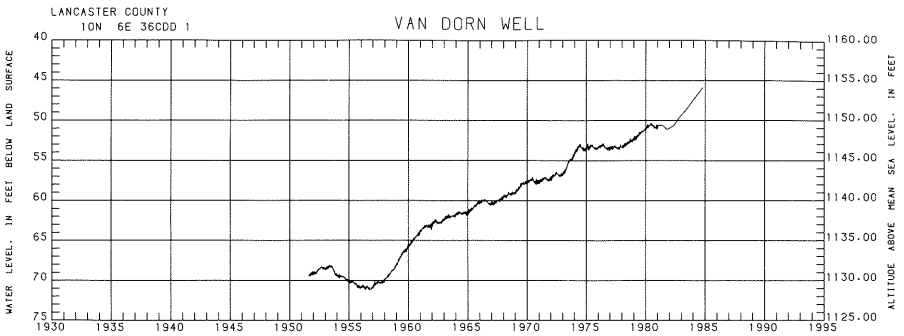


Lancaster County: Van Dorn

Estimated predevelopment water level: 35 ft

Net water-level change, fall 1983 to fall 1984: +1.91 ft

Net water-level change since 1951: +23.28 ft

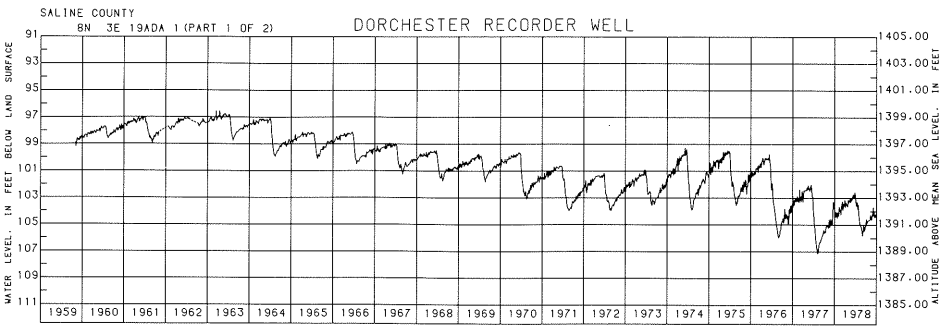


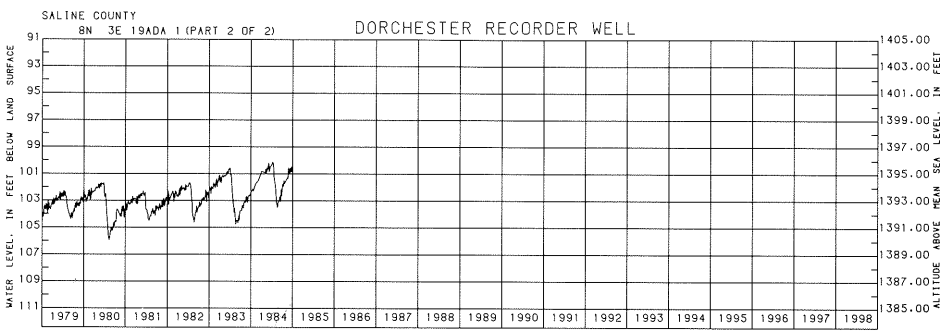
Saline County: Dorchester

Estimated predevelopment water level: 97 ft

Net water-level change in 1984: −1.91 ft

Net water-level change since 1959: −3.87 ft





Northeast Division

Water levels rose an average of 2.2 ft from fall 1983 to fall 1984 in wells measured in the Northeast Division. Levels rose 4 to 6 ft in many wells throughout the division, with the greatest rise (19.8 ft) occurring in Platte County. The rises reflect reduced withdrawals of groundwater for irrigation and above-normal precipitation in the spring and early summer. Water levels declined slightly in a few wells in all of the counties in the division, except in Dakota and Wayne counties.

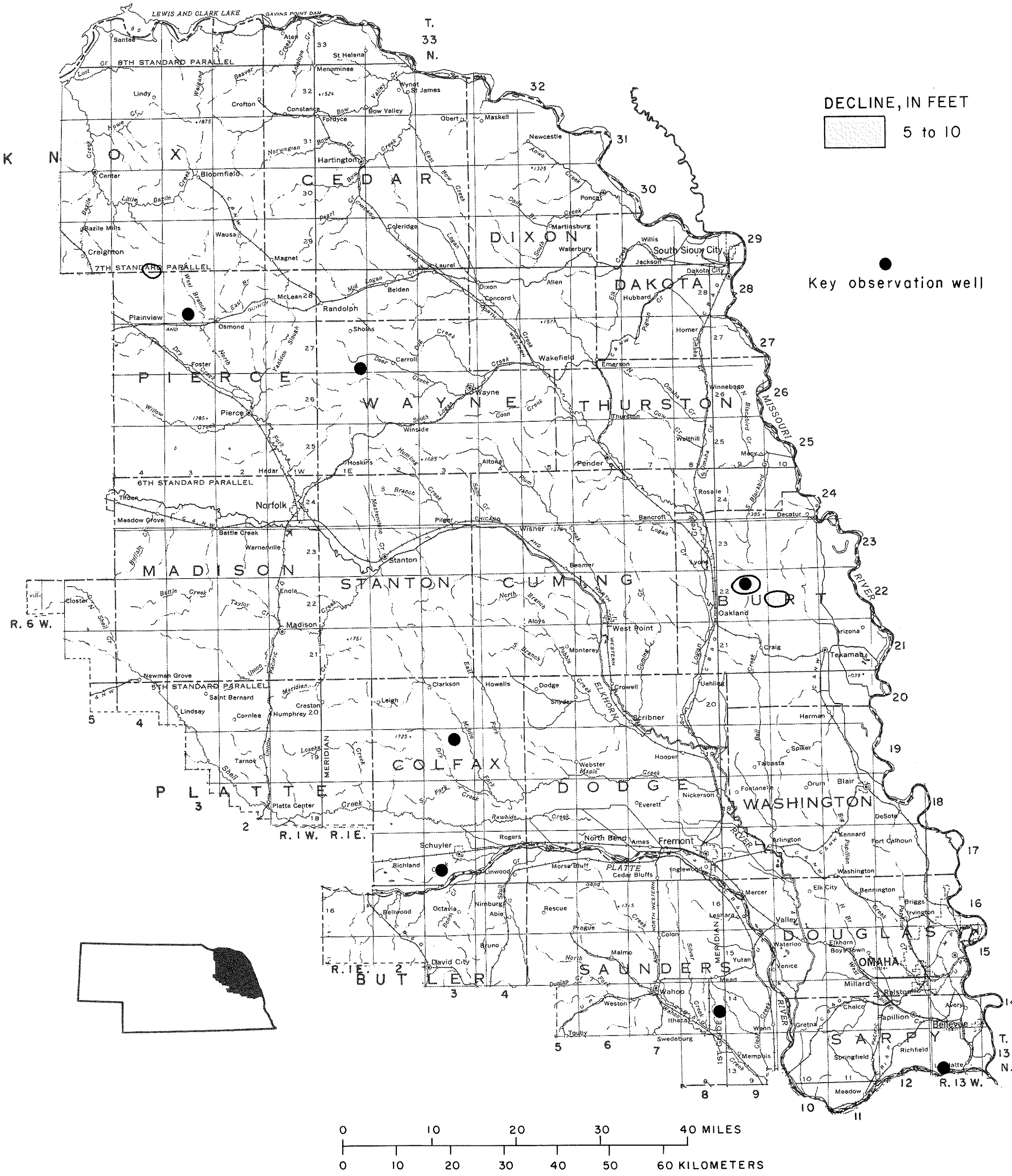
Fall 1984 water-level measurements indicate declines of 5 ft or more from estimated predevelopment levels in some counties in the Northeast Division. The areas of decline generally are small and cannot be delineated accurately from existing water-level data. The largest decline from estimated predevelopment level was 23.2 ft in a well in northern Pierce County. Water-level declines in the vicinity of this well represent decreases in artesian pressure rather than sizable decreases in groundwater storage.

Development of groundwater resources for irrigation began in the 1930s and accelerated in the early 1950s and mid-1970s because of droughts during those periods. In the 30-year period from 1950 to 1980, the number of irrigation wells installed and registered increased from about 300 to 7,100.

Above-normal precipitation and unfavorable economic conditions discouraged installation of new irrigation wells in 1984, and only 67 were installed and registered in the division.

Large declines from estimated predevelopment water levels, such as those detected in Burt, Knox, and Pierce counties, are the result of pumpage during the irrigation season. However, past spring measurements show that such declines are mostly seasonal and that water levels probably will recover to near estimated predevelopment levels by the start of the next irrigation season. Progressive declines in water levels might occur if a drought lasting several years caused a large increase in the amount of water pumped and a significant large decrease in the amount of recharge to the aquifer.

Sufficient data are now available to give reasonably good estimates of predevelopment water levels and current water-level changes throughout most of this division. Water-level measurements are made by the Lewis and Clark, Lower Elkhorn, Middle Missouri Tributaries, and Papio Natural Resources Districts, the Conservation and Survey Division, and the U.S. Geological Survey.



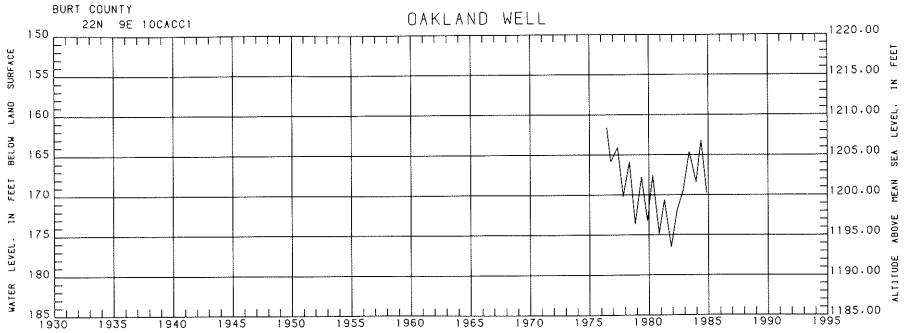
Areas of significant water-level change in the Northeast Division from 1950 to fall 1984

Burt County: Oakland

Estimated predevelopment water level: Not determined

Net water-level change, fall 1983 to fall 1984: −1.30 ft

Net water-level change since 1976: −3.82 ft

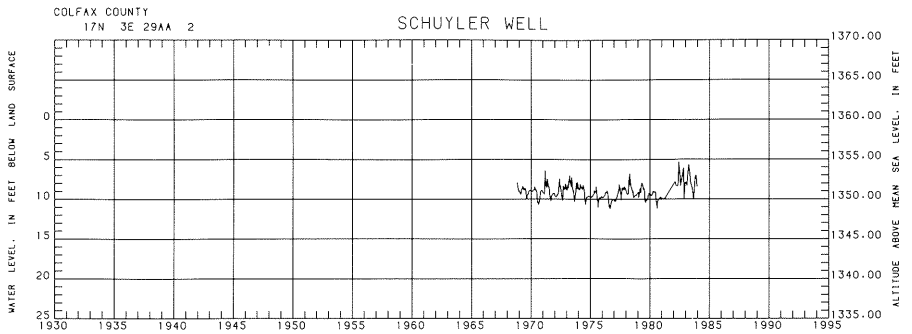


Colfax County: Schuyler

Estimated predevelopment water level: 7.5 ft

Net water-level change, fall 1983 to fall 1984: +0.44 ft

Net water-level change since 1968: +0.26 ft

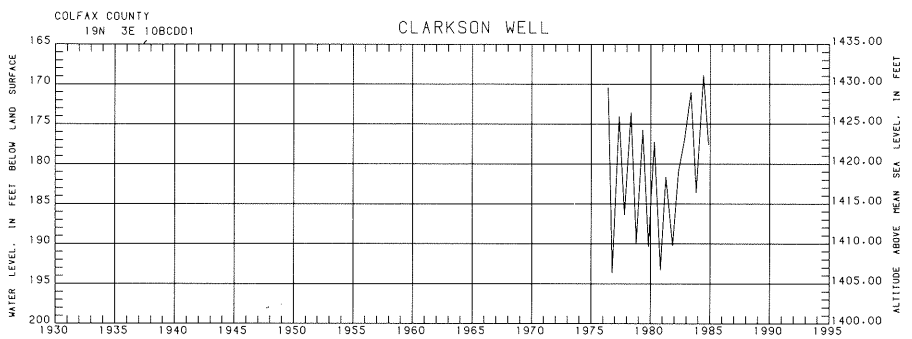


Colfax Country: Clarkson

Estimated predevelopment water level: Not determined

Net water-level change, fall 1983 to fall 1984: +6.05 ft

Net water-level change since 1976: +16.07 ft

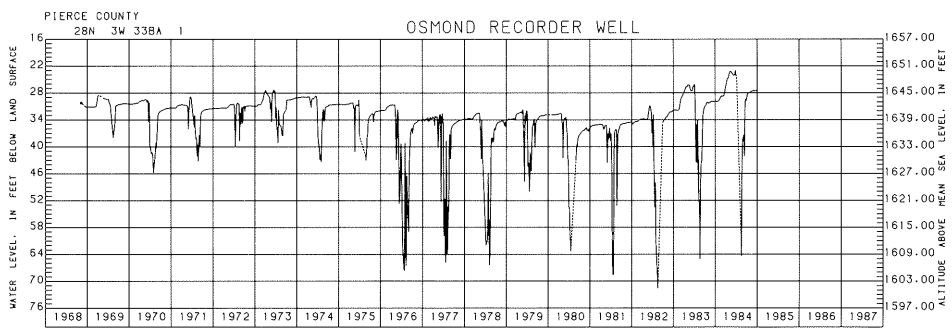


Pierce County: Osmond

Estimated predevelopment water level: 29 ft

Net water-level change in 1984: +2.38 ft

Net water-level change since 1968: +3.65 ft

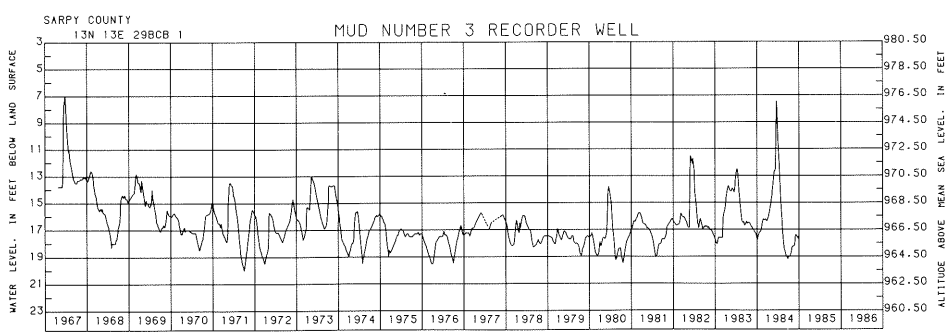


Sarpy County: MUD No. 3

Estimated predevelopment water level: 13 ft

Net water-level change in 1984: −0.60 ft

Net water-level change since 1967: −3.87 ft

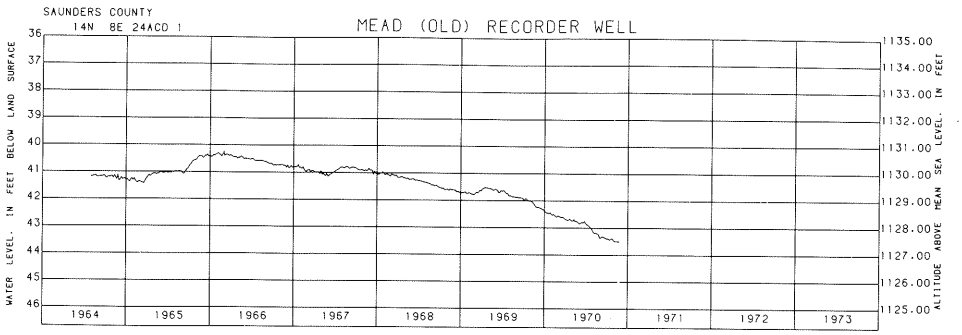


Saunders County: Mead (old)

Estimated predevelopment water level: 40 ft

Net water-level change in 1984: Well abandoned in 1970

Net water-level change from 1964 to 1970: −6.48 ft

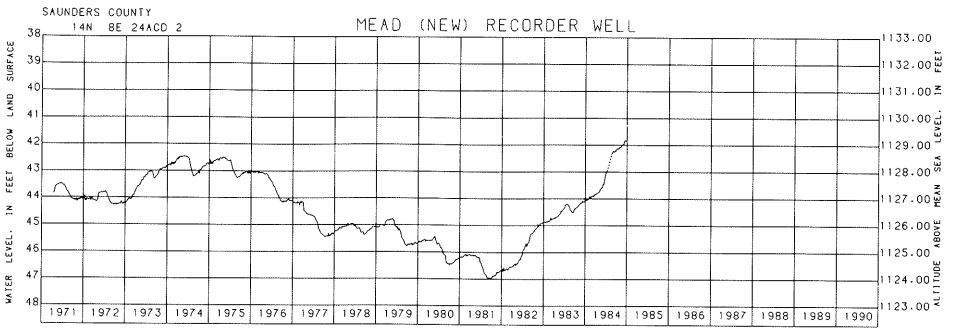


Saunders County: Mead (new)

Estimated predevelopment water level: 40 ft

Net water-level change in 1984: +2.24 ft

Net water-level change since 1971: +2.24 ft

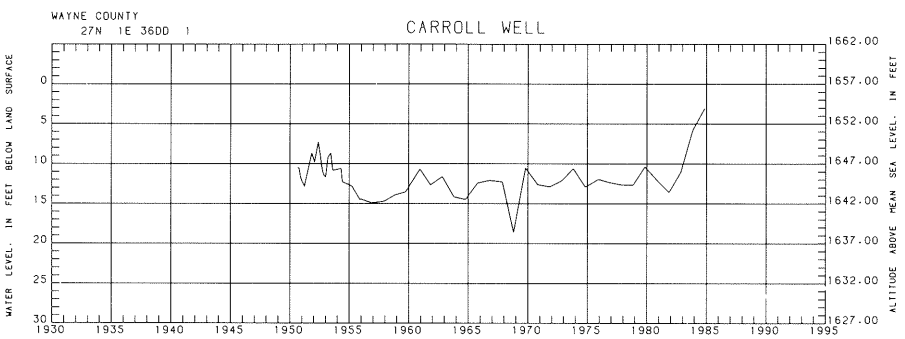


Wayne County: Carroll

Estimated predevelopment water level: 10.6 ft

Net water-level change, fall 1983 to fall 1984: +2.74 ft

Net water-level change since 1950: +8.51 ft



East South-Central Division

Water levels were higher in about 68 percent of the wells measured in the East South-Central Division in fall 1984 than in fall 1983. Levels averaged only 0.9 ft higher, and most were within 1 or 2 ft of the previous year's water level. Most wells Fillmore, Thayer, and Nuckolls counties had slightly lower water levels in fall 1984 than in fall 1983.

Pumping for irrigation during the past 34 years caused water levels to decline more than 5 ft below estimated predevelopment levels in an area of approximately 1.73 million acres. A maximum decline of approximately 39 ft has occurred in a well in Fillmore County.

Approximate areas of significant declines from estimated predevelopment water levels to fall 1984 water levels were:

Range in amount of decline, in feet	Approximate area of decline, in acres
5.00-10.00	642,000
10.00-15.00	449,000
15.00-20.00	409,000
20.00-25.00	163,000
25.00-30.00	50,000
30.00 or more	14,000

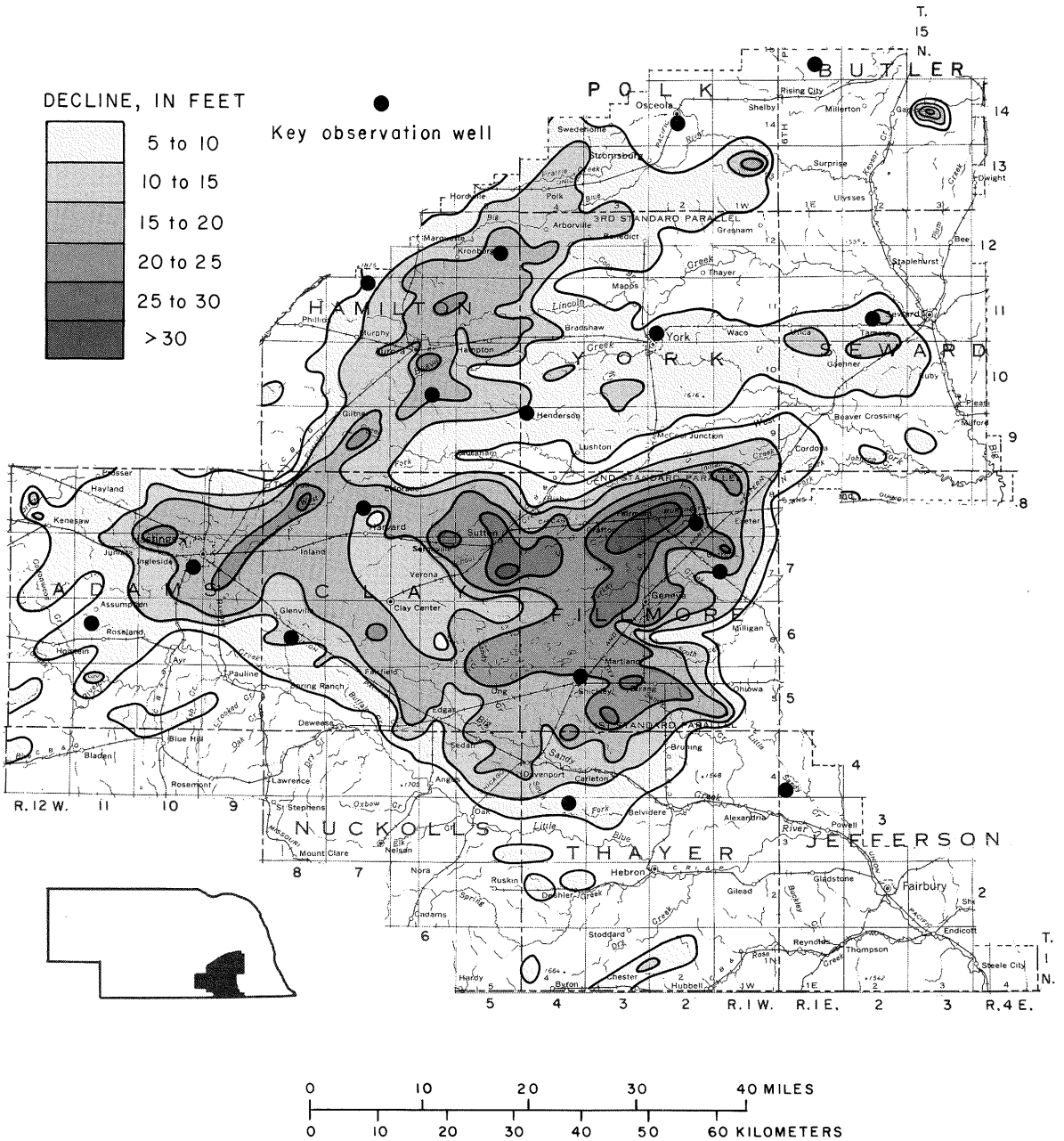
Sufficient data are available to give good definition of the estimated predevelopment water levels throughout most of the division. Data collected by the Upper Big Blue and Little Blue Natural Resources Districts, the Blue River Association of Ground Water Conservation Districts, and the Clay County Ground Water Conservation District are sufficient to evaluate current water-level changes.

Predevelopment water levels in this division are representative of the mean water levels in the early 1950s. Although about 700 irrigation wells had been drilled prior to 1950, they were widely distributed. Consequently, significant water-level declines had occurred in only a few small localities. Drought conditions from 1953 to 1956 resulted in such widespread development of groundwater for irrigation that by 1957 approximately 6,400 irrigation wells had been drilled. This intensive groundwater development, coupled with drought conditions, started widespread water-level declines in irrigated areas.

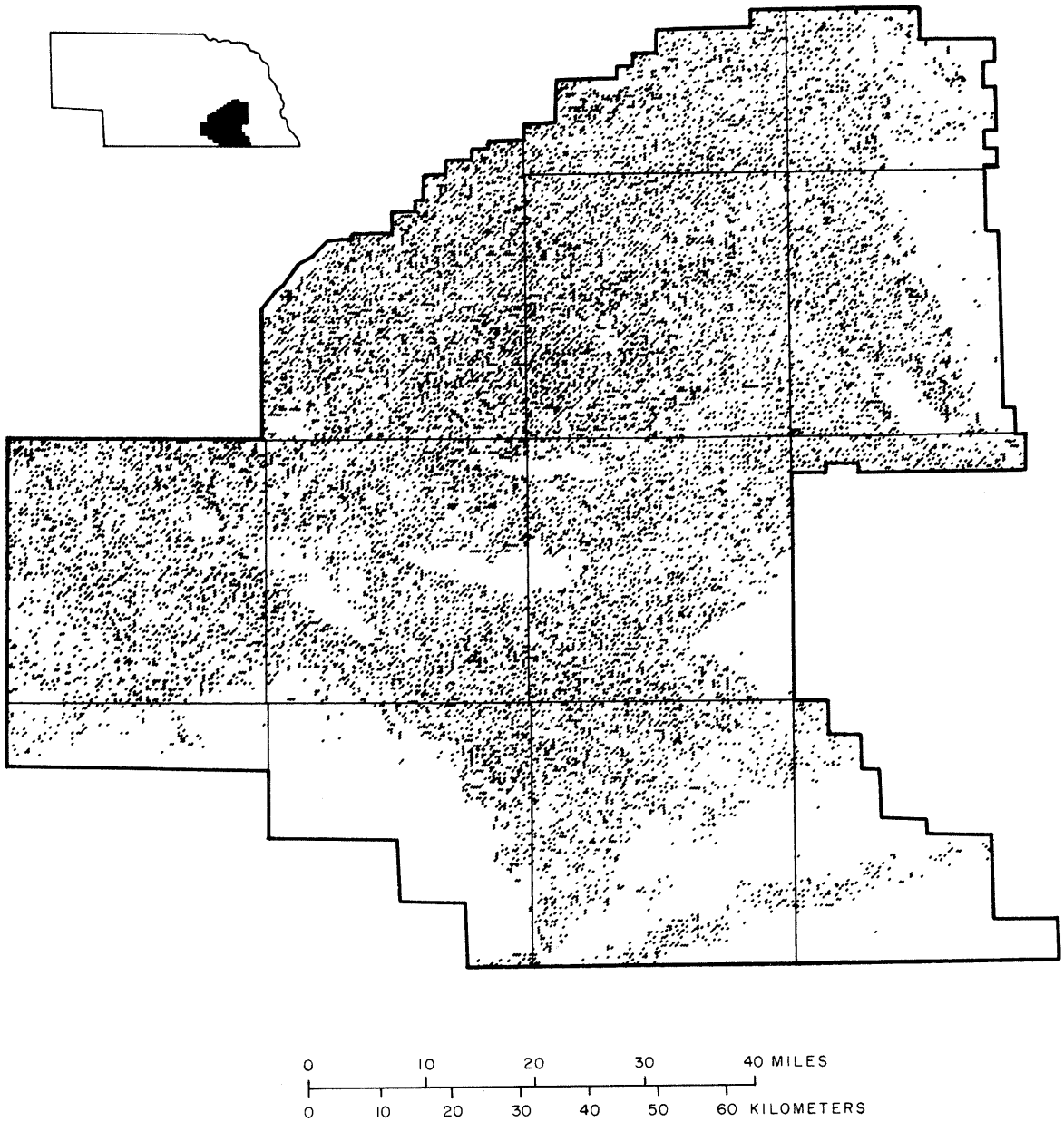
Drought and favorable economic conditions from 1973 to 1976 resulted again in an increase in the number of new irrigation wells installed annually and in the rate of water-level decline. However, above-normal precipitation and unfavorable economic conditions caused the rate of new well installations from 1977 to 1984 to decrease. By the end of 1984, a total of about 16,000 irrigation wells had been drilled and registered in the East South-Central Division, although only 113 new wells were added in 1984. Irrigation wells have been drilled in almost all parts of this division where groundwater supplies are adequate and where limitations on development—imposed by factors such as land use, soil type, or topography—are not restrictive.

Approximate areas of significant declines from estimated predevelopment water levels to spring 1984 water levels were:

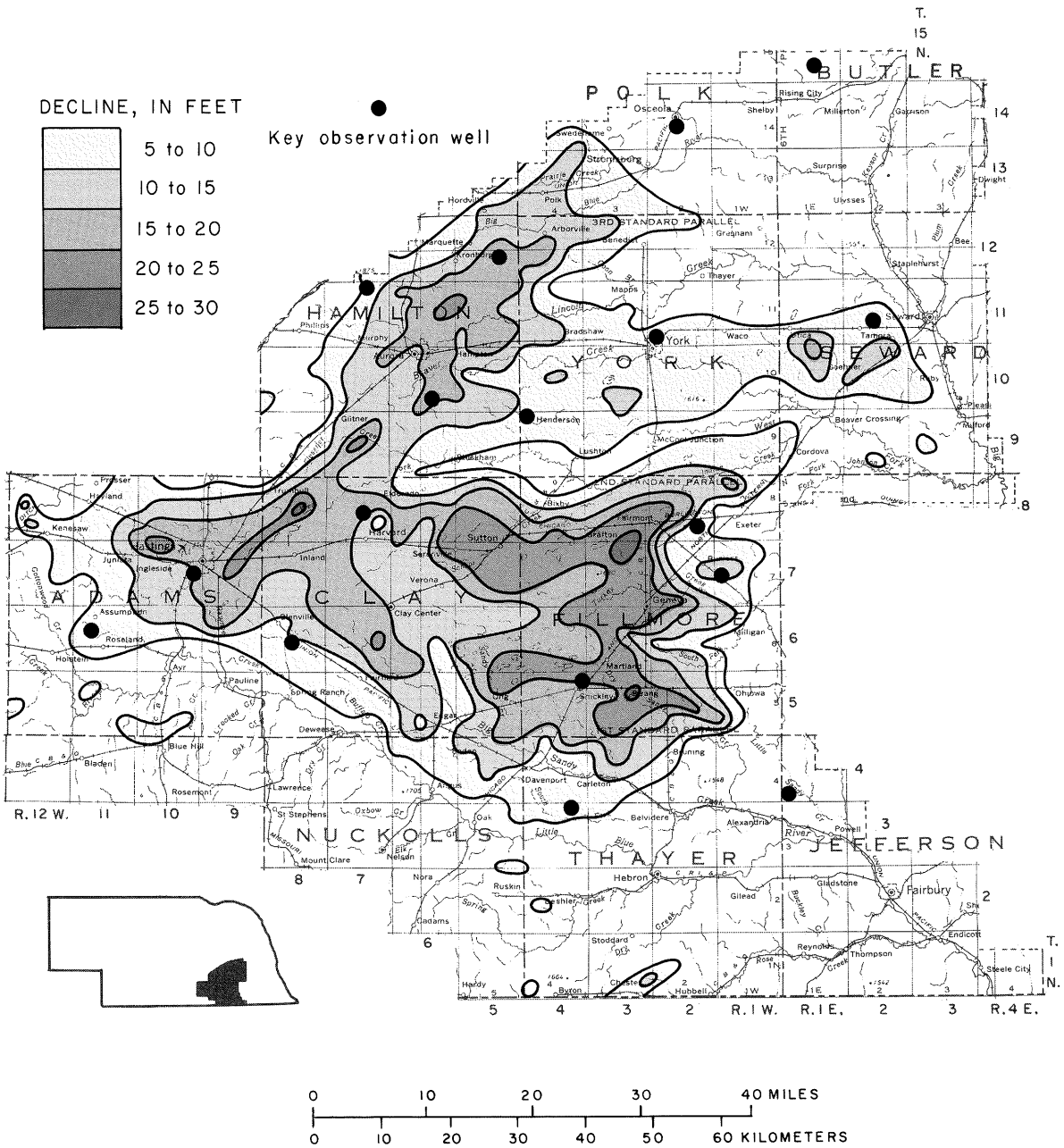
Range in amount of decline, in feet	Approximate area of decline, in acres
5.00-10.00	635,000
10.00-15.00	435,000
15.00-20.00	347,000
20.00-25.00	134,000
25.00 or more	4,800



Areas of significant water-level change in the East South-Central Division from 1950 to fall 1984



Location of registered irrigation wells in the East South-Central Division as of December 31, 1984



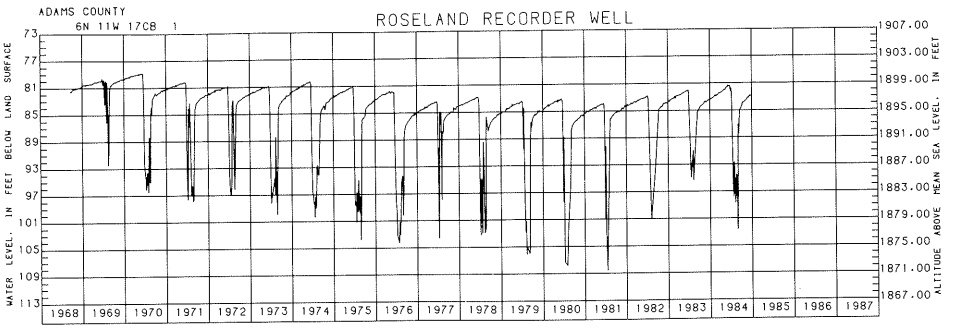
Areas of significant water-level change in the East South-Central Division from 1950 to spring 1984

Adams County: Roseland

Estimated predevelopment water level: 77 ft

Net water-level change in 1984: +0.54 ft

Net water-level change since 1968: −2.10 ft

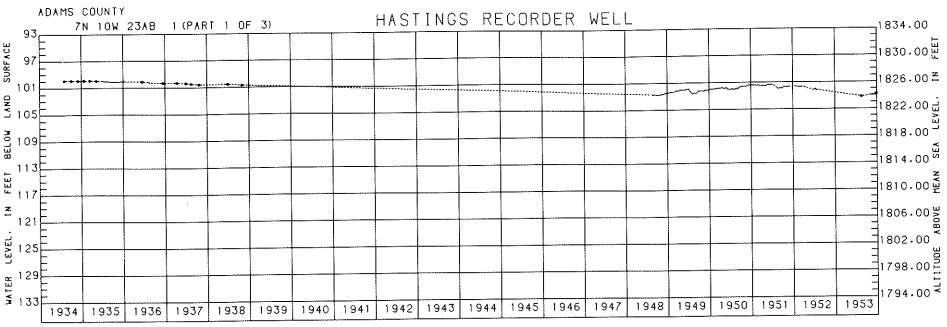


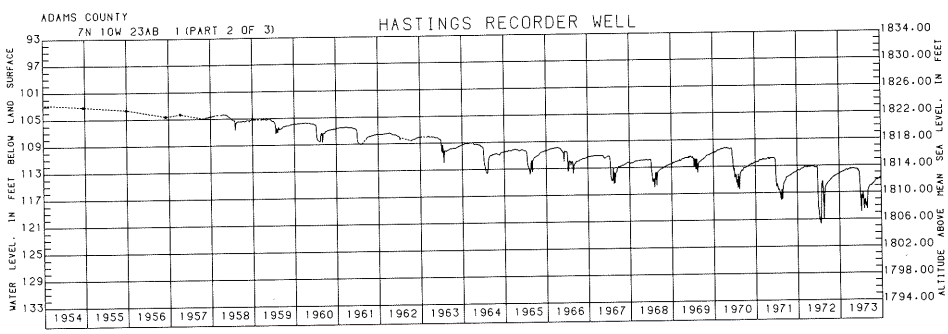
Adams County: Hastings

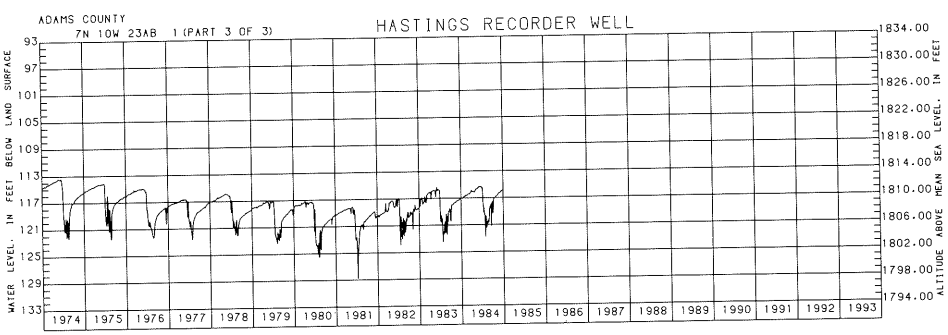
Estimated predevelopment water level: 102 ft

Net water-level change in 1984: +1.30 ft

Net water-level change since 1934: −15.82 ft





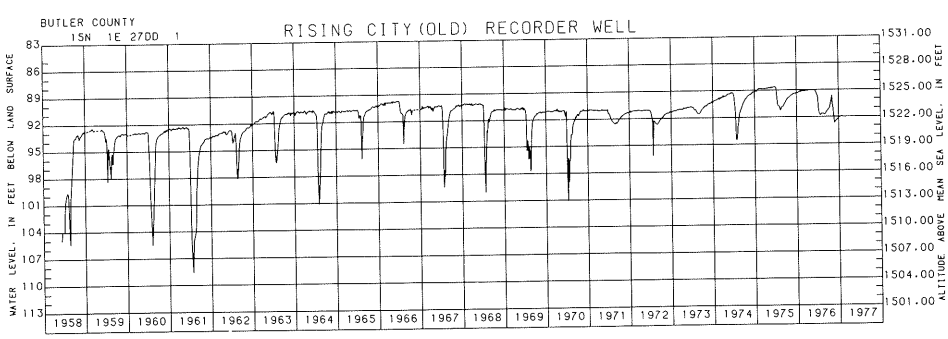


Butler County: Rising City (old)

Estimated predevelopment water level: 108 ft

Net water-level change in 1984: Well abandoned in 1977

Net water-level change from 1958 to 1976: +0.62 ft

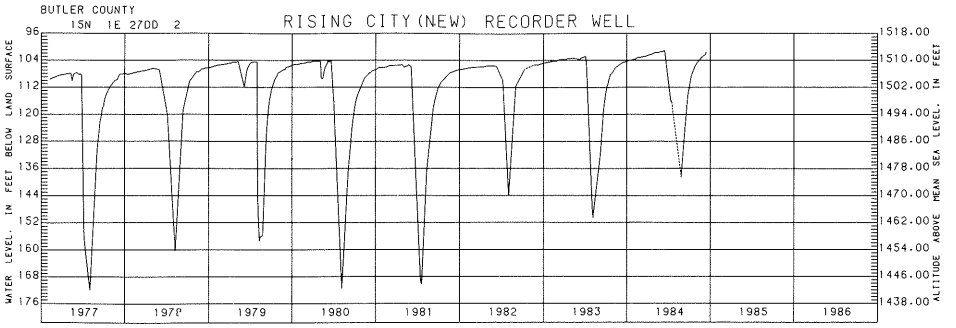


Butler County: Rising City (new)

Estimated predevelopment water level: 108 ft

Net water-level change in 1984: +2.70 ft

Net water-level change since 1977: +6.22 ft

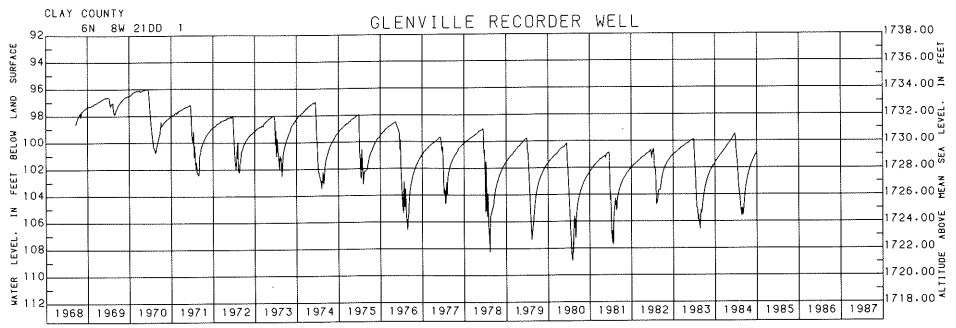


Clay County: Glenville

Estimated predevelopment water level: 93 ft

Net water-level change in 1984: +0.75 ft

Net water-level change since 1968: −3.53 ft

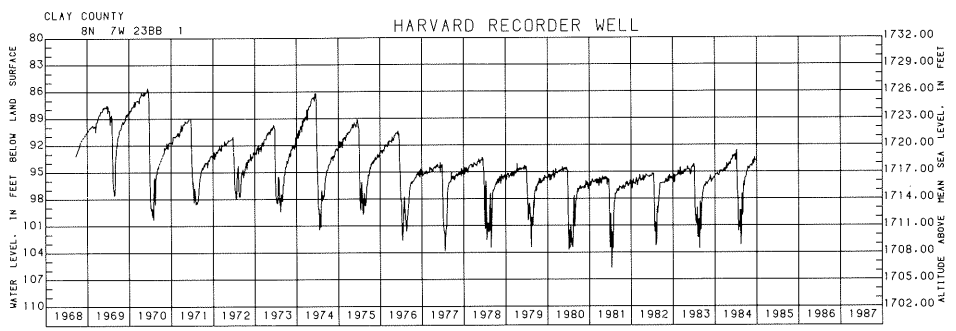


Clay County: Harvard

Estimated predevelopment water level: 79 ft

Net water-level change in 1984: +2.13 ft

Net water-level change since 1968: −3.12 ft

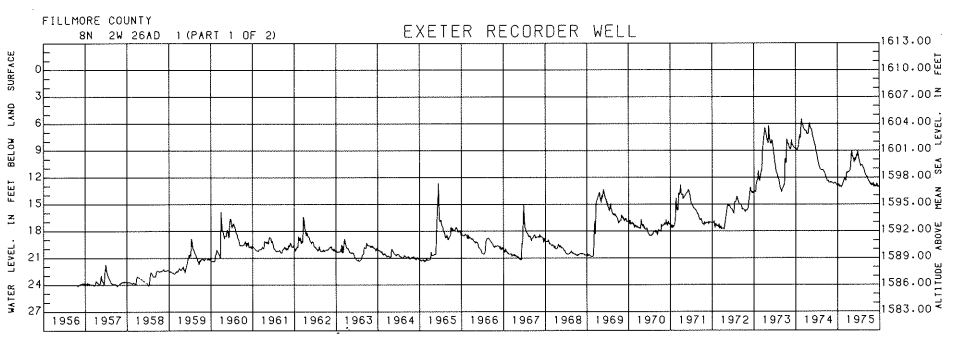


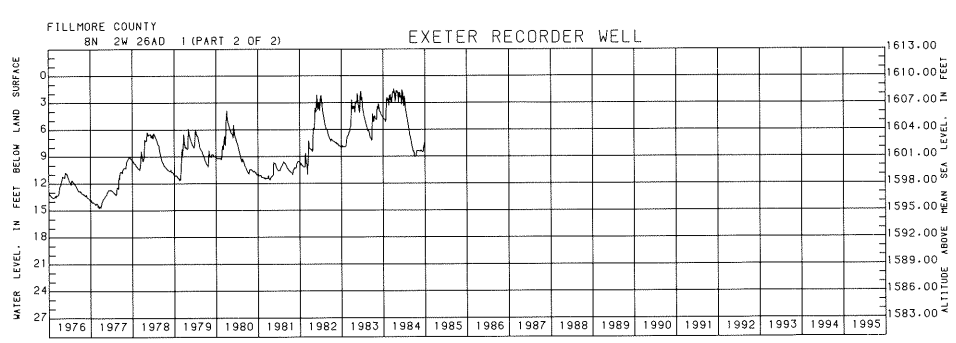
Fillmore County: Exeter

Estimated predevelopment water level: 24 ft

Net water-level change in 1984: −2.20 ft

Net water-level change since 1956: +16.94 ft



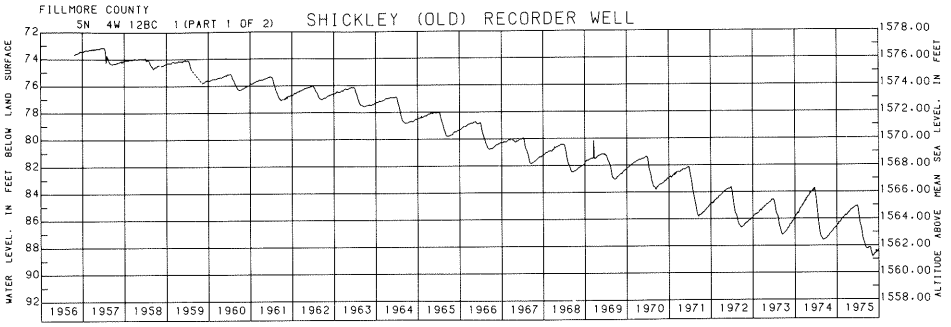


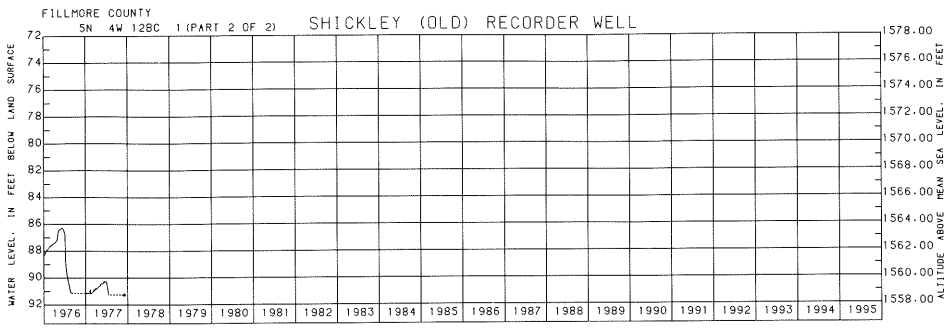
Fillmore County: Shickley (old)

Estimated predevelopment water level: 73 ft

Net water-level change in 1984: Well abandoned in 1977

Net water-level change from 1956 to 1976: −15.6 ft



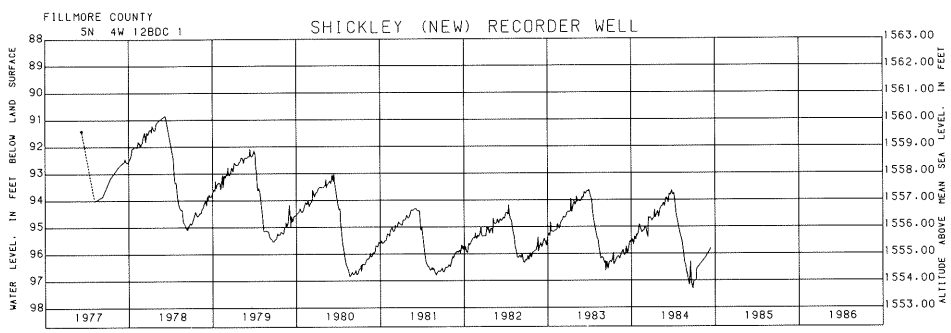


Fillmore County: Shickley (new)

Estimated predevelopment water level: 72 ft

Net water-level change in 1984: +0.14 ft

Net water-level change since 1977: −2.84 ft

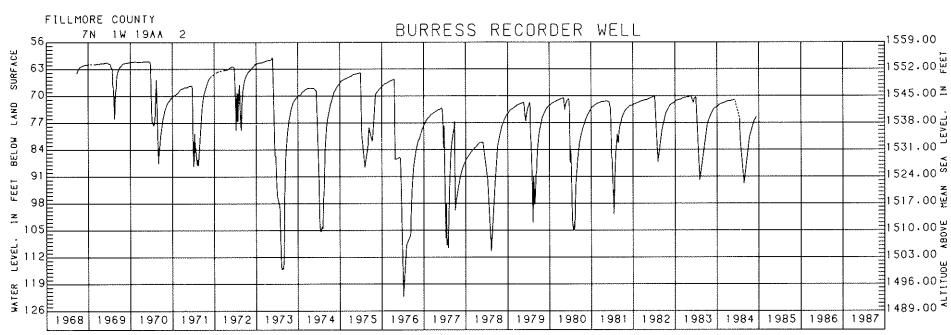


Fillmore County: Burress

Estimated predevelopment water level: 57 ft

Net water-level change in 1984: −1.65 ft

Net water-level change since 1968: −12.60 ft

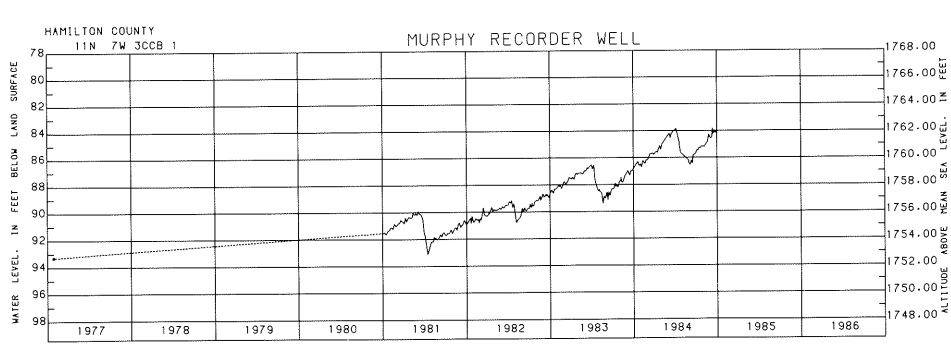


Hamilton County: Murphy

Estimated predevelopment water level: Not determined

Net water-level change in 1984: +2.94 ft

Net water-level change since 1977: +9.30 ft

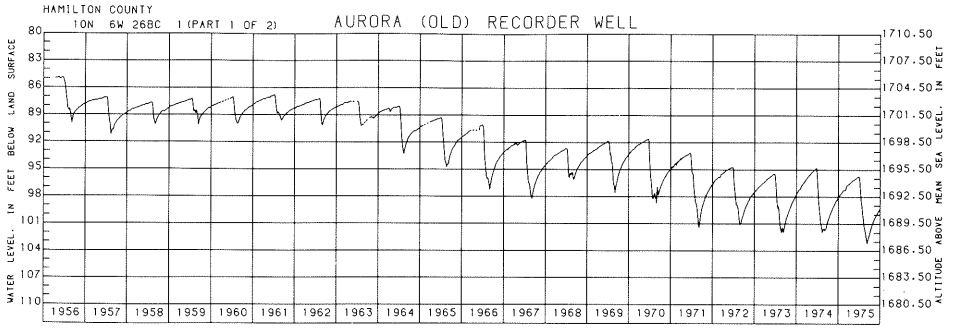


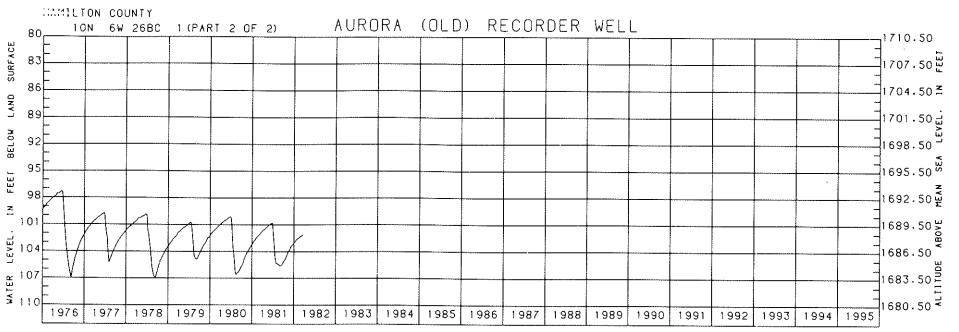
Hamilton County: Aurora (old)

Estimated predevelopment water level: 83 ft

Net water-level change in 1984: Well abandoned in 1981

Net water-level change since 1956: −15.20 ft



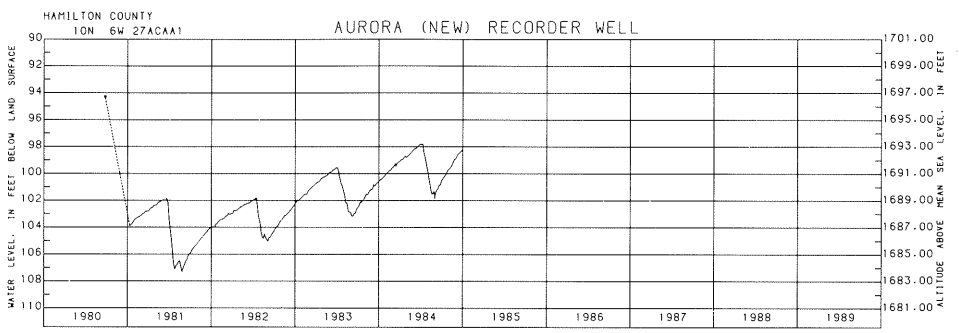


Hamilton County: Aurora (new)

Estimated predevelopment water level: 84 ft

Net water-level change in 1984: +2.40 ft

Net water-level change since 1980: +5.91 ft

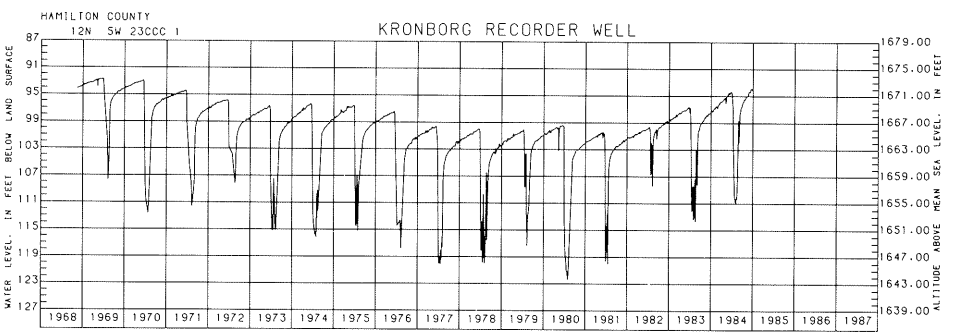


Hamilton County: Kronborg

Estimated predevelopment water level: 81 ft

Net water-level change in 1984: +3.41 ft

Net water-level change since 1968: −0.01 ft

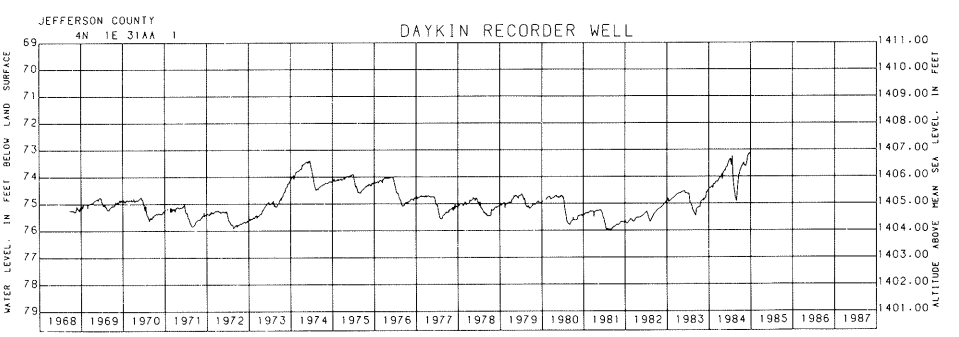


Jefferson County: Daykin

Estimated predevelopment water level: 74 ft

Net water-level change in 1984: +1.32 ft

Net water-level change since 1968: +2.08 ft

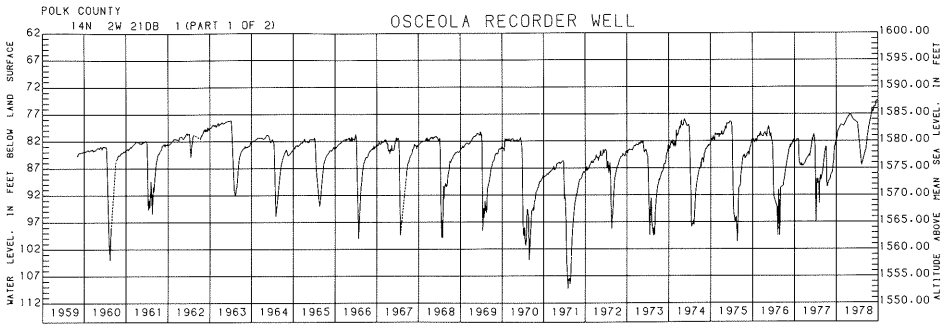


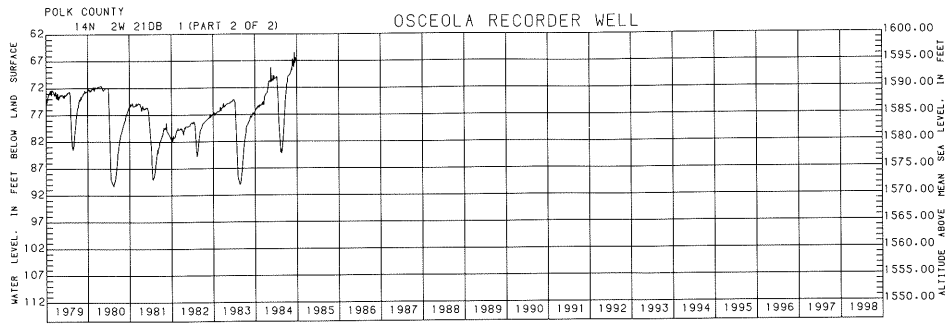
Polk County: Osceola

Estimated predevelopment water level: 80 ft

Net water-level change in 1984: +9.71 ft

Net water-level change since 1959: +17.24 ft



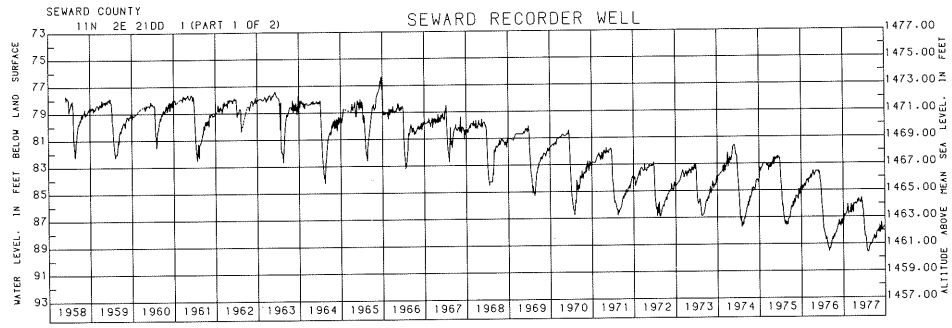


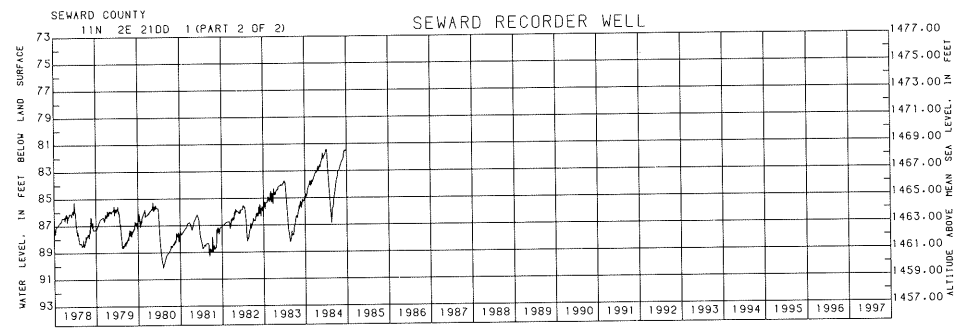
Seward County: Seward

Estimated predevelopment water level: 74 ft

Net water-level change in 1984: +3.67 ft

Net water-level change since 1958: −2.63 ft



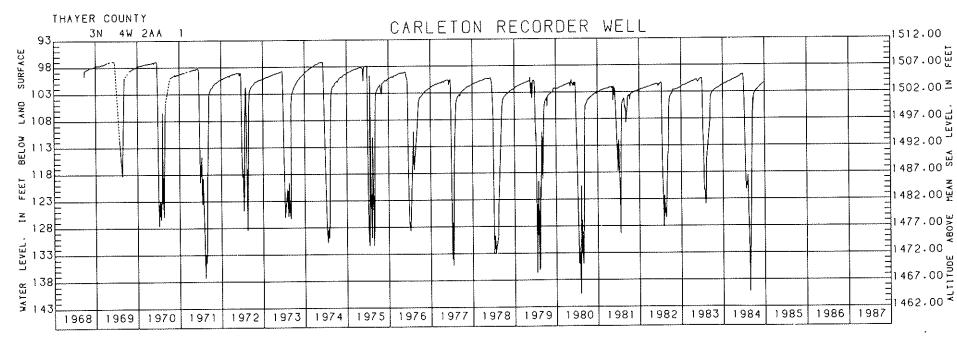


Thayer County: Carleton

Estimated predevelopment water level: 95 ft

Net water-level change in 1984: +0.51 ft

Net water-level change since 1968: −3.53 ft

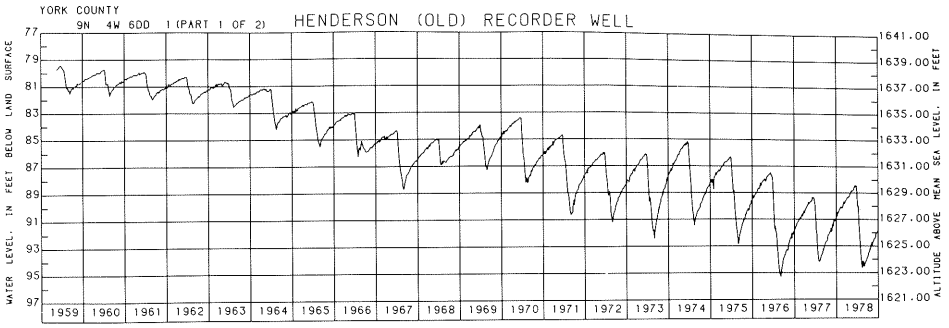


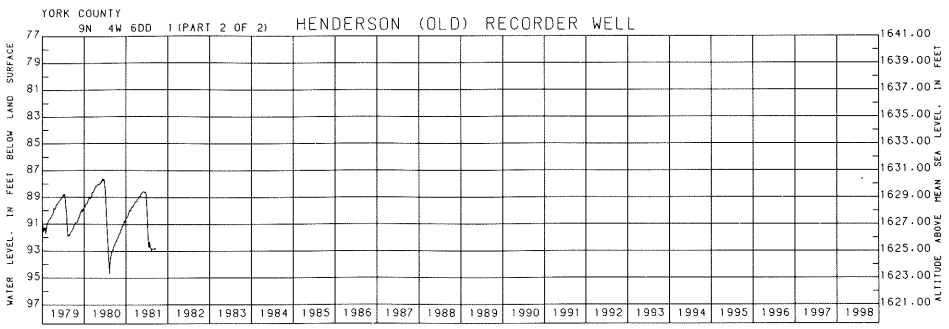
York County: Henderson (old)

Estimated predevelopment water level: 80 ft

Net water-level change in 1984: Well destroyed in 1981

Net water-level change from 1959 to 1981: −10.02 ft



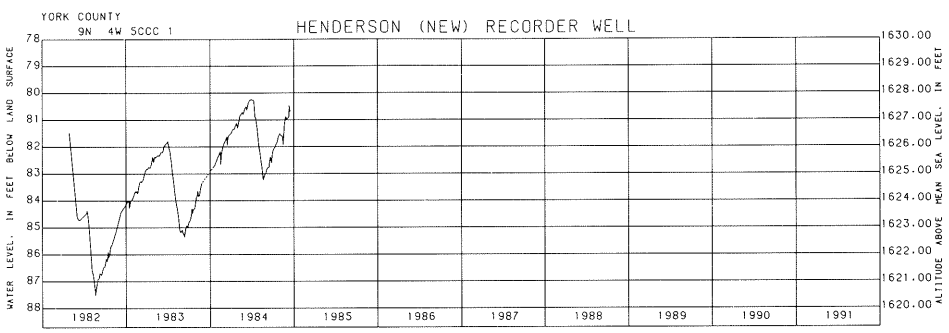


York County: Henderson (new)

Estimated predevelopment water level: 70 ft

Net water-level change in 1984: +2.73 ft

Net water-level change since 1982: +3.52 ft

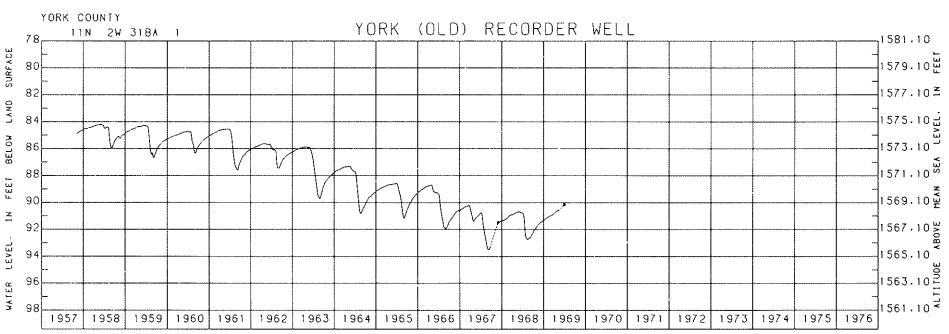


York County: York (old)

Estimated predevelopment water level: 84 ft

Net water-level change in 1984: Well abandoned in 1969

Net water-level change from 1957 to 1968: −6.78 ft

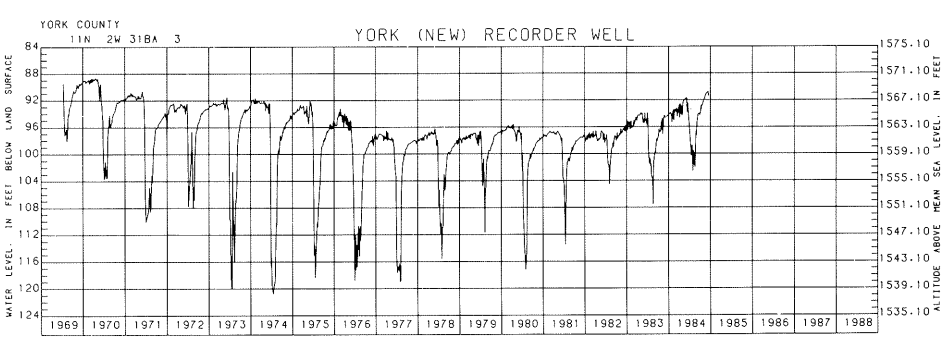


York County: York (new)

Estimated predevelopment water level: 85 ft

Net water-level change in 1984: +3.38 ft

Net water-level change since 1969: −1.70 ft



West South-Central Division

Water levels declined an average of 0.39 ft in wells measured in the West South-Central Division from fall 1983 to fall 1984. Levels were less than 2 ft lower in most wells, but were over 11 ft lower in two wells in Kearney County. Rainfall during July and August was significantly below normal, and large amounts of water were pumped for irrigation, causing water-level declines throughout much of the area. In shallow observation wells near the Platte River, water-levels commonly declined by less than one foot.

The water-level rise since predevelopment in this division is the greatest in Nebraska. In this area, water released from storage in Lake McConaughy and subsequently diverted from the Platte River near North Platte has been used for irrigation since 1941. Deep percolation of water from the irrigation distribution system and from water applied to crops has raised the water table 10 ft or more from its estimated predevelopment level beneath approximately 584,000 acres. The greatest known water-level rise from predevelopment level—about 92 ft—occurred approximately 6.5 mi north-northwest of Holdrege in Phelps County. Maximum known rises in the other counties in the area were about 67 ft in Kearney County and about 86 ft in Gosper County.

Approximate areas of significant water-level rises from estimated predevelopment to the fall of 1984 were:

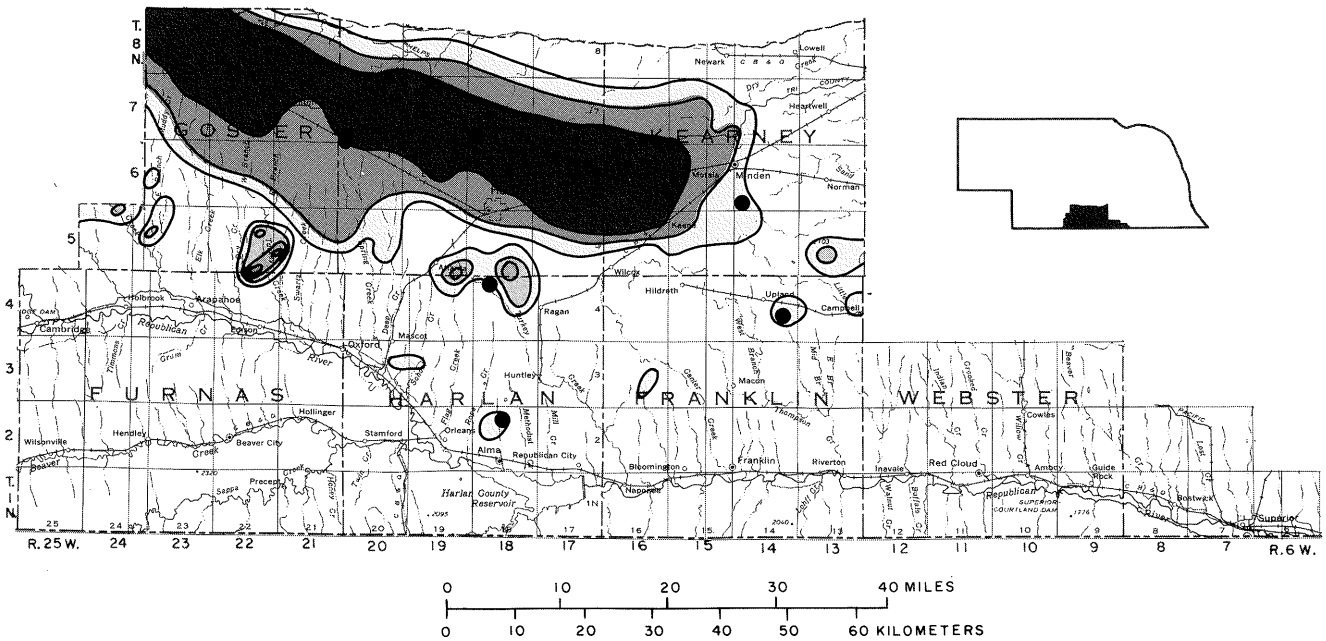
Range in amount of rise, in feet	Approximate area of rise, in acres
10.00-20.00	109,000
20.00-50.00	213,000
50.00 or more	262,000

Estimated predevelopment water levels of the Tri-County area are about equal to average water levels prior to 1940.

Use of groundwater for irrigation has stabilized the rate of water-level rise in many parts of the area. In some parts of the area, the water table has risen enough that evapotranspiration losses and groundwater discharge into streams have also contributed to stabilizing water levels.

Elsewhere in the division, increased use of groundwater for irrigation in recent years has lowered water levels significantly below estimated predevelopment levels in several small areas. Declines of 5 ft or more have occurred in areas totaling about 69,000 acres.

Data for estimating predevelopment water levels generally are adequate. However, evaluation of area-wide water-level changes during the period 1940 to 1947 cannot be made because of insufficient data. Since 1947, water-level measurement programs have provided enough data for a good evaluation of long-term water-level changes and also for the definition of current water-level changes. Water-level data are collected by the Tri-Basin and Lower Republican Natural Resources Districts, the Central Nebraska Public Power and Irrigation District and the Frenchman-Cambridge Irrigation District.



DECLINE, IN FEET

- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 25

RISE, IN FEET

- 10 to 20
- 20 to 50
- > 50

● Key observation well

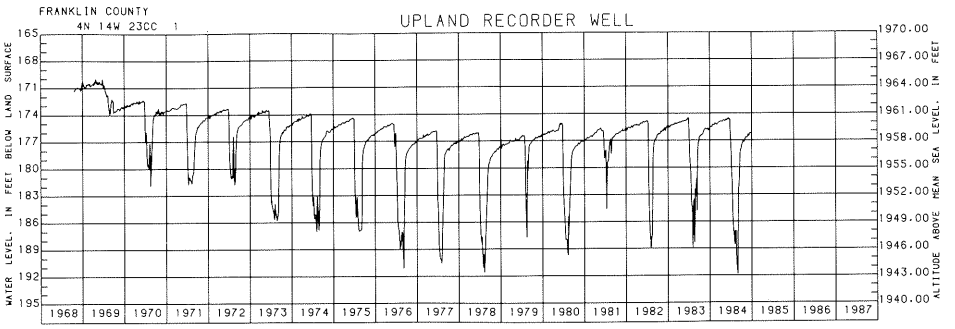
Areas of significant water-level change in the West South-Central Division from 1940 to fall 1984

Franklin County: Upland

Estimated predevelopment water level: 170 ft

Net water-level change in 1984: −0.59 ft

Net water-level change since 1968: −5.82 ft

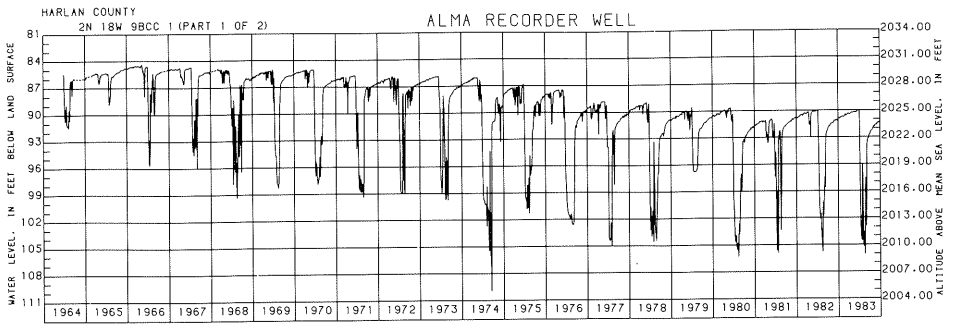


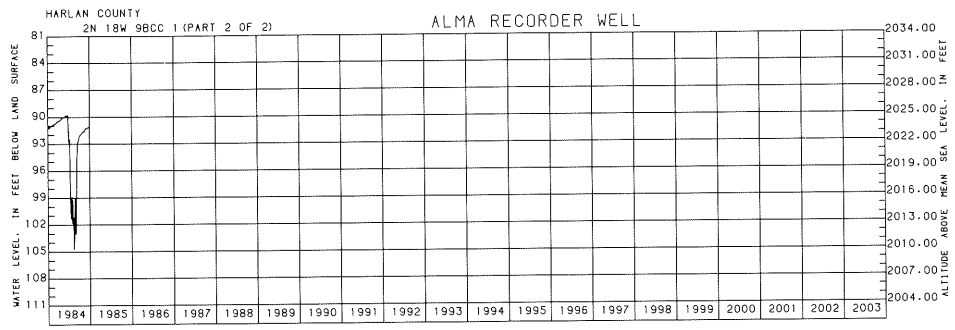
Harlan County: Alma

Estimated predevelopment water level: 85 ft

Net water-level change in 1984: +0.15 ft

Net water-level change since 1964: −5.09 ft



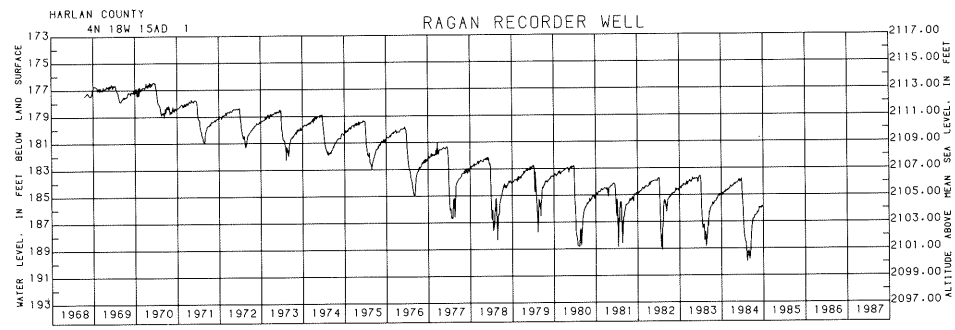


Harlan County: Ragan

Estimated predevelopment water level: 176 ft

Net water-level change in 1984: −1.05 ft

Net water-level change since 1968: −8.88 ft

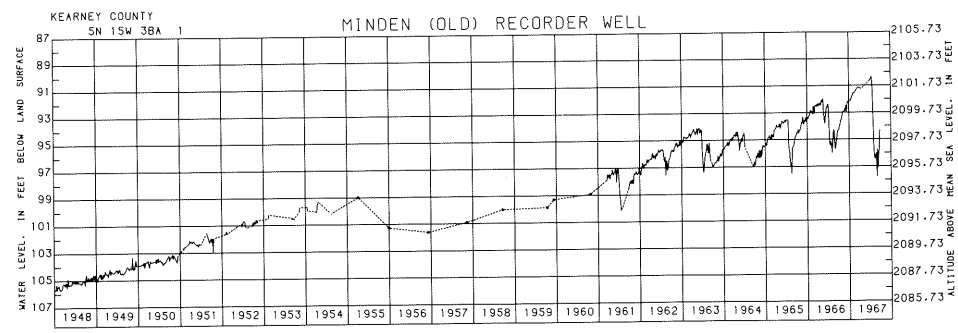


Kearney County: Minden (old)

Estimated predevelopment water level: 113 ft

Net water-level change in 1984: Well abandoned in 1967

Net water-level change from 1947 to 1966: +13.49 ft

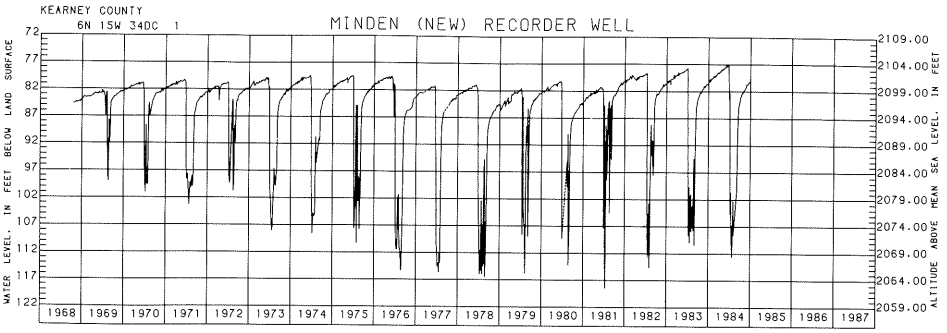


Kearney County: Minden (new)

Estimated predevelopment water level: 103 ft

Net water-level change in 1984: +0.10 ft

Net water-level change since 1968: +3.89 ft

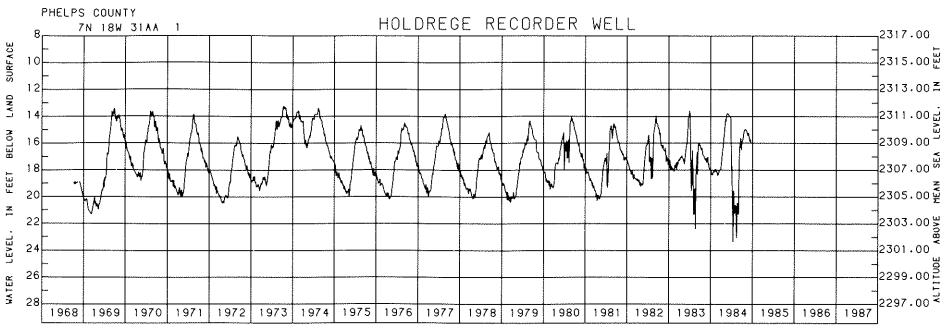


Phelps County: Holdrege

Estimated predevelopment water level: 100 ft

Net water-level change in 1984: +1.96 ft

Net water-level change since 1968: +4.02 ft

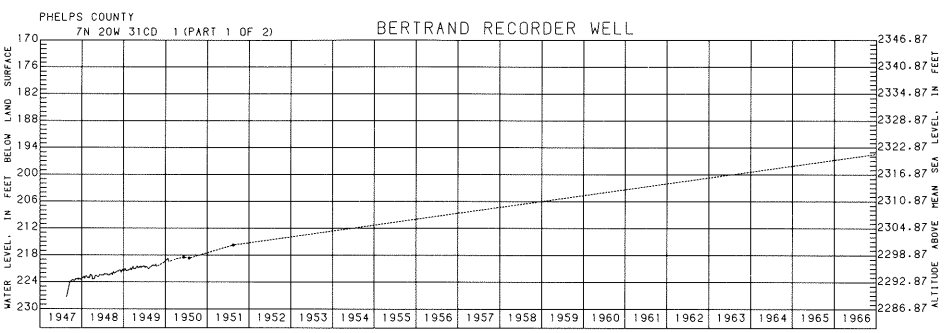


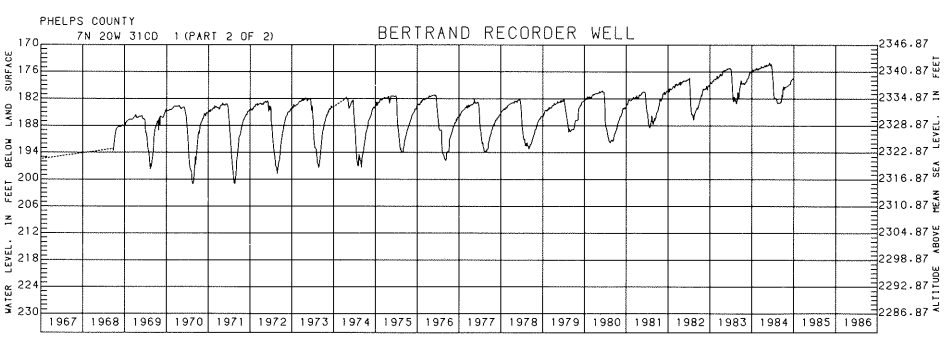
Phelps County: Bertrand

Estimated predevelopment water level: 232 ft

Net water-level change in 1984: −1.08 ft

Net water-level change since 1947: +45.66 ft





Central Division

Water levels rose in about 75 percent of the observation wells measured in the Central Division from fall 1983 to fall 1984. Levels averaged 1.23 ft higher, and rose less than 2 ft in most wells in the division. The largest water-level rises were in Buffalo and Howard counties, where levels were 5 to 10 ft higher in some wells.

Declines of 5 ft or more from estimated predevelopment water levels have occurred in an area of about 334,000 acres in Dawson, Buffalo, and Hall counties. Water levels have declined more than 20 ft in some wells on the uplands north of Wood River in Buffalo County, where intensive groundwater development for irrigation has resulted in progressive water-level declines since 1968.

In Dawson, Buffalo, and Hall counties, approximate areas of significant water-level declines from estimated predevelopment water levels to fall 1984 water levels were:

Range in amount of decline, in feet	Approximate area of decline, in acres
5.00-10.00	197,000
10.00-15.00	93,000
15.00-20.00	38,000
20.00-25.00	6,100

In central Valley County, pumping for irrigation has caused water-level declines of 5 ft or more from estimated predevelopment levels in an area of about 16,900 acres. A maximum decline of 16.8 ft occurred in a well located west of Ord.

In Valley County, the approximate areas of significant declines from estimated predevelopment water levels to fall 1984 water levels were:

Range in amount of decline, in feet	Approximate area of decline, in acres
5.00-10.00	12,300
10.00-15.00	4,200
15.00 or more	380

Estimated predevelopment water levels for Valley County are the approximate water levels prior to 1957.

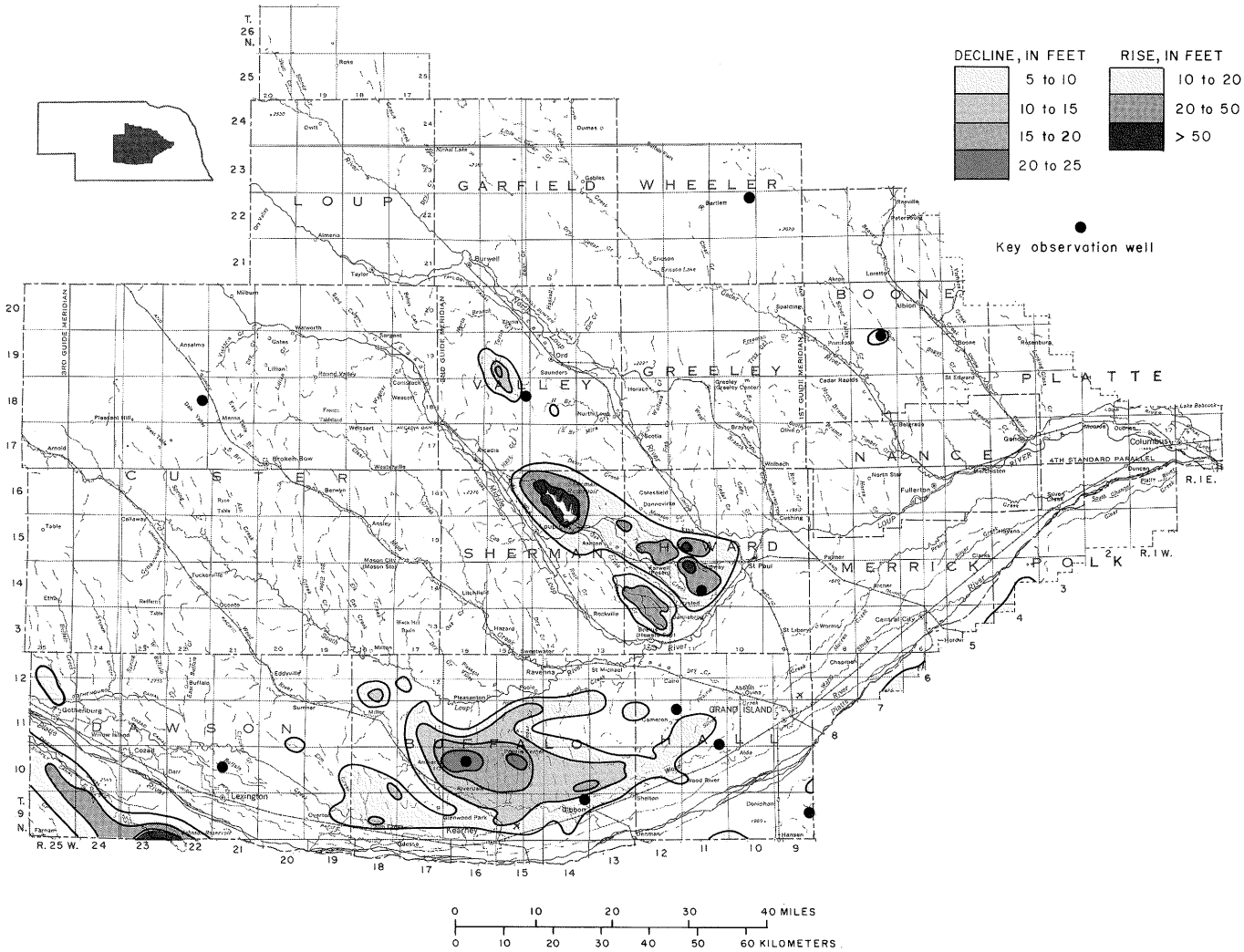
Water-level rises of 10 ft or more from estimated predevelopment levels have occurred beneath about 174,000 acres in the Farwell area of Sherman and Howard counties. Water levels began rising around 1963 because of water loss from irrigation canals, seepage from Sherman Reservoir, and deep percolation of water applied to crops in the Farwell Irrigation Project. The greatest water-level rises—more than 70 ft—are in the vicinity of Sherman Reservoir. The current rate of rise is so slow that most water-level changes now are related to fluctuations in reservoir stage.

Approximate areas of significant rises from estimated predevelopment to fall 1984 water levels were:

Range in amount of rise, in feet	Approximate area of rise, in acres
10.00-20.00	113,000
20.00-50.00	50,000
50.00 or more	11,000

Estimated predevelopment water levels in the area of the Farwell Irrigation Project are the approximate water levels prior to 1963.

Data available for the Central Division provide a good basis for estimating predevelopment water levels, water-level changes since predevelopment, and current water-level changes. Current water-level data are collected by the Central Platte and Lower Loup Natural Resources Districts, and the U.S. Bureau of Reclamation.



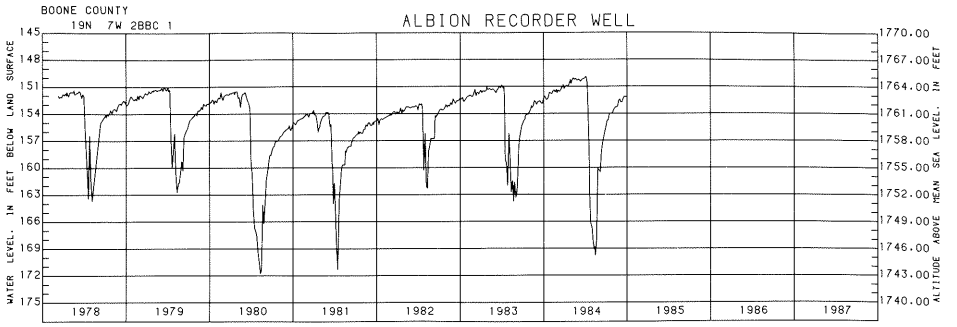
Areas of significant water-level change in the Central Division from 1951 to fall 1984

Boone County: Albion

Estimated predevelopment water level: 150 ft

Net water-level change in 1984: +0.24 ft

Net water-level change since 1978: +0.87 ft

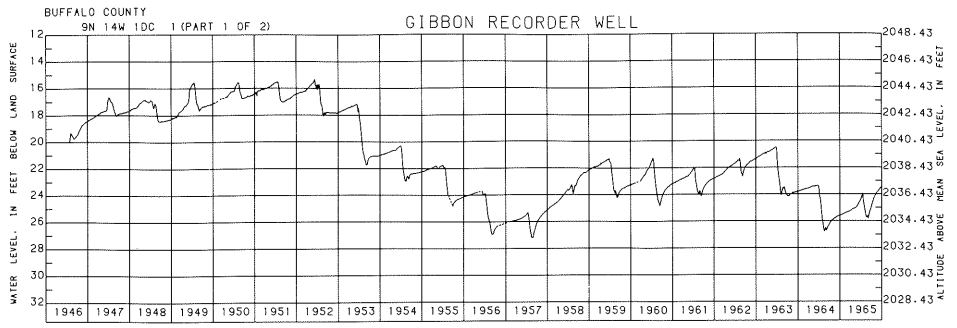


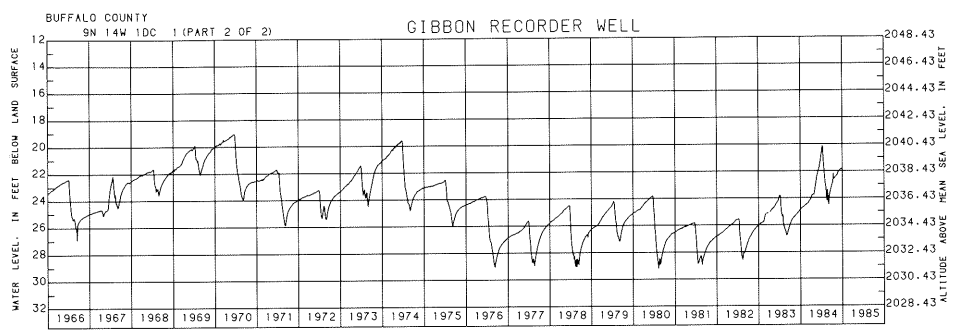
Buffalo County: Gibbon

Estimated predevelopment water level: 17.0 ft

Net water-level change in 1984: +3.08 ft

Net water-level change since 1946: −3.34 ft



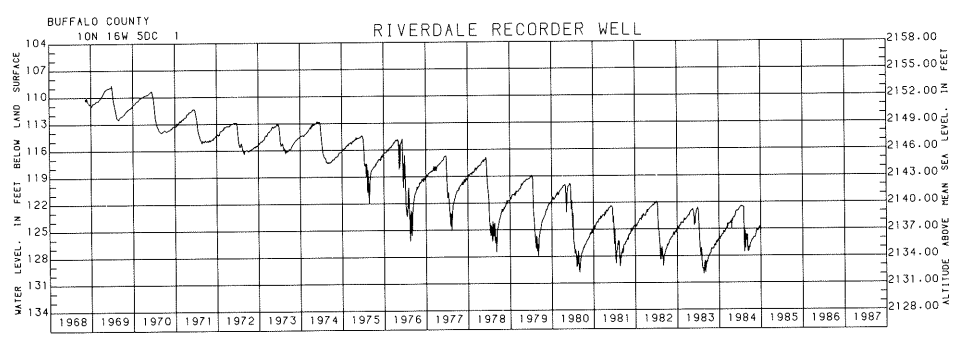


Buffalo County: Riverdale

Estimated predevelopment water level: 107 ft

Net water-level change in 1984: +1.35 ft

Net water-level change since 1968: −13.65 ft

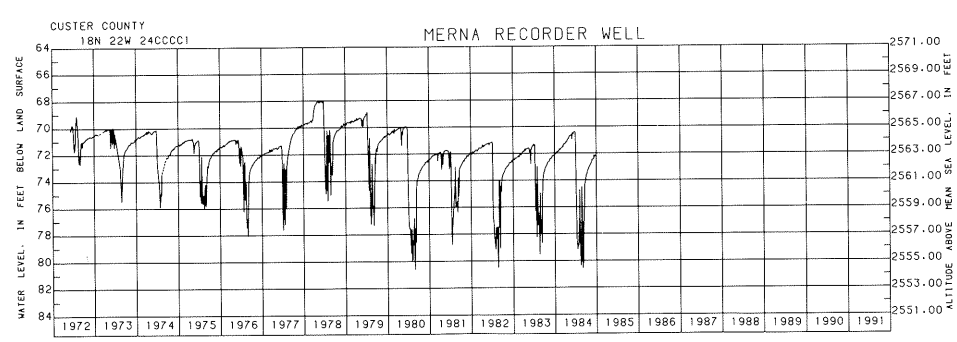


Custer County: Merna

Estimated predevelopment water level: 68 ft

Net water-level change in 1984: −0.08 ft

Net water-level change since 1972: −1.58 ft

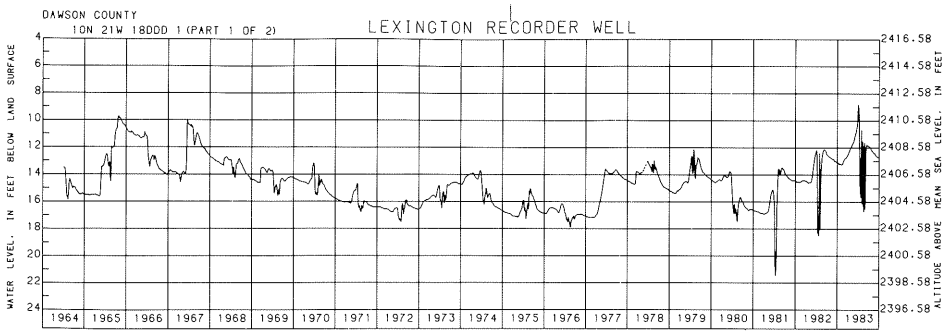


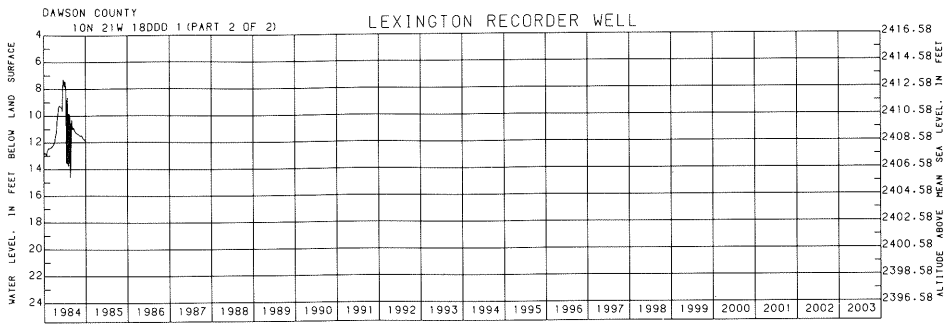
Dawson County: Lexington

Estimated predevelopment water level: 11 ft

Net water-level change in 1984: +0.85 ft

Net water-level change since 1964: +3.59 ft



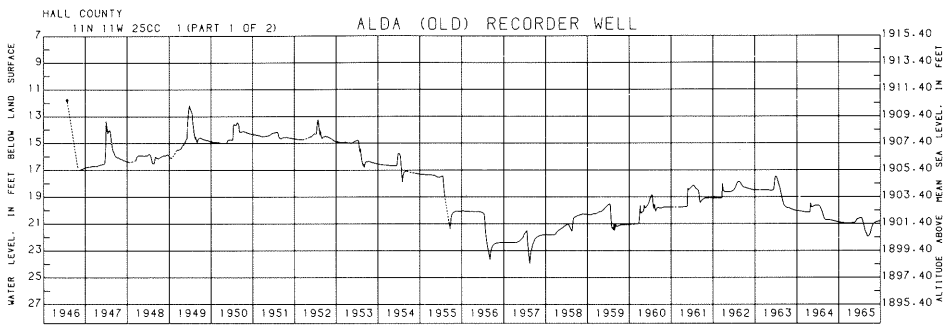


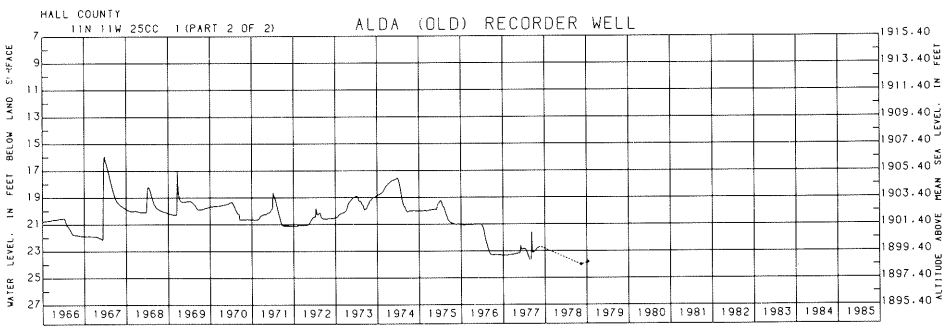
Hall County: Alda (old)

Estimated predevelopment water level: 15 ft

Net water-level change in 1984: Well abandoned in 1977

Net water-level change from 1946 to 1976: −6.51 ft



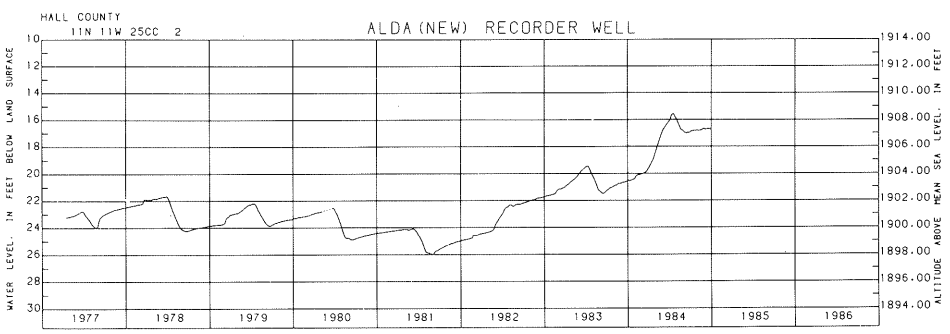


Hall County: Alda (new)

Estimated predevelopment water level: 15 ft

Net water-level change in 1984: +3.87 ft

Net water-level change since 1977: +5.78 ft

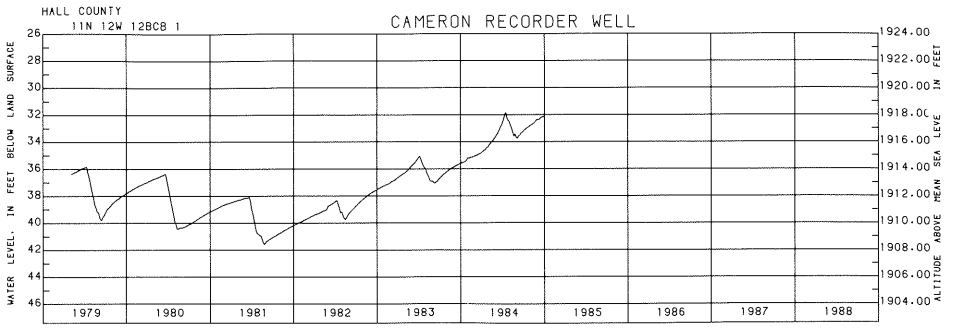


Hall County: Cameron

Estimated predevelopment water level: 27 ft

Net water-level change in 1984: +3.46 ft

Net water-level change since 1979: +5.68 ft

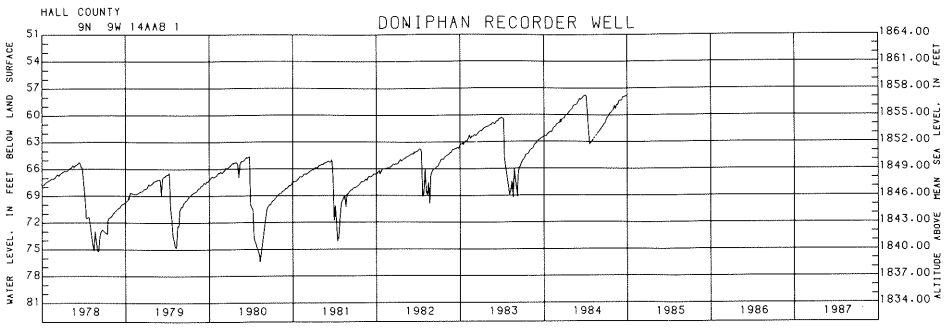


Hall County: Doniphan

Estimated predevelopment water level: 63 ft

Net water-level change in 1984: +4.46 ft

Net water-level change since 1978: +9.91 ft

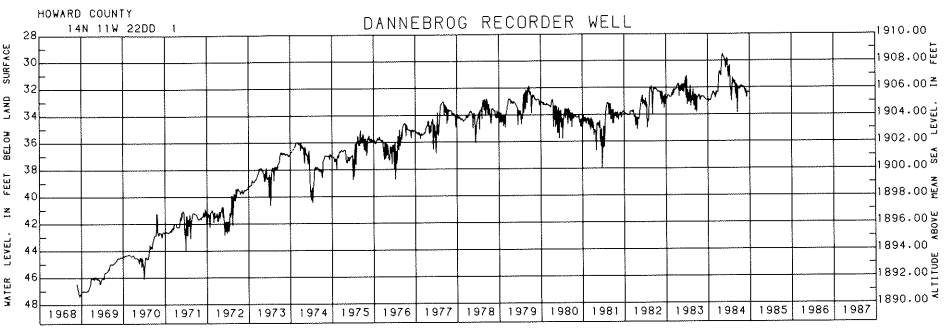


Howard County: Dannebrog

Estimated predevelopment water level: 62 ft

Net water-level change in 1984: +0.51 ft

Net water-level change since 1968: +14.65 ft

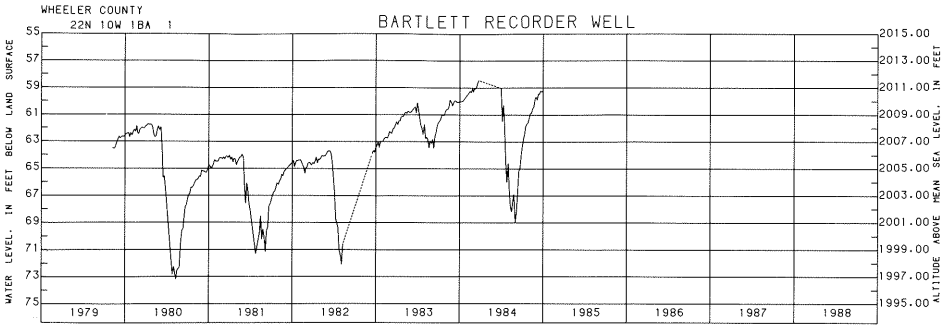


Wheeler County: Bartlett

Estimated predevelopment water level: Not determined

Net water-level change in 1984: +0.78

Net water-level change since 1979: +3.28

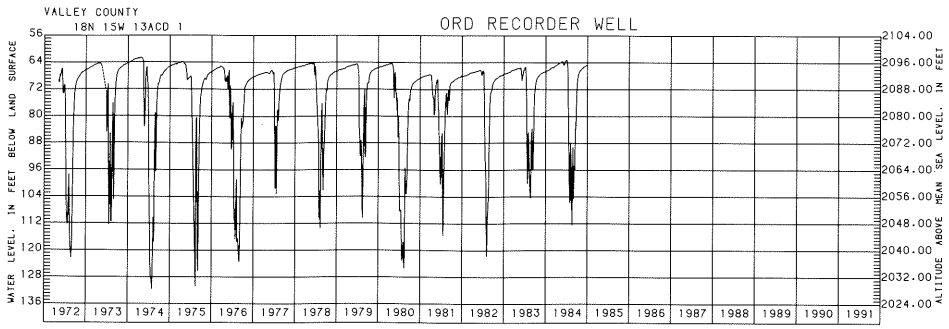


Valley County: Ord

Estimated predevelopment water level: 51 ft

Net water-level change in 1984: +1.87 ft

Net water-level change since 1972: +1.43 ft



East North-Central Division

Water levels measured in the East North-Central Division averaged 2.23 ft higher in fall 1984 than in fall 1983. Rainfall in the division was near normal during most of the growing season, so moderate amounts of groundwater were pumped for irrigation. During October and November precipitation was much above normal and more water was available for recharge.

By fall 1984, water-level declines of 5 ft or more from estimated predevelopment levels had occurred in a total area of approximately 35,000 acres. The largest decline—nearly 23.4 ft—occurred in a well northwest of O'Neill. Water levels declines of 5 to 10 ft occur in other areas of Holt and southern Antelope counties.

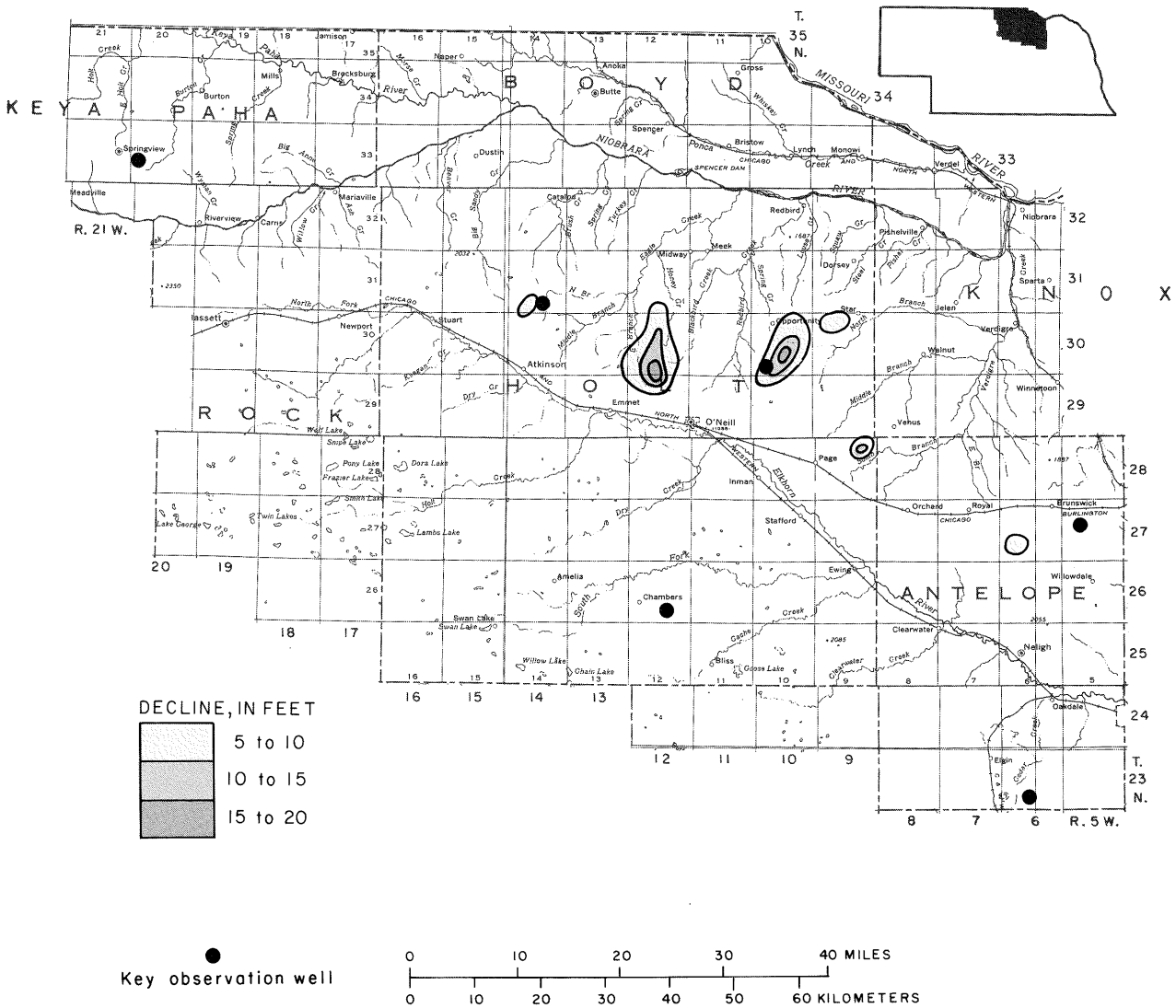
Approximate areas of significant declines from estimated predevelopment water levels to fall 1984 water levels were:

Range in amount of decline, in feet	Approximate area of decline, in acres
5.00-10.00	27,000
10.00-15.00	5,200
15.00-20.00	2,700

Estimated predevelopment water levels in the East North-Central Division are the approximate water levels prior to 1957.

Withdrawal of water for irrigation has caused a progressive decline in water levels since 1964 in some parts of the division; however, recharge from precipitation occasionally has resulted in short-term water-level rises or has lessened the rate of water-level decline. Available data indicate that the water level in some wells declined 5 ft or more during the drought of the mid-1950s and that levels in many wells rose more than 2 ft between 1970 and 1973, when precipitation was above normal. In much of the area, groundwater withdrawals for irrigation are large enough to cause net water-level declines in most years of near-normal or below-normal precipitation. In periods when precipitation is above normal, however, the water level in most wells rises in response to the greater recharge from precipitation and to the corresponding below-normal pumpage.

Sufficient data are available for a fairly good estimation of predevelopment water levels in the division, and the existing observation-well network provides adequate data for evaluation of current water-level changes. Prior to 1975, however, observation wells were too few to define the water-level changes adequately. Since 1975, water-level data collected by the Middle Niobrara and Upper Elkhorn Natural Resources Districts have supplemented the data networks of the U.S. Bureau of Reclamation and the U.S. Geological Survey.



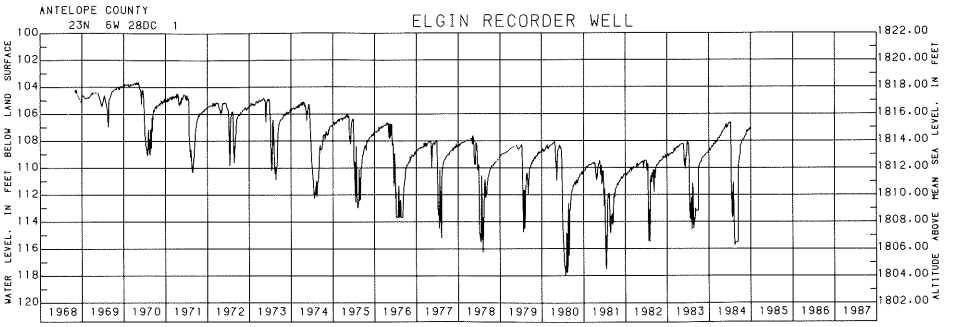
Areas of significant water-level change in the East North-Central Division from 1957 to fall 1984

Antelope County: Elgin

Estimated predevelopment water level: 102 ft

Net water-level change in 1984: +1.65 ft

Net water-level change since 1968: −2.20 ft

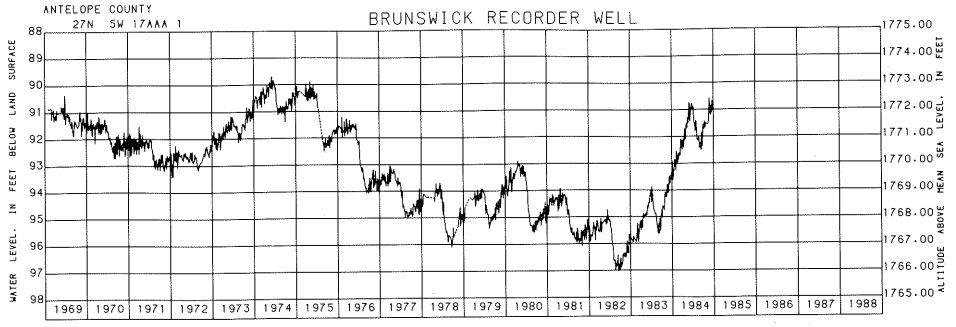


Antelope County: Brunswick

Estimated predevelopment water level: 90 ft

Net water-level change in 1984: +2.32 ft

Net water-level change since 1969: +0.33 ft

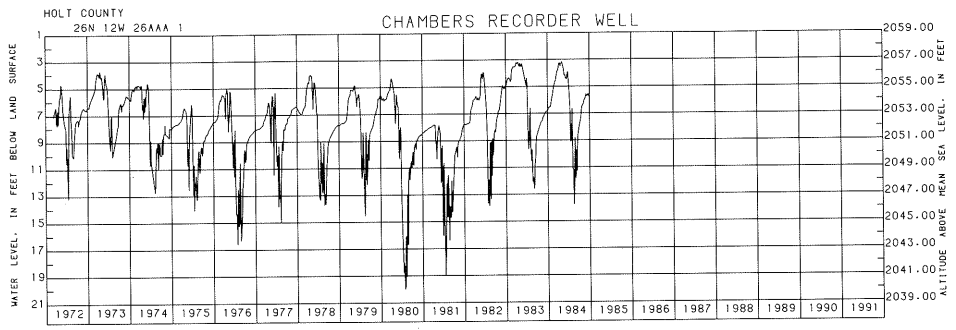


Holt County: Chambers

Estimated predevelopment water level: 6.0 ft

Net water-level change in 1984: +1.00 ft

Net water-level change since 1972: +0.63 ft

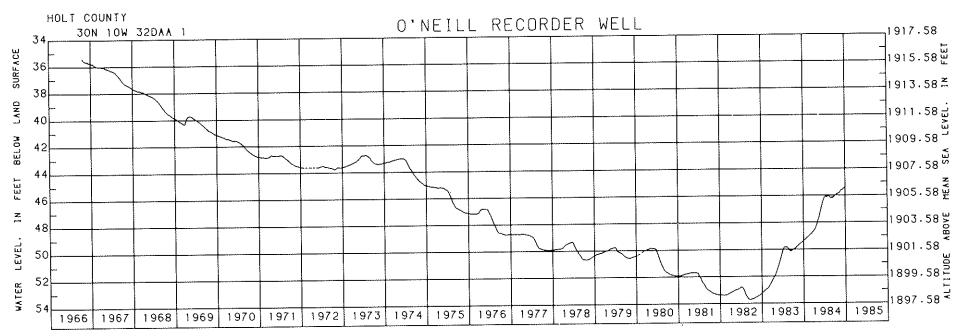


Holt County: O'Neill

Estimated predevelopment water level: 35 ft

Net water-level change in 1984: +3.91 ft

Net water-level change since 1966: −9.71 ft

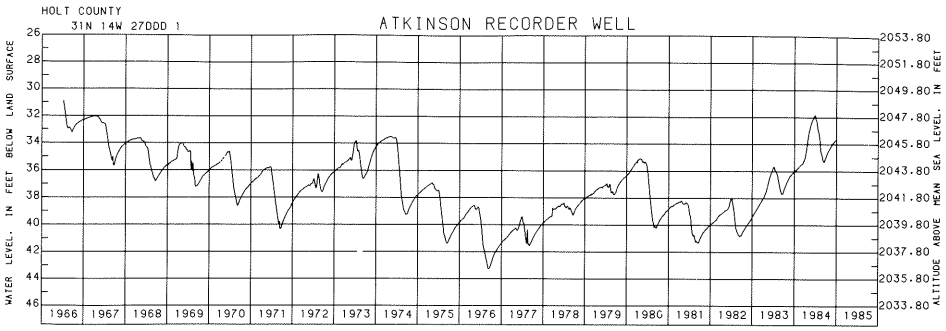


Holt County: Atkinson

Estimated predevelopment water level: 32 ft

Net water-level change in 1984: +2.34 ft

Net water-level change since 1966: −1.36 ft

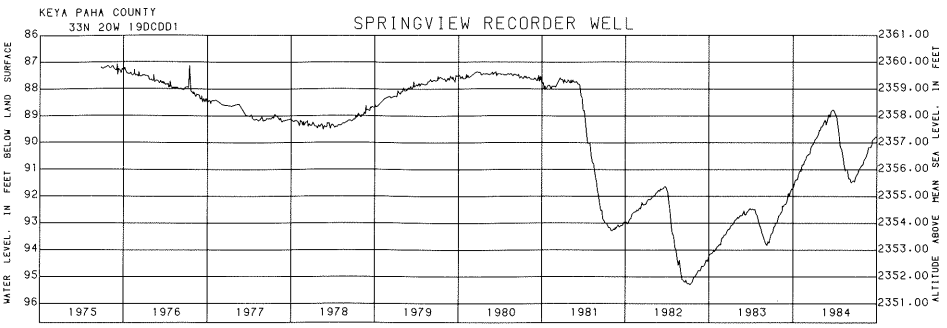


Keya Paha County: Springview

Estimated predevelopment water level: 87 ft

Net water-level change in 1984: +2.13 ft

Net water-level change since 1975: −2.47 ft



Southwest Division

Water levels declined in more than half the observation wells measured in the Southwest Division from fall 1983 to fall 1984. Most declines occurred in the part of the division south of the Platte and South Platte rivers, where precipitation was below normal during the irrigation season. Levels averaged slightly less than 1 ft lower in this area with the greatest declines—up to 5.8 ft—in Perkins County.

Water-level rises of 1.0 ft or more from estimated predevelopment levels occurred in areas totaling approximately 422,000 acres in southern Lincoln, eastern Perkins, and southeastern Keith counties. Water levels began rising in the early 1930s as a result of deep percolation of water from Sutherland Reservoir, Lake Maloney, Jeffrey Reservoir, and their associated canals. The groundwater ridge thus created has steepened the water-table gradient to the north and has increased the rate of groundwater discharge in the South Platte and Platte River valleys. The water level has risen more than 33 ft in a well located in the uplands north of Dickens in Lincoln County. In the immediate vicinities of Sutherland Reservoir, Lake Maloney, and Jeffrey Reservoir, where data are incomplete, water-level rises of 50 ft and more probably have occurred.

Increased development of groundwater for irrigation has caused water levels to decline in some wells within the large rise area since the mid-1970s. For example, the hydrograph of the well located southwest of Lake Maloney in Lincoln County shows a decline of almost 10 ft since the well was installed in 1978.

Approximate areas of significant water-level rises from estimated predevelopment to fall 1984 water levels were:

Range in amount of rise, in feet	Approximate area of rise, in acres
10.00-20.00	219,000
20.00-50.00	199,000
50.00 or more	4,000

Estimated predevelopment water levels are those prior to about 1940.

Surface-water developments in the Republican River valley in Frontier, Hayes, Hitchcock, and Red Willow counties have resulted in local water-level rises, but data are insufficient to delineate the areas of rise.

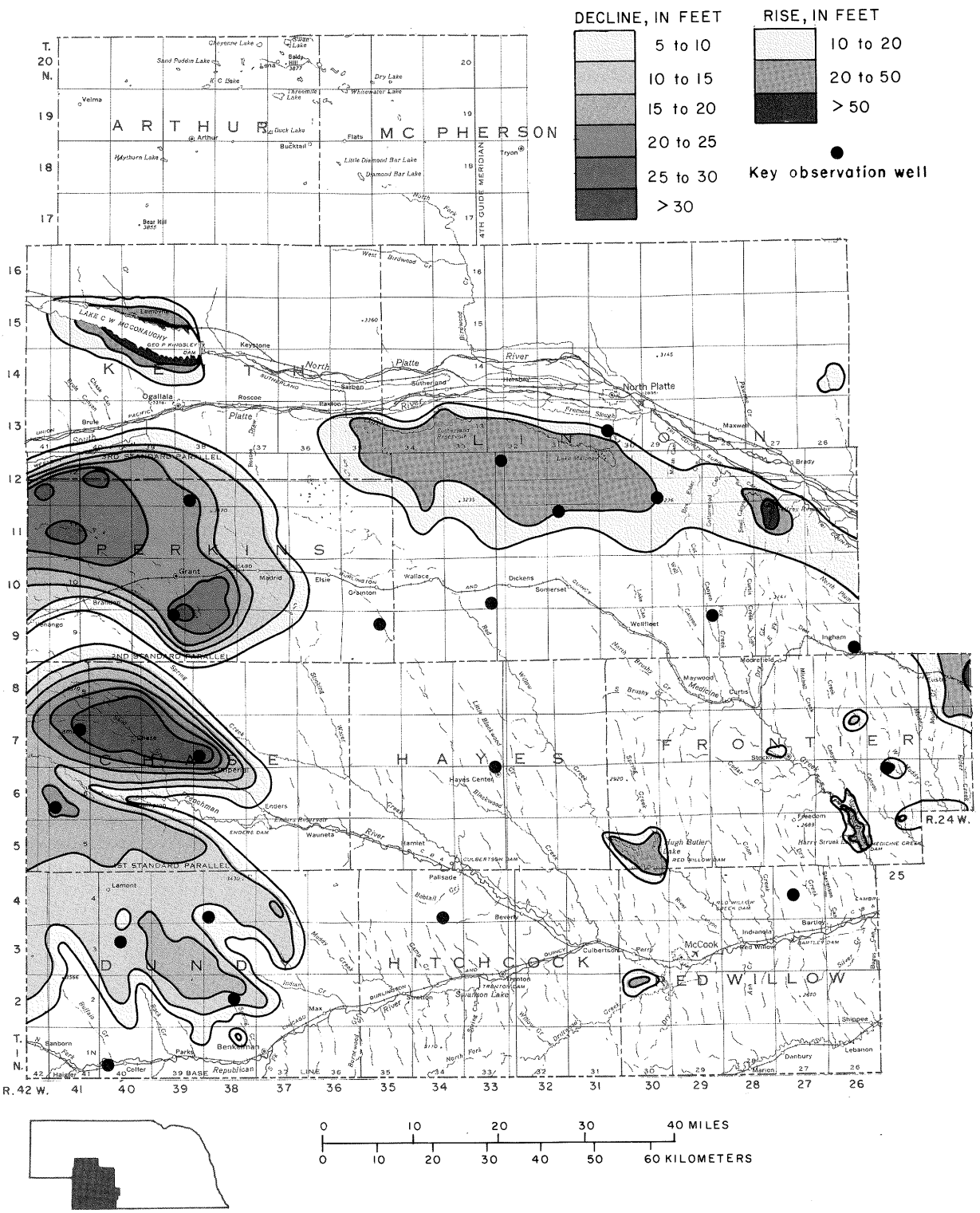
Impoundment of water by Kingsley Dam in the mid-1940s resulted in water-level rises of up to 60 ft in nearby observation wells. Levels stabilized in the early 1950s and since have fluctuated in response to climatic changes. Delineation of the area of water-level rise around Lake McConaughy was facilitated by long-term water-level records provided by the Central Nebraska Public Power and Irrigation District.

In some areas of Frontier, Hayes, and Hitchcock counties, water levels have declined 5 to 20 ft since predevelopment. A maximum decline of approximately 20 ft occurred in a well east of Blackwood Creek in northeastern Hitchcock County. The declines reflect areas of intensive irrigation development.

In Perkins, Chase, Dundy, and southern Keith counties, declines of 5 ft or more from estimated predevelopment levels occurred in approximately 1.10 million acres. Declines range from 5 to 20 ft in most of the area, but range from 25 to 50 ft locally in Chase and northwestern Perkins counties.

As of fall 1984 the approximate areas of water-level declines from estimated predevelopment water levels were:

Range in amount of decline, in feet	Approximate area of decline, in acres
5.00-10.00	203,000
10.00-15.00	352,000
15.00-20.00	221,000
20.00-25.00	146,000
25.00-30.00	129,000
30.00 or more	58,000



Areas of significant water-level change in Southwest Division from 1940 to fall 1984

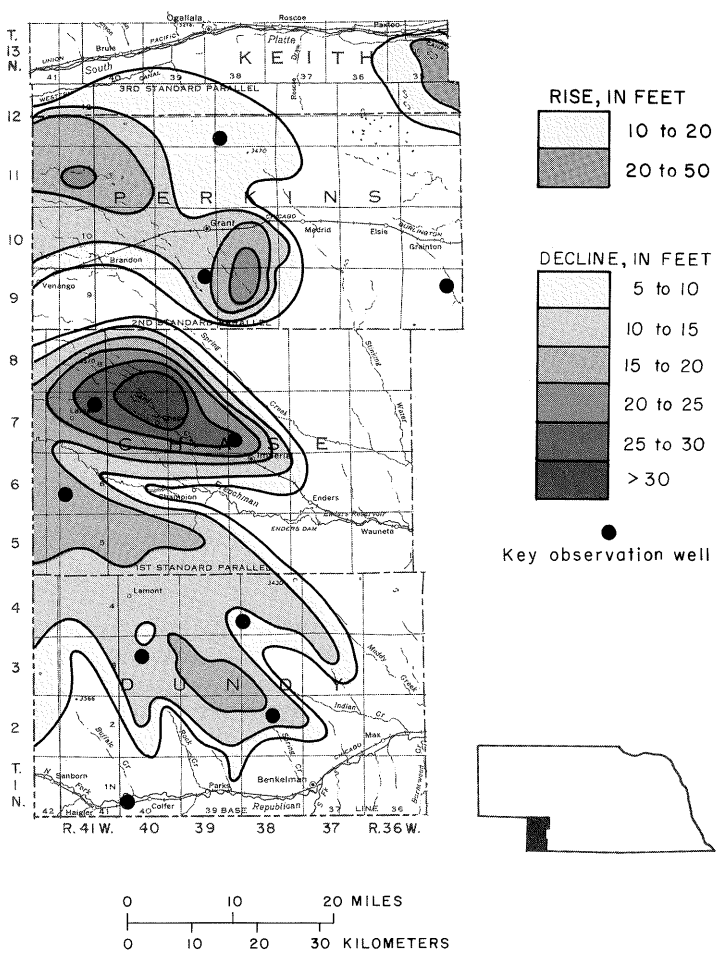
Estimated predevelopment water levels for wells in Perkins, Chase, Dundy, and Keith counties are the approximate water levels prior to 1953. Data are sufficient to make fairly good estimates of predevelopment water levels in most of this area, and measurements made by the Twin Platte and Upper Republican Natural Resources Districts provide adequate data for determining current water-level changes.

Although periodic water-level measurements were made in only a few observation wells in Perkins, Chase, Dundy, and southern Keith counties prior to 1974, available data indicate that a downward water-level trend started about 1966 and continued until 1981 as a result of intensive groundwater development for irrigation. From 1981 to 1983, levels rose in most wells in response to above-normal precipitation and reduced withdrawals of groundwater for irrigation. With the return of normal or below-normal precipitation in 1983, progressive groundwater-level declines have resumed.

The spring 1984 water-level change map shows that declines of 5 ft or more from estimated predevelopment levels occurred throughout an area of approximately 829,000 acres.

Approximate areas of water-level declines from estimated predevelopment water levels in the spring of 1984 were:

Range in amount of decline, in feet	Approximate area of decline, in acres
5.00-10.00	183,000
10.00-15.00	346,000
15.00-20.00	196,000
20.00-25.00	51,000
20.00-30.00	30,000
30.00 or more	23,000



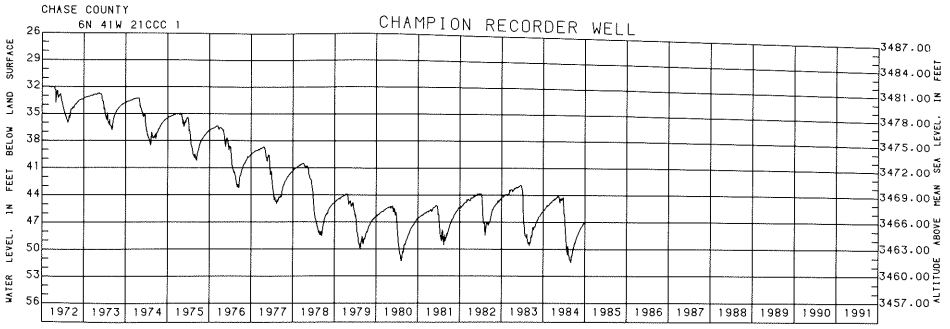
Areas of significant water-level change in Perkins, Chase, Dundy, and southern Keith counties from 1953 to spring 1984

Chase County: Champion

Estimated predevelopment water level: 30 ft

Net water-level change in 1984: −1.24 ft

Net water-level change since 1972: −13.67 ft

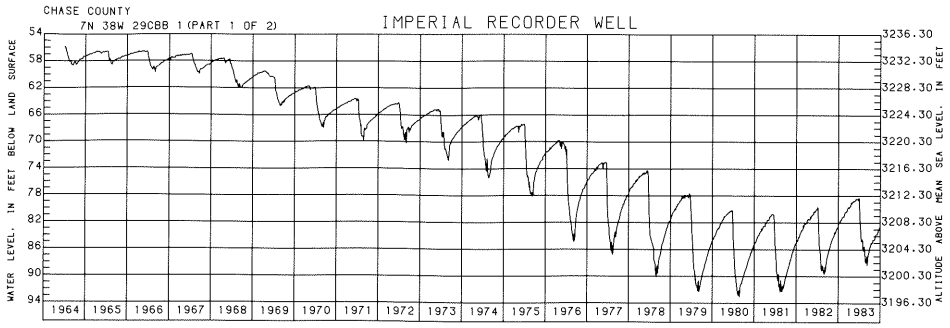


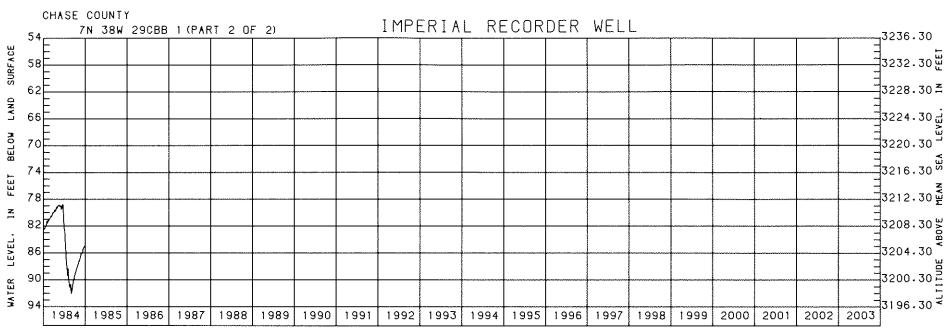
Chase County: Imperial

Estimated predevelopment water level: 56 ft

Net water-level change in 1984: −2.48 ft

Net water-level change since 1964: −27.48 ft



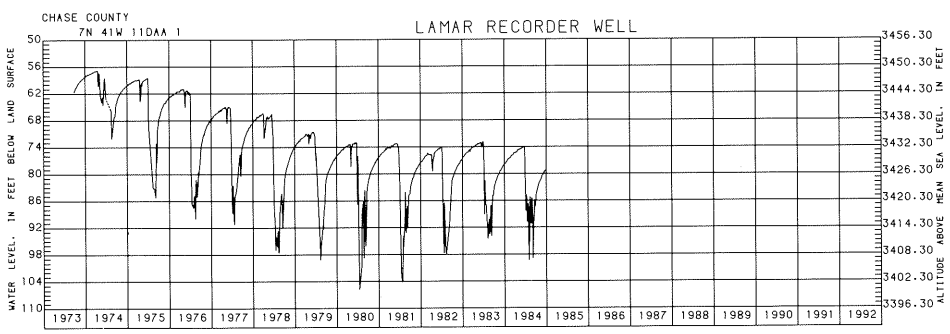


Chase County: Lamar

Estimated predevelopment water level: 50 ft

Net water-level change in 1984: −1.24 ft

Net water-level change since 1973: −20.80 ft

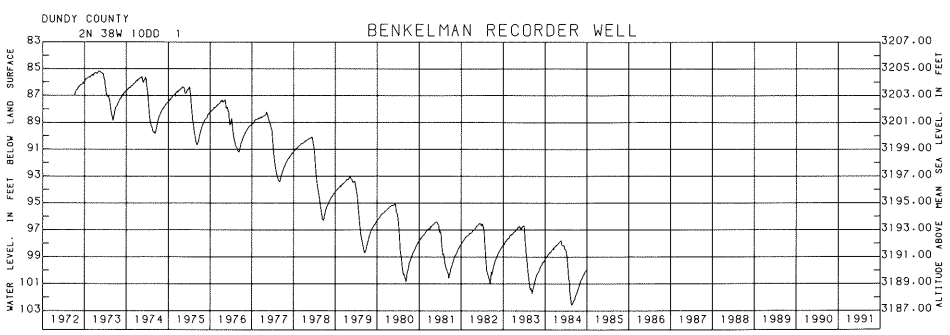


Dundy County: Benkelman

Estimated predevelopment water level: 84 ft

Net water-level change in 1984: −0.72 ft

Net water-level change since 1972: −13.91 ft

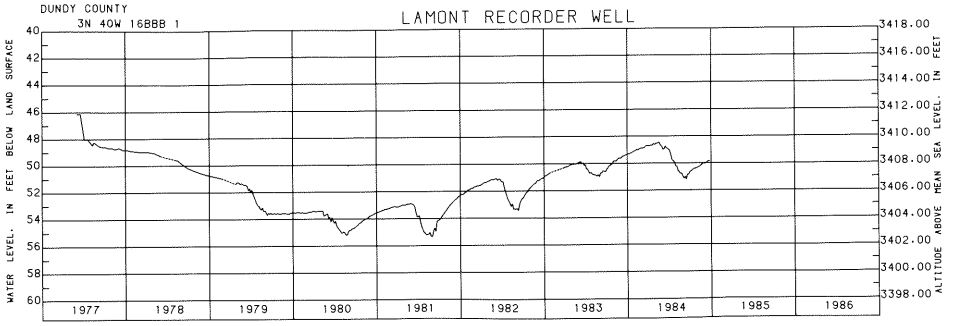


Dundy County: Lamont

Estimated predevelopment water level: 38 ft

Net water-level change in 1984: −0.39 ft

Net water-level change since 1977: −0.95 ft

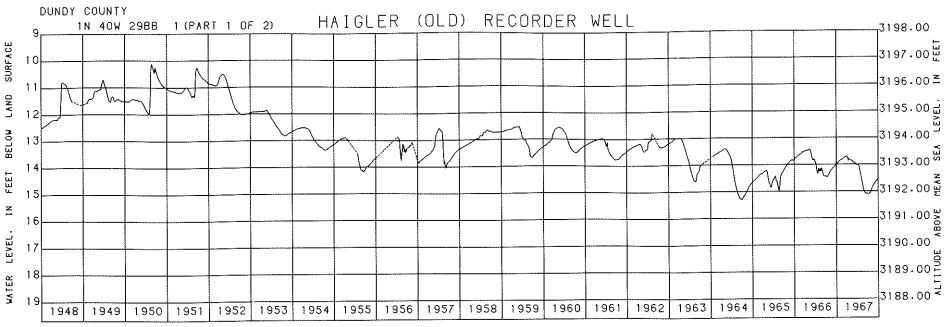


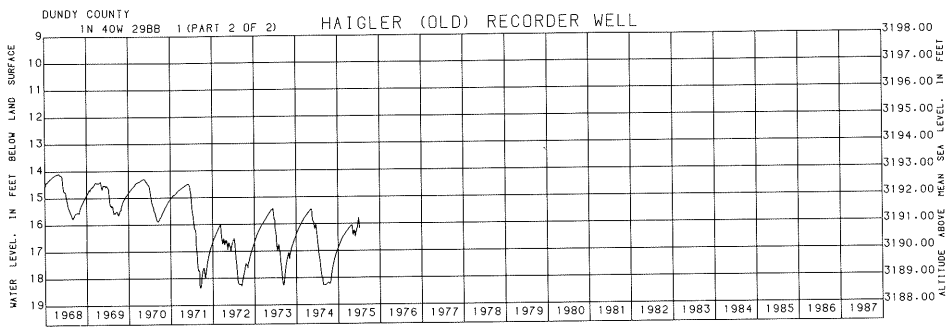
Dundy County: Haigler (old)

Estimated predevelopment water level: 12 ft

Net water-level change in 1984: Well abandoned in 1975

Net water-level change from 1946 to 1974: −4.63 ft



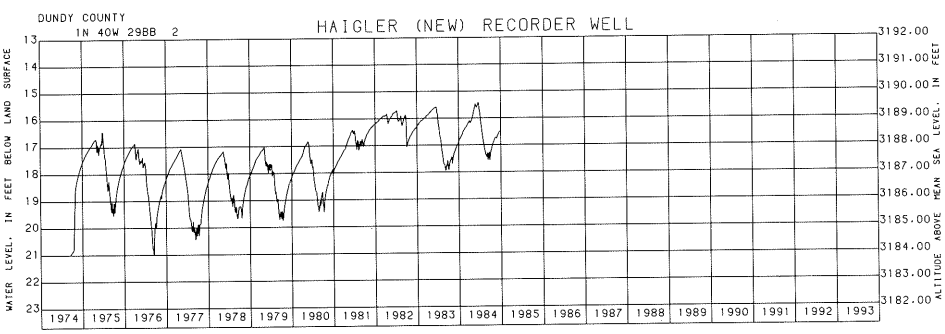


Dundy County: Haigler (new)

Estimated predevelopment water level: 10 ft

Net water-level change in 1984: +0.42 ft

Net water-level change from 1974: +1.12 ft

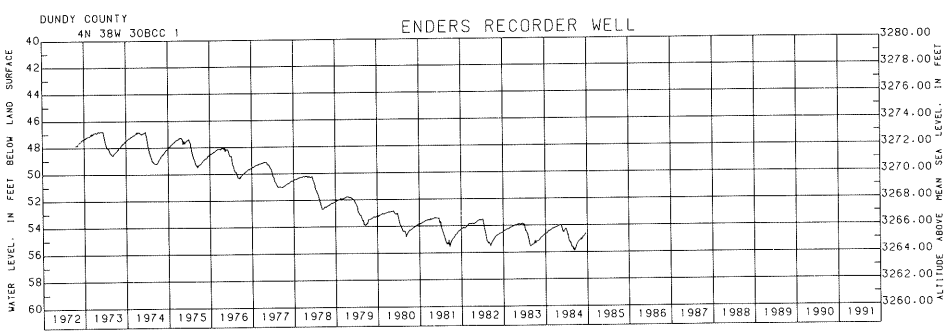


Dundy County: Enders

Estimated predevelopment water level: 46 ft

Net water-level change in 1984: +0.12 ft

Net water-level change since 1972: −7.20 ft

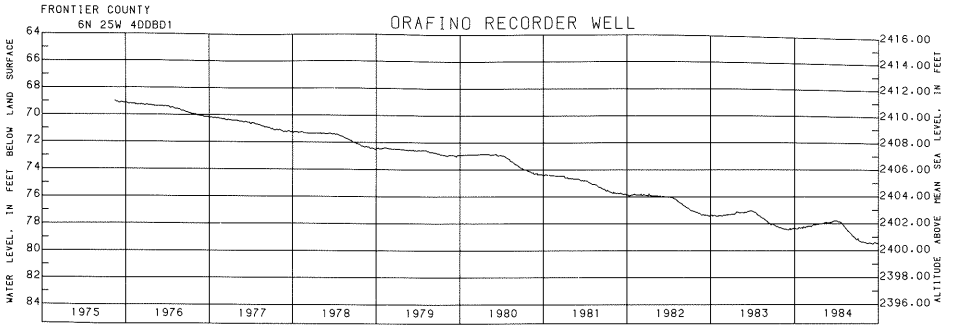


Frontier County: Orafino

Estimated predevelopment water level: 65 ft

Net water-level change in 1984: −1.06 ft

Net water-level change since 1975: −10.28 ft

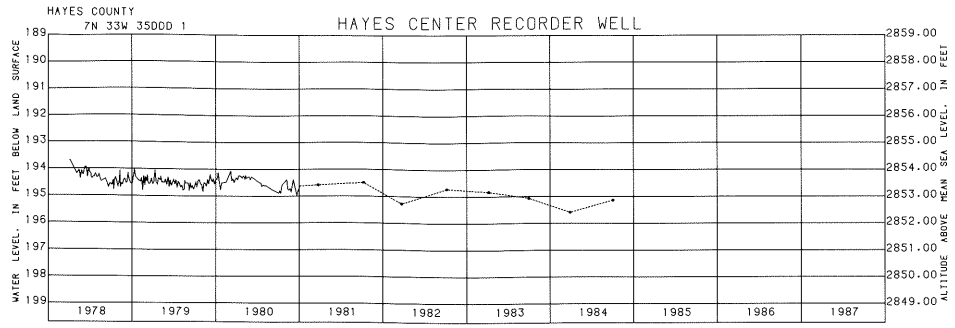


Hayes County: Hayes Center

Estimated predevelopment water level: 189 ft

Net water-level change, fall 1983 to fall 1984: −0.06 ft

Net water-level change since 1978: −0.52 ft

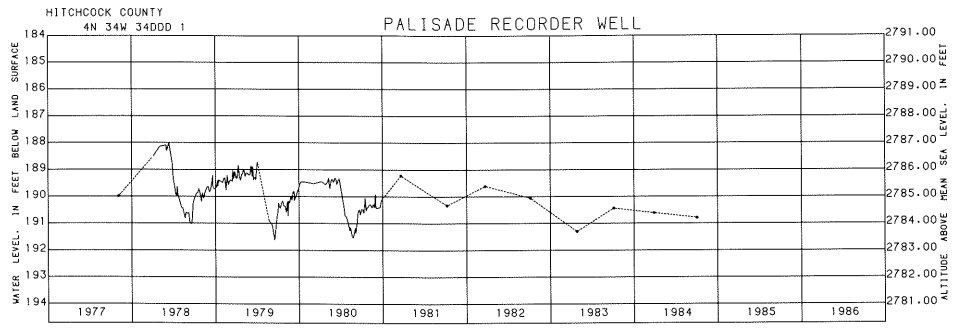


Hitchcock County: Palisade

Estimated predevelopment water level: 186 ft

Net water-level change, fall 1983 to fall 1984: −0.35 ft

Net water-level change since 1978: −0.75 ft

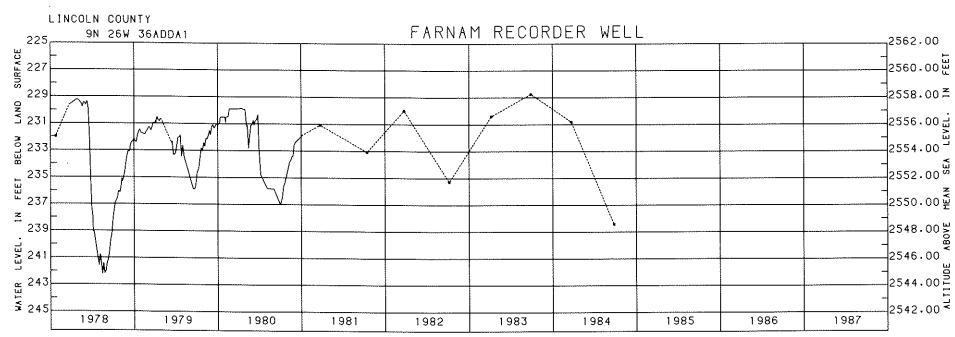


Lincoln County: Farnam

Estimated predevelopment water level: 243 ft

Net water-level change, fall 1983 to fall 1984: −9.68 ft

Net water-level change since 1978: −0.89 ft

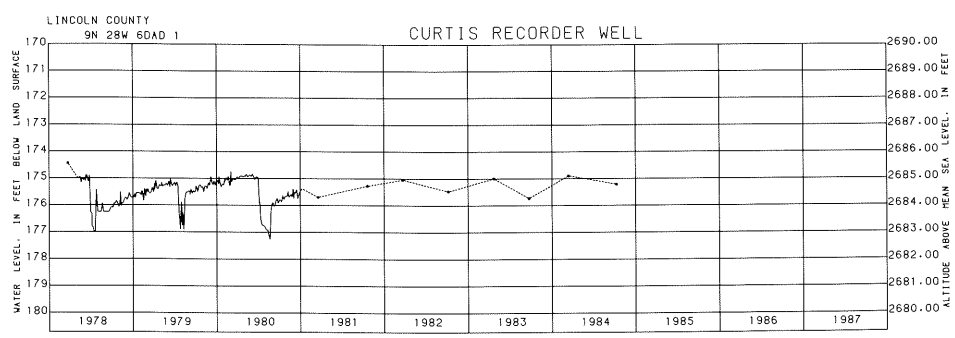


Lincoln County: Curtis

Estimated predevelopment water level: 169 ft

Net water-level change, fall 1983 to fall 1984: +0.52 ft

Net water-level change since 1978: −0.73 ft

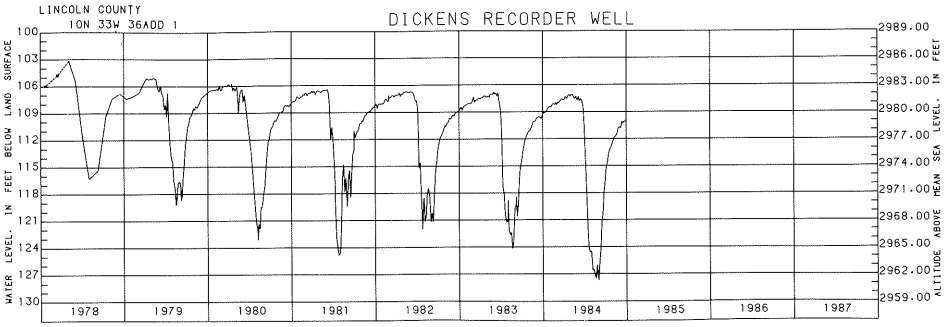


Lincoln County: Dickens

Estimated predevelopment water level: 108 ft

Net water-level change in 1984: −0.64 ft

Net water-level change since 1979: −2.71 ft

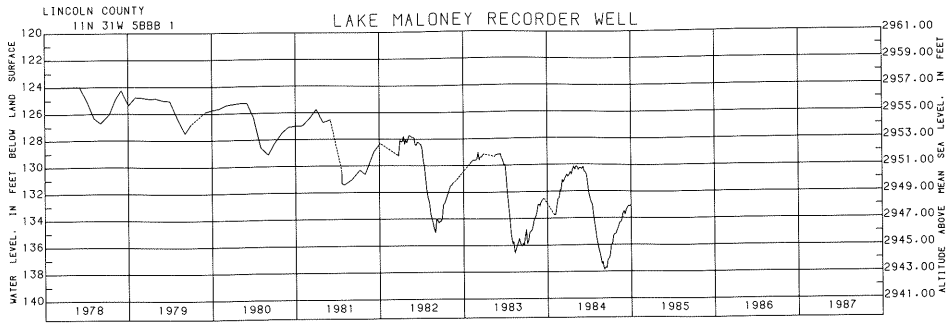


Lincoln County: Lake Maloney

Estimated predevelopment water level: Not determined

Net water-level change in 1984: −0.55 ft

Net water-level change since 1978: −7.70 ft

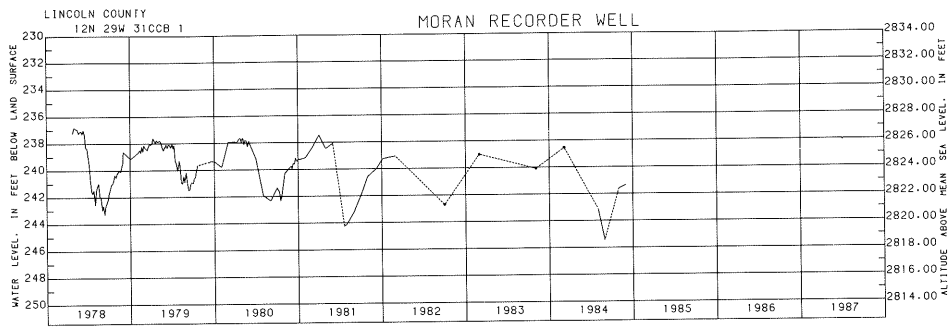


Lincoln County: Moran

Estimated predevelopment water level: 271 ft

Net water-level change, fall 1983 to fall 1984: −1.27 ft

Net water-level change since 1978: −0.82 ft

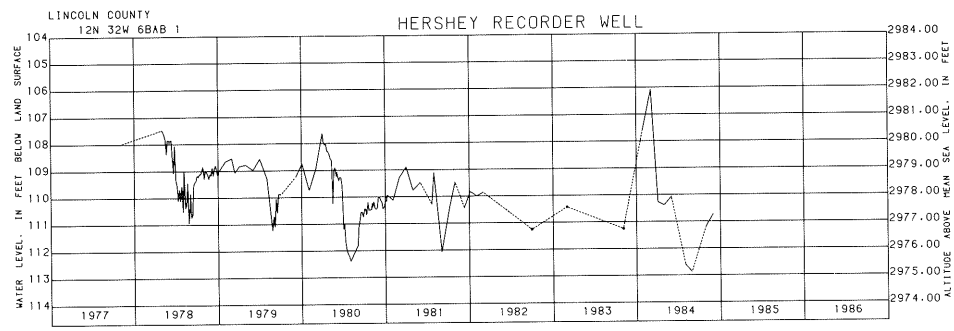


Lincoln County: Hershey

Estimated predevelopment water level: 131 ft

Net water-level change, fall 1983 to fall of 1984: +0.08 ft

Net water-level change since 1977: −3.18 ft

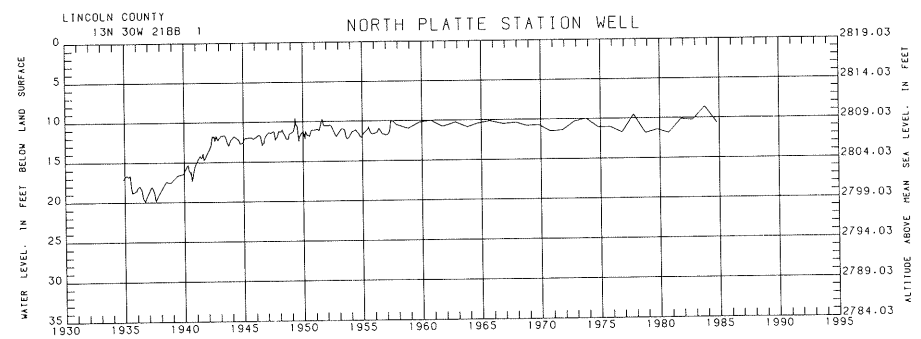


Lincoln County: North Platte Station

Estimated predevelopment water level: 17.8 ft

Net water-level change, fall 1983 to fall 1984: −2.06 ft

Net water-level change since 1934: +6.48 ft

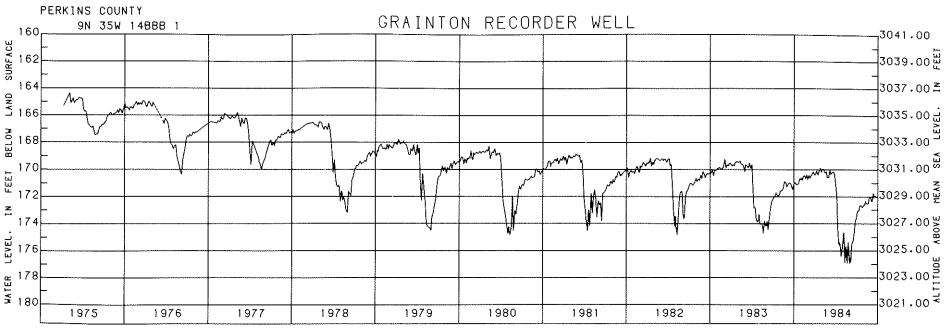


Perkins County: Grainton

Estimated predevelopment water level: 165 ft

Net water-level change in 1984: −0.96 ft

Net water-level change since 1975: −6.84 ft



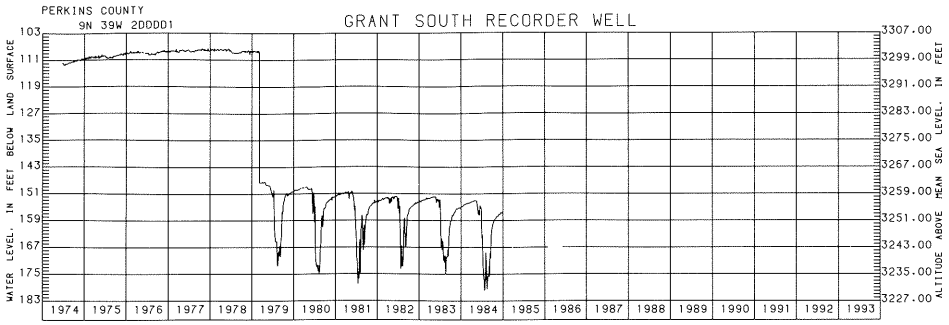
Perkins County: Grant South

Estimated predevelopment water level: 135 ft

Net water-level change in 1984: −1.73 ft

Net water-level change since 1979: −6.37 ft

[Well redeveloped in 1979, for explanation see 1980 Goundwater Level Report]

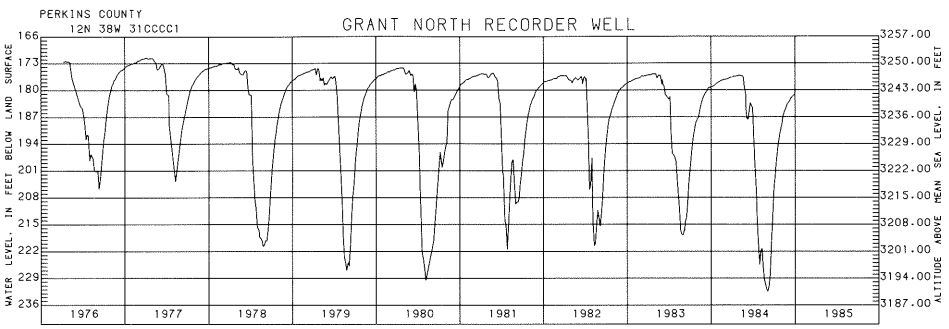


Perkins County: Grant North

Estimated predevelopment water level: 173 ft

Net water-level change in 1984: −1.82 ft

Net water-level change since 1976: −6.90 ft

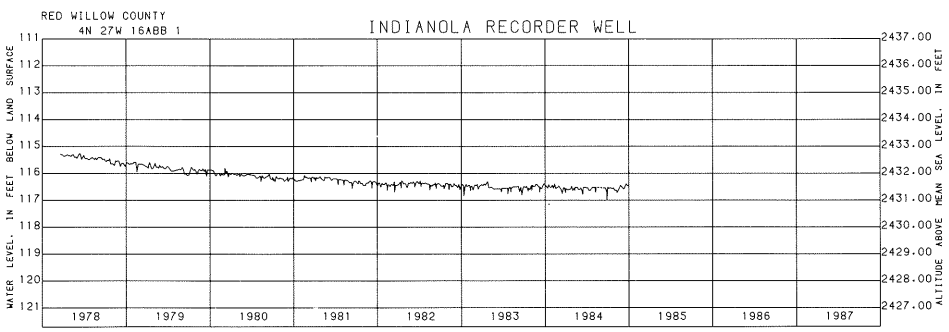


Red Willow County: Indianola

Estimated predevelopment water level: 115 ft

Net water-level change in 1984: −0.09 ft

Net water-level change since 1978: −0.82 ft



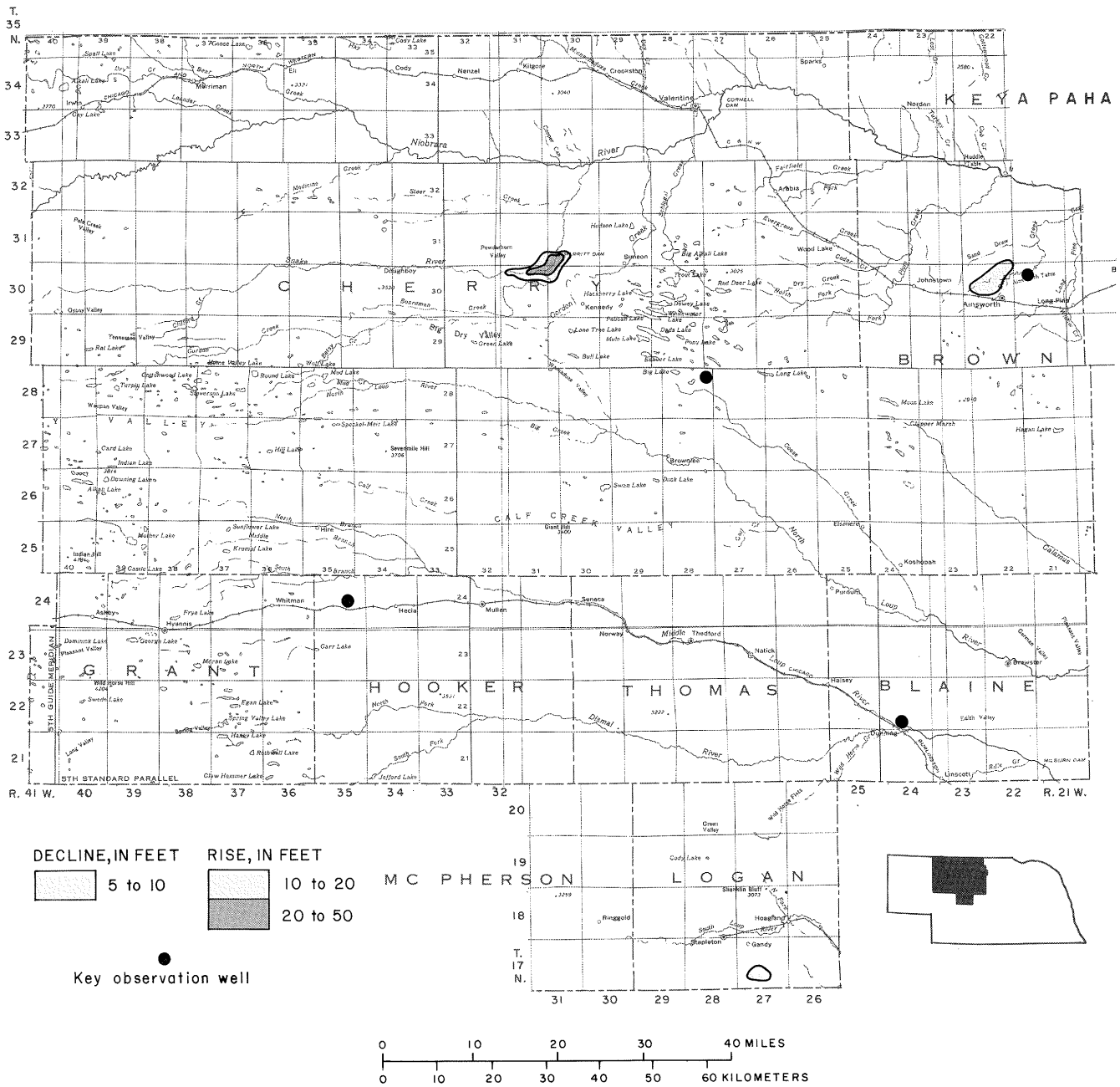
West North-Central Division

Water levels rose an average of 0.2 ft in the West North-Central Division from fall 1983 to fall 1984. Rainfall was near normal during most of the growing season, resulting in moderate withdrawals for irrigation. Most water levels ranged from 1 ft higher to 1 ft lower throughout the division.

Available water-level data are insufficient to determine accurately areas of long-term rise or decline in the division, except north of Ainsworth in Brown County. Because of leakage from surface irrigation systems, water levels in fall 1984 were as much as 15.0 ft higher than predevelopment levels. Levels have risen also in the vicinity of Merritt Reservoir but the area of rise delineated there is only an approximation because data are limited.

Historical records indicate that withdrawals of groundwater for irrigation have caused no long-term declines in water levels in this division, even though the number of registered irrigation wells increased from 104 to 1,331 from 1955 to 1984. Only 4 new wells were registered the division in 1984, and the average density of wells in the division is only about 1 per 8 mi^2.

Water levels in the division are measured by the Middle Niobrara and Upper Loup Natural Resources Districts and the U.S. Fish and Wildlife Service.



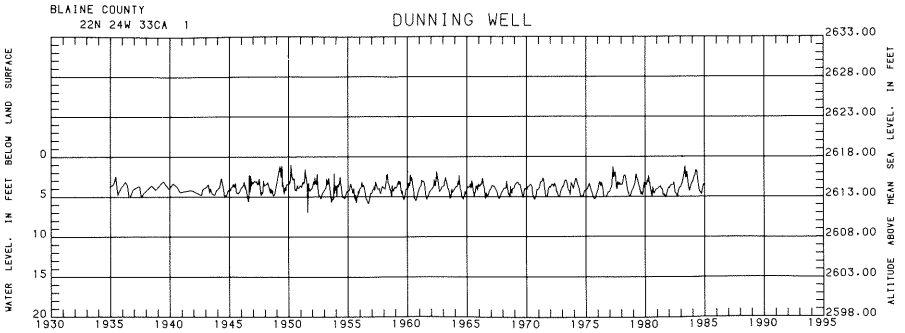
Areas of significant water-level change in the West North-Central Division from 1951 to fall 1984

Blaine County: Dunning

Estimated predevelopment water level: 4 ft

Net water-level change, fall 1983 to fall 1984: −0.45 ft

Net water-level change since 1934: +0.28 ft

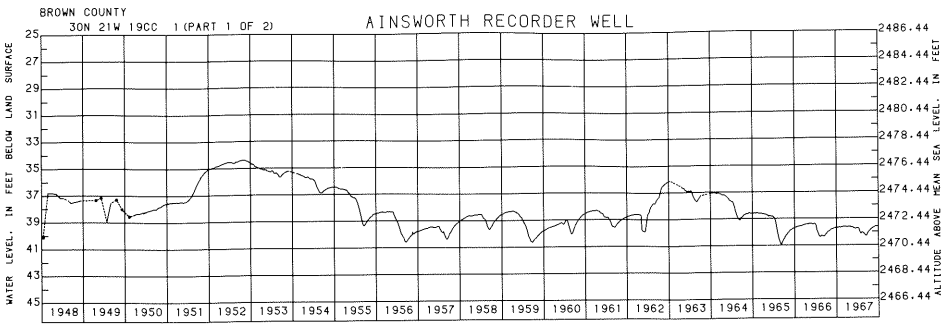


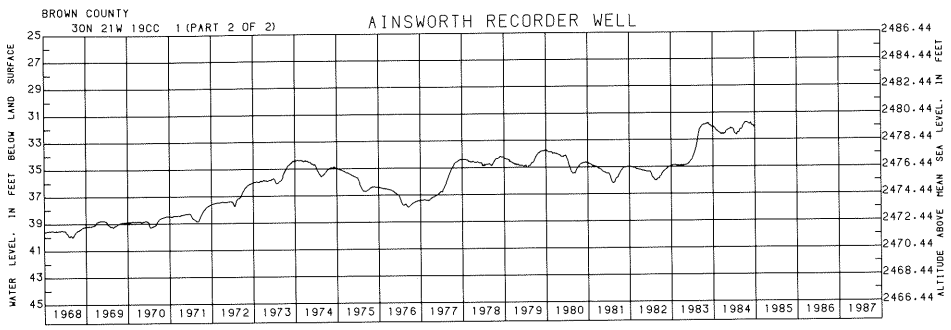
Brown County: Ainsworth

Estimated predevelopment water level: 36 ft

Net water-level change in 1984: −0.07 ft

Net water-level change since 1947: +7.80 ft



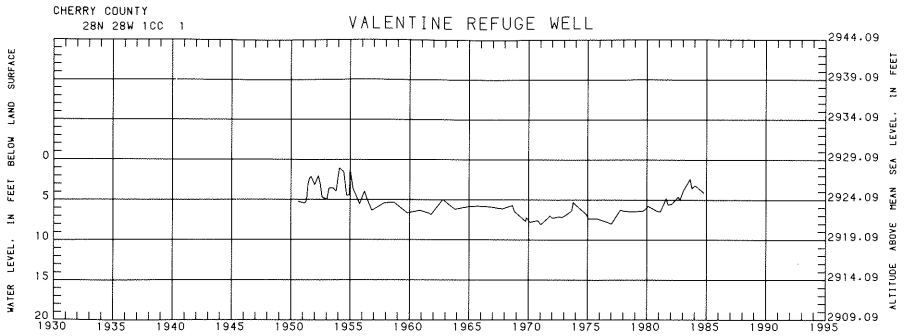


Cherry County: Valentine Refuge

Estimated predevelopment water level: 4 ft

Net water-level change, fall 1983 to fall 1984: −0.51 ft

Net water-level change since 1950: +1.18 ft

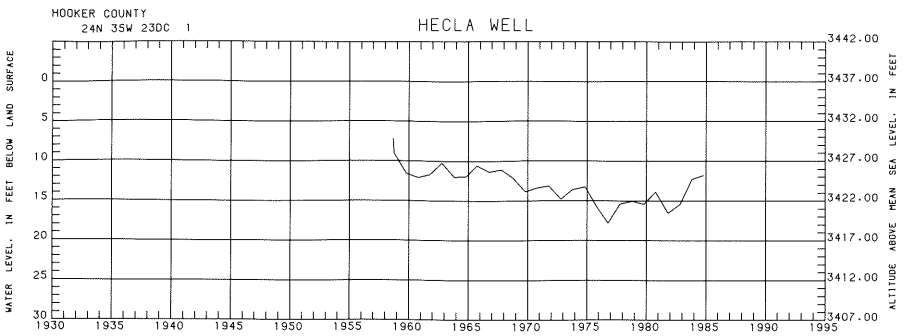


Hooker County: Hecla

Estimated predevelopment water level: 4 ft

Net water-level change, fall 1983 to fall 1984: +0.47 ft

Net water-level change since 1958: −2.78 ft



Panhandle Division

Water levels were lower in fall 1984 than in fall 1983 in about 60 percent of the observation wells measured in the Panhandle, averaging less than a foot lower. Levels mostly declined in all areas of the division except Banner, Scotts Bluff and parts of Cheyenne, Morrill and Dawes counties. The greatest rises—as much as 11 ft—occurred in Banner County, and the greatest declines—as much as 12 ft occurred in Cheyenne and Sheridan counties. Rainfall was slightly below-normal during the growing season in most of the Panhandle, so groundwater withdrawals were greater and less water was available for recharge than in wetter years.

Intensive groundwater development for irrigation north and west of Alliance caused water-level declines of 5 ft or more in an area of about 338,000 acres since 1950. A maximum long-term decline of slightly more than 55 ft is indicated by records for an observation well 3 mi north of Alliance.

As of fall 1984, the approximate areas of significant water-level declines from estimated predevelopment water levels in Box Butte County were:

Range in amount of decline, in feet	Approximate area of decline, in acres
5.00-10.00	51,000
10.00-15.00	47,500
15.00-20.00	48,000
20.00-25.00	60,000
25.00-30.00	54,000
30.00 or more	78,000

Water levels prior to about 1947 are used as the estimated predevelopment water levels in Box Butte County.

Sufficient data are available for good estimates of predevelopment water levels in most of Box Butte County, and existing water-level measurement programs provide sufficient data for fairly good definition of current water-level changes throughout most of the county. Water-level data are collected by the Upper Niobrara-White Natural Resources District.

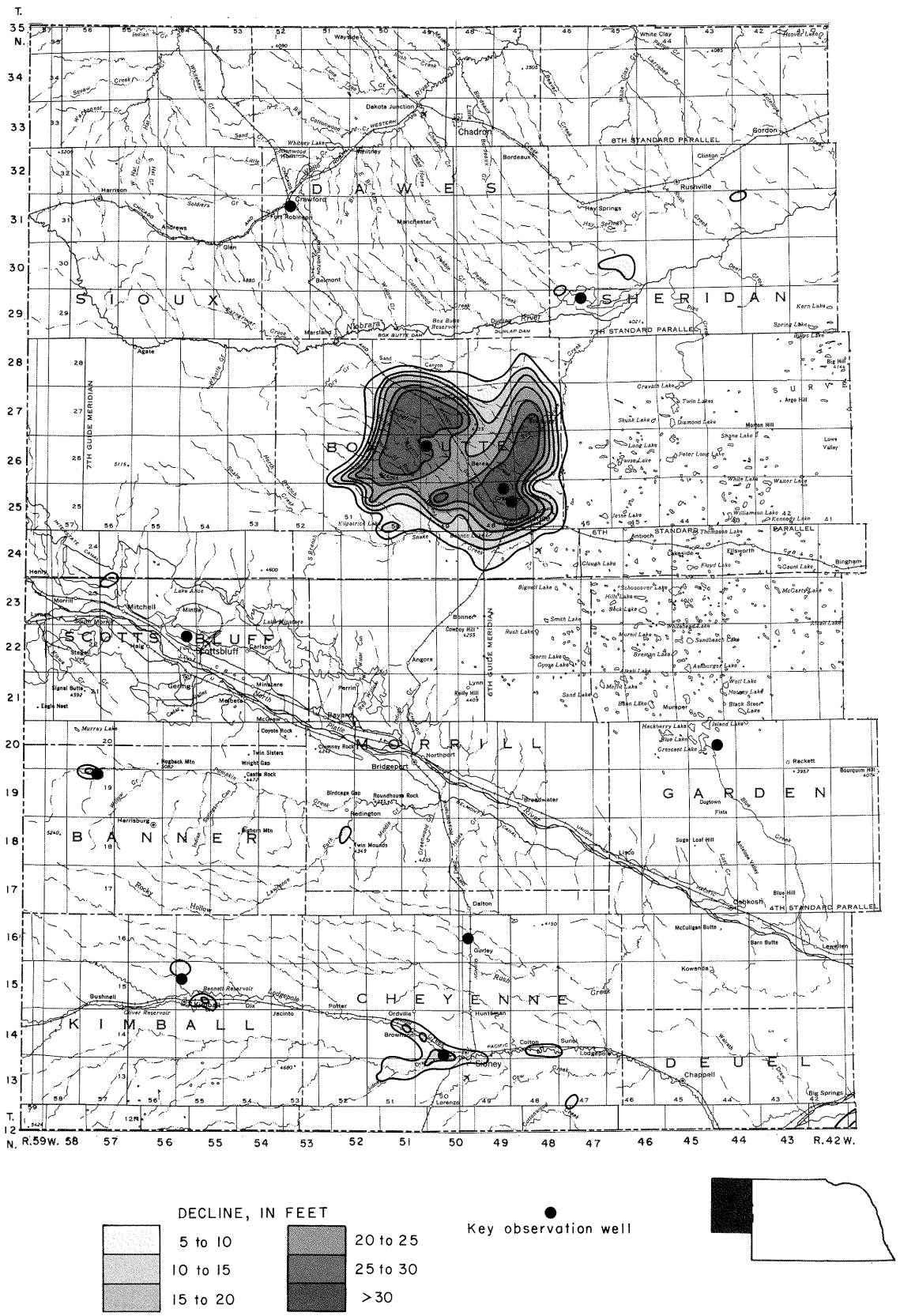
A second major area of significant water-level declines since predevelopment is along Lodgepole Creek valley and Sidney Draw southwest of Sidney in Cheyenne County. Groundwater withdrawals for irrigation have resulted in progressively declining water levels since 1969. Declines of 5 ft or more have occurred in an area of approximately 27,600 acres. A maximum decline of 15 ft from estimated predevelopment level was observed in several observation wells in Lodgepole Creek valley west of Sidney.

In fall 1984, the approximate areas of significant water-level declines from estimated predevelopment water levels were:

Range in amount of decline, in feet	Approximate area of decline, in acres
5.00-10.00	23,100
10.00-15.00	4,500

Estimated predevelopment water levels in Lodgepole Creek valley and Sidney Draw are the approximate water levels prior to 1950. Water-level changes are delineated from data collected by the South Platte Natural Resources District and the Conservation and Survey Division.

Water-level declines of more than 5 ft from estimated predevelopment levels have occurred also in upland areas in Cheyenne, Kimball and Scotts Bluff counties and along Pumpkin Creek in Banner and Morrill counties. However, available data are not sufficient for accurate delineation of the areas of decline. Water-level data are collected by the North and South Platte Natural Resources Districts and the Conservation and Survey Division.



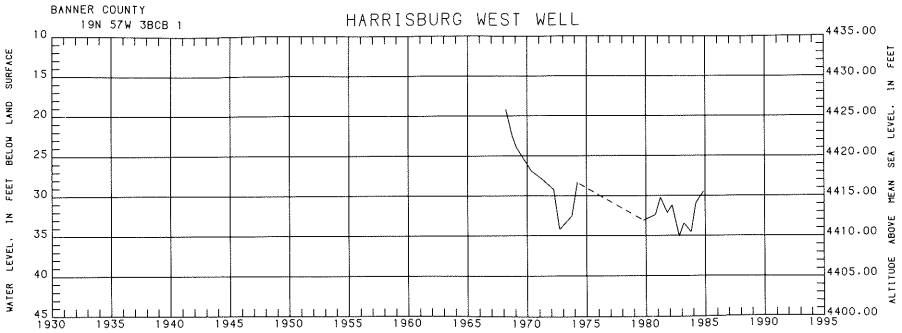
Areas of significant water-level change in the Panhandle Division from 1946 to fall 1984

Banner County: Harrisburg West

Estimated predevelopment water level: 19 ft

Net water-level change, fall 1983 to fall 1984: +5.06 ft

Net water-level change, since 1968: −7.04 ft

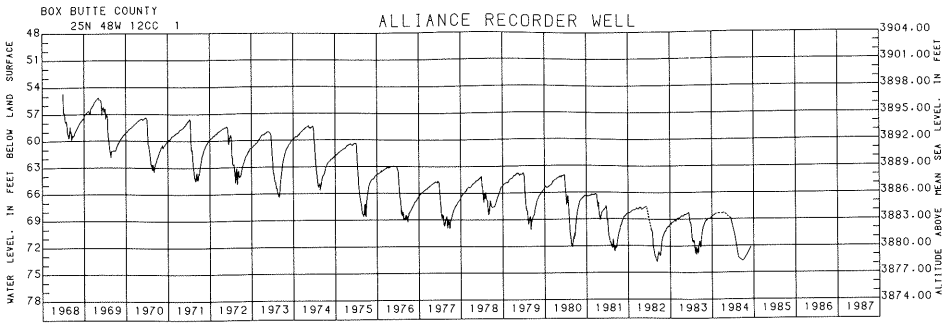


Box Butte County: Alliance

Estimated predevelopment water level: 17 ft

Net water-level change in 1984: −3.42 ft

Net water-level change since 1968: −14.79 ft

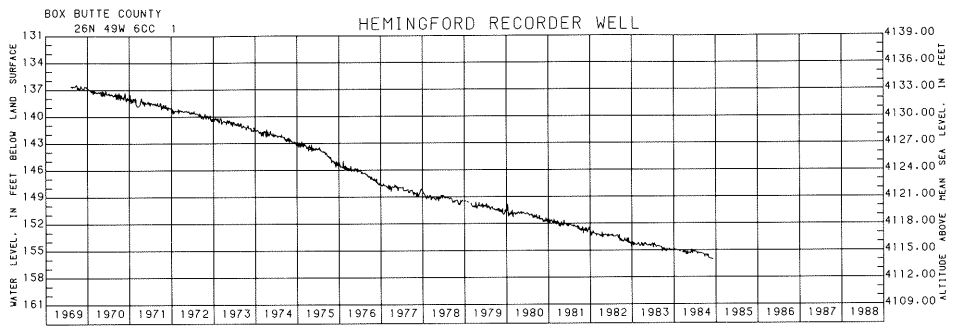


Box Butte County: Hemingford

Estimated predevelopment water level: 134 ft

Net water-level change in 1984: −1.26 ft

Net water-level change since 1969: −19.38 ft

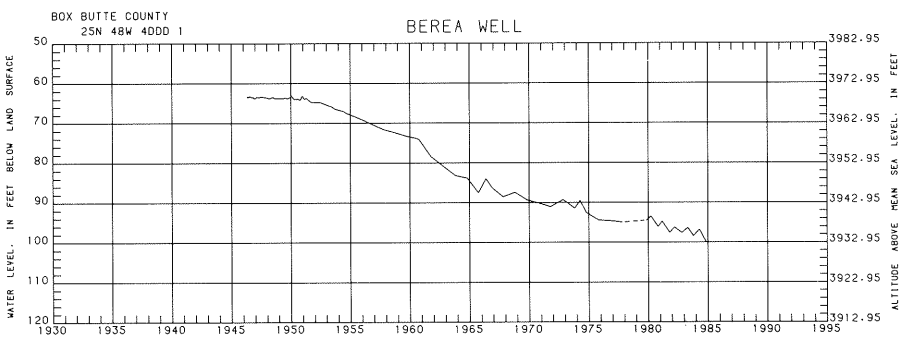


Box Butte County: Berea

Estimated predevelopment water level: 63 ft

Net water-level change, fall 1983 to fall 1984: −1.43 ft

Net water-level change since 1946: −36.31 ft

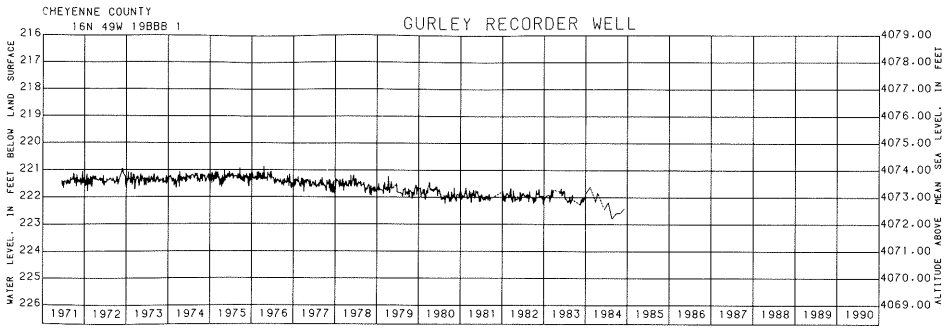


Cheyenne County: Gurley

Estimated predevelopment water level: 221 ft

Net water-level change, fall 1983 to fall 1984: −0.31 ft

Net water-level change since 1971: −0.89 ft

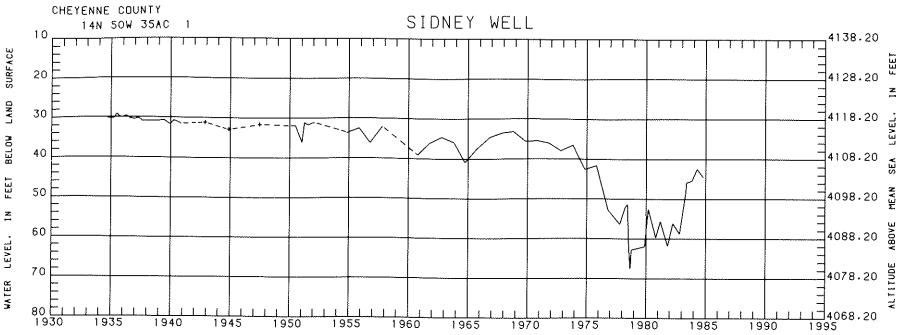


Cheyenne County: Sidney

Estimated predevelopment water level: 31 ft

Net water-level change, fall 1983 to fall 1984: +0.92 ft

Net water-level change since 1934: −14.16 ft

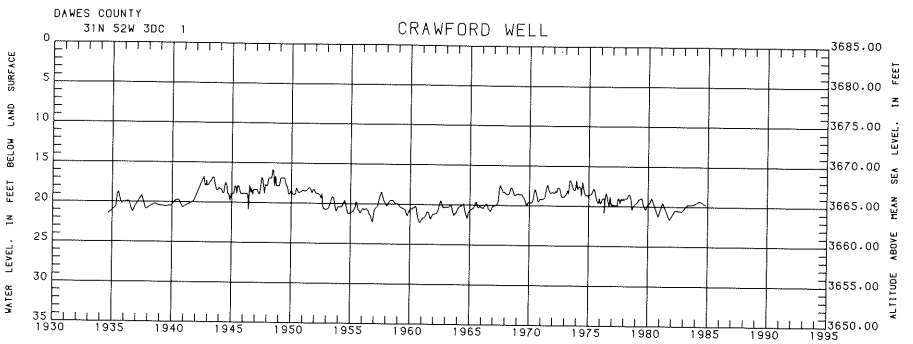


Dawes County: Crawford

Estimated predevelopment water level: 19.5 ft

Net water-level change, fall 1983 to fall 1984: −0.06 ft

Net water-level change since 1934: +1.42 ft

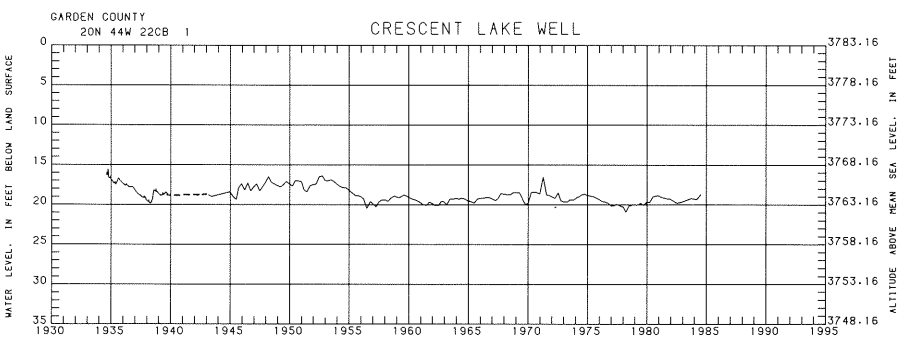


Garden County: Crescent Lake

Estimated predevelopment water level: 17.5 ft

Net water-level change, fall 1983 to fall 1984: not determinable

Net water-level change since 1934: not determinable

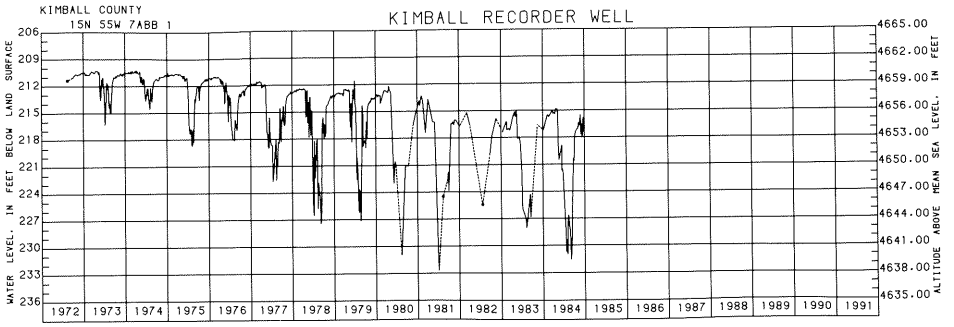


Kimball County: Kimball

Estimated predevelopment water level: 210 ft

Net water-level change in 1984: −1.03 ft

Net water-level change since 1972: −5.51 ft

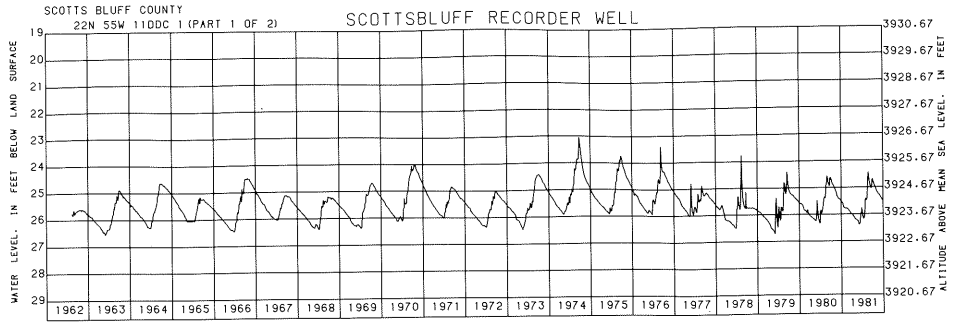


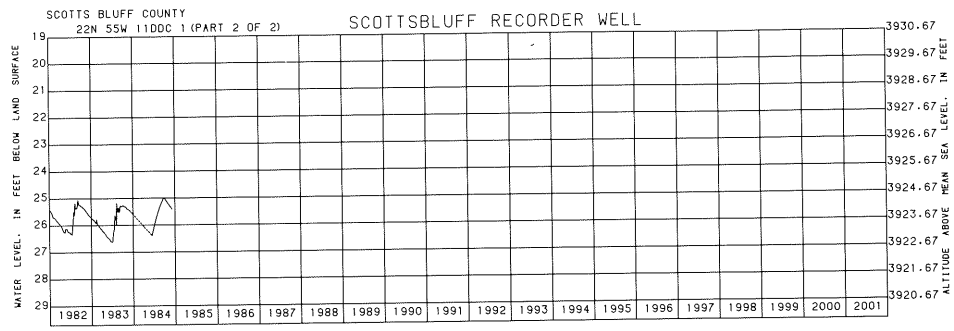
Scotts Bluff County: Scottsbluff

Estimated predevelopment water level: 26 ft

Net water-level change, fall 1983 to fall 1984: +0.18 ft

Net water-level change since 1962: +0.38 ft



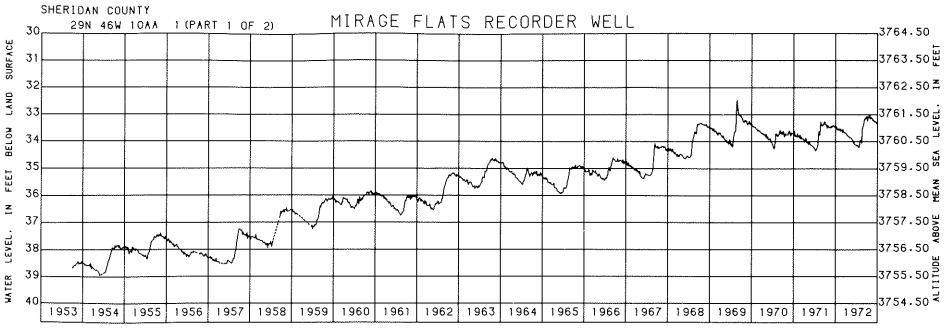


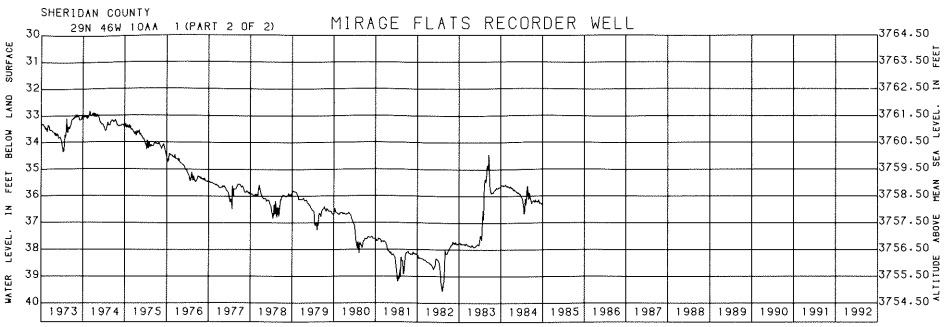
Sheridan County: Mirage Flats

Estimated predevelopment water level: 38.5 ft

Net water-level change in 1984: −0.75 ft

Net water-level change since 1953: +2.11 ft





WATER-LEVEL MEASUREMENT PROGRAM, 1984

Location of Observation Wells and Availability of Data

Thirty-three agencies collected water-level measurements which serve as basic data for this report.

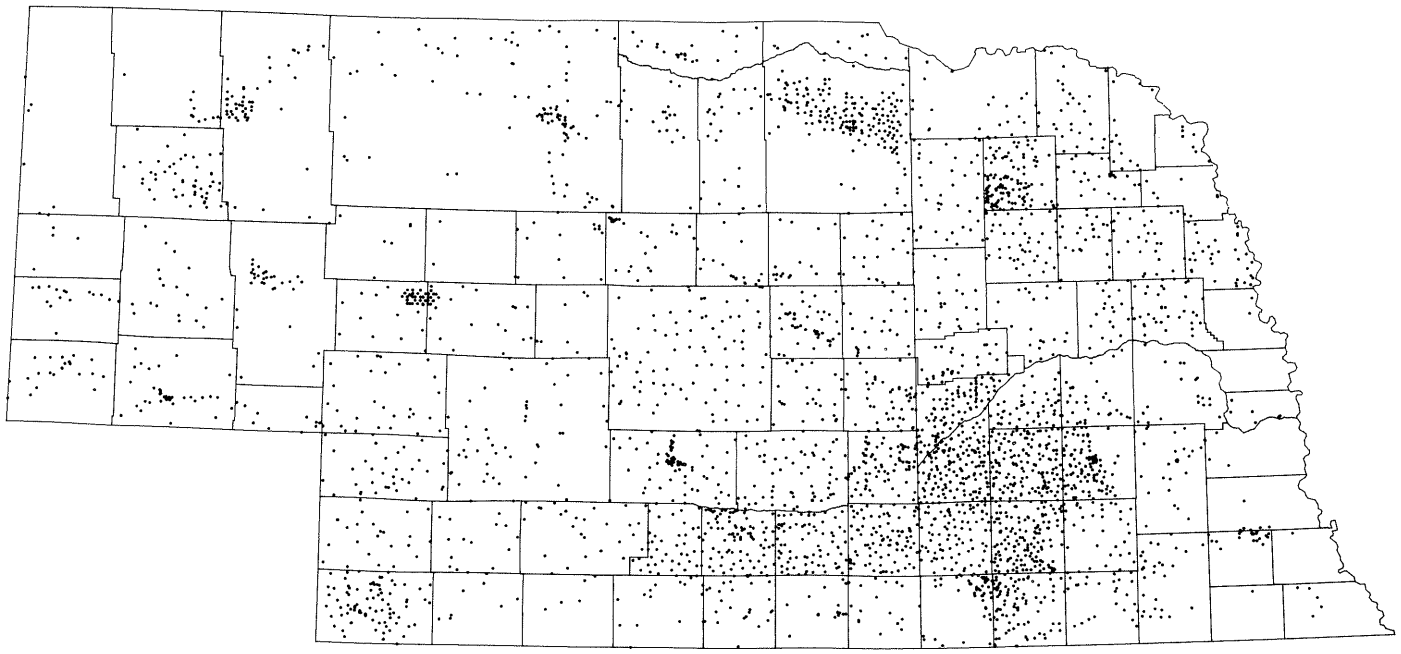
Observation-well networks operated by 33 federal, state, and local agencies and municipalities provide the water-level data used in preparing this report. Water-level measurements are made for a variety of needs, which helps to explain the nonuniform distribution of observation wells in the state. The number of observation wells per county ranges from one or two in several counties to more than 100 in others, with the greatest density in areas where significant changes in water levels have been recognized. Some areas where water levels have changed may not be detected or accurately delineated because of insufficient data.

Locations of all observation wells from which data were used in the preparation of this report are shown on the accompanying map. Measurements made in these wells are included in a computerized file of historical water-level records maintained by the U.S. Geological Survey and the Conservation and Survey Division. Records of water-level measurements included in the file may be obtained, upon request, from the U.S. Geological Survey, Room 406, Federal Building, 100 Centennial Mall North, Lincoln, Nebraska 68508; or from the Conservation and Survey Division, University of Nebraska, 113 Nebraska Hall, Lincoln, Nebraska 68588-0517.

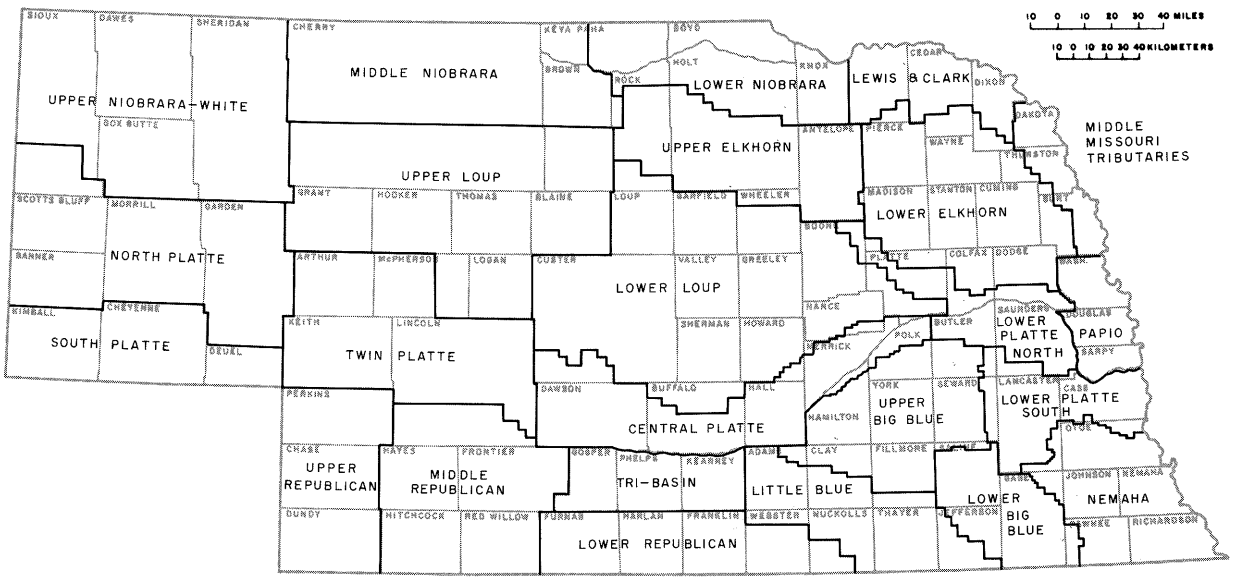
As part of the cooperative groundwater program of the U.S. Geological Survey and the Conservation and Survey Division, a statewide water-level measurement program was begun in 1930. Initially this program consisted of an observation-well network to provide long-term data on changes in the amount of groundwater in storage and to detect areas where changes in water levels indicated problems might occur. The original observation-well network was designed to provide data for only a generalized appraisal of the state's groundwater resources. In time, a need to obtain detailed water-level data for specific areas led to the establishment of a number of local observation-well networks.

The need for water-level data to use in planning and evaluating the development of Nebraska's groundwater resources has changed the original cooperative water-level measurement program considerably. Currently the program provides not only for the operation of a statewide observation-well network but also for assistance and advice to other agencies and associations in the establishment and operation of local observation-well networks, the operation and maintenance of a computer storage-and-retrieval system for water-level data from all networks, and the evaluation and dissemination of water-level data.

The cooperation and assistance of the following agencies and associations in collecting and providing water-level data during 1984 is gratefully acknowledged: U.S. Bureau of Reclamation; U.S. Fish and Wildlife Service; Nebraska Department of Water Resources; Big Blue River Compact Administration; Central Nebraska Public Power and Irrigation District; South-Central Nebraska Pump Irrigators Association; Ground Water Conservation Districts in Clay, Fillmore, Hamilton, Seward, and York counties; County Agents in Harlan, Franklin, and Furnas counties; Omaha Municipal Utilities District; Lincoln Water System; and the following natural resources districts: Lower Republican, Middle Republican, Upper Republican, Upper Big Blue, Little Blue, Lower Big Blue, Lower Platte North, Lower Platte South, Central Platte, Twin Platte, North Platte, South Platte, Lower Niobrara, Middle Niobrara, Upper Niobrara-White, Lower Loup, Upper Loup, Lower Elkhorn, Upper Elkhorn, Middle Missouri Tributaries, Lewis and Clark, Papio, Nemaha, and Tri-Basin.



Location of water-level observation wells in Nebraska

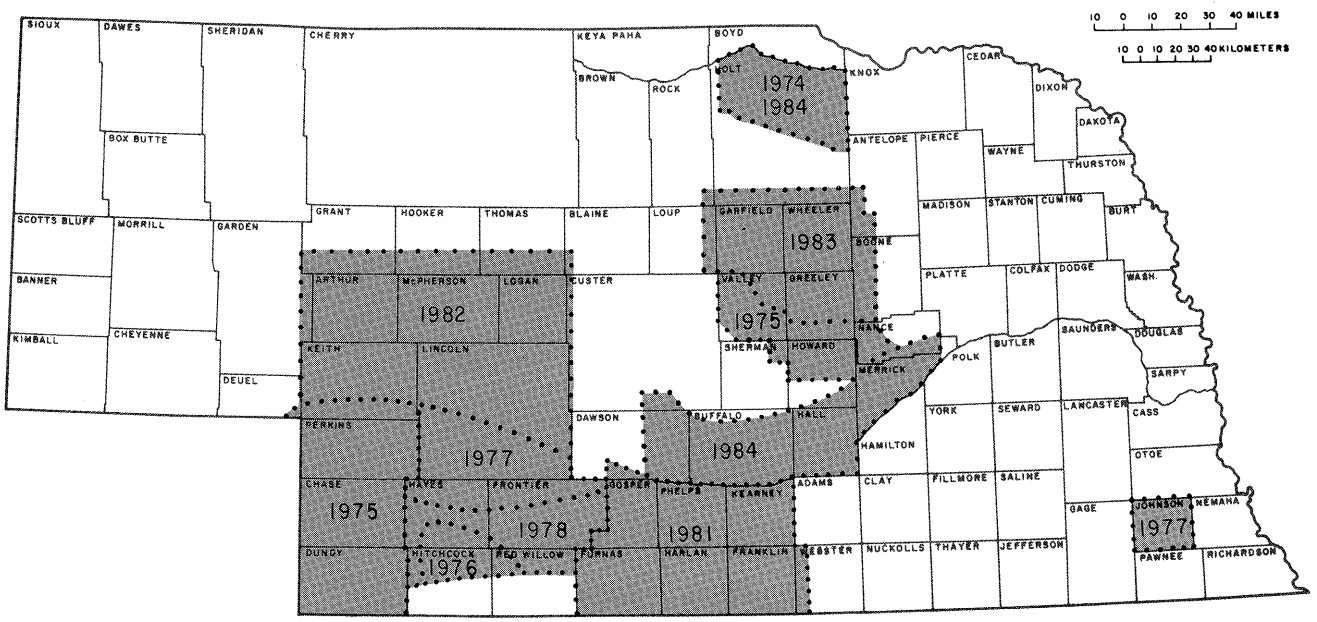


Location of Nebraska natural resources districts

Groundwater-Level Program Activities in 1984

Water-level measurements made in over 3,500 observation wells were entered in the computer file of the cooperative water-level measurement program in 1984. Records from nearly all agencies in Nebraska making water-level measurements were compiled and entered into the file. The processing of these data and supporting information was a major activity of the cooperative program.

Other groundwater data activities in 1984 included mass water-level measurements in central and northeastern Nebraska. A mass water-level measurement is the measurement of water levels in a large number of wells within a short period of time in order to obtain data representative of nearly uniform hydrologic conditions. The mass measurement, made in the spring of 1984, included measurements in about 154 wells in northern Holt County; and a mass measurement in the fall of 1984 included measurements in 210 wells in Buffalo, Custer, Dawson, Hall, Howard, Merrick and Nance counties. The measurements were made to provide data for special hydrogeologic studies. The wells measured were in addition to the wells regularly measured for existing observation-well networks.



Areas where mass water-level measurements have been made since 1974; number indicates year in which measurement was made

EFFECT OF PRECIPITATION ON GROUNDWATER LEVELS DURING 1984

In all eight of Nebraska's National Weather Service divisions, winter precipitation totals ranged from 40-70% above normal. Heavy spring rains, especially in April, kept soil moisture near capacity. The weather pattern changed in late June, however, and dry conditions developed in much of the state. In June, the total moisture over the state averaged 25% above normal, while during July the state averaged 25% below normal.

Much of the 1984 precipitation that occurred prior to July probably was stored in the soil and later consumed by evapotranspiration. Significant water movement below the plant root zone may have occurred during heavy spring rains, but probably was minimal in the drier months. Individual storms in June caused minimal lowland flooding in the eastern portions of Nebraska. The surface soils were near saturation due to earlier precipitation, thus additional rainfall generally exceeded the moisture-holding capacity of the soil leading to greater-than-normal runoff.

Surplus and deficit monthly precipitation amounts in 1984 resulted in totals for the year that were near average (15% above normal). The wettest part of the year occurred during the spring and fall months with about 250% of the monthly precipitation normal. The annual precipitation totals for all divisions ranged from 8% below normal in the Panhandle Division to 35% above normal in the Central Division. Below are some highlights for each division of the state.

For the Panhandle Division, the greatest positive monthly departure from normal (+1.61 inches) came in April and the greatest deficit (−1.54 inches) came in May. The Panhandle Division had the lowest percent of annual normal precipitation at 92 percent.

The greatest deficit (−1.06 inches) for the North Central Division occurred in May and the largest excess over normal (+2.35) occurred in April.

The Northwest Division's greatest deficit (−1.88 inches) was in August. The surplus (+5.66 inches) for the Northwest Division in April set a new record for that month. Historical records indicate that a surplus of this magnitude should occur only once in several hundred years.

The Central Division recorded the largest precipitation departures in April (+5.12 inches) and September (−1.89 inches). An April departure of this magnitude should occur only once in several hundred years. This division received the highest percent of annual normal precipitation (135%).

The East Central Division's greatest deficit (−2.29 inches) was in the month of August. The greatest monthly surplus (+4.04 inches) was in the month of April.

The Southwest Division's largest deficit (−1.40 inches) occurred in July, while the largest surplus (+3.09 inches) occurred in April.

A deficit of −2.27 inches from normal precipitation occurred in the South Central Division in July. April was the month of greatest precipitation surplus (+3.79 inches).

The departure in the Southeast Division was lowest (−2.59 inches) in August. The greatest positive departure occurred (+4.09 inches) in April.

All divisions received their greatest surplus of moisture in April.

—Prepared by Kenneth G. Hubbard and Mathew D. Werner, Center for Agricultural Meteorology and Climatology, IANR, University of Nebraska–Lincoln.

Summary of monthly, seasonal, and total precipitation in 1984 for eight National Weather Service divisions of Nebraska showing average precipitation amounts in inches, departure (+ or −) from normal precipitation in inches, and the percentage of normal precipitation

GROUNDWATER USE

Distribution of Irrigation Wells

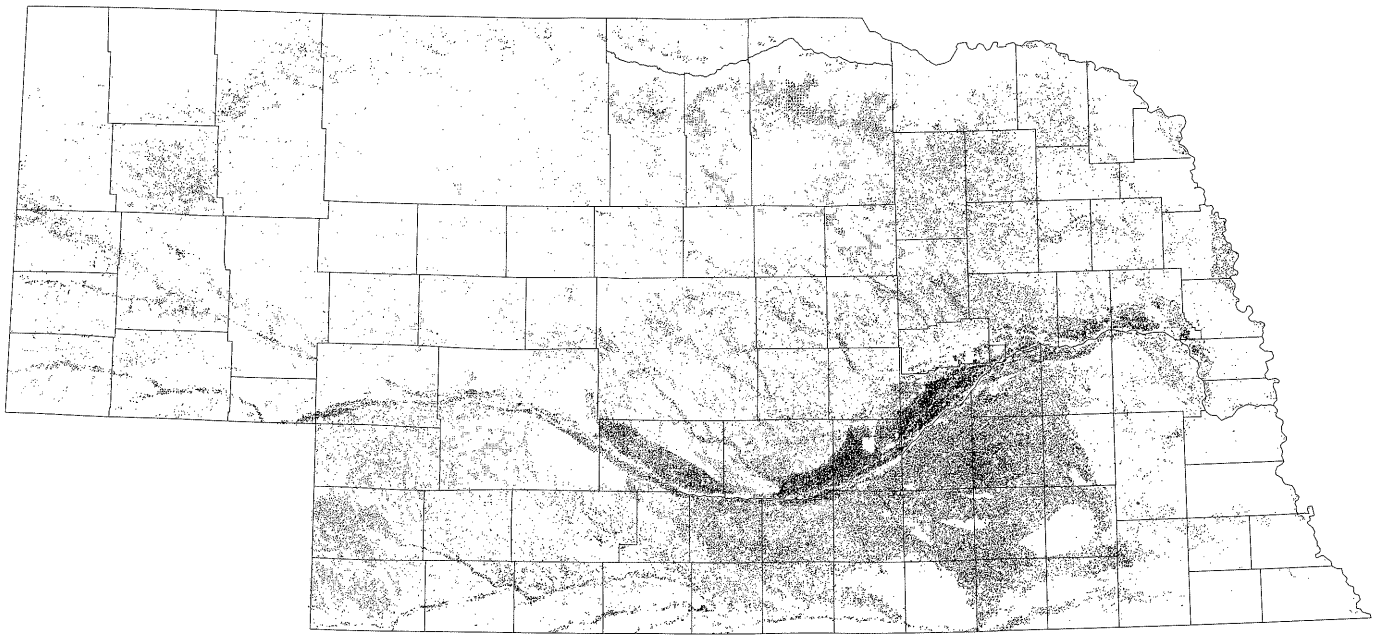
Nebraska's largest use of groundwater during 1984 was that pumped by the state's registered irrigation wells.

At the end of 1984, a total of 70,701 irrigation wells had been registered in Nebraska. These wells are the source of water used in irrigating almost 85 percent of the estimated 7.3 million acres of irrigated land in the state. The amount of groundwater pumped for irrigation each year has not been determined, but in 1984 is estimated to have been about 7.8 million acre-feet. This amount was several times more than the total amount of groundwater pumped for domestic, livestock, municipal, and industrial use.

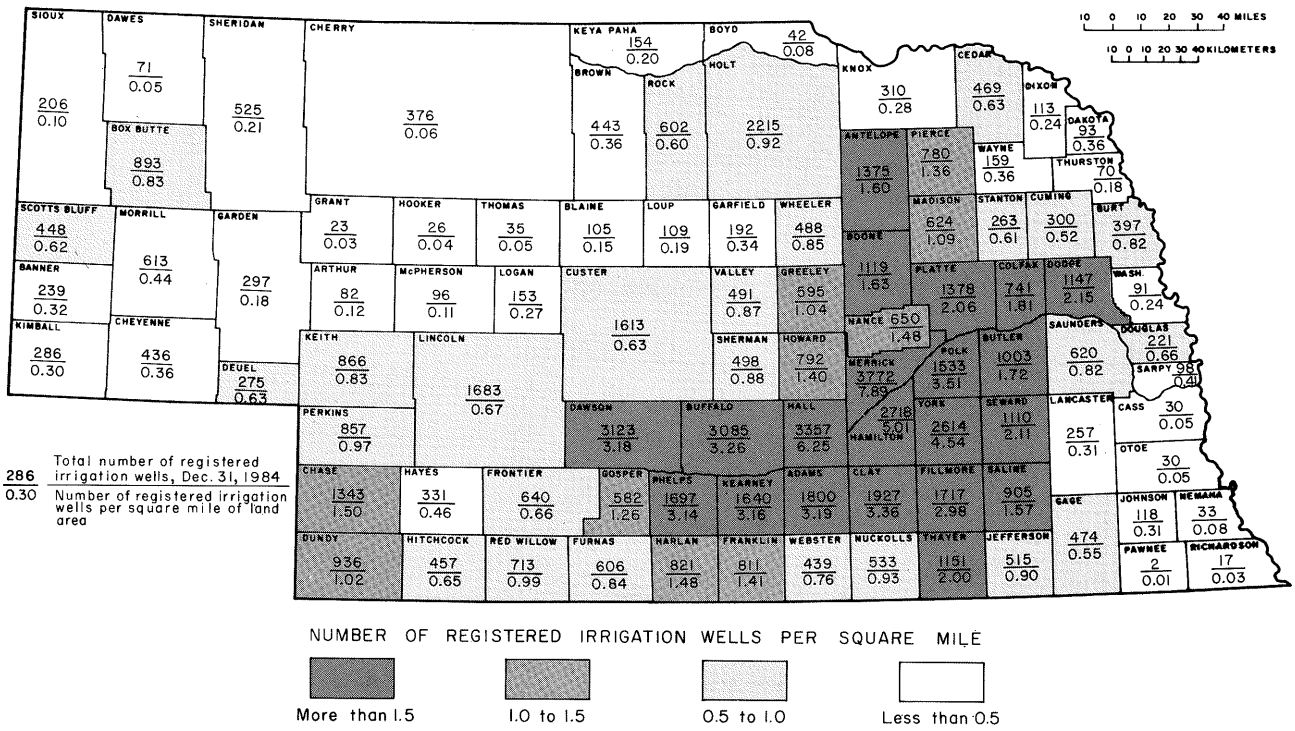
Although irrigation wells have been drilled in each of Nebraska's 93 counties, their number and density differ greatly from one county to another because of variations in land use, distribution of irrigable land, and availability of groundwater. About 60 percent of the registered irrigation wells are concentrated in a 13-county area comprising the upper part of the Big Blue River and Little Blue River basins and the central part of the Platte River valley. Buffalo, Dawson, Hall, Hamilton, Merrick, and York counties have more than 2,500 irrigation wells each and the remaining counties (Adams, Butler, Clay, Fillmore, Kearney, Phelps, and Polk) have more than 1,000 irrigation wells each. Antelope, Boone, Chase, Custer, Dodge, Holt, Lincoln, Platte, Seward, and Thayer counties are the only other counties in the state that have more than 1,000 irrigation wells each.

Although the total number of irrigation wells in a given county provides some indication of the amount of groundwater development that has taken place, the number of irrigation wells per square mile of land area in that county is a better index of the degree of development. A high density of irrigation wells in a county generally indicates both a large percentage of irrigable land and large amounts of available groundwater. Very low densities generally characterize counties where development is limited either by small amounts of irrigable land or by aquifers that yield only small amounts of water to wells, or both. Merrick County, averaging 7.89 irrigation wells per square mile of land area, has the highest well density of any county in the state. Pawnee County, which has only two irrigation wells in its 433 square miles of land area, has the lowest well density—an average of about one well per 216 square miles.

By far the largest use of groundwater in Nebraska is for irrigation, and most of the concern about changes in water levels and availability of groundwater is related to irrigation development. However, use of groundwater for rural domestic, livestock, industrial, and municipal supplies also is important. Groundwater is used for almost all rural domestic supplies; for almost all industrial supplies; and for all municipal supplies, except for Crawford, Beaver Lake, Blair, and part of Omaha's and Chadron's supplies.



Location of registered irrigation wells in Nebraska as of December 31, 1984



Total number and density of registered irrigation wells in Nebraska, by counties, as of December 31, 1984

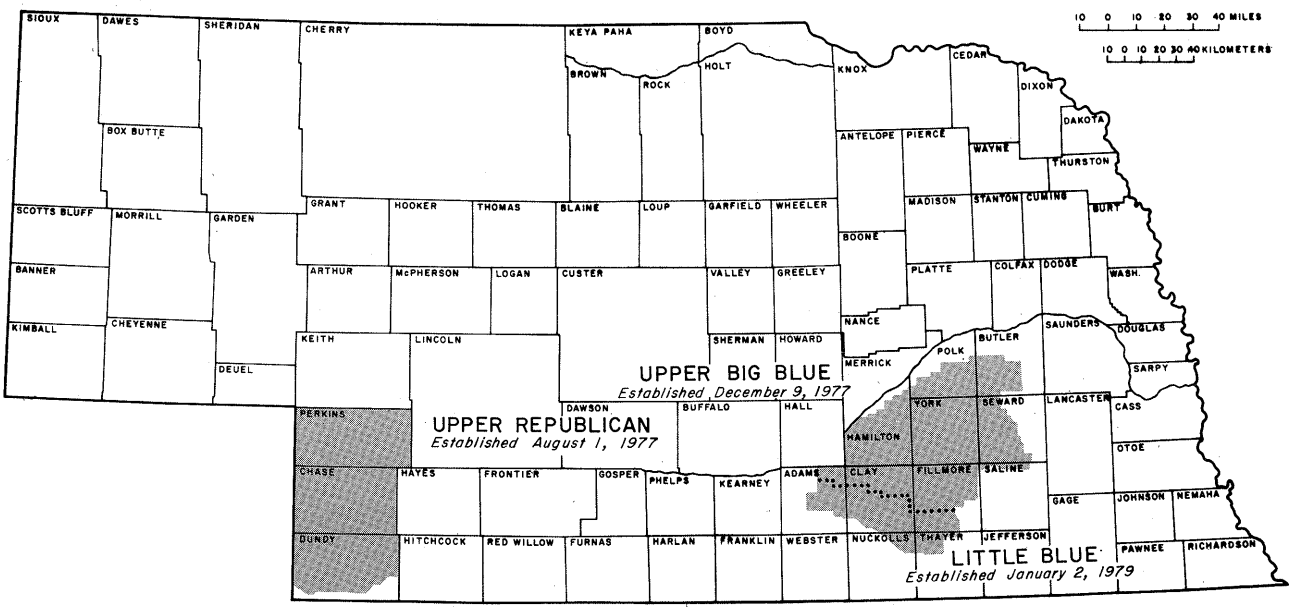
Recent Trends in Groundwater Use

The number—533—of new irrigation wells installed in 1984 is about the same as of that for 1983. This number was far less than the average annual number installed in the last 5-year (average = 1,270) period. New irrigation wells were installed in 74 of Nebraska's 93 counties. More wells were installed during 1984 than in 1983 for 30 counties.

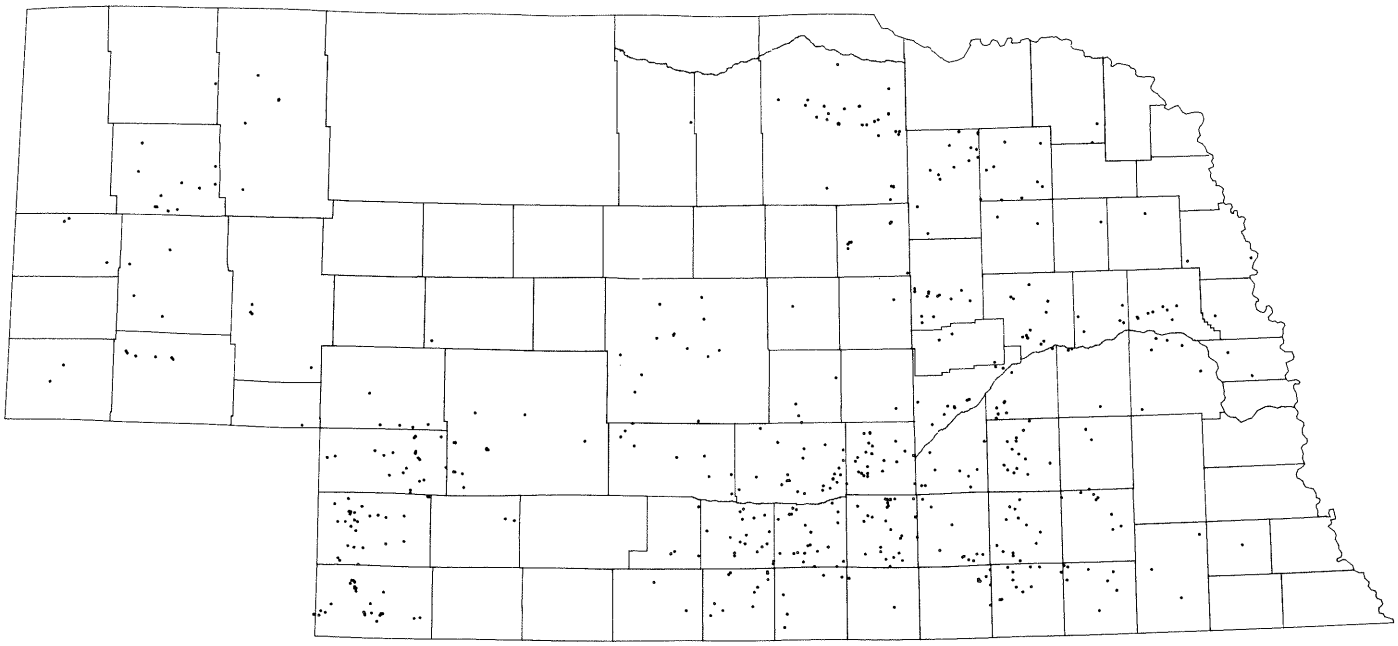
The decrease in the number of irrigation wells installed during the 1980-84 period compared to the mid-1970s can be explained in part by a combination of economic and climatic factors. Low prices for farm products coupled with the increasing cost of installing and operating irrigation systems discouraged farmers from investing in new well construction. Normal to above-normal precipitation for the state in 1978, 1979, and 1982-1984 further reduced the need for additional irrigation development.

The establishment of groundwater control areas was provided for in the Nebraska Ground Water Management Act of 1975 (LB 577). The management alternatives provided by the act include well spacing, rotation of pumping, allocation of water, and moratoriums on drilling.

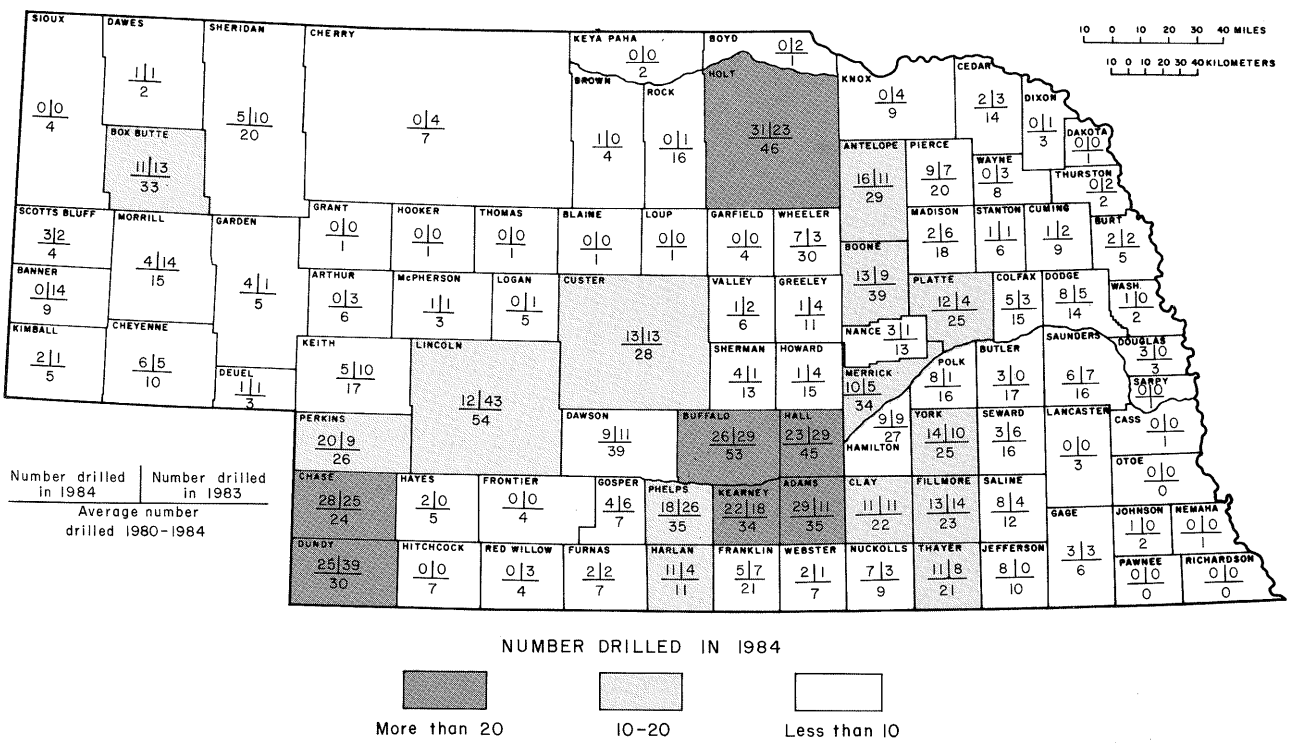
Two control areas were designated in 1977 in response to the initiatives of the Upper Republican Natural Resources District and the Upper Big Blue Natural Resources District. A third control area was designated in 1979 in response to the initiatives of the Little Blue Natural Resources District. It is too soon to assess how the establishment of these groundwater control areas will affect groundwater use in their regions.



Location of groundwater control areas



Location of registered irrigation wells drilled in Nebraska in 1984



Number of Nebraska registered irrigation wells drilled in 1984, 1983, and 1980-84, by counties

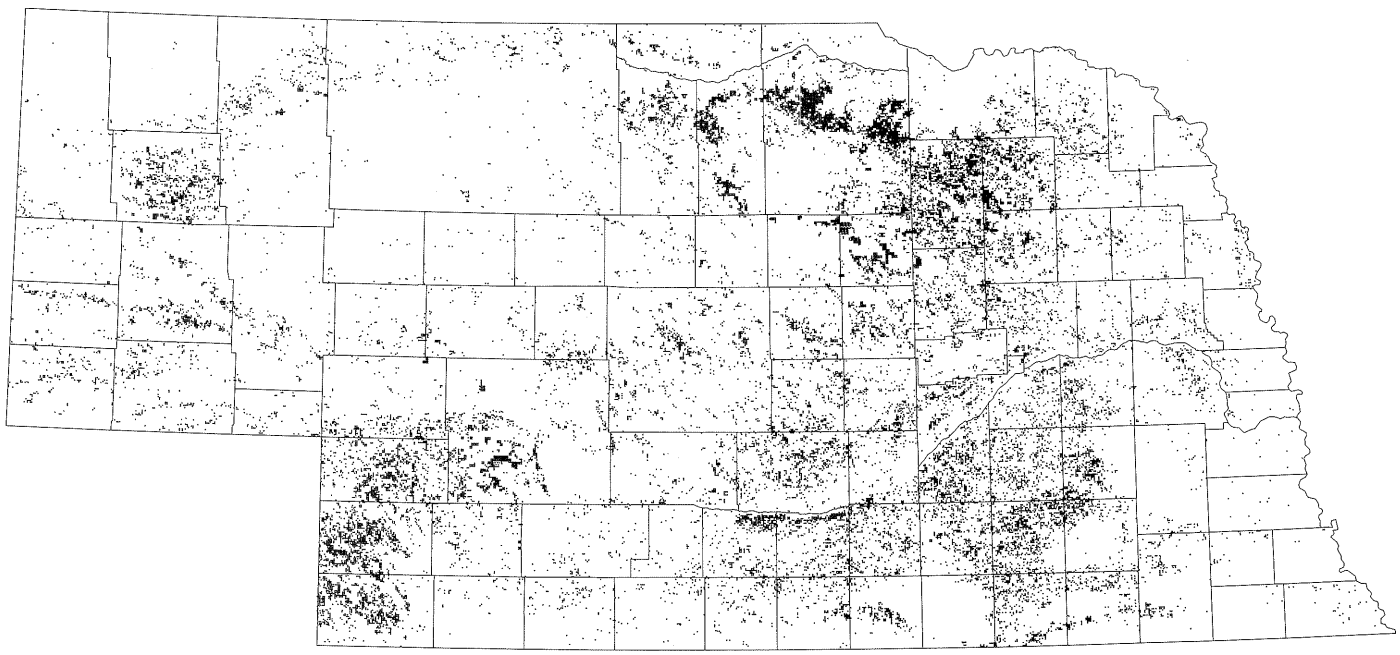
Historical Trends in Groundwater Use

Irrigation has become one of the most important factors in making Nebraska a leading state known for its agricultural productivity. During the last two decades, tapping groundwater resources to help meet agricultural demand for water has increased at such a rapid pace that now more than 73 percent of the water used for irrigation is pumped from wells.

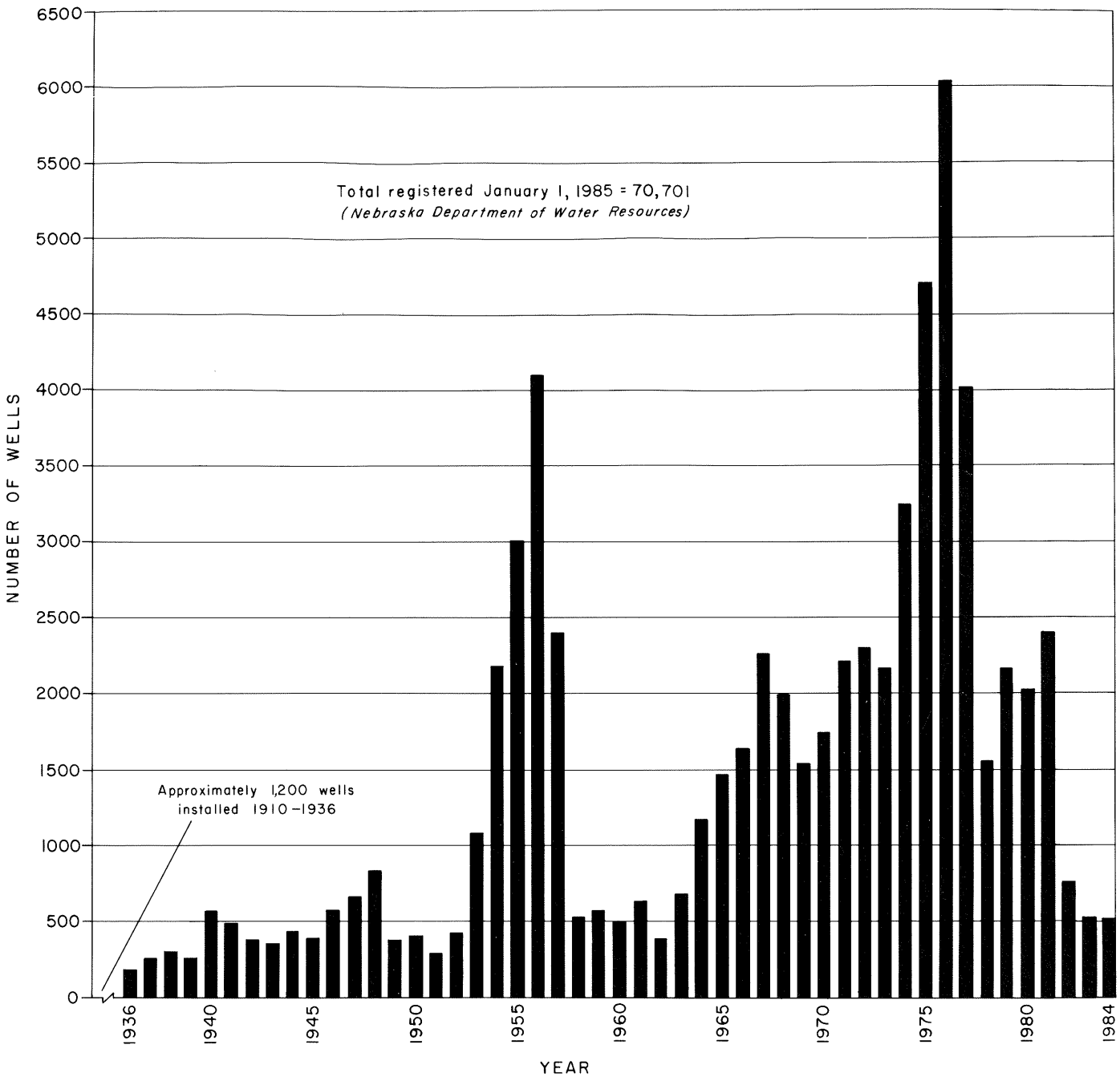
Climatic conditions affect the number of new wells installed annually. During periods of below-normal precipitation, such as the growing seasons in the years 1952-56, 1966, and 1974-76, the number of irrigation-well installations increased. Increased drilling often continues for a year or more after the drought period.

Center-pivot irrigation systems have played an important role in expanding irrigation from level land to hilly topography and sandy soils. Generally, the areas of new development are in the northeastern, central, and southwestern parts of the state where center-pivot irrigation systems provide a means to overcome limitations imposed by soil type and/or topography.

A combination of economic, climatic, and technologic factors account for the periods of high development. Drought conditions were primarily responsible for the rapid development of the mid-1950s. Starting in the mid-1960s, development was influenced by periods of drought, the availability of the center-pivot irrigation system, and favorable economic conditions (especially during 1973, 1974, and 1975).



Location of center-pivot irrigation systems in Nebraska as of December 31, 1983



Annual installation of irrigation wells in Nebraska through 1984
(estimated from historical surveys and irrigation well registration data)

Other reports give additional information about water levels in Nebraska.

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