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GEOLOGICAL SURVEY CIRCULAR 166

# GROUND WATER FOR IRRIGATION IN BOX BUTTE COUNTY NEBRASKA

WITH A SECTION ON THE CHEMICAL QUALITY OF THE WATER

UNITED STATES DEPARTMENT OF THE INTERIOR
Douglas McKay, Secretary

GEOLOGICAL SURVEY
W. E. Wrather, Director

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# GROUND WATER FOR IRRIGATION IN BOX BUTTE COUNTY, NEBRASKA

By Raymond L. Nace

WITH A SECTION ON THE CHEMICAL QUALITY OF THE WATER
By W. H. Durum

Prepared as part of a program of the Department of the Interior

for development of the Missouri River Basin

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# GROUND WATER FOR IRRIGATION IN BOX BUTTE COUNTY, NEBRASKA

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ABSTRACT

This report supplements U. S. Geological Survey Water-Supply Paper 969, Geology and ground-water resources of Box Butte County, Nebr., by R. C. Cady and O. J. Scherer. Sixty-five additional irrigation wells have been drilled since that investigation, which was conducted in 1938, and the total number on record on June 30, 1946, was 76. Most of the irrigation wells are within about 6 miles of Alliance.

The Bureau of Reclamation, U. S. Department of the Interior, made an investigation in Box Butte County in the spring of 1947 to determine the lands suitable for development by irrigation from wells. These lands are shown on plate 1.

About 9,000 acres of land was irrigated by ground water during 1946. It is expected that the irrigated acreage and the number of irrigation wells in the county will increase in the future.

The geologic formations exposed in the county are the Monroe Creek and Harrison sandstones of the Arikaree group, the Marsland formation, and the Box Butte member of the Sheep Creek formation--all of Miocene age. The Ogallala formation of Pliocene age is also exposed, and where its sandy and gravelly channel facies is well developed it is the best aquifer in the county.

The Chadron and Brule formations of the White River group of Oligocene age are not exposed in the county but are believed to be present at depth.

The locations of all irrigation wells, all observation wells which are being measured currently, a few other wells, and contour lines on the water table are shown on plate 1. The records of all wells shown on plate 1 are given in well tables. A comparison of water levels in wells between 1938 and 1946 is given. The study in 1946 strongly confirms the interpretation of Cady and Scherer as to the configuration of the water table, the general direction of movement, the depth to water, and the thickness of saturated materials.

Sixteen observation wells have been measured periodically during the past 9 to 13 years. During the 1946 investigation, additional observation wells were selected for periodic measurement. The water-level records are tabulated.

Construction and development of irrigation wells in Box Butte County are discussed and some suggestions for improving drilling technique are offered.

The yield of wells in the county ranges from 150 to 3,500 gpm. It is estimated that at no time in the past has the total withdrawal of ground water from wells exceeded 20 mgd. The maximum withdrawal of ground water for irrigation during 1946 is estimated to have been 7,300 acre-feet. It is probable that this withdrawal amounts to less than one-third of the estimated average annual recharge from precipitation, which Cady and Scherer estimated to be about 23,800 acre-feet in 1938.

The conclusion is reached that the total amount of water in storage beneath the county has not been decreased materially by pumping from wells, and that the water pumped has been salvaged largely from ground water that would otherwise have been lost from the county by underflow eastward, by evaporation in seep and lake areas, and by discharge into surface streams.

Water pumped from the Ogallala, Marsland, and Harrison formations of Tertiary age is moderately mineralized and hard. For the water analyzed, the concentration of dissolved solids ranges from 225 to 702 ppm. Hardness in the several water-bearing formations ranges from 111 to 238 ppm. Except for a high fluoride content in one sample, all the waters are satisfactory for domestic needs.

Increases in the dissolved-solids concentration are proportional to increases in sulfate. There is a considerable range in the percentage of sodium in the various formations, and this relation has a bearing on the desirability of the water for irrigation. All but one of the waters analyzed, however, rate good or excellent for irrigation.

## INTRODUCTION

### Previous investigations

A study of the geology and ground-water resources of Box Butte County, Nebr., was made in the summer of 1938 by Cady and Scherer, and the results of this study are embodied in a comprehensive report (Cady and Scherer, 1946). The report includes a detailed description of the geology and geography of the county, a county geologic map, a water-table contour map, and a depth-to-water map, a discussion of the hydrologic properties of the water-bearing formations, a tabulated inventory of representative wells that existed at the time the field investigation was made, data on the chemical quality of the ground waters, estimates of the rates of natural recharge, and a discussion of the rate and direction of movement of the ground water. At the time the field work was done for the report by Cady and Scherer only a few irrigation wells had been drilled in Box Butte County. Data on these wells were sufficient, however, to permit important inferences and conclusions as to the thickness of the saturated water-bearing materials beneath the county and as to the possibilities for further development of ground water for irrigation.

### Purpose and scope of report

During the period from 1938 to 1946 inclusive 65 additional irrigation wells were drilled, and the total number on record as of June 30, 1946, was 76. Nine of these wells have been abandoned; a few others never have been used systematically and persistently. Five are wells drilled in 1946, for which pumping equipment was not yet available at the time of the field investigation. Therefore, as of June 30, 1946, there were about 60 functional irrigation wells in the county, and it is believed that by the end of 1946 the number was increased to more than 70.

Most of the irrigation wells drilled in Box Butte County are within about 6 miles of Alliance, the county seat; the greater number of these wells are north and northeast of the town. The intensified local development of ground water for irrigation provided much additional useful information on the quantity of ground water available for irrigation. The development also emphasized the need for additional field study and interpretation of data. The local success of irrigation projects stimulated county-wide interest and demand for information concerning the location and quantity of ground-water supplies, probable pumping lifts, and suitable types of well construction.

The U. S. Bureau of Reclamation made a preliminary reconnaissance during March 1946 and a more detailed investigation in the spring of 1947 to determine the extent and location of areas in Box Butte County in which well irrigation may be developed. The results of this work are shown on plate 1.

About 9,000 acres of land had been placed under irrigation by the summer of 1946. Known plans of farmers, the availability of federal loan funds to finance irrigation projects, and the considerable area of irrigable land indicate that many more irrigation wells will be drilled in near-future years. Therefore, it is important that information be assembled to help the farmers and well drillers in planning and executing future irrigation projects in the county. The collection of additional information about the ground water in Box

Butte County is also important to regional ground-water studies in connection with the Missouri Basin development program.

The report by Cady and Scherer (1946) contains a detailed description and discussion of the geography, land forms, geology and ground-water hydrology of Box Butte County. The present report, compiled as a supplement to the report by Cady and Scherer, does not, therefore, include a detailed review of those major topics. The topics are discussed only in relation to the special problems encountered in the construction, development, and use of irrigation wells, and the subsequent effects on the water table and ground-water storage.

During the course of the investigation in Box Butte County 12 samples of ground water and 1 sample of surface water were collected. Chemical analyses of the samples were made in the laboratory of the U. S. Geological Survey, Quality of Water Branch, at Lincoln, to determine the suitability for irrigation.

## Personnel and acknowledgments

Ground-water studies by the U. S. Geological Survey in the Missouri Basin development program are under the field direction of G. H. Taylor, regional engineer in charge of ground-water studies. State and Federal cooperative ground-water investigations in Nebraska are under the general direction of A. N. Sayre, who on December 1, 1946, succeeded O. E. Meinzer as chief, Ground Water Branch, U. S. Geological Survey; and of G. E. Condra, dean and director, Conservation and Survey Division, University of Nebraska, and State geologist of Nebraska. Cooperative ground-water investigations in Nebraska have been carried on continuously since 1930. H. A. Waite, district geologist, U. S. Geological Survey, is in charge of the Federal cooperative and Missouri Basin ground-water investigations in Nebraska. E. C. Reed, associate State geologist, Conservation and Survey Division, University of Nebraska, supervised test-drilling activities in Box Butte County in 1938 and, because of his broad knowledge, contributed valuable assistance to the present investigation.

Data for the present report were gathered by the writer during the period from February 19 to June 17, 1946; however, a part of that period was spent on ground-water work not related to the present report.

H. F. Haworth, P. C. Tychsen, M. F. Sunyoke, and F. G. Schnittker, of the U. S. Geological Survey, assisted in the drilling of observation wells both by hand auger and with a State-owned drilling rig loaned by the Conservation and Survey Division, University of Nebraska. Elevations of the land surface at wells and of the measuring points of wells were determined by John Franks, working under the supervision of T. T. Ranney, and by permission of C. L. Sadler, all of the Topographic Branch, U. S. Geological Survey.

Quality-of-water studies carried on in Box Butte County, Nebr., were under the general direction of S. K. Love, chief, Quality of Water Branch, and under the immediate supervision of P. C. Benedict, regional engineer, in charge of Missouri River basin water-quality investigations. The chemical analyses of the ground- and surface-water samples collected in the area were made by Jeff Bonebright, R. P. Orth, F. H. Rainwater, and L. L. Thatcher.

Officials of the Chicago, Burlington & Quincy Railroad Company contributed results of analyses of ground-water samples. Officials of the city of Alliance likewise contributed the results of ground-water analyses and other valuable information concerning the wells of Alliance.

Land owners, tenants, and well drillers contributed much information that materially aided the progress of the investigation.

## Explanation of the well-numbering system

Well numbers used in this report are based on well locations within the Bureau of Land Management survey of the area. For example, in well number 27-47-5bb2, 27 indicates the township, 47 indicates the range, and 5 indicates the section. The lower-case letters which follow the section number indicate the position of the well within the section, the first letter indicating the quarter section and the second letter the quarter-quarter section. The letters a, b, c, and d are applied in counterclockwise direction beginning with a in the northeast quadrant. Thus bb indicates a position in the NW$\frac{1}{4}$ of the NW$\frac{1}{4}$ of the section. The last numeral indicates the number of the well within the tract of land indicated by the last letter. No number is shown unless more than one well is located within the given tract of land. (See fig. 1.)

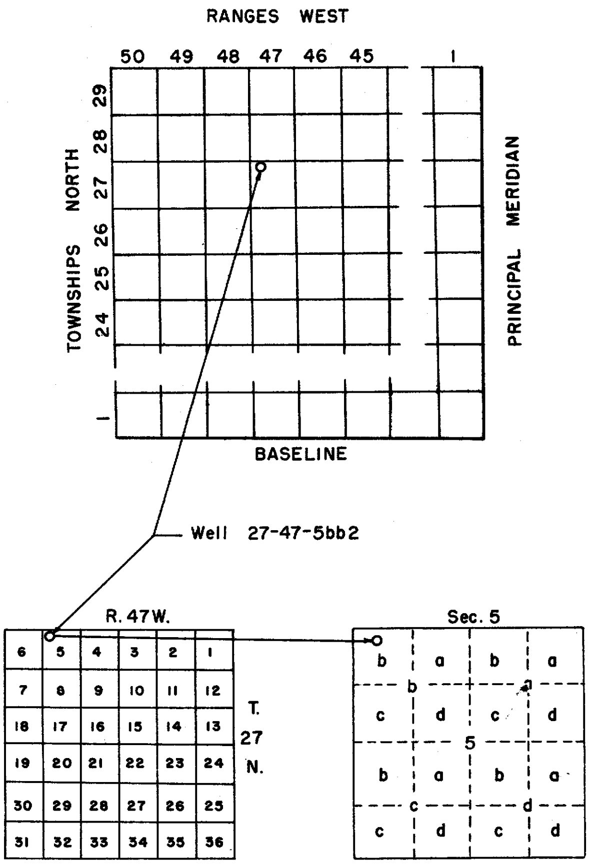


Figure 1.--Sketch showing application of Bureau of Land Management system of land subdivision to well-numbering system.

In the following list are given well numbers used in this report and their corresponding numbers in previous Water-Supply Papers of the U. S. Geological Survey.

| Well number in this report | Well number in Water-Supply Papers 840, 908, 938, 946, 988 | Well number in Water-Supply Papers 845, 886 | Well number in Water-Supply Paper 969 |
|---|---|---|---|
| 24-48-31bc | .......... | ......... | 186 |
| 24-50-10aa | 474 | 3 | 195 |
| 24cc | .......... | ......... | 199 |
| 24-52-13cb | 475 | 5 | 210 |
| 24-52-35aa | 476 | 6 | 214 |
| 25-47-7bb | ......... | ......... | 146 |
| 9bb | ......... | ......... | 147 |
| 19aa | ......... | 17 | 142 |
| 21bb | ......... | ......... | 149 |
| 29bb1 | ......... | ......... | 144 |
| 25-48-30ad | 473 | 2 | 155 |
| 25-50-31ab | 129 | 129 | 167 |
| 25-51-14aa | 477 | 7 | 170 |
| 26-47-34da | 484 | 16 | 103 |
| 26-48-36ac | ......... | ......... | 157 |
| 26-49-19aa | ......... | ......... | 113 |
| 26-50-12dc | 480 | 10 | 118 |
| 26-51-25bc | 478 | 8 | 127 |
| 26-52-10bc | 485 | ......... | 132 |
| 27-47-12da | 78 | ......... | ......... |
| 23ba | 483 | 15 | 61 |
| 25dc | ......... | ......... | 62 |
| 27-49-21cb | 338 | 338 | 73 |
| 27-50-20aa | 481 | 12 | 77 |
| 28-51-6da | ......... | ......... | 37 |
| 6dd | 378 | 378 | 38 |
| 8bc | 482 | 13 | 39 |
| 29-46-30cb | ......... | ......... | 8 |

## WATER-BEARING FORMATIONS

Table 7 includes data on all irrigation wells in Box Butte County that had been drilled, or in which drilling had begun, prior to July 1, 1946. The water-bearing properties of the geologic formations were interpreted from these data, from logs of 20 wells (see table 6), and from field examinations of the water-bearing formations in their outcrop areas. The classification of rocks that is used in this report is that used by the Nebraska Geological Survey.

### Tertiary system

#### Oligocene series

##### White River group

The Chadron and Brule formations of the White River group in western Nebraska are exposed principally in the valleys of the

North and South Platte Rivers and in the northern parts of Sioux, Dawes, and Sheridan Counties. These formations are believed to be present at depth beneath Box Butte County and beneath younger Tertiary strata throughout the rest of western Nebraska, although in parts of the area they may have been removed by erosion prior to the deposition of the younger sediments. No wells in Box Butte County are known to obtain water from the formations of the White River group.

Chadron formation.--The Chadron formation is an important source of small water supplies for wells and springs in parts of the northern High Plains. Its thickness and extent beneath Box Butte County are not known, but it probably is lithologically similar to rocks that crop out north and southwest of Box Butte County; in those localities the formation is 50 to 100 feet thick but is too fine-grained and argillaceous to be highly permeable. Therefore the formation probably would not yield sufficient water for irrigation projects in Box Butte County. Inasmuch as adequate supplies of water are present in formations younger than the White River group, it is unlikely that it will be necessary to explore the Chadron for even small supplies.

Brule formation.--The clay, silty clay, and thin volcanic-ash layers of the upper part of the Brule formation are not sufficiently permeable to transmit large quantities of ground water, although in some localities in western Nebraska fracture zones in the formation yield large amounts of water. The sandy clays and channel sandstones of the lower part in some places may also yield small amounts of water to wells and springs. The thickness of the Brule formation ranges from 325 to 600 feet in areas where it is exposed.

### Miocene series

#### Arikaree group

Formations of the Arikaree group, particularly the Harrison sandstone, are among the most important water-bearing rocks in Box Butte County. These formations yield water to wells much more readily than rocks of the overlying Hemingford group but are inferior to the channel sand and gravel facies of the Ogallala formation (Cady and Scherer, 1946). Because of their wide distribution beneath the surface, these formations are of great regional importance.

Gering and Monroe Creek sandstones.--The Gering sandstone, which ranges in thickness from 100 to 230 feet in Scotts Bluff County, does not crop out in Box Butte County. Although possibly present under part or all of the county, it has not been positively identified in well cuttings in the county. The Monroe Creek sandstone crops out along the Niobrara River valley in the northwest part of the county, and where fully exposed in adjoining counties ranges from 285 to 370 feet in thickness. Well 28-51-6da penetrates the Monroe Creek and possibly the Gering sandstone. The owner stated that the well was drilled through 25 feet of unconsolidated river sand and gravel, then through 285 feet of sandstone, and then through about 20 feet of conglomerate. The relatively low yield of 150 gpm from this well is believed to be caused partly by the type of well construction and not entirely by the poor water-yielding capacities of the Monroe Creek and possibly Gering sandstones that it penetrates. Only the upper 20 feet of the well is cased. It has never been adequately developed or tested. The discharge per foot of drawdown in well 28-51-6da is 6 gpm, but this low specific capacity is not considered to be a fair index of the water-yielding capacities of the Monroe Creek and Gering sandstones. These sandstones are, however, noticeably finer-grained, more indurated, and less permeable than the overlying Harrison sandstone. Their permeability and transmissibility are perhaps intermediate between those of sandstones of the Marsland formation and those of the Harrison sandstone. The owner's description of materials encountered in well 28-51-6da does not indicate that it penetrated the White River group. If, as the scanty data do indicate, the Brule formation was not reached, the combined thickness of the Gering and Monroe Creek sandstones in northwestern Box Butte County is greater than has been supposed, and the thickness of saturated sandstones beneath the valley of Niobrara River is considerably more than the 100 or more feet inferred by Cady and Scherer (1946, p. 44).

Harrison sandstone.--The Harrison sandstone is an important aquifer throughout the tableland areas of Box Butte County and is the principal aquifer for at least eight irrigation wells in the county. The average yield of those wells is about 1,130 gpm and their average specific capacity is about 24 gpm per foot of drawdown. Three other wells that penetrate a great thickness of saturated Marsland formation, but also extend well into the Harrison sandstone, have an average yield of about 1,070 gpm and an average specific capacity of about 31 gpm per foot of drawdown.

The Harrison sandstone generally is coarser and contains less interstitial cementing material than the Gering and Monroe Creek sandstones. These factors contribute materially to the higher permeability of the Harrison sandstone.

## Hemingford group

Marsland formation.--The Marsland formation consists chiefly of impure sandstone and siltstone interlaid with a few highly calcareous layers or zones. Most of the formation is argillaceous, well consolidated, and, in many places, extensively impregnated with secondary calcium carbonate. The formation is generally more indurated and less permeable than the Harrison sandstone.

No irrigation wells in Box Butte County are known to depend exclusively on the Marsland formation for water. Three wells (25-47-7bb, 25-48-2ab, and 26-48-36ab) depend principally on this formation for water and have relatively low yields. Those wells apparently penetrate only small thicknesses of formations other than the Marsland. Their average reported yield is 335 gpm and their average specific capacity is 5.3 gpm per foot of drawdown. Wells in the Marsland formation have been dynamited at their bottoms, gravel packed, and subjected to prolonged hard pumping in attempts to improve their yields, but such attempts have generally been unsuccessful.

The Marsland formation can be expected to yield moderate supplies of ground water in areas where the formation is thick and where the water table stands high in the formation. Wells will generally need to be drilled through the Marsland and into the Harrison sandstone if larger supplies are required. However, larger supplies might be obtained without drilling through the Marsland into the Harrison if there is an appreciable thickness of Ogallala formation above the Marsland and if the water table stands in the Ogallala. For example, water is obtained from both the Marsland and Ogallala formations by wells 26-47-34da and 26-48-36ac, which have an average yield of 1,000 gpm and an average specific capacity of 43 gpm per foot of drawdown.

Sheep Creek formation.--The Sheep Creek formation, which is represented in this county chiefly by the Box Butte member, is generally so fine-grained and argillaceous as to be practically impermeable. It can be a source of water for wells only where a sandy or silty channel facies is developed locally. Moreover, the formation lies above the water table in most of its area of occurrence in the county.

## Pliocene series

## Ogallala formation

The Ogallala formation, where its sandy and gravelly channel facies is well developed, is the best aquifer in Box Butte County. The coarse sandy and gravelly beds are well developed in the middle portion of the channel facies in the area near Alliance and they extend northeast of that town. Irrigation wells in that area have the largest reported yields in the county. Six wells, which apparently draw water largely from the Ogallala formation but penetrate differing thicknesses of other formations, have an average reported yield of 1,375 gpm and an average specific capacity of about 34 gpm per foot of drawdown. Twenty-three other wells, believed to draw water entirely or almost entirely from the Ogallala formation, have an average reported yield of 1,286 gpm and an average specific capacity of 42.5 gpm per foot of drawdown. Three of the wells in the Ogallala formation have been excluded from this computation: 25-48-36c, because it was a small test hole that was never pumped at a high rate; and 24-48-31ba and 24-48-31bc, because their reported drawdowns are too small and the resultant specific capacities too high to be acceptable without confirmation.

## THE WATER TABLE

### Depth and shape

Plate 1 is a map of Box Butte County on which the locations of all irrigation wells, all observation wells on which measurements are currently being made, and a few stock, domestic, and other miscellaneous wells that were visited for inventory purposes are plotted. Water-table contours are also shown on this map.

Table 7 of this report contains records of a number of wells that were contained in table 14 of the report by Cady and Scherer (1946). It will be noted that the altitudes of the measuring points of most of the wells differ from one report to the other. Differences of altitudes of measuring point range up to a maximum of 20 feet and are due to the fact that the altitudes in the earlier report were determined by Cady and Scherer by altimeter surveys. Altitudes were determined by traverse with Paulin altimeters from bench marks of the U. S. Coast and Geodetic Survey and the U. S. Geological Survey. To obtain altitudes by more accurate methods was not practicable during the course of the field work in 1938.

Altitudes used in this report were obtained by a leveling party of the Topographic Branch of the U. S. Geological Survey by running unclosed spur traverses from third-order prism-level lines. These altitudes are considered to be correct to within one-tenth of a foot. The figures in column 7 of table 1 may be applied as a correction to the altitude of the water level in the wells as determined by Cady and Scherer in 1938.

Application of corrections to the water-table altitudes determined by Cady and Scherer produces no significant change in the trend of their water-table contours; however, the corrections do shift the positions of some of the contours an appreciable amount. The water-table contour map shown by plate 1 of this report is not intended to be a substitute for or correction of plate 8 of U. S. Geological Survey Water-Supply Paper 969. The map was constructed to determine whether or not there has been any significant change in the configuration of the water table or in the direction of ground-water movement since 1938. A relatively large number of water-level measurements and determinations of surface elevations were made in the Alliance irrigation area, and the water-table contours within that area are believed to be as accurate as can reasonably be determined. Only a few measurements were made of the depth to water in wells outside the Alliance irrigation area and these were made chiefly in the high tablelands northwest of Alliance. On the basis of water-level measurements made in that area, water-table contours were constructed to determine whether or not the general shape and position of the water table has changed significantly since 1938. The data obtained are believed to demonstrate adequately that the configuration of the water table in Box Butte County has remained essentially the same during the period 1938 to 1946, inclusive. This conclusion is substantiated by the data in column 4 of table 1, which shows that the net change in water levels in the wells measured in 1938 and 1946 was inconsequential if reasonable allowance is made for seasonal fluctuations of the water table. No long-term general trend, either upward or downward, can be detected in the water levels. It is emphasized, therefore, that most of the indicated shifting of the water-table contours between 1938 and 1946 was not real but was apparently caused by corrections in altitudes and not by changes in water levels.

The study in 1946 adds few new data to those obtained by Cady and Scherer on the movement of ground water in Box Butte County, but it does confirm strongly their interpretation of the configuration of the water table, the general direction of ground-water movement, the depth to ground water, and the thickness of saturated materials. Moreover, the differences found in the measured and reported yields and specific capacities of wells in the different geologic formations conform generally to the differences in the permeabilities of the formations as deduced by Cady and Scherer.

The eastward movement of the ground water from Box Butte County and the behavior of the water table in the sandhills east of Box Butte County are of prime interest and importance. A large contribution to the study of these phenomena can be made by the construction of a water-table contour map for the area east of Box Butte County, which will be an eastward continuation of the water-table contour map of Box Butte County. A large share of the 1946 field season was devoted to

Table 1.--Comparison of water levels and altitudes of measuring points

| Well number | Depth to water (feet below measuring point) | | Net change (feet) | Altitude of measuring point above sea level | | |
|---|---|---|---|---|---|---|
| | 1938 | 1946 | | Altimeter altitude (feet) | Corrected altitude --prism level (feet) | Net correction (feet) |
| 24-48-31bc | 36.37 | ...... | .......... | 4,018.2 | 4,022.9 | +4.7 |
| 24-50-10aa | 51.78 | 49.99 | +1.79 | 4,114.3 | 4,094.5 | -19.8 |
| 24cc | 29.79 | 27.76 | +3.03 | 4,097.5 | 4,079.6 | -12.6 |
| 24-52-13cb | 78.09 | 77.75 | +.34 | 4,278.2 | ................. | .............. |
| 35aa | 99.93 | 100.13 | -.20 | 4,346.2 | ................. | .............. |
| 25-47-7bb | 57.50 | 53.55 | +3.95 | 3,977.4 | 3,982.7 | +5.3 |
| 9bb | 24.39 | 18.85 | +5.54 | 3,919 | 3,926.5 | +7.5 |
| 19aa | 22.06 | 23.77 | -1.71 | 3,918.4 | 3,932.1 | +13.7 |
| 21bb | a28.7 | 20.74 | +8 | 3,917.1 | 3,926.7 | +9.6 |
| 25-48-30ad | 15.50 | 12.84 | +2.66 | 3,979.3 | 3,983.0 | +3.7 |
| 25-50-31ab | 103.67 | 103.53 | +.14 | 4,229.7 | 4,220.9 | -8.8 |
| 25-51-14aa | 88.83 | 89.41 | -.58 | 4,278.4 | 4,262.3 | -16.1 |
| 26-47-34da | 25.42 | ...... | .......... | 3,914 | 3,921.9 | +7.9 |
| 26-48-36ac | a64 | 67.17 | -3 | 4,002.7 | 4,010.1 | +7.4 |
| 26-49-19aa | 119.12 | 121.58 | -2.46 | 4,229.8 | 4,227.0 | -2.8 |
| 26-50-12dc | 102.17 | 101.89 | +.28 | 4,247 | 4,238.8 | -8.2 |
| 26-51-25bc | 95.99 | 95.82 | +.17 | 4,311 | 4,299.7 | -11.3 |
| 26-52-10bc | 93.37 | 93.04 | +.33 | 4,436.6 | ................. | .............. |
| 27-47-23ba | 29.92 | 22.17 | +7.75 | 3,881.7 | 3,890.8 | +9.1 |
| 25dc | 30.47 | 28.19 | +2.28 | 3,881 | 3,891.0 | +10.0 |
| 27-49-21cb | 119.26 | 119.90 | -.64 | 4,230.7 | 4,230.5 | -.2 |
| 27-50-20aa | 176.50 | 175.99 | +.51 | 4,372 | 4,371.5 | -.5 |
| 28-51-6dd | 5.19 | 4.15 | +1.04 | 4,119.1 | 4,116.9 | -2.2 |
| 8bc | 86.67 | 86.44 | +.23 | 4,207.2 | 4,200.6 | -6.6 |

[a] Reported.

ground-water investigations and water-level measurements in western Sheridan County. Altitudes of well sites and measuring points, however, were not available. The eastward extension of the water-table contour map of Box Butte County is dependent upon the availability of those data.

## IRRIGATION WELLS

### Construction and development

Some wells in Box Butte County have been constructed by professional drillers; others have been drilled by landowners. Most of the professional drilling has been done with percussion-type drilling machines. However, one hydraulic rotary-type drilling machine has been used, and several wells have been put down by the sand-bucket method.

A typical installation consists of one well equipped with a deep-well turbine pump that is driven by an electric motor, stationary engine, or tractor engine. The wells are cased with boiler steel, galvanized steel or iron, or black iron casing, and their diameters range from 6 to 36 inches. The majority of casings are 18 inches in diameter. The casing in most wells is perforated or slotted between the static water level and the bottom of the well. The bottom of the casing is generally open or filled with a few inches of coarse gravel; the bottoms of a few wells, however, are filled with concrete. The top of the casing is commonly allowed to project a few inches above the land surface and may be encased in a concrete curb.

In Box Butte County the irrigation wells are generally gravel-packed by artificial means. A hole, usually from 18 to 30 inches in diameter, is drilled, and a perforated casing that is smaller than the hole is set on the bottom. The annular space between the perforated casing and the wall of the hole is then filled with coarse, unsorted gravel and sand containing particles that range from medium sand-grain size to pebbles $1\frac{1}{2}$ inches in diameter. The pump and power unit are then installed and pumping is begun. A large quantity of fine sand, silt, and clay, from 1 to 10 percent of the fluid pumped, usually comes out with the water during the initial pumping period. The gravel that was introduced in the annular space sinks and spreads to replace the sand pumped from the well, and additional gravel is fed into the top of the annular space. Usually a hole cased with 4-inch galvanized iron pipe is left in the concrete curb to allow for additions of gravel into the annular space as pumping continues.

The common practice during the early stages of development of a well is to pump sporadically for periods of one to several hours at the convenience of the owner or available help. Reliable estimates indicate that the total quantity of sand pumped from a well in the first few weeks or months of operation may be from 1 to 100 railroad carloads. The coarse sand is shoveled from the ditches and the fine is allowed to spread over the farmland.

The methods by which irrigation wells are drilled, and the drilling tools used in Box Butte County, are largely improvised. These methods and tools have served remarkably well for drilling many wells, especially where the upper part of the hole is in the relatively well-consolidated and compacted Marsland formation. Generally, most of the beds in this formation will not cave in an open hole, but some of the unconsolidated beds are troublesome in this respect. The loosely consolidated sands in the Ogallala formation are especially susceptible to caving; and the Harrison sandstone is troublesome in some localities, especially where it is not protected by overlying consolidated beds. Serious caving can sometimes be prevented if the hole is kept full of water during drilling operations. Nearly all well-drilling operations in the county have been hampered to some extent by caving; in a number of wells it has been a serious problem, and several wells have caved so badly that drilling was abandoned with a considerable loss of time, tools, and money. Drillers have had much trouble in some areas preventing loss of drilling water into highly permeable strata or into open crevices in strata lying above the water table.

Nearly all the water-bearing materials in Box Butte County are fine grained. The development of wells in these materials presents problems that require considerable ingenuity to solve. Undoubtedly, there are special drilling problems peculiar to this region and to the water-bearing formations in it. Lessons gained from experience in other areas of similar geology and hydrology can, however, be used to advantage in this area. Use of dummy[1] casing, with necessary adaptive changes in drilling tools, would be desirable. The use of dummy casing also facilitates the sealing of permeable layers and open channels above the water table where drilling water is lost.

Examination of sands pumped from wells in Box Butte County shows that much of the unsorted gravel used for gravel-packing is too fine and is pumped out of the wells. The use of sorted gravel of specified grade sizes would reduce the amount of gravel used, reduce wear on pumps, and possibly decrease the drawdowns in wells, with consequent savings in operation costs.

Most wells are equipped with perforated casing, either vertically slotted or with shutter-type openings. The most common size of opening is 3/8 inch. Further investigation and experimentation are needed in Box Butte County to determine the drilling methods best adapted to the geologic conditions in the county. Special attention should be given to the most suitable methods

[1] A dummy casing is a casing which has a diameter slightly larger than the diameter of the drilled well and which is sunk to the bottom of the well either during the drilling process or immediately after drilling is completed. Its purpose is to prevent the hole from caving and to facilitate gravel packing of the permanent screen. The dummy casing is withdrawn as the gravel pack is placed to uncover the perforated casing and to allow water to flow through the packing from the water-bearing material.

of gravel-packing, the most efficient gravel sizes for the gravel pack, the most effective types of screens or perforated casings, and the most suitable methods of well development.

Methods of well drilling and construction currently in use in the county are successful to the extent that a rather large number of wells have been constructed and the majority of these, once completed, have been satisfactory. However, about 25 percent of the total number of wells started have been lost during construction because of caving. About 75 percent of the remainder gave some trouble by caving or other mishap before completion of the development process. Excessive amounts of sand are pumped from a large percentage of wells, and some continue to yield sand after months of operation. The amount of sand pumped far exceeds the amount of gravel introduced in most wells and indicates that large underground cavities exist around some wells. The subsurface rocks apparently are sufficiently competent to prevent, for a time, the collapse of the roofs over cavities of this sort, but roof collapse is a future possibility and might result in serious property or other loss.

The effectiveness of well development could be increased by using better pumping methods during the development period. Pumping should begin at a low rate and continue until the water clears; the rate of pumping should then be increased and held constant until the water again clears; and this procedure should be repeated until a yield a little greater than the maximum desired rate of pumping is reached. The permanent pump should not be used to develop a well as the large amount of sand pumped from wells in the county causes excessive wear of working parts and may result in a pump that is badly worn before utility pumping begins. For details on methods of drilling and developing irrigation wells, the reader is referred to reports by Davison (1939), Bennison (1943), and Rohwer (1940).

## Costs of construction and pumping

A comprehensive study of construction and pumping costs was not made. The cost of individual installations, including drilling, casing, development, and installation of permanent pumping equipment, ranged from $2,000 to $6,000 at 1946 prices. Disregarding the initial cost of equipment, diesel power is believed to be cheaper than electric power at 1946 prices. According to owners' reports, an installation on a well southwest of Alliance, powered by electricity and having a total pumping lift of about 51 feet, costs $1.12 an hour to operate at a pumping rate of 1,800 gpm; another pumping plant on a well west of Berea, powered by a diesel engine and having a total pumping lift of about 175 feet, costs $0.48 an hour to operate at a pumping rate of about 1,300 gpm.

## Yields

The yields of only a few wells in Box Butte County have been accurately measured. The reports of drillers, well owners, and well users have necessarily been depended upon heavily throughout this report. On the basis of measurements and reports, the average yield from 75 irrigation and municipal wells in the county is about 1,000 gpm. Individual yields range from 150 to 3,500 gpm. If all 75 wells were pumped 24 hours a day, the total daily withdrawal would be about 108 million gallons, or about 330 acre-feet of water. However, not all wells are pumped continuously and none are pumped every day during the entire irrigation season. Moreover, a number of the wells do not yet have permanent pumping equipment and have been pumped only a few hours at a time during development operations. It is estimated that at no time in the past has the total withdrawal of ground water in the county exceeded 20 million gallons a day. The average yearly irrigation period is about 4 months. Thus, the withdrawal of ground water for irrigation during 1946 is estimated to have been about 7,300 acre-feet or less. The amount will doubtless increase progressively in future years. Cady and Scherer (1946, p. 55) estimated that, in the central tableland of the county, the average annual ground-water recharge from precipitation on the land surface is about 23,800 acre-feet of water. If the estimated annual withdrawal of water from irrigation wells is even approximately correct, the withdrawal of ground water in the tableland during 1946 amounted to less than a third of the estimated average annual recharge from rainfall. Moreover, an appreciable quantity of the water that is applied to the land surface for irrigation seeps downward to the zone of saturation. Quantitative data on this source of recharge are not available. If the above estimates are valid, the Box Butte tableland area can support considerably more development of ground water for irrigation. The quantities of water withdrawn to date have not noticeably lowered the water levels in wells. Therefore, it is inferred that the total amount of water in storage beneath the county has not been materially decreased by pumping from wells. It is also inferred that the water pumped has been salvaged largely from ground water that would otherwise have been lost from the county by underflow, probably eastward into Sheridan County; by evaporation and transpiration in areas where the water table is near the surface of the ground; and by discharge into surface streams and into lakes.

to wells. Except for the public-supply well of the city of Alliance (25-48-36bc), all other wells sampled were supplying water for irrigation. Five of the samples represent mixtures of water from two or more water-bearing formations. Because of the very limited data available, the character of the water from the various strata can be described in only a general way.

The results of analyses of samples from the several water-bearing formations and from Bronco Lake are given in table 2. The wells are listed by field location and geologic source. Figure 2 is a map of Box Butte County showing the locations where water samples were taken. Except for one sample, the content of dissolved solids in ground-

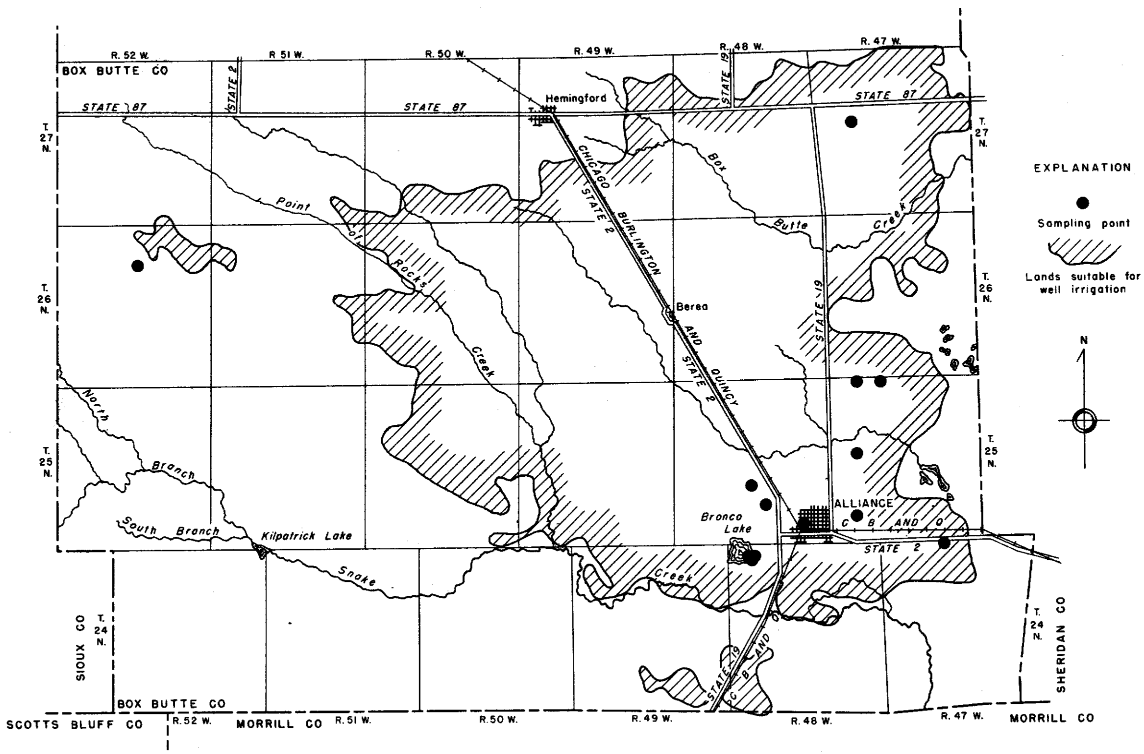


Figure 2.--Map showing sampling points in Box Butte County, Nebr.

THE CHEMICAL QUALITY OF THE WATER

General

All ground-water samples were obtained from deep wells that tap deposits of Tertiary age at depths from 160 to 408 feet. No samples of water from alluvium were obtained as the alluvium is reported to yield water sparingly

water samples, was less than 500 ppm. All waters were fairly hard; the hardness as $CaCO_3$ ranged from 111 to 238 ppm. Most of the hardness is the carbonate or "temporary" type and is removable by application of heat. Percentages of sodium are variable, ranging from 5 to 62. The results of total iron determinations for about half the samples indicate no particular iron problems in waters from these formations.

Table 2.--Chemical analyses and related physical measurements of waters for irrigation, Box Butte County, Nebr.
[Results of analyses in parts per million, except as indicated]

| Source | Date of collection | Depth (feet) | Temperature (°F) | pH | Specific conductance (micromhos at 25°C) | Silica ($SiO_2$) | Iron (Fe) | Calcium (Ca) | Magnesium (Mg) | Sodium (Na) | Potassium (K) | Carbonate ($CO_3$) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Fluoride (F) | Nitrate ($NO_3$) | Boron (B) | Dissolved solids | Hardness as $CaCO_3$ | | Percent sodium |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | Total | Noncarbonate | |
| **Ogallala formation** | | | | | | | | | | | | | | | | | | | | | | |
| 24-48-6da1 | 4-18-47 | 200 | 52 | 7.7 | 535 | .. | 0.09 | 74 | 13 | 22 | | 0 | 250 | 65 | 8.0 | 1.0 | 0.1 | 0.00 | 350 | 238 | 33 | 17 |
| 6da2 | 7-14-47 | 200 | 55 | 8.1 | 539 | 36 | .... | 41 | 12 | 46 | 15 | 0 | 248 | 53 | 7.0 | 1.1 | .4 | .09 | 337 | 152 | 0 | 37 |
| 25-47-17cc | 8-26-47 | 170 | 53 | 8.4 | 419 | 61 | .... | 34 | 16 | 28 | 9.0 | 10 | 179 | 43 | 6.0 | .8 | 1.9 | .36 | 303 | 151 | 0 | 27 |
| 32bb | 8-26-47 | 280 | 52 | 8.4 | 1,030 | 58 | .50 | 41 | 23 | 156 | 7.0 | 10 | 274 | 230 | 41 | .8 | 1.3 | .26 | 702 | 197 | 0 | 62 |
| 25-48-36bc | 4-15-47 | 307 | 53 | 8.2 | 550 | 42 | .... | 60 | 16 | 24 | 20 | 0 | 254 | 62 | 9.8 | .8 | 6.0 | .09 | 374 | 216 | 8 | 18 |
| **Ogallala and Marsland formations** | | | | | | | | | | | | | | | | | | | | | | |
| 24-47-4ba | 8-26-47 | 200 | 52 | 8.5 | 615 | 63 | 0.10 | 23 | 22 | 77 | 9.0 | 12 | 215 | 109 | 6.0 | 0.8 | 0.2 | 0.20 | 418 | 148 | 0 | 51 |
| **Marsland formation** | | | | | | | | | | | | | | | | | | | | | | |
| 27-47-17db | 8-26-47 | 160 | 53 | 8.3 | 458 | 64 | .... | 28 | 10 | 54 | 7.0 | 5 | 138 | 91 | 6.0 | 2.0 | 7.8 | 0.11 | 347 | 111 | 0 | 49 |
| **Marsland and Harrison formations** | | | | | | | | | | | | | | | | | | | | | | |
| 25-47-4bb | 8-26-47 | 297 | 55 | 7.8 | 459 | 64 | 0.12 | 29 | 20 | 26 | 16 | 0 | 204 | 45 | 5.0 | 0.3 | 6.7 | 0.14 | 314 | 155 | 0 | 24 |
| 5bb | 4-17-47 | 280 | 55 | 7.8 | 450 | 52 | .... | 38 | 20 | 7.0 | 31 | 5 | 226 | 26 | 4.5 | .4 | 6.0 | .08 | 299 | 177 | 0 | 7 |
| 25-48-27db2 | 4-17-47 | 236 | 54 | 7.7 | 490 | 42 | .... | 58 | 16 | 5.0 | 20 | 0 | 224 | 41 | 10 | 1.0 | 6.0 | .10 | 332 | 211 | 27 | 5 |
| **Marsland, Harrison, and Monroe Creek formations** | | | | | | | | | | | | | | | | | | | | | | |
| 25-48-22cc | 8-27-47 | 408 | 54 | 8.5 | 454 | 64 | 0.11 | 42 | 15 | 25 | 17 | 11 | 196 | 44 | 8.0 | 1.1 | 8.1 | 0.00 | 320 | 166 | 0 | 22 |
| **Harrison formation** | | | | | | | | | | | | | | | | | | | | | | |
| 26-52-10bc | 8-26-47 | 198 | 55 | 8.4 | 302 | 58 | 0.10 | 42 | 8.0 | 9.6 | 1.0 | 6 | 143 | 7.0 | 5.0 | 0.4 | 12 | 0.07 | 225 | 138 | 10 | 13 |
| **Surface water** | | | | | | | | | | | | | | | | | | | | | | |
| Bronco Lake | 4-18-47 | ... | .. | 8.9 | 3,200 | .. | 0.02 | 27 | 61 | 691 | | 149 | 1,040 | 483 | 144 | 5.5 | 0.2 | 0.70 | 2,080 | 318 | 0 | 83 |

The differences in the character of the water can be seen more easily in the bar diagram in figure 3, where equivalents per million of the major ions are shown as a vertical column. It can be noted readily that sulfate is the major contributor (anion) to increases in dissolved solids, and a fairly linear increase is shown in a plot of the sulfate versus dissolved solids, in parts per million. (See fig. 4.) Thus an increase in dissolved solids content is approximately proportional to an increase in sulfate. Reacting values (equivalents per million), expressed as a percentage of the total equivalents of bases, are plotted for the cations. (See fig. 4.) There is considerable

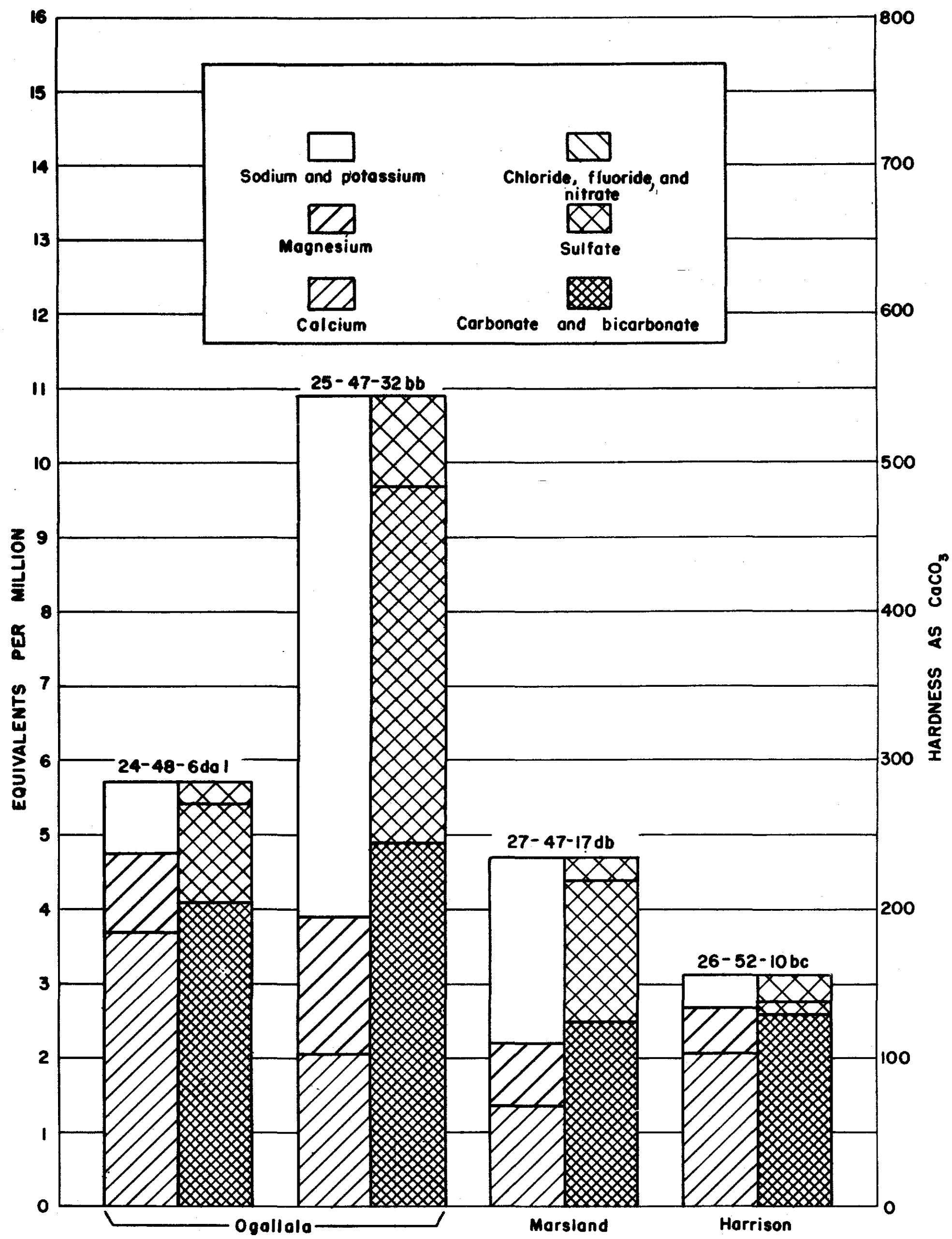


Figure 3.--Principal mineral constituents in representative ground waters.

variation in the ratio of calcium to sodium, whereas the percentage of magnesium remains relatively uniform. As the bicarbonate concentrations remain more nearly the same, it can be concluded that most of the increases in the content of dissolved solids must be due to increases in sodium sulfate. Evidence is lacking as to whether this accretion is due to direct addition of sodium sulfate (Glauber's salt) or to increase in calcium sulfate (gypsum) followed by base exchange.

appears to be affected by the more concentrated waters of Bronco Lake, which is an undrained depression (Hayes and Agee, 1918, p. 6). The lake is fed by seepage and surface runoff from the tablelands. Evaporation of these waters has subsequently increased the salt content of the lake.

Water from well 25-47-32bb has about twice the mineral content of the other waters from the Ogallala, and the dissolved solids are

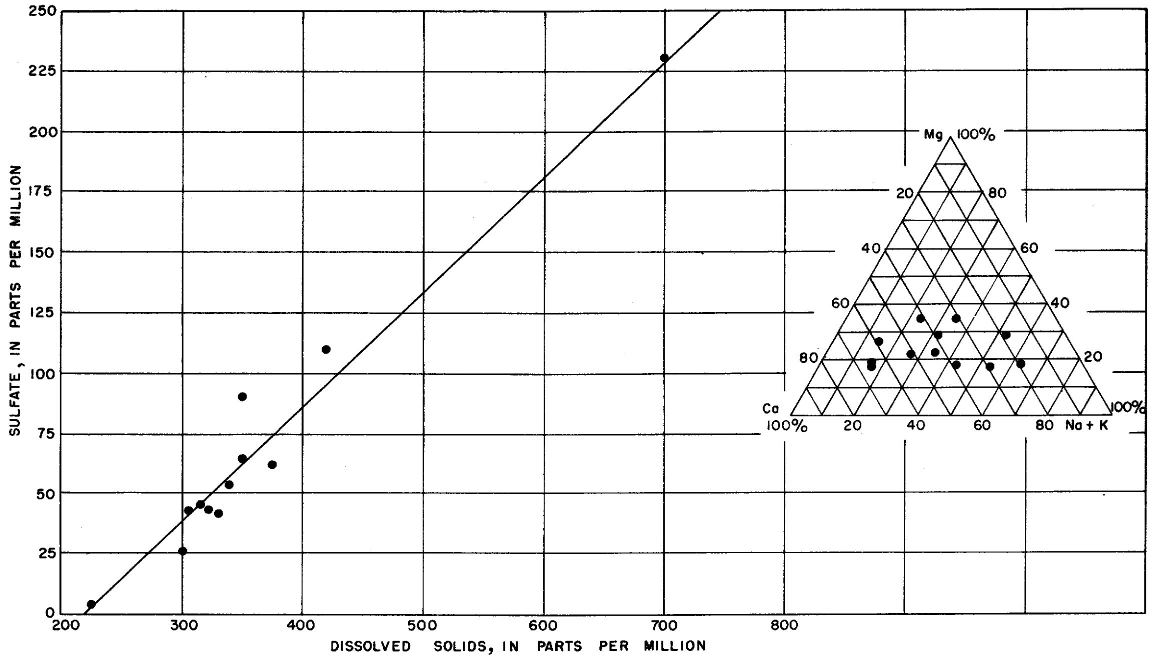


Figure 4.--Relation of sulfate to dissolved solids and percentages of reacting values of basic radicals in ground water.

## Water in the Ogallala formation

Four of the water samples obtained from wells in the lower part of the Ogallala formation, at depths that range from 170 to 307 feet, are very similar, both in dissolved-solids content and in the quantities of the individual constituents. The dissolved-solids concentrations range from 303 to 374 ppm, and the hardness ranges from 151 to 238 ppm. Wells 24-48-6da1 and 24-48-6da2, both 200 feet deep, near Bronco Lake, are probably drawing water from the same aquifer. The only significant difference in the chemical character of the two waters is the ratio of sodium to calcium. Neither of the waters

composed largely of sodium sulfate and sodium bicarbonate. The chloride content of 41 ppm is significantly higher than that obtained in other ground waters sampled. This would indicate that there is considerable variation in the distribution of soluble minerals in the formation or that ground waters do not move as freely in the part of the formation that is represented by the sample.

## Water in the Marsland formation

Although only a single sample was obtained from the Marsland formation, several mixed waters from the Ogallala and Marsland formations and Marsland and Harrison formations were analyzed. Waters from the Marsland formation, as represented by samples from wells 24-47-4ba and 27-47-17db, are similar to the high sodium sulfate water in the lower part of the Ogallala formation. (See table 2.) However, the dissolved-solids concentrations of 418 and 347 ppm are about the same as those observed in the normal bicarbonate waters in both formations. To some extent the higher sodium ratios in representative waters from the Marsland formation could be related to the lower permeability of the materials in this water-bearing stratum. The supply from well 27-47-17db has a higher fluoride content (2.0 ppm) than other waters sampled.

Waters from the Marsland and Harrison formations are very similar to waters from the Ogallala formation that are characterized by a moderately low dissolved-solids content, composed principally of calcium bicarbonate. These waters are hard and probably represent a mixture of waters from the two sources.

## Water in the Harrison formation

The sample from well 26-52-10bc (198 feet deep) in the Harrison formation has the lowest dissolved-solids content (225 ppm) of all waters analyzed. The mineral character of this water is comparable to that found in the waters in the overlying Ogallala formation. Mixtures of waters from the Harrison with those from the Marsland and Monroe Creek formations have a lower percentage of sodium than the unmixed waters from the Marsland. As in some water samples from other formations, small amounts of carbonate are found.

Cady and Scherer (1946, p. 82) reported the chemical analysis of a water sample collected from well 26-52-10bc on October 3, 1938. An excerpt of the results of analyses as compared to a resample obtained 9 years later, on August 26, 1947, is shown in the following table:

Analyses of water, well 26-52-10bc (parts per million)

| | Oct. 3, 1938 | Aug. 26, 1947 |
|---|---|---|
| Calcium........... | 44 | 42 |
| Magnesium......... | 11 | 8.0 |
| Sodium + potassium | 8.0 | 11 |
| Bicarbonate....... | 178 | 155 |
| Sulfate........... | 8.6 | 7.0 |
| Total hardness.... | 155 | 138 |
| Dissolved solids.. | 243 | 225 |

Except for small changes in the quantity of bicarbonate and hardness, the water has remained nearly uniform in character.

## Quality of water in relation to use

According to the drinking-water standards published by the U. S. Public Health Service (1946), the limits of a few common chemical substances in waters to be used in interstate traffic are as follows:

| Constituent | Maximum parts per million | |
|---|---|---|
| Iron and manganese (together)...... | 0.3 | |
| Magnesium......... | 125 | |
| Sulfate........... | 250 | |
| Fluoride.......... | 1.5 | |
| Chloride.......... | 250 | |
| Dissolved solids.. | 500 | (1,000 permitted) |

These data are useful for comparison with results obtained for waters in Box Butte County. It is noteworthy that, except for one sample, all waters analyzed had less than 500 ppm of dissolved solids.

Well 25-48-36bc (city of Alliance) is the only supply sampled that furnishes water for domestic needs. Except for being quite hard (216 ppm), the water is of satisfactory quality. No iron analysis was made; however, the iron concentrations in waters in the various formations are generally low.

It should be noted that the fluoride content of 2.0 ppm in one of the waters from the Marsland formation (well 27-47-17db) is slightly higher than is desirable in drinking waters. Concentrations of fluoride that exceed 1.5 ppm are associated with the permanent mottling of the enamel surface of the teeth of young children who use this supply more or less continuously.

With respect to use for irrigation, most of the waters rate excellent or good by the method of rating proposed by Wilcox (1948, p. 27). This method considers the relation of percentage of sodium and specific conductance (expressed in micromhos per centimeter at 25°C) in the water. Specific conductance (see table 2) is an electrical measurement of the total ions in the water and is useful in approximating the dissolved-solids content of the water. Because the conductivity measurement can be easily made in the field, it has wide application in agriculture for the expression of concentrations of dissolved minerals in soil solutions and natural waters. The various classes or groups proposed are more easily seen in figure 5. Waters that have a specific conductance of less than 2,000 micromhos at 25°C and a percentage of sodium of less than 50 are satisfactory for irrigation. Waters of lower specific conductance have a higher allowable percentage of sodium. Investigators have observed that small quantities of boron are essential to growth of most plants; however, concentrations of boron that exceed 1.0 ppm may be harmful in waters used for the irrigation of boron-sensitive plants. Concentrations of boron in the waters analyzed were less than 0.40 ppm.

Wilcox (1948, p. 27) assumes, in rating waters for irrigation, that normal conditions exist with reference to soil, crop growth, quantity of water used, and drainage.

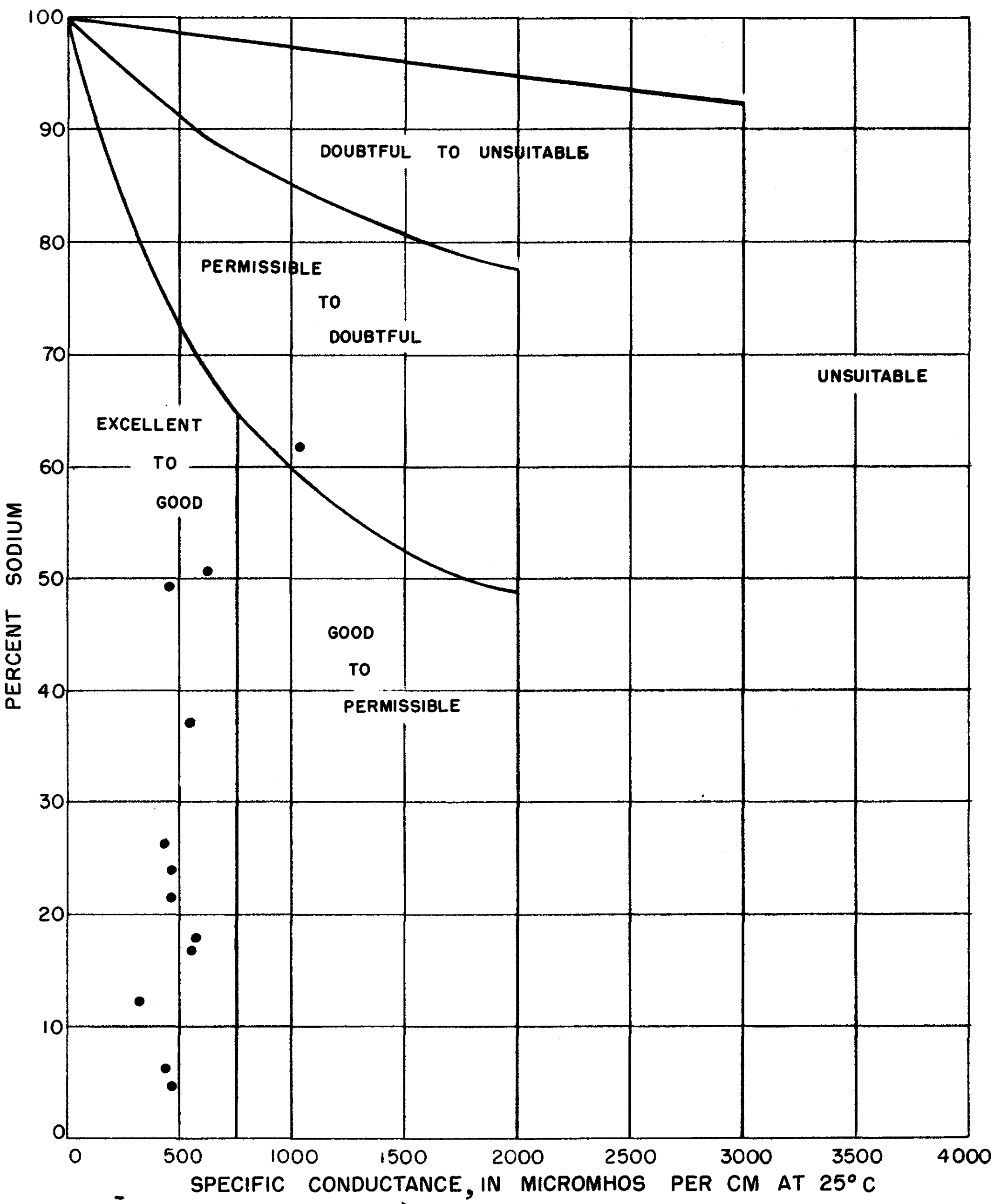


Figure 5.--Classification of ground water in Box Butte County for irrigation use (after Wilcox).

All the waters analyzed, with one exception, have a chemical quality that is satisfactory for irrigation. Water from well 25-47-32bb rates "permissible"; the lower rating is given by reason of a high percentage of sodium (62) and a relatively high conductivity (1,030).

The ratings given above provide an index of the quality of waters in the deposits of Tertiary age only, and they are not to be construed as representative of other water-bearing strata in the area.

## Conclusions

Results of analyses of 12 water samples from wells in deposits of Tertiary age indicate that supplies from these sources are moderately mineralized and hard. The waters show similarities in chemical character, although some differences occur in both the quantity of mineral substances and the degree of hardness in waters from the same formation. Generally, an increase in dissolved-solids concentration is associated with a proportional increase in sulfate. All the waters analyzed had appreciable quantities of silica.

Although somewhat harder than is desirable, the waters are generally of satisfactory quality for domestic needs. The results of the few analyses that were made of iron indicate that quantities of iron in the various waters are probably low. One sample from the Marsland formation had 2.0 ppm of fluoride; otherwise the quantities of fluoride are less than the maximum limit suggested by the U. S. Public Health Service.

All but one water rated good or excellent for irrigation; however, the percentage of sodium in the various formations is variable and examination of waters from other than Tertiary water-bearing strata should be made prior to use for irrigation. No samples were obtained from the alluvium as only limited supplies are available from that source.

## RECORD OF WATER LEVELS IN OBSERVATION WELLS

Depth-to-water measurements in 33 observation wells are shown in table 3. Of these wells, 2 have records beginning in 1934, 2 beginning in 1935, and 12 beginning in 1938. The other 15 have 2-year records beginning in the spring of 1946. The 16 wells having the records of 9 to 13 years are observation wells which are visited periodically as part of the State-wide cooperative study of ground-water resources of Nebraska by the U. S. Geological Survey and the Conservation and Survey Division of the University of Nebraska. The State-wide program of water-level measurements in wells was begun in 1934, but except for the years of 1935, 1936, and 1938 the measurements were made at infrequent intervals until the present investigation was begun in 1946.

Net changes and maximum fluctuations of water levels in the 16 wells having the longer periods of record are summarized in tables 4 and 5, respectively.

Table 3.--Water-level measurements in wells

Water level, in feet below land surface

| Date | Water level | Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|---|---|
| | | | | 24-47-1db | | | |
| Mar. 28, 1946 | 11.44 | June 17, 1946 | 11.92 | Aug. 5, 1946 | 12.26 | Feb. 17, 1947 | 11.79 |
| Apr. 4 | 11.77 | 24 | 11.83 | Oct. 11 | 12.07 | Apr. 28 | 11.76 |
| May 14 | 12.45 | July 1 | 11.90 | Nov. 12 | 12.06 | June 6 | 11.79 |
| 23 | 12.45 | 11 | 11.91 | Dec. 17 | 11.99 | Aug. 27 | 11.81 |
| June 3 | 11.62 | 22 | 12.07 | Jan. 16, 1947 | 11.91 | Oct. 27 | 11.75 |
| 10 | 11.82 | 29 | 12.18 | | | | |
| | | | | 24-48-4bb | | | |
| Apr. 11, 1946 | 13.32 | June 3, 1946 | 13.46 | June 24, 1946 | 13.47 | July 22, 1946 | 13.45 |
| May 9 | 13.46 | 10 | 13.46 | July 1 | 13.44 | 29 | 13.46 |
| 23 | 13.50 | 17 | 13.48 | 11 | 13.42 | Aug. 5 | 13.49 |

Table 3.--Water-level measurements in wells--Continued

Water level, in feet below land surface

| Date | Water level | Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|---|---|
| 24-48-4bb--Continued | | | | | | | |
| Sept.12, 1946 | 13.59 | Dec. 17, 1946 | 13.76 | Mar. 14, 1947 | 13.84 | Aug. 28, 1947 | 13.85 |
| Oct. 11 | 13.64 | Jan. 16, 1947 | 13.78 | May 1 | 13.87 | Oct. 28 | 13.93 |
| Nov. 12 | 13.72 | Feb. 17 | 13.81 | 27 | 13.91 | | |

24-48-10bb. Lowest daily water level, in feet below land surface
[Taken from recorder charts]

| Day | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1946 | | | | | | | | | | | | |
| 1 | ..... | ..... | ..... | ..... | 10.53 | 10.51 | 10.59 | 10.74 | 10.96 | 11.05 | 11.14 | 11.17 |
| 2 | ..... | ..... | ..... | ..... | 10.52 | 10.50 | 10.59 | 10.74 | 10.96 | 11.06 | 11.15 | 11.17 |
| 3 | ..... | ..... | ..... | ..... | 10.52 | 10.50 | 10.58 | 10.76 | 10.97 | 11.06 | 11.14 | 11.17 |
| 4 | ..... | ..... | ..... | ..... | 10.52 | 10.50 | 10.58 | 10.77 | 10.97 | 11.07 | 11.14 | 11.17 |
| 5 | ..... | ..... | ..... | ..... | 10.52 | 10.50 | 10.57 | 10.78 | 10.97 | 11.07 | 11.14 | 11.17 |
| 6 | ..... | ..... | ..... | ..... | 10.54 | 10.51 | 10.56 | 10.79 | 10.98 | 11.08 | 11.15 | 11.17 |
| 7 | ..... | ..... | ..... | ..... | 10.55 | 10.50 | 10.56 | 10.80 | 10.98 | 11.08 | 11.15 | 11.18 |
| 8 | ..... | ..... | ..... | ..... | 10.55 | 10.51 | 10.55 | 10.81 | 10.99 | 11.08 | 11.16 | 11.18 |
| 9 | ..... | ..... | ..... | ..... | 10.54 | 10.51 | 10.55 | 10.82 | 10.99 | 11.08 | 11.16 | 11.18 |
| 10 | ..... | ..... | ..... | ..... | 10.54 | 10.51 | 10.55 | 10.82 | 10.99 | 11.09 | 11.18 | 11.18 |
| 11 | ..... | ..... | ..... | ..... | 10.53 | 10.52 | 10.55 | 10.83 | 11.00 | 11.09 | 11.18 | ..... |
| 12 | ..... | ..... | ..... | ..... | 10.53 | 10.53 | 10.55 | 10.85 | 11.00 | 11.09 | 11.18 | ..... |
| 13 | ..... | ..... | ..... | ..... | 10.52 | 10.53 | 10.55 | 10.86 | 11.01 | 11.09 | 11.17 | ..... |
| 14 | ..... | ..... | ..... | ..... | 10.53 | 10.54 | 10.56 | 10.86 | 11.02 | 11.09 | 11.16 | ..... |
| 15 | ..... | ..... | ..... | ..... | 10.54 | 10.54 | 10.56 | 10.87 | 11.02 | 11.09 | 11.16 | ..... |
| 16 | ..... | ..... | ..... | ..... | 10.55 | 10.55 | 10.56 | 10.88 | 11.02 | 11.10 | 11.15 | ..... |
| 17 | ..... | ..... | ..... | ..... | 10.54 | 10.55 | 10.57 | 10.88 | 11.03 | 11.10 | 11.16 | ..... |
| 18 | ..... | ..... | ..... | ..... | 10.55 | 10.56 | 10.58 | 10.88 | 11.03 | 11.10 | 11.16 | ..... |
| 19 | ..... | ..... | ..... | ..... | 10.55 | 10.57 | 10.60 | 10.89 | ..... | 11.10 | 11.16 | ..... |
| 20 | ..... | ..... | ..... | ..... | 10.55 | 10.58 | 10.61 | 10.90 | ..... | ..... | 11.16 | ..... |
| 21 | ..... | ..... | ..... | ..... | 10.55 | 10.58 | 10.62 | 10.92 | 11.03 | ..... | 11.16 | ..... |
| 22 | ..... | ..... | ..... | ..... | 10.55 | 10.58 | 10.62 | 10.92 | 11.03 | 11.12 | 11.16 | ..... |
| 23 | ..... | ..... | ..... | ..... | 10.54 | 10.58 | 10.63 | 10.94 | 11.04 | 11.13 | 11.17 | 11.23 |
| 24 | ..... | ..... | ..... | ..... | 10.54 | 10.57 | 10.65 | 10.94 | 11.04 | 11.13 | 11.17 | 11.23 |
| 25 | ..... | ..... | ..... | ..... | ..... | 10.57 | 10.66 | 10.94 | 11.04 | 11.14 | 11.17 | 11.23 |
| 26 | ..... | ..... | ..... | ..... | ..... | 10.57 | 10.67 | 10.94 | 11.04 | 11.14 | 11.17 | 11.23 |
| 27 | ..... | ..... | ..... | ..... | ..... | 10.58 | 10.68 | 10.95 | 11.05 | 11.16 | 11.17 | 11.23 |
| 28 | ..... | ..... | ..... | ..... | 10.54 | 10.58 | 10.69 | 10.95 | 11.05 | 11.16 | 11.17 | 11.22 |
| 29 | ..... | | ..... | 10.57 | 10.53 | 10.58 | 10.70 | 10.96 | 11.05 | 11.16 | 11.17 | 11.23 |
| 30 | ..... | | ..... | 10.56 | 10.53 | 10.58 | 10.71 | 10.96 | 11.05 | 11.15 | 11.17 | 11.23 |
| 31 | ..... | | ..... | | 10.51 | | 10.72 | 10.96 | | 11.15 | | ..... |

Table 3.--Water-level measurements in wells--Continued

24-48-10bb--Continued

| Day | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1947 | | | | | | |
| 1 | 11.24 | 11.25 | 11.30 | ..... | 11.23 | 11.19 | 10.42 | ..... | 10.47 | ..... | a 10.64 | ..... |
| 2 | 11.24 | 11.25 | 11.30 | ..... | 11.23 | 11.19 | 10.39 | ..... | 10.48 | ..... | ..... | ..... |
| 3 | 11.24 | 11.25 | 11.31 | ..... | 11.22 | 11.19 | 10.36 | ..... | 10.49 | ..... | ..... | ..... |
| 4 | 11.23 | 11.25 | 11.31 | ..... | 11.22 | 11.18 | 10.34 | ..... | 10.50 | ..... | ..... | ..... |
| 5 | 11.23 | 11.26 | 11.31 | ..... | ..... | 11.18 | 10.32 | ..... | ..... | ..... | ..... | ..... |
| 6 | 11.22 | 11.26 | 11.31 | ..... | ..... | 11.17 | 10.29 | ..... | ..... | ..... | ..... | ..... |
| 7 | 11.22 | 11.26 | 11.31 | ..... | ..... | 11.17 | 10.25 | ..... | ..... | ..... | ..... | ..... |
| 8 | 11.22 | 11.27 | 11.31 | ..... | ..... | 11.16 | 10.23 | ..... | ..... | ..... | ..... | ..... |
| 9 | 11.22 | 11.27 | 11.31 | ..... | ..... | 11.16 | 10.21 | ..... | ..... | ..... | ..... | ..... |
| 10 | 11.22 | 11.28 | 11.31 | ..... | ..... | 11.15 | 10.20 | ..... | ..... | ..... | ..... | ..... |
| 11 | 11.22 | 11.28 | 11.31 | ..... | ..... | 11.14 | 10.18 | ..... | ..... | ..... | ..... | ..... |
| 12 | 11.22 | 11.28 | 11.31 | ..... | 11.22 | 11.14 | 10.16 | ..... | ..... | ..... | ..... | ..... |
| 13 | 11.23 | 11.28 | 11.31 | 11.30 | 11.22 | 11.14 | 10.16 | ..... | ..... | ..... | ..... | ..... |
| 14 | 11.22 | 11.28 | 11.31 | 11.30 | 11.22 | 11.13 | ..... | ..... | ..... | ..... | ..... | ..... |
| 15 | 11.22 | 11.28 | 11.31 | 11.30 | 11.22 | 11.13 | ..... | ..... | ..... | ..... | ..... | ..... |
| 16 | 11.23 | 11.28 | 11.32 | 11.30 | 11.22 | 11.13 | ..... | ..... | ..... | ..... | ..... | ..... |
| 17 | 11.23 | 11.29 | 11.32 | 11.30 | 11.21 | 11.12 | ..... | ..... | ..... | ..... | ..... | ..... |
| 18 | 11.24 | 11.29 | ..... | 11.29 | 11.21 | 11.11 | ..... | ..... | ..... | ..... | ..... | ..... |
| 19 | 11.24 | 11.29 | ..... | 11.29 | 11.21 | 11.10 | ..... | ..... | ..... | ..... | ..... | ..... |
| 20 | 11.25 | 11.29 | ..... | 11.28 | 11.21 | 11.09 | ..... | ..... | ..... | ..... | ..... | ..... |
| 21 | 11.25 | 11.29 | ..... | 11.28 | 11.21 | 11.07 | ..... | ..... | ..... | ..... | ..... | ..... |
| 22 | 11.25 | 11.29 | ..... | 11.28 | 11.20 | 11.06 | ..... | ..... | ..... | ..... | ..... | ..... |
| 23 | 11.25 | 11.29 | ..... | 11.27 | 11.20 | 10.97 | ..... | ..... | ..... | ..... | ..... | ..... |
| 24 | 11.25 | 11.30 | ..... | 11.27 | 11.20 | 10.81 | ..... | ..... | ..... | ..... | ..... | ..... |
| 25 | 11.25 | 11.30 | ..... | 11.27 | 11.20 | 10.71 | ..... | ..... | ..... | 10.62 | ..... | ..... |
| 26 | 11.25 | 11.30 | ..... | 11.27 | 11.20 | 10.64 | ..... | ..... | ..... | 10.62 | ..... | ..... |
| 27 | 11.25 | 11.30 | ..... | 11.27 | 11.20 | 10.58 | ..... | ..... | ..... | 10.62 | ..... | ..... |
| 28 | 11.25 | 11.30 | ..... | 11.28 | 11.20 | 10.53 | ..... | 10.43 | ..... | 10.63 | ..... | ..... |
| 29 | 11.25 | | ..... | 11.23 | 11.20 | 10.49 | ..... | 10.44 | ..... | 10.63 | ..... | ..... |
| 30 | 11.25 | | ..... | 11.23 | 11.20 | 10.45 | ..... | 10.45 | ..... | 10.63 | ..... | ..... |
| 31 | 11.25 | | ..... | | 11.20 | | ..... | 10.46 | | 10.63 | | ..... |

a No further record for 1947.

Water level, in feet below land surface

| Date | Water level | Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|---|---|
| | | | 24-48-11dd | | | | |
| Mar. 22, 1946 | 5.37 | June 17, 1946 | 5.44 | Aug. 5, 1946 | 6.35 | Feb. 17, 1947 | 6.64 |
| Apr. 11 | 5.26 | 24 | 5.36 | Sept. 14 | 6.96 | Mar. 14 | 6.59 |
| May 13 | 5.04 | July 1 | 5.50 | Oct. 11 | 7.03 | May 1 | 6.18 |
| 23 | 5.03 | 11 | 5.67 | Nov. 12 | 7.05 | June 6 | 5.95 |
| June 3 | 5.05 | 22 | 5.99 | Dec. 17 | 6.90 | Aug. 28 | 4.81 |
| 10 | 5.15 | 29 | 6.18 | Jan. 16, 1947 | 6.77 | Oct. 27 | 5.57 |

Table 3.--Water-level measurements in wells--Continued

24-48-31ba. Lowest daily water level, in feet below land surface
[Taken from recorder charts]

| Day | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1946 | | | | | | |
| 1 | ..... | ..... | ..... | ..... | ..... | 39.19 | 39.17 | 39.06 | 39.04 | 38.87 | 38.89 | 38.91 |
| 2 | ..... | ..... | ..... | ..... | ..... | 39.18 | 39.17 | 39.02 | 38.99 | 38.94 | 39.00 | 38.93 |
| 3 | ..... | ..... | ..... | ..... | 39.10 | 39.17 | 39.16 | 39.07 | 38.95 | 38.95 | 39.01 | 38.93 |
| 4 | ..... | ..... | ..... | ..... | 39.08 | 39.13 | 39.19 | 39.04 | 38.95 | 38.91 | 38.97 | 38.89 |
| 5 | ..... | ..... | ..... | ..... | 39.11 | 39.11 | 39.13 | 39.04 | 39.01 | 39.01 | 38.92 | 38.90 |
| 6 | ..... | ..... | ..... | ..... | 39.12 | 39.11 | 39.14 | 39.03 | 39.02 | 38.97 | 38.82 | 38.86 |
| 7 | ..... | ..... | ..... | ..... | 39.11 | 39.19 | 39.12 | 39.05 | 38.99 | 38.92 | 38.88 | 38.86 |
| 8 | ..... | ..... | ..... | ..... | 39.05 | 39.20 | 39.08 | 39.06 | 38.97 | 38.94 | 38.90 | 38.89 |
| 9 | ..... | ..... | ..... | ..... | 39.12 | 39.16 | 39.17 | 39.06 | 39.00 | 38.94 | 38.86 | 38.92 |
| 10 | ..... | ..... | ..... | ..... | 39.08 | 39.14 | 39.16 | 39.04 | 39.00 | 38.99 | 38.89 | 38.89 |
| 11 | ..... | ..... | ..... | ..... | 39.05 | 38.18 | 39.14 | 39.02 | 38.97 | 38.97 | 38.94 | 38.83 |
| 12 | ..... | ..... | ..... | ..... | 39.04 | 39.18 | 39.07 | 39.01 | 38.96 | 38.93 | 38.95 | 38.90 |
| 13 | ..... | ..... | ..... | 39.12 | 39.06 | 39.17 | 39.09 | 39.01 | 38.95 | 38.93 | 38.90 | 38.90 |
| 14 | ..... | ..... | ..... | ..... | 39.09 | 39.10 | 39.10 | 39.04 | 38.94 | 38.93 | 38.83 | 38.87 |
| 15 | ..... | ..... | ..... | ..... | 39.09 | 39.12 | 39.08 | 39.01 | 38.93 | 38.94 | 38.97 | 38.80 |
| 16 | ..... | ..... | ..... | ..... | ..... | 39.20 | 39.05 | 39.00 | 38.92 | 38.93 | 39.00 | 39.00 |
| 17 | ..... | ..... | ..... | ..... | 39.09 | 39.17 | 39.08 | 39.07 | 39.00 | 38.88 | 38.93 | 38.97 |
| 18 | ..... | ..... | ..... | ..... | 39.19 | 39.20 | 39.12 | 39.04 | 38.98 | 38.92 | 38.87 | 38.89 |
| 19 | ..... | ..... | ..... | ..... | 39.19 | 39.19 | 39.11 | 38.99 | 38.97 | 38.94 | 38.85 | 38.85 |
| 20 | ..... | ..... | ..... | ..... | 39.18 | 39.14 | 39.08 | 38.99 | 38.89 | ..... | 38.88 | 38.90 |
| 21 | ..... | ..... | ..... | ..... | 39.11 | 39.13 | 39.05 | 39.01 | 38.99 | ..... | 38.99 | 38.89 |
| 22 | ..... | ..... | ..... | ..... | 39.12 | 39.12 | 39.01 | 39.01 | 39.01 | 38.86 | 38.95 | 38.91 |
| 23 | ..... | ..... | ..... | ..... | 39.16 | 39.16 | ..... | 38.99 | 39.00 | 38.94 | 38.85 | 38.93 |
| 24 | ..... | ..... | ..... | ..... | 39.19 | 39.17 | ..... | 38.97 | 38.97 | 38.90 | 38.95 | 38.93 |
| 25 | ..... | ..... | ..... | ..... | 39.18 | 39.16 | ..... | 39.01 | 38.95 | 38.86 | 38.95 | 38.87 |
| 26 | ..... | ..... | ..... | ..... | 39.13 | 39.12 | ..... | 39.02 | 38.93 | 38.94 | 39.00 | 38.85 |
| 27 | ..... | ..... | ..... | ..... | 39.12 | 39.12 | ..... | 39.01 | 38.97 | 38.94 | 39.00 | 38.91 |
| 28 | ..... | ..... | ..... | ..... | 39.12 | 39.19 | ..... | 39.02 | 39.03 | 38.89 | 38.95 | 38.95 |
| 29 | ..... | | ..... | ..... | 39.11 | 39.14 | 39.00 | 39.01 | 38.99 | 38.96 | 38.90 | ..... |
| 30 | ..... | | ..... | ..... | 39.16 | 39.20 | 39.01 | 38.96 | 38.90 | 38.98 | 39.00 | ..... |
| 31 | ..... | | ..... | | 39.17 | | 39.05 | 39.02 | | 38.93 | | ..... |
| | | | | | | 1947 | | | | | | |
| 1 | 38.97 | 39.01 | 38.93 | ..... | 39.08 | 38.02 | 39.05 | ..... | 38.70 | ..... | a 38.51 | ..... |
| 2 | 38.96 | 38.89 | 38.88 | ..... | 39.03 | 39.02 | 38.99 | ..... | 38.67 | ..... | ..... | ..... |
| 3 | 38.95 | 39.02 | 38.91 | ..... | 38.99 | 38.96 | 38.97 | ..... | 38.73 | ..... | ..... | ..... |
| 4 | 38.87 | 38.98 | 38.96 | ..... | 39.00 | 39.01 | 39.03 | ..... | ..... | ..... | ..... | ..... |
| 5 | 38.87 | 38.88 | 39.00 | ..... | 39.01 | 39.01 | 39.05 | ..... | ..... | ..... | ..... | ..... |
| 6 | 38.88 | 38.90 | 38.96 | ..... | ..... | 39.02 | 39.01 | ..... | ..... | ..... | ..... | ..... |
| 7 | 38.92 | 38.95 | 38.88 | ..... | ..... | 39.04 | 38.99 | ..... | ..... | ..... | ..... | ..... |
| 8 | 38.95 | 38.94 | 38.89 | ..... | ..... | 38.96 | 38.99 | ..... | ..... | ..... | ..... | ..... |
| 9 | 38.91 | 38.94 | 38.92 | ..... | ..... | 38.95 | 38.97 | ..... | ..... | ..... | ..... | ..... |
| 10 | 38.85 | 38.87 | 38.88 | ..... | ..... | 39.06 | 38.95 | ..... | ..... | ..... | ..... | ..... |
| 11 | 38.85 | 38.94 | 38.98 | ..... | ..... | 39.06 | 38.92 | ..... | ..... | ..... | ..... | ..... |
| 12 | 38.81 | 38.93 | 39.00 | ..... | 38.98 | 39.03 | 38.98 | ..... | ..... | ..... | ..... | ..... |
| 13 | 38.90 | 38.94 | 38.94 | 38.98 | 38.97 | 39.01 | 38.96 | ..... | ..... | ..... | ..... | ..... |
| 14 | 38.96 | 38.94 | 38.96 | 38.99 | 38.99 | 39.04 | ..... | ..... | ..... | ..... | ..... | ..... |
| 15 | 38.97 | 38.91 | 38.96 | 39.02 | 39.02 | 38.99 | ..... | ..... | ..... | ..... | ..... | ..... |

a No further record in 1947.

Table 3.--Water-level measurements in wells--Continued

24-48-31ba--Continued

| Day | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1947 | | | | | | |
| 16 | 38.97 | 38.90 | 38.97 | 38.97 | 39.01 | 39.00 | ..... | ..... | ..... | ..... | ..... | ..... |
| 17 | 38.94 | 38.92 | ..... | 38.90 | 39.00 | 39.03 | ..... | ..... | ..... | ..... | ..... | ..... |
| 18 | 38.92 | 38.94 | ..... | 39.01 | 39.01 | 39.05 | ..... | ..... | ..... | ..... | ..... | ..... |
| 19 | 38.91 | 38.93 | ..... | 38.99 | 38.99 | 39.01 | ..... | ..... | ..... | ..... | ..... | ..... |
| 20 | 38.96 | 38.91 | ..... | 38.97 | 39.04 | 38.96 | ..... | ..... | ..... | ..... | ..... | ..... |
| 21 | 38.96 | 38.90 | ..... | ..... | 39.01 | 39.04 | ..... | ..... | ..... | ..... | ..... | ..... |
| 22 | 38.89 | 38.93 | ..... | ..... | 39.02 | 39.05 | ..... | ..... | ..... | ..... | ..... | ..... |
| 23 | 38.87 | 38.94 | ..... | ..... | 39.01 | 39.05 | ..... | ..... | ..... | ..... | ..... | ..... |
| 24 | 38.88 | 38.93 | ..... | ..... | 38.98 | 39.02 | ..... | ..... | ..... | ..... | ..... | ..... |
| 25 | 38.93 | 38.94 | ..... | ..... | 39.03 | 38.99 | ..... | ..... | ..... | 38.46 | ..... | ..... |
| 26 | 38.91 | 38.93 | ..... | ..... | 39.02 | 38.97 | ..... | ..... | ..... | 38.46 | ..... | ..... |
| 27 | 38.92 | 38.86 | ..... | ..... | 39.00 | 38.98 | ..... | 38.75 | ..... | 38.48 | ..... | ..... |
| 28 | 38.89 | 38.95 | ..... | 38.89 | 39.01 | 39.07 | ..... | 38.70 | ..... | 38.44 | ..... | ..... |
| 29 | 38.91 | | ..... | 38.94 | 39.01 | 39.09 | ..... | 38.70 | ..... | 38.43 | ..... | ..... |
| 30 | 38.91 | | ..... | 39.04 | 39.00 | 39.08 | ..... | 38.72 | ..... | 38.52 | ..... | ..... |
| 31 | 39.02 | | ..... | | 38.97 | | ..... | 38.72 | | 38.55 | | ..... |

Water level, in feet below land surface

| Date | Water level | Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|---|---|
| | | | 24-49-36ac | | | | |
| Mar. 18, 1946 | 38.46 | June 3, 1946 | 38.70 | June 24, 1946 | 38.64 | July 11, 1946 | 38.61 |
| May 9 | 38.62 | 10 | 38.66 | July 1 | 38.70 | 29 | a38.47 |
| 24 | 38.70 | 17 | 38.67 | | | | |

a Well destroyed after July 29, 1946.

| Date | Water level | Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|---|---|
| | | | 24-50-10aa | | | | |
| June 23, 1938 | 51.28 | May 1, 1940 | 51.70 | June 3, 1946 | 48.68 | Oct. 10, 1946 | 49.83 |
| July 2 | 52.02 | July 22 | 51.66 | 10 | 49.66 | Nov. 12 | 49.85 |
| 11 | 51.23 | Nov. 2 | 51.73 | 17 | 49.65 | Dec. 21 | 49.89 |
| 21 | 51.24 | Oct. 20, 1941 | 51.70 | 24 | 49.65 | Jan. 16, 1947 | 49.94 |
| Aug. 1 | 51.25 | Nov. 13, 1942 | 50.07 | July 1 | 50.14 | Feb. 17 | 49.97 |
| 10 | 51.34 | Aug. 16, 1944 | 49.84 | 11 | 49.58 | Mar. 14 | 49.98 |
| 24 | 51.25 | Feb. 27, 1946 | 49.67 | 22 | 49.63 | May 1 | 50.02 |
| Sept. 3 | 51.27 | Apr. 13 | 49.67 | 29 | 49.64 | 29 | 49.97 |
| 20 | 51.29 | May 9 | 49.69 | Aug. 5 | 49.63 | Aug. 27 | 49.50 |
| Oct. 3 | 51.28 | 24 | 49.71 | Sept. 12 | 49.69 | Oct. 27 | 49.47 |
| June 8, 1939 | 51.48 | | | | | | |
| | | | 24-52-13cb | | | | |
| June 11, 1938 | 77.89 | Aug. 24, 1938 | 77.96 | Feb. 27, 1946 | 77.65 | Jan. 17, 1947 | 77.65 |
| 23 | 77.94 | Sept. 3 | 77.98 | Apr. 16 | 77.85 | Feb. 19 | 77.71 |
| July 2 | 77.96 | 20 | 78.26 | July 12 | 78.15 | Mar. 13 | 77.60 |
| 11 | 77.95 | Oct. 3 | 77.95 | Aug. 14 | 78.04 | May 2 | 77.62 |
| 21 | 77.93 | Apr. 1, 1940 | 78.20 | Sept. 12 | 78.07 | June 4 | 77.81 |
| Aug. 1 | 77.93 | Nov. 13, 1942 | 77.91 | Nov. 13 | 77.67 | Aug. 27 | 77.93 |
| 10 | 77.97 | Aug. 16, 1944 | 77.78 | Dec. 20 | 77.67 | Oct. 27 | 77.80 |

Table 3.--Water-level measurements in wells--Continued

Water level, in feet below land surface

| Date | Water level | Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|---|---|
| | | | 24-52-35aa | | | | |
| June 23, 1938 | 98.97 | Sept. 3, 1938 | 98.90 | July 12, 1946 | 98.06 | Feb. 19, 1947 | 98.09 |
| July 2 | 98.94 | June 8, 1939 | 98.82 | Aug. 14 | 98.28 | Mar. 13 | 98.09 |
| 11 | 98.95 | July 22, 1940 | 97.61 | Sept.12 | 98.12 | May 2 | 98.07 |
| 21 | 98.95 | Nov. 2 | 98.53 | Oct. 10 | 98.21 | June 4 | 98.13 |
| Aug. 1 | 98.92 | Oct. 20, 1941 | 98.67 | Nov. 13 | 98.12 | Aug. 27 | 98.17 |
| 10 | 98.95 | May 9, 1946 | 99.13 | Dec. 20 | 98.20 | Oct. 27 | 97.70 |
| 24 | 98.90 | June 12 | 98.50 | Jan. 17, 1947 | 98.13 | | |
| | | | 25-47-31cc | | | | |
| Mar. 27, 1946 | 14.72 | June 17, 1946 | 15.26 | Aug. 5, 1946 | 15.47 | Feb. 17, 1947 | 16.25 |
| Apr. 11 | 15.36 | 24 | 15.36 | Sept.14 | 16.08 | Mar. 14 | 16.38 |
| May 13 | 15.19 | July 1 | 15.19 | Oct. 11 | 16.22 | May 1 | 15.99 |
| 23 | 15.33 | 11 | 15.14 | Nov. 12 | 16.08 | 27 | 15.57 |
| June 3 | 15.39 | 22 | 15.13 | Dec. 17 | 15.72 | Aug. 28 | 14.29 |
| 10 | 15.45 | 29 | 15.18 | Jan. 16, 1947 | 15.96 | Oct. 28 | 16.11 |
| | | | 25-48-4dd | | | | |
| Apr. 29, 1946 | 63.30 | June 24, 1946 | 63.27 | Sept.14, 1946 | 63.45 | Mar. 13, 1947 | 63.40 |
| May 14 | 63.42 | July 1 | 63.34 | Oct. 11 | 63.56 | May 2 | 63.63 |
| 24 | 63.65 | 11 | 63.50 | Nov. 7 | 63.42 | 27 | 63.40 |
| June 3 | 63.49 | 22 | 63.15 | Dec. 17 | 63.91 | Aug. 27 | 63.45 |
| 10 | 63.34 | 29 | 63.37 | Jan. 16, 1947 | 63.72 | Oct. 26 | 63.51 |
| 17 | 63.36 | Aug. 5 | 63.32 | Feb. 17 | 63.46 | | |

25-48-14aa. Lowest daily water level, in feet below land surface
[Taken from recorder charts]

| Day | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1946 | | | | | | |
| 1 | ..... | ..... | ..... | 48.93 | ..... | ..... | 48.31 | 48.43 | 48.58 | 48.48 | 48.68 | 48.68 |
| 2 | ..... | ..... | ..... | 48.93 | ..... | ..... | 48.36 | 48.37 | 48.51 | 48.55 | 48.80 | 48.76 |
| 3 | ..... | ..... | ..... | 48.92 | ..... | 48.32 | 48.38 | 48.42 | 48.47 | 48.61 | 48.79 | 48.76 |
| 4 | ..... | ..... | ..... | 48.94 | ..... | ..... | 48.43 | 48.41 | 48.47 | 48.55 | 48.76 | 48.72 |
| 5 | ..... | ..... | ..... | ..... | ..... | ..... | 48.40 | 48.40 | 48.56 | 48.73 | 48.69 | 48.73 |
| 6 | ..... | ..... | 48.06 | ..... | ..... | ..... | 48.39 | 48.36 | 48.58 | 48.63 | 48.57 | 48.69 |
| 7 | ..... | ..... | ..... | ..... | ..... | ..... | 48.39 | 48.43 | 48.54 | 48.55 | 48.69 | 48.69 |
| 8 | ..... | ..... | ..... | ..... | ..... | ..... | 48.34 | 48.48 | 48.52 | 48.57 | 48.71 | 48.79 |
| 9 | ..... | ..... | ..... | ..... | ..... | ..... | 48.46 | 48.49 | 48.59 | 48.59 | 48.70 | 48.82 |
| 10 | ..... | ..... | ..... | ..... | ..... | ..... | 48.46 | 48.37 | 48.59 | 48.67 | 48.72 | 48.82 |
| 11 | ..... | ..... | ..... | ..... | ..... | ..... | 48.42 | 48.36 | ..... | 48.64 | 48.78 | 48.71 |
| 12 | ..... | ..... | ..... | ..... | ..... | ..... | 48.30 | 48.32 | ..... | 48.63 | 48.78 | 48.80 |
| 13 | ..... | ..... | ..... | ..... | ..... | ..... | 48.34 | 48.42 | ..... | 48.63 | 48.70 | 48.80 |
| 14 | ..... | ..... | ..... | ..... | ..... | 48.26 | 48.38 | 48.42 | 48.50 | 48.63 | 48.70 | 48.77 |
| 15 | ..... | ..... | ..... | ..... | ..... | 48.28 | 48.37 | 48.42 | 48.47 | 48.66 | 48.81 | 48.68 |
| 16 | ..... | ..... | ..... | 50.90 | ..... | 48.32 | 48.34 | 48.43 | 48.49 | 48.65 | 48.85 | 48.95 |
| 17 | ..... | ..... | ..... | ..... | ..... | 48.27 | 48.35 | 48.52 | 48.60 | 48.59 | 48.75 | 48.93 |
| 18 | ..... | ..... | ..... | ..... | ..... | 48.35 | 48.48 | 48.49 | 48.61 | 48.67 | 48.65 | 48.78 |
| 19 | ..... | ..... | ..... | ..... | ..... | 48.35 | 48.48 | 48.44 | 48.58 | 48.67 | 48.62 | 48.72 |
| 20 | ..... | ..... | ..... | ..... | ..... | 48.32 | 48.41 | 48.40 | 48.49 | ..... | 48.62 | 48.83 |
| 21 | ..... | ..... | ..... | ..... | ..... | 48.30 | 48.39 | 48.46 | 48.57 | ..... | 48.82 | 48.80 |
| 22 | ..... | ..... | ..... | ..... | ..... | 48.30 | 48.42 | 48.46 | 48.65 | 48.63 | 48.78 | 48.84 |

Table 3.--Water-level measurements in wells--Continued

25-48-14aa--Continued

| Day | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1946 | | | | | | |
| 23 | ..... | ..... | ..... | ..... | ..... | 48.30 | 48.43 | 48.44 | 48.61 | 48.66 | 48.66 | 48.86 |
| 24 | ..... | ..... | ..... | 48.40 | ..... | 48.33 | 48.41 | 48.42 | 48.59 | 48.65 | 48.87 | 48.87 |
| 25 | ..... | ..... | ..... | ..... | ..... | 48.33 | 48.41 | 48.48 | 48.56 | 48.57 | 48.85 | 48.79 |
| 26 | ..... | ..... | ..... | ..... | ..... | 48.31 | 48.36 | 48.48 | 48.54 | 48.71 | 48.92 | 48.77 |
| 27 | ..... | ..... | ..... | ..... | ..... | 48.29 | 48.39 | 48.47 | 48.64 | 48.71 | 48.90 | 48.88 |
| 28 | ..... | ..... | 48.81 | ..... | ..... | 48.34 | 48.38 | 48.49 | 48.69 | 48.66 | 48.81 | ..... |
| 29 | ..... | | 48.82 | ..... | ..... | 48.31 | 48.36 | 48.49 | 48.66 | 48.73 | 48.71 | ..... |
| 30 | ..... | | 48.93 | ..... | ..... | ..... | 48.33 | ..... | 48.51 | 48.76 | 48.81 | ..... |
| 31 | ..... | | 48.93 | | ..... | | 48.37 | 48.55 | | 48.69 | | ..... |
| | | | | | | 1947 | | | | | | |
| 1 | ..... | 49.04 | 49.00 | ..... | 49.21 | ..... | 49.19 | ..... | 49.03 | ..... | a 49.28 | ..... |
| 2 | 48.87 | 48.86 | 48.92 | ..... | 49.15 | 49.15 | 49.12 | ..... | 48.99 | ..... | ..... | ..... |
| 3 | 48.87 | 49.06 | 48.97 | ..... | 49.12 | 49.12 | 49.08 | ..... | 49.05 | ..... | ..... | ..... |
| 4 | 48.76 | 49.00 | 49.03 | ..... | 49.12 | 49.21 | 49.15 | ..... | ..... | ..... | ..... | ..... |
| 5 | 48.77 | 48.85 | 49.07 | ..... | 49.12 | 49.21 | 49.17 | ..... | ..... | ..... | ..... | ..... |
| 6 | 48.82 | 48.91 | 49.01 | ..... | ..... | 49.21 | 49.12 | ..... | ..... | ..... | ..... | ..... |
| 7 | 48.86 | 48.97 | 48.91 | ..... | ..... | 49.24 | 49.09 | ..... | ..... | ..... | ..... | ..... |
| 8 | 48.89 | 48.94 | 48.94 | ..... | ..... | 49.15 | 49.08 | ..... | ..... | ..... | ..... | ..... |
| 9 | 48.83 | 48.94 | 48.98 | ..... | ..... | 49.12 | 49.06 | ..... | ..... | ..... | ..... | ..... |
| 10 | 48.73 | 48.86 | 48.96 | ..... | ..... | 49.26 | ..... | ..... | ..... | ..... | ..... | ..... |
| 11 | 48.76 | 48.98 | 49.06 | ..... | ..... | 49.26 | ..... | ..... | ..... | ..... | ..... | ..... |
| 12 | 48.70 | 48.96 | 49.08 | ..... | 49.13 | 49.21 | ..... | ..... | ..... | ..... | ..... | ..... |
| 13 | 48.85 | 48.98 | 48.97 | 49.05 | 49.10 | 49.20 | ..... | ..... | ..... | ..... | ..... | ..... |
| 14 | 48.91 | 48.98 | 49.03 | 49.05 | 49.12 | 49.21 | ..... | ..... | ..... | ..... | ..... | ..... |
| 15 | 48.95 | 48.93 | 49.01 | 49.14 | 49.17 | 49.21 | ..... | ..... | ..... | ..... | ..... | ..... |
| 16 | 48.92 | 48.93 | 49.05 | 49.07 | 49.15 | 49.20 | ..... | ..... | ..... | ..... | ..... | ..... |
| 17 | 48.90 | 48.97 | 49.04 | 48.97 | 49.13 | 49.24 | ..... | ..... | ..... | ..... | ..... | ..... |
| 18 | 48.86 | 48.98 | ..... | 49.14 | 49.16 | 49.27 | ..... | ..... | ..... | ..... | ..... | ..... |
| 19 | 48.88 | 48.99 | ..... | 49.14 | 49.16 | 49.21 | ..... | ..... | ..... | ..... | ..... | ..... |
| 20 | 48.87 | 48.98 | ..... | 49.07 | 49.18 | 49.16 | ..... | ..... | ..... | ..... | ..... | ..... |
| 21 | 48.87 | 48.95 | ..... | 49.08 | 49.17 | 49.25 | ..... | ..... | ..... | ..... | ..... | ..... |
| 22 | 48.85 | 48.99 | ..... | 49.09 | 49.17 | 49.26 | ..... | ..... | ..... | ..... | ..... | ..... |
| 23 | 48.85 | 49.00 | ..... | 49.14 | 49.17 | 49.25 | ..... | ..... | ..... | ..... | ..... | ..... |
| 24 | 48.85 | 48.96 | ..... | 49.14 | 49.13 | 49.21 | ..... | ..... | ..... | ..... | ..... | ..... |
| 25 | 48.95 | 48.97 | ..... | 49.15 | 49.15 | 49.18 | ..... | ..... | ..... | 49.19 | ..... | ..... |
| 26 | 48.91 | 48.97 | ..... | 49.09 | 49.15 | 49.14 | ..... | ..... | ..... | 49.20 | ..... | ..... |
| 27 | 48.93 | 48.87 | ..... | 49.09 | 49.16 | 49.14 | ..... | 49.00 | ..... | 49.23 | ..... | ..... |
| 28 | 48.84 | 49.01 | ..... | 48.98 | 49.17 | 49.23 | ..... | 48.98 | ..... | 49.19 | ..... | ..... |
| 29 | 48.91 | | ..... | 49.05 | ..... | 49.25 | ..... | 49.00 | ..... | 49.16 | ..... | ..... |
| 30 | 48.91 | | ..... | 49.16 | ..... | 49.24 | ..... | 49.00 | ..... | 49.31 | ..... | ..... |
| 31 | 49.06 | | ..... | | ..... | | ..... | 49.05 | | 49.32 | | ..... |

a No further record.

Table 3.--Water-level measurements in wells--Continued

| Date | Water level | Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|---|---|
| | | Water level, in feet below land surface | | | | | |
| | | | 25-48-25bb | | | | |
| Feb. 28, 1946 | 71.81 | June 17, 1946 | 71.80 | Sept.14, 1946 | 74.70 | Feb. 17, 1947 | 72.70 |
| Mar. 29 | 70.76 | 24 | 71.89 | Oct. 11 | 73.64 | Mar. 13 | 72.55 |
| May 13 | 71.65 | July 1 | 72.69 | Nov. 7 | 73.22 | May 1 | 72.65 |
| June 3 | 71.92 | 11 | 72.24 | Dec. 17 | 72.90 | 27 | 72.89 |
| 10 | 71.80 | 29 | 74.76 | Jan. 17, 1947 | 72.78 | Oct. 26 | 74.26 |
| | | | 25-48-27db2 | | | | |
| Mar. 7, 1946 | 67.99 | June 24, 1946 | 69.00 | Nov. 7, 1946 | 68.72 | Mar. 13, 1947 | 68.62 |
| 29 | 67.99 | July 1 | 68.50 | Dec. 17 | 68.68 | May 2 | 68.69 |
| May 13 | 67.90 | 11 | 68.30 | Jan. 17, 1947 | 68.69 | 27 | 68.71 |
| 24 | 68.24 | Sept.13 | 69.45 | Feb. 18 | 68.71 | Oct. 26 | 68.55 |
| June 3 | 68.02 | Oct. 11 | 68.75 | | | | |
| | | | 25-48-30ad | | | | |
| June 20, 1938 | 15.00 | Oct. 3, 1938 | 15.47 | May 24, 1946 | 12.73 | Oct. 11, 1946 | 12.79 |
| 23 | 15.15 | June 8, 1939 | 14.86 | June 3 | 12.74 | Dec. 21 | 13.03 |
| July 2 | 15.00 | Apr. 1, 1940 | 15.30 | 10 | 12.75 | Jan. 16, 1947 | 13.05 |
| 11 | 14.93 | July 22 | 15.40 | 17 | 12.83 | Feb. 17 | 13.06 |
| 21 | 14.80 | Nov. 2 | 15.09 | 24 | 12.73 | Mar. 14 | 13.12 |
| Aug. 1 | 14.63 | Oct. 20, 1941 | Dry | July 1 | 12.65 | May 1 | 13.15 |
| 10 | 14.65 | Nov. 14, 1942 | 13.53 | 11 | 12.54 | 27 | 14.77 |
| 24 | 14.63 | Aug. 17, 1944 | 12.72 | 29 | 12.63 | Aug. 27 | 13.06 |
| Sept. 3 | 14.62 | Feb. 28, 1946 | 12.70 | Aug. 5 | 12.63 | Oct. 26 | 13.10 |
| 20 | 14.58 | May 13 | 12.74 | Sept.13 | 12.87 | | |
| | | | 25-49-14da | | | | |
| Mar. 12, 1946 | 32.45 | June 10, 1946 | 31.45 | Sept.13, 1946 | 31.68 | Feb. 17, 1947 | 31.84 |
| Apr. 1 | 31.46 | 17 | 31.49 | Oct. 11 | 31.69 | Mar. 14 | 31.88 |
| May 13 | 31.43 | 24 | 31.50 | Nov. 12 | 31.78 | May 1 | 31.94 |
| 24 | 31.49 | July 11 | 31.54 | Dec. 21 | 31.81 | 27 | 32.00 |
| June 3 | 31.48 | 22 | 31.47 | Jan. 16, 1947 | 31.83 | Oct. 26 | 31.56 |
| | | | 25-50-22aa | | | | |
| Apr. 1, 1946 | 132.22 | Aug. 14, 1946 | 132.12 | Dec. 20, 1946 | 132.22 | May 1, 1947 | 132.54 |
| May 13 | 132.01 | Sept.12 | 132.16 | Jan. 7, 1947 | 132.48 | June 4 | 132.17 |
| June 12 | 132.23 | Oct. 10 | 132.17 | Feb. 19 | 132.38 | Aug. 27 | 132.09 |
| July 12 | 132.20 | Nov. 13 | 132.29 | Mar. 13 | 132.48 | Oct. 27 | 132.07 |
| | | | 25-50-31ab | | | | |
| Nov. 12, 1934 | 102.81 | Jan. 17, 1936 | 103.07 | July 22, 1940 | 103.28 | Oct. 10, 1946 | 103.06 |
| Jan. 5, 1935 | 102.76 | Mar. 27 | 103.96 | Nov. 2 | 103.32 | Nov. 13 | 102.89 |
| Feb. 26 | 102.90 | Aug. 27 | 103.04 | Oct. 20, 1941 | 103.41 | Dec. 20 | 103.00 |
| Apr. 19 | 102.86 | Nov. 23 | 103.01 | Nov. 13, 1942 | 103.26 | Jan. 17, 1947 | 102.92 |
| June 8 | 102.86 | Apr. 2, 1937 | 102.92 | Aug. 16, 1944 | 103.14 | Feb. 19 | 102.89 |
| July 15 | 102.89 | June 17 | 103.02 | Feb. 27, 1946 | 102.80 | Mar. 13 | 102.85 |
| Aug. 15 | 102.89 | Oct. 15 | 102.94 | June 12 | 103.03 | May 2 | 102.87 |
| Sept.14 | 102.81 | Oct. 23, 1938 | 103.17 | July 12 | 102.88 | June 4 | 102.87 |
| Oct. 23 | 102.99 | June 8, 1939 | 103.21 | Aug. 14 | 102.98 | Aug. 27 | 102.82 |
| Nov. 25 | 102.87 | Dec. 1 | 103.22 | Sept.12 | 102.87 | Oct. 27 | 102.89 |
| Dec. 28 | 102.97 | Apr. 1, 1940 | 103.27 | | | | |

Table 3.--Water-level measurements in wells--Continued

Water level, in feet below land surface

| Date | Water level | Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|---|---|
| | | | 25-51-14aa | | | | |
| June 3, 1938 | 88.33 | Oct. 3, 1938 | 88.35 | Apr. 1, 1946 | 88.73 | Dec. 20, 1946 | 88.12 |
| July 2 | 88.33 | June 8, 1939 | 88.39 | May 13 | 88.91 | Jan. 17, 1947 | 88.05 |
| 11 | 88.33 | Apr. 1, 1940 | 88.52 | June 12 | 88.97 | Feb. 19 | 88.20 |
| 21 | 88.33 | July 22 | 87.52 | July 12 | 88.96 | Mar. 13 | 88.04 |
| Aug. 1 | 88.34 | Nov. 2 | 88.43 | Aug. 14 | 88.94 | May 1 | 88.02 |
| 10 | 88.41 | Oct. 21, 1941 | 88.54 | Sept. 12 | 88.00 | June 4 | 88.06 |
| 24 | 88.41 | Nov. 13, 1942 | 88.39 | Oct. 10 | 88.13 | Aug. 27 | 88.10 |
| Sept. 3 | 88.39 | Aug. 16, 1944 | 88.30 | Nov. 13 | 88.01 | Oct. 27 | 88.02 |
| 20 | 88.38 | Feb. 27, 1946 | 90.04 | | | | |
| | | | 26-47-17dd | | | | |
| Apr. 22, 1946 | 53.26 | June 17, 1946 | 53.36 | Oct. 11, 1946 | 53.18 | Mar. 14, 1947 | 53.37 |
| May 16 | 53.21 | July 1 | 53.39 | Nov. 7 | 53.16 | May 1 | 53.46 |
| 24 | 53.27 | 22 | 53.30 | Dec. 17 | 53.25 | 27 | 53.42 |
| June 3 | 53.35 | Aug. 5 | 53.36 | Jan. 16, 1947 | 53.26 | Aug. 27 | 53.13 |
| 10 | 53.30 | Sept. 13 | 53.26 | Feb. 17 | 53.26 | Oct. 26 | 52.89 |
| | | | 26-47-35dd | | | | |
| Mar. 27, 1946 | 11.18 | June 24, 1946 | 12.32 | Sept. 14, 1946 | 13.50 | Feb. 17, 1947 | 13.18 |
| May 17 | 12.10 | July 1 | 12.47 | 22 | 13.59 | Mar. 14 | 13.29 |
| 24 | 12.09 | 11 | 12.62 | Oct. 11 | 13.53 | May 1 | 12.98 |
| June 3 | 12.10 | 22 | 12.80 | Nov. 7 | 13.39 | 27 | 13.03 |
| 10 | 12.13 | 29 | 12.96 | Dec. 17 | 13.26 | Aug. 27 | 12.95 |
| 17 | 12.25 | Aug. 5 | 13.07 | Jan. 16, 1947 | 13.24 | Oct. 26 | 13.25 |
| | | | 26-49-13dc | | | | |
| Mar. 29, 1946 | 90.46 | July 1, 1946 | 90.89 | Oct. 10, 1946 | 90.66 | Mar. 13, 1947 | 90.55 |
| May 15 | 90.74 | 11 | 90.94 | Nov. 12 | 90.81 | May 1 | 90.67 |
| June 3 | 90.98 | 22 | 90.65 | Dec. 17 | 90.77 | 27 | 90.49 |
| 10 | 90.67 | 29 | 90.90 | Jan. 17, 1947 | 90.76 | Aug. 26 | 90.50 |
| 17 | 90.69 | Aug. 5 | 91.21 | Feb. 18 | 90.65 | Oct. 21 | 90.47 |
| 24 | 90.39 | Sept. 12 | 90.67 | | | | |
| | | | 26-50-12dc | | | | |
| June 18, 1938 | 101.17 | Aug. 10, 1938 | 101.41 | Mar. 19, 1946 | 100.93 | Jan. 17, 1947 | 100.95 |
| 23 | 101.20 | 24 | 101.36 | 29 | 100.77 | Feb. 18 | 100.82 |
| July 2 | 101.28 | Sept. 3 | 101.46 | June 12 | 100.89 | Mar. 13 | 100.80 |
| 11 | 101.21 | 20 | 101.30 | July 11 | 100.92 | May 1 | 102.26 |
| 21 | 101.31 | Nov. 14, 1942 | 101.14 | Aug. 14 | 100.83 | 27 | 101.05 |
| Aug. 1 | 101.23 | Feb. 27, 1946 | 100.84 | Nov. 12 | 102.38 | Oct. 26 | 100.73 |
| | | | 26-51-25bc | | | | |
| June 23, 1938 | 95.74 | Oct. 3, 1938 | 95.80 | Apr. 1, 1946 | 96.15 | Dec. 20, 1946 | 96.17 |
| July 2 | 95.77 | June 8, 1939 | 95.88 | May 13 | 96.02 | Jan. 17, 1947 | 96.07 |
| 11 | 95.79 | Apr. 1, 1940 | 95.99 | June 12 | 96.18 | Feb. 19 | 96.50 |
| 21 | 95.79 | July 22 | 95.49 | July 12 | 96.01 | Mar. 13 | 96.04 |
| Aug. 1 | 95.79 | Nov. 2 | 95.76 | Aug. 14 | 96.10 | May 2 | 96.06 |
| 10 | 95.89 | Oct. 21, 1941 | 96.00 | Sept. 12 | 96.02 | June 4 | 96.10 |
| 24 | 95.83 | Nov. 13, 1942 | 95.59 | Oct. 10 | 96.21 | Aug. 27 | 96.05 |
| Sept. 3 | 95.83 | Aug. 16, 1944 | 95.71 | Nov. 13 | 96.02 | Oct. 27 | 96.08 |
| 20 | 95.84 | Feb. 27, 1946 | 95.95 | | | | |

Table 3.--Water-level measurements in wells--Continued

Water level, in feet below land surface

| Date | Water level | Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|---|---|
| | | | 26-52-10bc | | | | |
| July 22, 1938 | 93.37 | Apr. 1, 1940 | 93.68 | July 12, 1946 | 95.44 | Feb. 18, 1947 | 95.43 |
| Aug. 24 | 95.55 | Nov. 13, 1942 | 95.86 | Sept. 13 | 99.11 | Mar. 13 | 95.32 |
| Sept. 3 | 96.40 | Feb. 27, 1946 | 94.97 | Oct. 10 | 97.45 | May 2 | 95.20 |
| 20 | 94.90 | Apr. 12 | 98.89 | Nov. 13 | 96.33 | June 5 | 95.11 |
| Oct. 3 | 94.48 | May 13 | 94.54 | Dec. 20 | 95.98 | Oct. 27 | 96.18 |
| June 8, 1939 | 93.86 | June 12 | 95.29 | Jan. 17, 1947 | 95.66 | | |
| | | | 26-52-17ab | | | | |
| June 23, 1938 | 73.60 | Oct. 3, 1938 | 73.65 | May 13, 1946 | 73.79 | Jan. 17, 1947 | 73.50 |
| July 2 | 73.68 | June 8, 1939 | 73.67 | June 12 | 73.84 | Feb. 18 | 75.46 |
| 11 | 73.66 | Apr. 1, 1940 | 73.73 | July 12 | 73.79 | Mar. 13 | 73.47 |
| 21 | 73.65 | July 22 | 73.63 | Aug. 14 | 73.80 | May 2 | 73.45 |
| Aug. 1 | 77.66 | Nov. 2 | 73.97 | Sept. 13 | 73.84 | June 5 | 73.48 |
| 10 | 73.62 | Oct. 21, 1941 | 74.17 | Oct. 10 | 73.79 | Aug. 26 | 73.44 |
| Sept. 3 | 73.66 | Nov. 13, 1942 | 73.63 | Nov. 13 | 73.56 | Oct. 27 | 73.48 |
| 20 | 73.67 | Aug. 16, 1944 | 73.68 | Dec. 20 | 73.54 | | |
| | | | 27-47-12da | | | | |
| Aug. 27, 1934 | 11.83 | Sept. 14, 1935 | 10.35 | Jan. 17, 1936 | 10.25 | Aug. 28, 1936 | 11.70 |
| Nov. 11 | 12.09 | Oct. 22 | 10.34 | Mar. 27 | 11.38 | Apr. 2, 1937 | 12.04 |
| Apr. 19, 1935 | 12.22 | Nov. 25 | 10.21 | June 2 | 10.64 | June 5, 1946 | 7.71 |
| July 14 | 10.71 | Dec. 28 | 10.15 | July 21 | 11.33 | | |
| | | | 27-47-23ba | | | | |
| June 20, 1938 | 28.92 | Sept. 3, 1938 | 28.87 | Nov. 14, 1942 | 21.75 | Dec. 17, 1946 | 20.97 |
| 23 | 28.68 | 21 | 28.87 | Aug. 16, 1944 | 21.46 | Jan. 16, 1947 | 21.08 |
| July 2 | 28.72 | Oct. 3 | 28.76 | Feb. 28, 1946 | 20.51 | Feb. 17 | 21.12 |
| 11 | 28.71 | June 7, 1939 | 28.80 | Apr. 12 | 21.17 | Mar. 14 | 21.45 |
| 21 | 28.83 | Apr. 1, 1940 | 29.12 | Aug. 14 | 21.04 | May 1 | 21.84 |
| Aug. 1 | 28.68 | July 22 | 29.48 | Sept. 13 | 21.09 | 27 | 21.72 |
| 10 | 27.96 | Nov. 2 | 29.94 | Oct. 11 | 20.81 | Aug. 26 | 18.58 |
| 24 | 28.85 | Oct. 20, 1941 | 29.14 | Nov. 7 | 20.65 | Oct. 26 | 18.21 |
| | | | 27-49-21cb | | | | |
| Aug. 14, 1935 | 118.52 | Nov. 23, 1936 | 119.02 | Oct. 20, 1941 | 119.41 | Nov. 12, 1946 | 118.54 |
| Sept. 14 | 118.73 | Apr. 2, 1937 | 118.41 | Nov. 14, 1942 | 118.41 | Dec. 17 | 118.52 |
| Oct. 22 | 119.10 | June 16 | 118.68 | Aug. 16, 1944 | 118.33 | Jan. 17, 1947 | 118.45 |
| Nov. 25 | 118.96 | Aug. 9 | 118.75 | Aug. 17, 1945 | 118.38 | Feb. 18 | 118.41 |
| Dec. 28 | 118.58 | Oct. 14 | 118.82 | Feb. 27, 1946 | 118.00 | Mar. 13 | 118.28 |
| Jan. 17, 1936 | 118.69 | July 15, 1938 | 118.95 | Mar. 29 | 118.10 | May 1 | 118.48 |
| Mar. 27 | 118.46 | Oct. 25 | 118.98 | June 12 | 118.50 | 27 | 118.27 |
| June 2 | 118.71 | June 7, 1939 | 118.86 | July 11 | 118.53 | Aug. 26 | 118.34 |
| July 21 | 118.93 | Dec. 1 | 118.79 | Sept. 13 | 118.28 | Oct. 26 | 118.20 |
| Aug. 28 | 118.99 | Mar. 30, 1940 | 118.56 | Oct. 10 | 118.27 | | |

Table 3.--Water-level measurements in wells--Continued

Water level, in feet below land surface

| Date | Water level | Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|---|---|
| 27-50-20aa | | | | | | | |
| June 23, 1938 | 174.50 | Sept. 3, 1938 | 174.74 | Nov. 14, 1942 | 174.20 | July 11, 1946 | 174.37 |
| July 2 | 174.51 | 21 | 174.77 | Aug. 16, 1944 | 174.44 | Aug. 14 | 174.15 |
| 11 | 174.59 | Oct. 3 | 174.61 | Feb. 27, 1946 | 173.99 | Sept.13 | 174.23 |
| 21 | 174.77 | May 22, 1940 | 174.79 | Mar. 29 | 174.11 | Oct. 10 | 174.17 |
| Aug. 1 | 174.52 | Nov. 2 | 174.77 | May 15 | 174.23 | Nov. 13 | 174.26 |
| 10 | 174.82 | Oct. 20, 1941 | 174.79 | June 12 | 174.39 | Dec. 30 | 174.09 |
| 24 | 174.70 | | | | | | |
| 27-51-6bb1 | | | | | | | |
| Apr. 1, 1946 | 220.67 | Oct. 10, 1946 | 220.35 | May 2, 1947 | 220.52 | Aug. 26, 1947 | 220.45 |
| May 15 | 221.84 | Nov. 13 | 220.49 | June 5 | 220.31 | Oct. 26 | 220.37 |
| Sept.13 | 220.48 | Dec. 20 | 220.44 | | | | |
| 28-51-6dd | | | | | | | |
| Nov. 25, 1935 | 2.18 | Oct. 14, 1937 | 2.84 | Nov. 14, 1942 | 2.42 | Nov. 13, 1946 | 2.36 |
| Dec. 28 | 1.90 | July 15, 1938 | 3.70 | Aug. 16, 1944 | 2.72 | Dec. 20 | 2.31 |
| Jan. 17, 1936 | 1.72 | Oct. 23 | 3.25 | Aug. 2, 1945 | 3.15 | Jan. 17, 1947 | 2.42 |
| Mar. 27 | 1.67 | Dec. 1, 1939 | 2.81 | Feb. 27, 1946 | 1.97 | Feb. 18 | 1.89 |
| June 2 | 2.16 | Mar. 30, 1940 | 2.45 | Apr. 1 | 2.20 | Mar. 13 | 1.93 |
| July 21 | 3.85 | July 20 | 4.08 | May 15 | 2.65 | May 2 | 2.51 |
| Sept.11 | 3.83 | Nov. 1 | 3.14 | July 11 | 3.53 | June 5 | 3.17 |
| Nov. 23 | 2.37 | Oct. 20, 1941 | 2.87 | Sept.13 | 2.79 | Aug. 26 | 2.99 |
| June 16, 1937 | 2.66 | Aug. 22, 1942 | 3.11 | Oct. 10 | 2.42 | Oct. 26 | 2.32 |
| Aug. 9 | 4.00 | | | | | | |
| 28-51-8bc | | | | | | | |
| June 18, 1938 | 85.57 | Oct. 3, 1938 | 86.00 | Feb. 27, 1946 | 85.60 | Dec. 20, 1946 | 85.17 |
| July 2 | 85.70 | June 7, 1939 | 85.80 | Apr. 1 | 85.03 | Jan. 17, 1947 | 85.11 |
| 11 | 85.76 | Mar. 30, 1940 | 86.40 | June 12 | 85.39 | Feb. 18 | 85.04 |
| 21 | 85.79 | July 20 | 85.72 | July 11 | 85.36 | Mar. 13 | 85.00 |
| Aug. 1 | 85.87 | Nov. 1 | 85.97 | Aug. 14 | 85.63 | May 2 | 85.04 |
| 10 | 85.98 | Oct. 20, 1941 | 86.04 | Sept.13 | 85.55 | June 5 | 85.39 |
| 24 | 86.04 | Nov. 14, 1942 | 85.38 | Oct. 10. | 85.47 | Aug. 26 | 85.18 |
| Sept. 3 | 86.06 | Aug. 16, 1944 | 85.20 | Nov. 13 | 85.28 | Oct. 26 | 85.20 |
| 21 | 86.00 | Aug. 17, 1945 | 85.30 | | | | |

Table 4.--Net changes in water levels during the period of record

| Well number | First measurement | | Latest measurement | | Net rise or fall of water level |
|---|---|---|---|---|---|
| | Date | Depth to water (feet) | Date | Depth to water (feet) | |
| 24-50-10aa | June 23, 1938 | 51.28 | Oct. 27, 1947 | 49.47 | +1.81 |
| 24-52-13cb | June 11, 1938 | 77.89 | Oct. 27, 1947 | 77.80 | +.09 |
| 35aa | June 23, 1938 | 98.97 | Oct. 27, 1947 | 97.70 | +1.27 |
| 25-48-30ad | June 20, 1938 | 15.00 | Oct. 26, 1947 | 13.10 | +1.90 |
| 25-50-31ab | Nov. 12, 1934 | 102.81 | Oct. 27, 1947 | 102.89 | -.08 |
| 25-51-14aa | June 3, 1938 | 88.33 | Oct. 27, 1947 | 88.02 | +.31 |
| 26-50-12dc | June 18, 1938 | 101.17 | Oct. 26, 1947 | 100.73 | +.44 |
| 26-51-25bc | June 23, 1938 | 95.75 | Oct. 27, 1947 | 96.08 | -.33 |

Table 4.--Net changes in water levels during the period of record--Continued

| Well number | First measurement | | Latest measurement | | Net rise or fall of water level |
|---|---|---|---|---|---|
| | Date | Depth to water (feet) | Date | Depth to water (feet) | |
| 26-52-10bc | July 22, 1938 | 93.37 | Oct. 27, 1947 | 96.18 | -2.81 |
| 17ab | June 23, 1938 | 73.60 | Oct. 27, 1947 | 73.48 | +.12 |
| 27-47-12da | Aug. 27, 1934 | 11.83 | June 5, 1946 | 7.71 | +4.12 |
| 23ba | June 20, 1938 | 28.92 | Oct. 26, 1947 | 18.21 | +10.71 |
| 27-49-21cb | Aug. 14, 1935 | 118.52 | Oct. 26, 1947 | 118.20 | +.32 |
| 27-50-20aa | June 23, 1938 | 174.50 | Dec. 30, 1946 | 174.09 | +.41 |
| 28-51-6dd | Nov. 5, 1935 | 2.18 | Oct. 26, 1947 | 2.32 | -.14 |
| 8bc | June 18, 1938 | 85.57 | Oct. 26, 1947 | 85.20 | +.37 |

Table 5.--Maximum changes in water levels during the period of record

| Well number | Lowest recorded water level | | Highest recorded water level | | Maximum change (feet) |
|---|---|---|---|---|---|
| | Date | Depth to water (feet) | Date | Depth to water (feet) | |
| 24-50-10aa | July 2, 1938 | 52.02 | June 3, 1946 | 48.68 | 3.34 |
| 24-52-13cb | Sept.20, 1938 | 78.26 | Mar. 13, 1947 | 77.60 | .66 |
| 35aa | May 9, 1946 | 99.13 | July 22, 1940 | 97.61 | 1.52 |
| 25-48-30ad | Oct. 20, 1941 | a Dry | July 11, 1946 | 12.54 | 8.46+ |
| 25-50-31ab | Mar. 27, 1936 | 103.96 | Jan. 5, 1935 | 102.76 | 1.20 |
| 25-51-14aa | Feb. 27, 1946 | 90.04 | July 22, 1940 | 87.52 | 2.52 |
| 26-50-12dc | Nov. 12, 1946 | 102.38 | Oct. 26, 1947 | 100.73 | 1.63 |
| 26-51-25bc | Feb. 19, 1947 | 96.50 | July 22, 1940 | 95.49 | 1.01 |
| 26-52-10bc | Oct. 10, 1946 | 97.45 | July 22, 1938 | 93.37 | 4.08 |
| 17ab | Aug. 1, 1938 | 77.66 | Aug. 26, 1947 | 73.44 | 4.22 |
| 27-47-12da | Apr. 19, 1935 | 12.22 | June 5, 1946 | 7.71 | 4.51 |
| 23ba | Nov. 2, 1940 | 29.94 | Oct. 26, 1947 | 18.21 | 11.71 |
| 27-49-21cb | Oct. 20, 1941 | 119.41 | Feb. 27, 1946 | 118.00 | 1.41 |
| 27-50-20aa | Aug. 10, 1938 | 174.82 | Feb. 27, 1946 | 173.99 | .83 |
| 28-51-6dd | July 20, 1940 | 4.08 | Mar. 27, 1936 | 1.67 | 2.41 |
| 8bc | Mar. 30, 1940 | 86.40 | Apr. 1, 1940 | 85.03 | 1.37 |

a Depth of well is 21 feet.

Table 6.--Logs of wells

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 24-47-1db. Authority: R. L. Nace, from examination of drill cuttings. | | |
| Sod and topsoil, sandy, light-brown............. | 1.0 | 1.0 |
| Sand, fine-grained, light-brown.................... | 3 | 4 |
| Sand, fine-grained, brownish-gray................. | 2 | 6 |
| Sand, medium-grained, poorly sorted, brownish-gray..................... | 5 | 11 |
| Sand, fine- to medium-grained, gray........... | 2.5 | 13.5 |

Table 6.--Logs of wells--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 24-47-1db--Continued | | |
| Sand, fine-grained, yellowish-gray.............. (Drive-point well screen driven to depth of 18.7 feet) | 1.5 | 15 |
| 24-48-3ad. Authority: Clyde Campbell, owner and driller, from memory. | | |
| Soil and subsoil, sandy loam..................... | 3.0 | 3.0 |
| Sand, fine-grained, gray and tan................. | 34.5 | 37.5 |

Table 6.--Logs of wells--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 24-48-3ad--Continued | | |
| Sandstone, fine-grained, hard, grayish-tan........ | 62.5 | 100 |
| Sand, calcareous concretions, pale-buff to tan and gray................ | 40 | 140 |
| 24-48-4bb. Authority: R. L. Nace, from examination of drill cuttings. | | |
| Sod, dark................. | 0.25 | 0.25 |
| Soil, sandy loam, brown... | 1.75 | 2 |
| Hardpan, clay, alkaline, light-gray.............. | 2 | 4 |
| Silt, argillaceous, yellowish-gray.............. | 2.5 | 6.5 |
| Sand, medium-grained, "salt and pepper," with some quartz pebbles as much as ¼ inch in diameter.................... | 5.5 | 12 |
| (Drive-point well screen driven to depth of 18.4 feet) | | |
| 24-48-10bb. Authority: H. F. Haworth, from examination of drill cuttings. | | |
| Soil, sandy clay, and fine sand..................... | 5 | 5 |
| Sand, fine-grained, buff.. | 2 | 7 |
| Sand and fine gravel...... | 3 | 10 |
| Sand and fine- to medium-grained gravel........... | 2 | 12 |
| Sand and fine- to medium-grained gravel with water-worn pebbles of sandstone................ | 2 | 14 |
| Sand, fine-grained, and fine- to medium-grained gravel with sandstone pebbles.................. | 4 | 18 |
| Gravel, fine- to medium-grained, about 50 percent sandstone pebbles........ | 2 | 20 |
| Gravel, fine, and sand, loosely consolidated, with some coarse pebbles predominantly greenish color.................. | 3 | 23 |
| Sand, silty to argillaceous, greenish......... | 3 | 26 |
| (Bottom 3 feet of hole filled with silt) | | |

Table 6.--Logs of wells--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 24-48-11dd. Authority: R. L. Nace, from examination of drill cuttings. | | |
| Soil, sandy loam, light-brown.................... | 1.0 | 1.0 |
| Sand, fine-grained, argillaceous, grayish-brown... | 2 | 3 |
| Sand, fine- to medium-grained, grayish-brown... | 2 | 5 |
| Sand, argillaceous, light-brown.................... | 2 | 7 |
| Sand, fine- to medium-grained, yellowish-gray.. | 5 | 12 |
| Sand, medium-grained to coarse, conglomeratic, yellowish-gray........... | 1.5 | 13.5 |
| 24-48-31bc. Authority: O. A. Odell, driller and owner, from memory. | | |
| Soil and sand............. | 10 | 10 |
| Loose sand................ | 15 | 25 |
| Clay, weathers bluish-white.................... | 4 | 29 |
| Pebble gravel, hard, white | 1 | 30 |
| Channel gravel, pebble, white.................... | 13 | 43 |
| Material not recorded...... | 4 | 47 |
| Hard rock................. | 2 | 49 |
| Channel gravel, pebble, white.................... | 4 | 53 |
| Rock, hard, white......... | 6 | 59 |
| Bedrock................... | 15 | 74 |
| Cobblerock and concretions, with red sand and boulders | 54 | 128 |
| Sand and gravel........... | 9 | 137 |
| (Test-pumped at 900 gpm; after several hours pumping the drawdown was about 3 feet) | | |
| 25-47-5bb. Authority: R. L. Nace, from examination of drill cuttings collected by Frank Pence, driller. | | |
| Soil; brown sandy loam; and subsoil, argillaceous sand..................... | 4 | 4 |
| Sand, fine-grained, clear, gray..................... | 21 | 25 |
| Sand, fine-grained, pale yellowish-gray, with thin layers of fine white sandstone............... | 30 | 55 |

Table 6.--Logs of wells--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **25-47-5bb--Continued** | | |
| Sand and silt, fine-grained, argillaceous, yellowish-gray.......... | 5 | 60 |
| Sand, medium-grained, gray, with thin layers of hard, white sandstone......... | 10 | 70 |
| Clay, silty, pale flesh-colored; and argillaceous grayish-buff silt........ | 20 | 90 |
| Siltstone and sandstone, grayish-tan to grayish-buff.................... | 5 | 95 |
| Clay, silty, pale flesh-colored................. | 25 | 120 |
| Siltstone, gray; and fine- to medium-grained poorly sorted gray sandstone.... | 40 | 160 |
| Sandstone, medium-grained, poorly sorted, yellowish gray.................... | 10 | 170 |
| Sandstone, medium-grained, poorly sorted, gray...... | 10 | 180 |
| Silt and sandstone, fine-grained, loosely indurated, argillaceous...... | 20 | 200 |
| Sand, fine-grained, poorly sorted, argillaceous, yellowish-gray.......... | 20 | 220 |
| Sand, medium-grained, poorly sorted, gravelly, loosely consolidated, with a few pebbles as much as ¼ inch in diameter..................... | 12 | 232 |
| Sandstone, fine-grained, gray.................... | 3 | 235 |
| Sandstone, fine-grained, hard, gray, alternating with loosely consolidated medium-grained poorly sorted gravelly gray sand, with pebbles as much as ½ inch in diameter..................... | 5 | 240 |
| Sandstone, fine-grained, gray and white, calcareous..................... | 5 | 245 |
| Sandstone, medium-grained, poorly sorted, gray, with unconsolidated, gravelly layers containing pebbles as much as ¼ inch in diameter................ | 5 | 250 |

Table 6--Logs of wells--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **25-47-5bb--Continued** | | |
| Sandstone, fine-grained, gray.................... | 6 | 256 |
| Sandstone and sand, fine- to medium-grained, gravelly, gray to pale-tan... | 4 | 260 |
| Sand, medium- to coarse-grained, gray, with calcareous and argillaceous concretions............. | 13 | 273 |
| Material not recorded..... | 7 | 280 |

25-47-6ba. Authority: R. L. Nace, from examination of drill cuttings collected by Edward Thompson, driller.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Soil; brown sandy loam; and argillaceous sand.... | 3 | 3 |
| Sand, fine- to medium-grained, poorly sorted, tan..................... | 27 | 30 |
| Sand, fine-grained, grayish-white............... | 10 | 40 |
| Sandstone, fine-grained, calcareous, grayish-white | 10 | 50 |
| Sandstone, fine- to coarse-grained, grayish-white, with veinlets of secondary calcite........ | 50 | 100 |
| Siltstone and sandstone, fine-grained, argillaceous, grayish-brown..... | 60 | 160 |
| Sandstone and siltstone, well-consolidated, buff to gray; successive layers vary from friable to hard; some layers medium- to coarse-grained, with grains as much as 1/8 inch in diameter......... | 60 | 220 |
| Sandstone, fine-grained; and argillaceous gray, tan, and white siltstone. | 40 | 260 |
| Sand and sandstone, fine- to medium-grained, poorly sorted, pale-buff and gray..................... | 10 | 270 |
| Sandstone, fine-grained, friable, argillaceous, light-brown. Some layers are rather coarse and poorly sorted........... | 10 | 280 |

Table 6.--Logs of wells--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 25-47-6ba--Continued | | |
| Sandstone, fine-grained to coarse, argillaceous, pale-buff; contains a few pebbles as much as ¼ inch in diameter................ | 10 | 290 |
| Sandstone, fine-grained, calcareous, gray to white | 10 | 300 |
| Sandstone, coarse, gravelly, gray to brown. The gravel in this sand was probably introduced into the hole by the driller in the belief that it would facilitate drilling of hard beds............ | 10 | 310 |
| Sand, medium- to coarse-grained, gray and pale-buff.................... | 20 | 335 |

25-47-31cc. Authority: R. L. Nace, from exam-examination of drill cuttings.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Soil, sandy, light........ | 1 | 1 |
| Subsoil, clayey, sandy, very dark............... | 1 | 2 |
| Clay, sandy, brown........ | 1 | 3 |
| Clay, sandy, dark......... | 1 | 4 |
| Clay, silty, brownish-gray | 1 | 5 |
| Sand, argillaceous, fine-grained, gray........... | 2 | 7 |
| Sand, poorly sorted, conglomeratic, with pebbles as much as 1 inch in diameter, gray.......... | 4 | 11 |
| Sand, fine-grained, argillaceous, conglomeratic, greenish-gray........... | 2 | 13 |
| Sand, medium- to coarse-grained, conglomeratic, gray.................... | 4 | 17 |
| (Drive-point well screen driven to depth of 21 feet) | | |

25-48-4dd. Authority: H. Haworth, from examination of drill cuttings.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Soil, argillaceous, and fine sand............... | 3.5 | 3.5 |
| Sand, silty to argillaceous.................... | 3 | 6.5 |
| Sandstone, concretionary.. | 4 | 10.5 |
| Sandstone, hard, concretionary................. | 5.5 | 16 |

Table 6.--Logs of wells--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 25-48-4dd--Continued | | |
| Sandstone, very hard, concretionary............... | 3 | 19 |
| Sandstone, hard........... | 11 | 30 |
| Sandstone, hard........... | 35 | 65 |
| Sandstone, softer than that above, with concretionary layers........... | 33 | 98 |
| (Water encountered at about 65 feet) | | |

25-48-24cc. Authority: Floyd Warden, owner and driller, from memory.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Soil, clay, and sand...... | 25 | 25 |
| Clay, sandy, alternating with sandstone and clay. Sandstone beds about 3 feet thick and 10-12 feet apart. Blue-clay balls in sandstone contain bits of fossil bone........... | 45 | 70 |
| Sand, coarse.............. | 20 | 90 |
| Sandstone................. | 3 | 93 |
| Sand, coarse.............. | 12 | 105 |
| Sandstone................. | 1 | 106 |
| Sand, coarse, with some gravel.................. | 31 | 137 |

25-48-25dc2. Test well drilled adjacent to well 25-48-25dc1. Authority: Written records of H. C. Minnick, driller.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Soil, sand, and clay...... | 20 | 20 |
| Sand, fine................ | 40 | 60 |
| Sand, fair; some clay..... | 20 | 80 |
| Sand, good; some clay..... | 20 | 100 |
| Sand, fair................ | 20 | 120 |
| Clay and some sand........ | 40 | 160 |
| Sand, good................ | 20 | 180 |
| Sand, fine................ | 20 | 200 |
| Sand, fair................ | 20 | 220 |
| Sand, fair; some clay..... | 20 | 240 |
| Sand, good................ | 40 | 280 |
| Sand and clay............. | 20 | 300 |
| Sand, good; some clay..... | 20 | 320 |
| Sand, good................ | 40 | 360 |
| Bedrock, hard............. | 10 | 370 |

25-48-27db1. Authority: Francis McDonald, assistant driller, from memory.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Topsoil, sand, and clay.... | 6 | 6 |
| Lime...................... | 2 | 8 |
| Material not recorded; probably fine sand, clay and sandy clay........... | 52 | 60 |

Table 6.--Logs of wells--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 25-48-27db1--Continued | | |
| Sand; encountered water at about 70 feet | 20 | 80 |
| Sandstone | 20 | 100 |
| Gravel | 2 | 102 |
| Sandstone | 20 | 122 |
| Limestone and gravel, with thin layers of sand | 78 | 200 |
| Sandstone, rather hard, medium-grained, poorly sorted, gray to yellowish-gray | 36 | 236 |

25-48-36ba2. Test well drilled adjacent to well 25-48-36ba1. Authority: Written records of H. C. Minnick, driller.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Soil | 3 | 3 |
| Sand | 17 | 20 |
| Magnesia and river gravel | 10 | 30 |
| Fine sand | 10 | 40 |
| Clay | 1 | 41 |
| Sand | 55 | 96 |
| Sand, medium to coarse | 24 | 120 |
| Sand, coarse | 5 | 125 |
| Sand, very coarse | 1 | 126 |
| Sand, coarse | 24 | 150 |
| Sand, coarse | 17 | 167 |
| Clay layer, thin; thickness not determined | ? | 167+ |
| Sand, coarse | 33- | 200 |
| Sand, fine; some clay | 40 | 240 |
| Sand, medium | 40 | 280 |
| Sand, medium, with some fine sand | 20 | 300 |
| Sand, fine and medium, with some rock and clay | 20 | 320 |
| Sand, fine | 10 | 330 |
| Sand, fine; and clay | 15 | 345 |

25-48-36bc2. Test well drilled adjacent to well 25-48-36bc1. Authority: Written records of H. C. Minnick, driller.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Soil, sand, and gravel | 20 | 20 |
| Sand, fine | 20 | 40 |
| Sand, medium, clean | 20 | 60 |
| Sand, fair, clean | 20 | 80 |
| Clay and fine sand | 20 | 100 |
| Sand, fair | 22 | 122 |
| Clay, hard | 8 | 130 |
| Sand | 10 | 140 |
| Sand, fine, clean | 10 | 150 |
| Sand, fair, clean | 10 | 160 |
| Sand, good | 10 | 170 |

Table 6.--Logs of wells--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 25-48-36bc2--Continued | | |
| Sand, good; some clay | 20 | 190 |
| Sand, fair; some clay | 40 | 230 |
| Clay and good sand | 10 | 240 |
| Sand, good | 20 | 260 |
| Sand, fair | 20 | 280 |
| Sand, good | 27 | 307 |
| Hard rock | 2 | 309 |

25-48-36bc3. Test well drilled near present site of municipal water plant, Alliance, Nebr. Exact location not known. Authority: Written records of H. C. Minnick, driller.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Soil (static water level in well about at base of bed) | 54.0 | 54.0 |
| Sand, medium-fine | 20 | 74 |
| Sand, good, medium-coarse | 32.75 | 106.75 |
| Sand and clay | 9.25 | 116 |
| Sand, good, medium-coarse | 10 | 126 |
| Sand, medium-coarse; some clay | 10 | 136 |
| Sand, medium-coarse, good | 11 | 147 |
| Sand, medium; and spotted clay | 10 | 157 |
| Sand, good, medium-coarse | 10 | 167 |
| Sand, medium | 8 | 175 |
| Gravel, fine | 11 | 186 |
| Sand, fine, clean | 10 | 196 |
| Sand, good, medium-coarse | 12 | 208 |
| Sand, medium-coarse | 10 | 218 |
| Sand, medium-fine; and spotted clay | 9 | 227 |
| Sand, medium-fine, sharp | 11 | 238 |
| Sand, fine; and clay | 10 | 248 |
| Sand, good, medium-coarse | 23 | 271 |
| Sand, fine, clean | 10 | 281 |
| Sand, very fine | 10 | 291 |
| Sand, medium-fine | 9 | 300 |
| Sand, fine | 7 | 307 |
| Hard rock | ..... | ...... |

25-48-36c. Authority: Documentary records of Chicago, Burlington & Quincy Railroad Co.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Topsoil | 3.0 | 3.0 |
| Sand | 52 | 55 |
| Clay | 2 | 57 |
| Sand rock | 3 | 60 |
| Quicksand | 7 | 67 |
| Clay | 33 | 100 |
| Quicksand, with some gravel | 20 | 120 |
| Water sand; some gravel | 47.5 | 167.5 |

Table 6.--Logs of wells--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **25-48-36c--Continued** | | |
| Sandstone................ | 0.5 | 168 |
| Water sand; some gravel... | 10 | 178 |
| Sand rock................ | 15 | 193 |
| Quicksand................ | 6 | 199 |
| Lime rock................ | 1 | 200 |
| Quicksand................ | 7 | 207 |
| Lime rock................ | 3 | 210 |
| Quicksand................ | 8 | 218 |
| Lime rock................ | 14 | 232 |
| Sand rock................ | 22 | 254 |
| Quicksand................ | 5 | 259 |
| Sand rock................ | 4 | 263 |
| Bottom of hole in quicksand.................... | ..... | ...... |
| (Test-pumped 6 hours at 45 gpm; drawdown, 2 feet) | | |
| **26-47-35dd. Authority: R. L. Nace, from examination of drill cuttings.** | | |
| Sand, argillaceous, brown. | 3 | 3 |
| Sand, fine-grained, argillaceous, brown........... | 1 | 4 |
| Sand, fine-grained, brownish-gray................ | 1 | 5 |
| Sand, fine-grained, light-gray.................... | 4 | 9 |
| Sand, medium-grained, conglomeratic, gray......... | 2 | 11 |
| Sand, fine-grained, with thin layers of lightly indurated yellowish-gray sandstone................ | 2 | 13 |
| Sandstone, lightly indurated, yellowish-gray.... | 1 | 14 |
| **26-48-31da. Authority: R. L. Nace, from examination of drill cuttings collected by Edward Thompson, driller.** | | |
| Soil, subsoil, and clay, buff, gray and brown..... | 6 | 6 |
| Limestone, arenaceous, white; interbedded with fine- to medium-grained, moderately well sorted, calcareous sandstone and argillaceous tan silt and sand.................... | 28 | 34 |
| Sandstone, fine- to medium-grained, rounded to subangular, loosely consolidated, grayish-tan....... | 16 | 50 |

Table 6.--Logs of wells--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| **26-48-31da--Continued** | | |
| Sandstone, fine- to medium-grained, poorly sorted, argillaceous, grayish-buff..................... | 60 | 110 |
| Sand, fine- to medium-grained, loosely consolidated, grayish-buff...... | 8 | 118 |
| Sandstone, as from 50 to 110 feet................. | 12 | 130 |
| Sand, fine- to medium-grained, loosely consolidated, yellowish-gray; becomes coarser as depth increases................ | 20 | 150 |
| Sand, very fine-grained, and argillaceous buff silt..................... | 10 | 160 |
| Sandstone, fine-grained, argillaceous, grayish-buff..................... | 15 | 175 |
| Sandstone, fine-grained, argillaceous, buff; interbedded with buff fine-grained friable sandstone................ | 5 | 180 |
| Sandstone, fine-grained, argillaceous, yellowish-gray.................... | 25 | 205 |
| Sand and sandstone, fine-grained, lightly indurated, argillaceous, with irregular epigenetic calcareous concretions, grayish-yellow........... | 5 | 210 |
| Sandstone, fine- to medium-grained; becomes coarser as depth increases; secondary veinlets and tubules of white calcite; occurs in alternating layers of gray and yellowish gray........... | 20 | 230 |
| Sandstone, fine-grained, hard, gray, alternating with lightly indurated argillaceous yellowish sandstone............... | 21 | 251 |
| Sandstone, medium-grained, poorly sorted, gray and yellow................. | 29 | 280 |
| Sand and sandstone, fine- to medium-grained, grayish-buff................ | 10 | 290 |

Table 6.--Logs of wells--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 26-48-31da--Continued | | |
| Sand, medium- to coarse-grained, gravelly, buff; pebbles up to ¼ inch in diameter................ | 10 | 300 |
| Sandstone, fine- to medium-grained, friable. Some layers are calcareous..... | 29 | 329 |
| Sand and silt, fine-grained, gray and yellowish. Hard concretions occur at about 390 feet... | 71 | 400 |
| Bottom of well on hard rock.................... | ..... | ...... |

26-48-36ba. Authority: R. L. Nace, from examination of drill cuttings collected by George Naeve, driller.

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| Soil, sandy-loam, brown... | 1.0 | 1.0 |
| Sand, argillaceous, light-brown.................. | 2.5 | 3.5 |
| Hardpan, clay, calcareous(?), buff............ | 1.5 | 5 |
| Sand and silt, very fine-grained, light-gray, with many nodules of secondary friable white calcite.... | 8 | 13 |
| Sand, medium-grained to fine, yellowish-gray, with hard calcareous concretions................ | 1 | 14 |
| Sandstone, fine-grained, calcareous, grayish-white | 4 | 18 |
| Sand, medium- to coarse-grained, pebbly, gray.... | 12 | 30 |
| Sandstone, fine-grained, gray.................... | 30 | 60 |
| Sandstone, fine-grained, slightly indurated argillaceous, yellowish-gray; thin layers of greenish-gray sandy clay.......... | 15 | 75 |
| Clay, sandy, pale olive-green.................. | 1 | 76 |
| Sandstone, fine- to medium-grained, hard, grayish-white; thin layers of hard white calcite....... | 9 | 85 |

Table 6.--Logs of wells--Continued

| | Thickness (feet) | Depth (feet) |
|---|---|---|
| 26-48-36ba--Continued | | |
| Sandstone, fine-grained, well-consolidated, pale-brown; layers of white, sandy, tuffaceous(?) clay | 20 | 105 |
| Sandstone, fine-grained, hard, pale-brown; lower 10 feet medium-grained and poorly sorted........ | 20 | 125 |
| Sandstone, hard, tough, medium-grained, argillaceous, grayish-white..... | 15 | 140 |
| Sand, medium-grained, gray, alternating with bentonitic(?), greenish clay, and argillaceous, white limestone......... | 15 | 155 |
| Sand, fine-grained, argillaceous, pale-buff....... | 10 | 165 |
| (Note: Original well began to cave and fill at a depth of 165 feet. A new hole was drilled 300 feet southwest from the first hole and samples from 165 feet to the bottom were collected from the new hole.) | | |
| Sandstone, soft, silty and argillaceous, gray, with small concretions at about 205 feet........... | 60 | 225 |
| Siltstone, hard, argillaceous, grayish-buff with a few calcareous layers.. | 15 | 240 |
| Sandstone and siltstone, hard, fine-grained, gray; some layers argillaceous, and thin layers of pale green, bentonitic(?) clay | 25 | 265 |
| Sandstone, fine-grained, concretionary, gray...... | 10 | 275 |
| Sandstone, fine-grained, gray.................... | 10 | 285 |
| Sandstone, fine-grained, hard, gray, with yellowish-gray concretions..... | 30 | 315 |
| Sandstone, fine-grained, moderately well consolidated, gray............. | 12 | 327 |

Table 7.--Summary of well records, Box Butte County, Nebr.

Well number: See explanation of well-numbering system on page 3 of text.
Type of well: Dn, driven well; Dr, drilled well; Du, dug well.
Depth of well: M, measured; R, reported.
Type of casing: BS, boiler steel; C, concrete; GI, galvanized iron; I, iron; N, none; W, wood.
Type of pump: Cy, cylinder; N, none; P, plunger; T, turbine.

Kind of power: D, diesel; E, electric; G, gasoline; H, hand operated; N, none; O, distillate or fuel-oil; T, tractor; W, windmill.
Use: A, abandoned; D, domestic; I, irrigation; In, industrial; O, observation; PS, public supply; S, stock.
Depth to water: Measured depths to water given to nearest hundredth of a foot; reported depths shown in feet only.

| Well number | Property owner or tenant | Driller | Year completed | Type of well | Depth of well (feet) | Diameter of well (inches) | Type of casing | Principal aquifer | Method of lift: Type of pump | Method of lift: Kind of power | Use of water: Use | Use of water: Acreage irrigated | Measuring point: Description | Measuring point: Distance above land surface (feet) | Measuring point: Height above mean sea level (feet) | Depth to water level below measuring point (feet) | Date of measurement | Remarks (Yield given in gallons a minute; drawdown in feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24-47-1db | U. S. Geol. Survey....... | M. Sunyoke...... | 1946 | Dn | 18M | 1¼ | GI | Eolian sand.............. | N | N | O | ... | Top of pipe...... | 1.0 | 3,910.40 | 12.77 | 4- 4-46 | |
| 4ba | George Stalbaum.......... | H. C. Minnick.... | 1945 | Dr | 200M | 18 | BS | Lower part of the Ogallala and the Marsland. | T | E | I | 280 | Top of casing.... | 1.0 | 3,963.04 | 56.15 | 11- 1-45 | 1,200; 47. Chemical analysis. |
| 4ca | Agatha Stay.............. | .....do......... | 1941 | Dr | 214M | 18 | GI | .....do................. | T | D | I | 80 | .....do.......... | 1.6 | 3,958.59 | 51.44 | 4-11-46 | 900; 40. |
| 5bb1 | Edward Kastner........... | Raily Kooser.... | 1945 | Dr | 270M | 18 | BS | Lower part of the Ogallala. | T | E | I | 240 | .....do.......... | .8 | 3,944.27 | 31 | 1945 | |
| 5bb2 | .....do.................. | .....do......... | 1945 | Dr | 187M | 24-19 | .. | .....do.................. | N | N | A | ... | Land surface..... | .0 | 3,942.00 | 29 | 1945 | Well casing is cemented over. |
| 8bb | Carl Buechsenstein....... | .....do......... | 1945 | Dr | 117M | 18 | GI | .....do.................. | T | E | I | 157 | Hole in pump base. | .1 | 3,952.06 | 42.53 | 4-11-46 | |
| 24-48-1ba | .....do.................. | .....do......... | 1941 | Dr | 315M | 18 | BS | .....do.................. | T | E | I | 160 | .....do.......... | .8 | 3,956.72 | 54 | 1941 | 1,500; 34. Depth to water shown is probably in error. |
| 3ad | Clyde Campbell........... | Clyde Campbell.. | 1946 | Dr | 139R | 16 | .. | .....do.................. | T | E | I | ... | Top of casing.... | .4 | 3,945.00 | 18.13 | 4-16-46 | Not yet pumped. |
| 4bb | U. S. Geol. Survey....... | M. Sunyoke...... | 1946 | Dn | 18M | 1¼ | GI | Quaternary river sand and gravel. | N | N | O | ... | Top of pipe...... | 1.0 | 3,943.80 | 14.32 | 4-11-46 | |
| 6da1 | Conrad Schnell........... | ................ | .... | Dr | 200R | 6 | GI | Lower part of the Ogallala. | P | N | D | ... | Top of casing.... | ... | ........ | 24 | 4-18-47 | Chemical analysis. |
| 6da2 | .....do.................. | Henry J. Hetrick | 1947 | Dr | 200R | 6 | I | .....do.................. | T | T | I | ... | .....do.......... | ... | ........ | 24 | 7-11-47 | Do. |
| 10bb | .....do.................. | H. F. Haworth... | 1946 | Dr | 23R | 8 | GI | ......................... | N | N | O | ... | .....do.......... | 2.2 | 3,943.30 | 12.77 | 4-29-46 | Automatic water-stage recorder installed Apr. 29, 1946. |
| 11dd | .....do.................. | M. Sunyoke...... | 1946 | Dn | 13M | 1¼ | GI | Quaternary river sand and gravel. | N | N | O | ... | Top of pipe...... | 1.5 | 3,931.70 | 6.76 | 4-11-46 | |
| 31ba | Owen A. Odell............ | Owen A. Odell... | 1940 | Dr | 70M | 12 | BS | Lower part of the Ogallala. | N | N | A | ... | Top of oil drum over casing. | .5 | 4,019.00 | 39.65 | 5-24-46 | Original depth reported as 140 feet; lower half of well now filled with sand. Equipped with automatic water-stage recorder. |
| 31bc | .....do.................. | .....do......... | 1937 | Du | 137M | 20 | W | .....do.................. | N | N | A | ... | Top of 12 by 12-inch wood beam. | 1.0 | 4,022.90 | 37.37 | 7-20-38 | Depth to water could no longer be measured in 1946; well is caving. |
| 24-49-5cc | William Cope............. | Lynn E. Fry..... | 1941 | Dr | 153R | 20 | .. | .....do.................. | T | T | I | ... | Land surface..... | .0 | 4,053.40 | 50 | 1945 | 800; 35. |
| 36ac | Carrie Liggett........... | Owen A. Odell... | 1938 | Dr | 103R | 16 | BS | .....do.................. | N | N | A | ... | Top of abandoned pump column. | 3.0 | 4,034.15 | 41.46 | 3-18-46 | Well reported to have had satisfactory original yield, but well was not properly constructed and lower part of hole filled with sand that locked the pump bowls and tubing. |
| 24-50-10aa | John Nolan............... | ................ | .... | Dr | 82M | 12 | W | Harrison................. | N | N | A | ... | Top of casing.... | .5 | 4,094.52 | 50.7 | 2-27-46 | |
| 24cc | Ferdinand Trenkle........ | Lynn E. Fry..... | 1938 | Dr | 125R | 12 | GI | Lower part of the Ogallala. | T | D | I | 80 | Base of pump..... | .0 | 4,079.63 | 27.76 | 4-13-46 | 506; 14. |
| 24-52-13cb | R. A. Wyland............. | ................ | .... | Dr | 93M | 6 | I | ......................... | .. | . | .... | ... | Top of platform.. | .2 | ........ | 77.85 | 2-27-46 | |
| 35aa | .....do.................. | ................ | .... | Dr | 120M | 4 | GI | ......................... | Cy | W | .... | ... | Hole in pump base. | .5 | ........ | 98.56 | 4-16-46 | |
| 25-47-4bb | Henry Reitz.............. | Chas. Johannsen.. | 1946 | Dr | 297R | 18 | I | ......................... | N | N | I | ... | Land surface..... | .0 | 3,979.90 | 66.78 | 6-20-46 | Chemical analysis. |
| 5bb | William Johnson.......... | Frank Pence..... | 1946 | Dr | 280R | 18 | BS | Marsland and Harrison..... | T | D | I | ... | Base of temporary pump. | .8 | 3,944.94 | 24.96 | 5-14-46 | Do. |
| 5db | R. W. Laing.............. | Raily Kooser.... | 1942 | Dr | 152R | 18 | GI | Lower part of the Ogallala and the Marsland. | T | T | I | 140 | Top of casing.... | .4 | 3,931.73 | 18.84 | 4-23-46 | 700; 80. Inadequate for acreage irrigated. |
| 6ba | Chris Guy................ | Edw. Thompson... | 1946 | Dr | 335R | 18-15 | BS | Marsland and Harrison..... | N | N | I | ... | .....do.......... | 1.2 | 4,005.40 | 74.32 | 5-14-46 | Pump not installed. |
| 7bb | E. W. Purinton........... | Lynn E. Fry..... | 1938 | Dr | 248R | 18 | BS | Marsland and Deep Creek... | T | E | I | 70 | Top of pump base. | .8 | 3,982.67 | 53.55 | 3-11-46 | 200; 47. Water table is in Sheep Creek beds, but the amount of water derived from these is probably small. |
| 7cb | Alex Dietrich....... .... | Edw. Thompson... | 1946 | Dr | 298M | 18 | BS | ......................... | N | N | I | ... | Top of casing.... | .1 | 3,976.20 | 51.06 | 6- 4-46 | Pump not installed. |
| 9bb | Nels M. Peterson......... | H. H. Harmon.... | 1938 | Dr | 130R | 16 | .. | Lower part of the Ogallala. | T | G | I | 70 | Bottom rim of vertical pulley on pump. | 1.2 | 3,926.54 | 18.85 | 3-21-46 | 1,000; 32. |
| 16ca | Bernard Bauer............ | Lynn E. Fry..... | 1939 | Dr | 152R | 16 | .. | .....do.................. | T | O | I | 160 | Hole in pump base. | .0 | 3,920.13 | 15.10 | 3-21-46 | 1,400; 45. |
| 17bb | Emil Regan............... | Raily Kooser.... | .... | Dr | 150R | 18 | .. | Lower part of the Ogallala and the Marsland. | T | D | I | 80 | .....do.......... | 1.3 | 3,924.72 | 13.88 | 3-21-46 | |

Table 7.--Summary of well records, Box Butte County, Nebr.--Continued

| Well number | Property owner or tenant | Driller | Year completed | Type of well | Depth of well (feet) | Diameter of well (inches) | Type of casing | Principal aquifer | Method of lift: Type of pump | Method of lift: Kind of power | Use of water: Use | Use of water: Acreage irrigated | Measuring point: Description | Measuring point: Distance above land surface (feet) | Measuring point: Height above mean sea level (feet) | Depth to water level below measuring point (feet) | Date of measurement | Remarks (Yield given in gallons a minute; drawdown in feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25-47-17cc | Fred Nuss............... | Raily Kooser.... | .... | Dr | 170R | 18 | .. | Lower part of the Ogallala. | T | D | I | 150 | Hole under pump base. | 0.5 | 3,936.40 | 26.60 | 3-21-46 | Chemical analysis. |
| 18bd | Raily Kooser............ | .....do......... | 1941 | Dr | 134R | 18 | GI | Lower part of the Ogallala and the Marsland. | T | D | I | 220 | Top edge of hand hole. | 2.1 | 3,943.59 | 29.02 | 3-30-46 | 1,500; 55. |
| 19aa | John Lawlar............. | John Lawlar..... | .... | Dr | 35M | 6 | GI | ......................... | .. | W | .... | ... | Top of casing.... | 1.0 | 3,932.10 | 22.59 | 6- 3-46 | |
| 20bc | .....do................. | .....do......... | 1942 | Dr | 208R | 18 | GI | Lower part of the Ogallala and probably the Harrison. | T | O | I | 160 | Hole in pump base | .2 | 3,943.78 | 34.48 | 3-29-46 | 1,500; 25. |
| 21bb | George Smith............ | H. C. Minnick... | 1941 | Dr | 215R | 16 | GI | Lower part of the Ogallala. | T | O | I | 50 | Top of casing.... | 1.7 | 3,926.75 | 20.79 | 3-21-46 | 500; 24. |
| 29bb1 | Koester Bros............ | .....do......... | 1936 | Dr | 311R | 18 | .. | .....do................... | N | N | A | ... | Land surface..... | .0 | 3,975.20 | 63 | 1936 | Reported to be first successful irrigation well drilled in Box Butte County. Perforated casing reported clogged by incrustation, which necessitated abandonment of well. Well 25-47-29bb2, drilled a few feet away as a substitute, apparently has not become incrusted. |
| 29bb2 | .....do................. | Raily Kooser.... | 1943 | Dr | 310R | 18 | .. | .....do................... | T | D | I | 300 | .....do......... | .0 | 3,975.20 | 63 | 1943 | 2,000; 80. |
| 29ca | .....do................. | H. C. Minnick... | 1939 | Dr | 273R | 18 | BS | .....do................... | T | D | I | 320 | .....do......... | .0 | 3,970.55 | 60 | 1939 | |
| 30da | Emma Nelson and Chas. O'Bannon. | .....do......... | 1941 | Dr | 220R | 18 | .. | .....do................... | T | E | I | 150 | Bottom of pump base. | .7 | 3,974.65 | 63.12 | 3-12-46 | 1,000; 20. |
| 30db | Chas. Clough............ | .....do......... | .... | Dr | 201R | 18 | .. | .....do................... | T | E | I | 80 | Top of concrete floor. | .8 | 3,977.86 | 63.80 | 3- 4-46 | |
| 31ab | Koester Bros............ | .....do......... | 1940 | Dr | 286R | 30 | BS | .....do................... | T | D | I | 280 | Top of metal base plate of pump. | .5 | 3,971.14 | 58.16 | 3- 4-46 | 2,600; 50. |
| 31cc | U. S. Geol. Survey....... | M. Sunyoke...... | 1946 | Dn | 21M | 1¼ | GI | Quaternary sand and gravel. | N | N | O | ... | Top of pipe...... | 1.0 | 3,943.72 | 16.36 | 4-11-46 | |
| 31dc | Irvin H. Peters......... | H. C. Minnick... | 1942 | Dr | 180R | 18 | .. | Lower part of the Ogallala. | T | E | I | 85 | Hole in pump base | .4 | 3,964.50 | 46.16 | 3-12-46 | 900; 25. |
| 32aa | O. E. Black............. | .....do......... | 1940 | Dr | 137R | 18-12 | BS | .....do................... | T | D | I | 200 | Top of concrete base. | .5 | 3,965.83 | 56.60 | 3- 4-46 | |
| 32bb | Koester Bros............ | .....do......... | 1941 | Dr | 280R | 30 | BS | .....do................... | T | D | I | 320 | Top of hole in concrete base. | .0 | 3,967.36 | 55.81 | 2-28-46 | 3,000; 45. Chemical analysis. |
| 32cb | Thos. P. Stalos......... | .....do......... | 1944 | Dr | 210R | 18 | BS | .....do................... | T | E | I | 85 | Top of casing.... | 1.5 | 3,960.17 | 45.30 | 3-14-46 | |
| 34ab | Koester Bros............ | .....do......... | 1941 | Dr | 437R | 18 | .. | Lower part of the Ogallala and the Marsland, Harrison, and Monroe Creek. | T | D | I | 250 | Top of drain orifice in concrete platform. | .0 | 3,958.50 | 48.66 | 3-12-46 | 2,000; 90. |
| 34bb | .....do................. | Edw. Thompson... and Frank Pence | 1946 | Dr | 368R | 18 | BS | Lower part of the Ogallala and possibly the Harrison. | T | D | I | ... | Top of casing.... | .6 | 3,960.56 | 53.89 | 4-23-46 | |
| 25-48-2ab | John Reid............... | Raily Kooser.... | 1945 | Dr | 325R | 18 | BS | Marsland and Harrison...... | T | E | I | 160 | .....do......... | .5 | 4,013.83 | 66.76 | 3- 6-46 | 600; 68. Lower 45 feet of well filled with sand. Inadequate for acreage irrigation. |
| 2db1 | .....do................. | H. C. Minnick... | 1946 | Dr | 245R | ...... | N | Marsland.................. | .. | . | A | ... | Land surface..... | .0 | ........ | 65 | 4- -46 | Well caved and filled to within 25 feet of surface before drilling was completed. |
| 2db2 | .....do................. | Frank Pence..... | 1946 | Dr | .... | ...... | .. | ......................... | N | N | I | ... | Top of outer casing. | ... | 4,007.19 | ...... | ........ | Drilling in progress on June 22, 1946. |
| 4dd | U. S. Geol. Survey....... | H. F. Haworth... | 1946 | Dr | 98M | 1¼ | GI | Marsland.................. | N | N | O | ... | Top of pipe...... | 1.8 | 4,034.80 | 65.27 | 5-14-46 | |
| 10db | William Newman.......... | Lynn E. Fry..... | 1941 | Dr | 248R | 18 | .. | Marsland and Harrison...... | T | G | I | 125 | Top of base plate of pump. | .0 | 4,028.25 | 76.25 | 3- 7-46 | 1,150; 119. |
| 14aa | L. F. Powell............ | ................ | .... | Dr | 65M | 6 | GI | Lower part of the Ogallala. | N | N | A | ... | Top of casing.... | .7 | 3,984.40 | 48.76 | 3- 6-46 | Automatic water-stage recorder installed June 14, 1946. |
| 15ab | M. S. Donovan........... | H. C. Minnick... | 1945 | Dr | 234M | 18-14 | BS | Marsland and Harrison...... | T | E | .... | ... | .....do......... | 1.3 | 4,020.77 | 69.39 | 3- 7-46 | Original depth reported as 254 feet. |
| 15cb | Joseph Shoemaker........ | Tom Tuchek...... | 1940 | Dr | 210R | 18 | BS | .....do................... | T | D | I | 136 | Base of pump..... | 1.0 | 4,016.05 | 61.30 | 3-13-46 | 1,100; 21. |
| 22cc | Geo. W. Neuswanger....... | H. C. Minnick... | 1946 | Dr | 408M | 18 | BS | Marsland, Harrison, and Monroe Creek. | T | D | I | 320 | Top of casing.... | 1.5 | 4,046.69 | 98.8 | 2-25-46 | 1,800; 47.8. Chemical analysis. |
| 22da | I. L. Peters............ | .....do......... | 1940 | Dr | 390R | 18 | .. | Marsland and Harrison...... | T | E | I | 200 | .....do......... | .0 | 4,000.50 | 64.68 | 3-14-46 | 1,100; 45. |
| 23da | John Miller............. | Blackledge...... | 1946 | Dr | 80R | 5 | GI | Lower part of the Ogallala. | .. | E | D | ... | .....do......... | .5 | 3,986.50 | 49.60 | 3- 6-46 | |
| 24cc | Floyd Warden............ | Floyd Warden.... | 1942 | Dr | 137R | 18 | .. | .....do................... | T | G | I | 160 | .....do......... | .0 | 3,992.08 | 71.27 | 3- 6-46 | 800; 30. |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25ac | Andrew Irwin.......... | H. C. Minnick... | .... | Dr | 200R | 18 | .. | .....do.......... | T | E | I | 150 | Bottom of pump base. | .8 | 3,986.80 | 67.30 | 3- 7-46 | 900; 50. |
| 25bb1 | A. G. Burnham.......... | .....do........ | 1941 | Dr | 163M | 18 | .. | Lower part of the Ogallala and the Marsland. | T | D | I | 100 | Top of casing.... | .6 | 3,992.20 | 74.08 | 6-14-46 | 1,150; 30. |
| 25bb2 | .....do.......... | .....do........ | 1941 | Dr | 161M | 18 | BS | .....do.......... | N | N | A | ... | .....do........ | .0 | 3,990.80 | 71.81 | 2-28-46 | Well was unsatisfactory because of faulty construction. |
| 25cb | B. L. Williams.......... | .....do........ | 1942 | Dr | 110R | 5 | GI | Lower part of the Ogallala. | Cy | G | I | 1 | Land surface..... | .0 | 3,987.40 | 65 | 1942 | Used for small truck garden. |
| 25da | Andrew Irwin.......... | .....do........ | .... | Dr | 156R | 16 | .. | .....do.......... | T | E | I | 20 | Bottom of pump base. | 1.0 | 3,978.70 | 64.60 | 3-12-46 | 650; 10. Reported adequate for 80 acres. |
| 25dc | City of Alliance.......... | .....do........ | 1938 | Dr | 340R | 18 | GI | .....do.......... | T | E | PS | ... | Land surface..... | .0 | ........ | 50 | 1938 | |
| 26ac | Newberry's Hardware Store. | .....do........ | 1940 | Dr | 150R | 17 | BS | .....do.......... | T | E | I | 140 | .....do........ | .0 | 3,992.30 | 60 | 1940 | 1,000; 30. |
| 26da | Jay H. Vance.......... | Lynn E. Fry..... | 1941 | Dr | 130R | 14 | .. | .....do.......... | T | G | I | 25 | .....do........ | .0 | 3,987.90 | 59 | 1941 | 500; 20. |
| 27cb | L. I. Powell.......... | Edw. Thompson... | 1946 | Dr | .... | .... | .. | .................... | .. | . | I | ... | ................ | ... | ........ | ...... | ........ | Drilling scheduled to begin about July 1, 1946. |
| 27db1 | Andrew Pepplar.......... | Raily Kooser.... | 1945 | Dr | 155R | 24 | BS | Marsland.......... | T | E | I | ... | Top of casing.... | .8 | 4,001.37 | 67.19 | 3- 7-46 | |
| 27db2 | .....do.......... | .....do........ | 1946 | Dr | 236M | 18 | GI | Marsland and Harrison...... | T | E | I | 160 | .....do........ | 1.0 | 4,001.67 | 68.00 | 3- 7-46 | Chemical analysis. |
| 30ad | I. L. Peters.......... | ................ | .... | Dr | 21R | 6 | GI | .................... | N | N | A | ... | Mark on inside of casing 0.4 feet below top of casing. | .1 | ........ | 12.80 | 2-28-46 | |
| 35ca | Fred Harris.......... | Raily Kooser.... | 1941 | Dr | 204R | 18 | GI | Lower part of the Ogallala. | T | E | I | 85 | Top of hole in pump base. | 1.0 | 3,976.10 | 50.13 | 3-18-46 | 1,500; 30. |
| 35db1 | F. M. Miller.......... | H. C. Minnick... | 1938 | Dr | 300R | 18 | .. | .....do.......... | T | E | I | 38 | Bottom of pump base. | .9 | 3,971.11 | 48.82 | 3-13-46 | |
| 35db2 | .....do.......... | .....do........ | 1944 | Dr | 120R | 6 | GI | .....do.......... | T | E | I,In | 2 | Land surface..... | .0 | 3,962.60 | 45 | 1940 | Slaughterhouse water supply; also irrigated 2 acres of land. |
| 36ba | City of Alliance.......... | .....do........ | 1938 | Dr | 300R | 18 | GI | .....do.......... | T | E | PS | ... | .....do........ | .0 | 3,963.80 | 44 | 1938 | 1,510; 29.3. City well 10; called the "Box Butte well." |
| 36bc | .....do.......... | .....do........ | 1938 | Dr | 307R | 18 | GI | .....do.......... | T | E | PS | ... | .....do........ | .0 | 3,968.30 | 46 | 1938 | 1,303; 37.8. City well 12; called the "Emerson Street Well." Chemical analysis. |
| 36cb | .....do.......... | .....do........ | 1945 | Dr | 300R | 18 | BS | .....do.......... | T | E | PS | ... | .....do........ | .0 | 3,968.40 | 56 | 1945 | 1,200; 18. Called the "warehouse well." |
| 36c | Chicago, Burlington & Quincy Railroad Co. | T. R. Walker.... | 1937 | Dr | 263R | 12-8-6 | .. | .....do.......... | N | N | A | ... | .....do........ | .0 | ........ | 48 | 10- 4-37 | Well drilled for prospective railroad supply; water unsatisfactory, casing pulled and well abandoned. |
| 25-49-11dc | John Sass.......... | ................ | .... | Dr | .... | 6 | GI | Marsland.......... | Cy | W | S | ... | Bottom of board base. | .8 | 4,070.30 | 54.00 | 3- 5-46 | |
| 14cd | Freda Collins.......... | George Naeve.... | 1946 | Dr | 45M | 6 | GI | .....do.......... | Cy | W | D | ... | Top of casing.... | .6 | 4,038.50 | 32.16 | 3-13-46 | Depth originally 94 feet; filled with sand to 45 feet. |
| 14da | John Sass.......... | ................ | .... | Dr | .... | 6 | GI | .....do.......... | Cy | W | A | ... | Notch in top of casing. | 1.4 | 4,036.13 | 33.85 | 3-12-46 | |
| 15dc | Edw. Jellinek.......... | George Naeve.... | 1946 | Dr | 66M | 6 | GI | .....do.......... | Cy | W | S,D | ... | Land surface..... | .0 | 4,043.00 | 31 | 3-12-46 | Depth originally 110 feet; filled in to 66 feet. |
| 25-50-22aa | Anna Hollister.......... | ................ | .... | Du | 135M | 36 | N | Harrison.......... | N | N | A | ... | Top of slot in wood platform. | .8 | 4,222.26 | 133.02 | 4- 1-46 | |
| 31ab | Martin Jacobsen.......... | ................ | .... | Dr | 110M | 6 | .. | Arikaree group.......... | Cy | H | A | ... | Edge of iron plate. | .6 | 4,220.90 | 103.41 | 2-27-46 | |
| 25-51-14aa | C. A. Allen.......... | ................ | .... | Dr | 112M | 6 | GI | .................... | N | N | A | ... | Top of casing.... | .5 | 4,262.32 | 89.47 | 6-12-46 | |
| 26-47-17dd | David Lawrence.......... | ................ | .... | Dr | 129M | 6 | GI | Sheep Creek.......... | Cy | W | S | ... | .....do........ | .6 | 3,985.92 | 53.89 | 4-22-46 | |
| 34da | Geo. Neuswanger.......... | Lynn E. Fry..... | 1941 | Dr | 270R | 16-10 | BS | Lower part of the Ogallala and the Marsland. | T | O | I | 160 | .....do........ | 1.0 | 3,921.86 | 26.42 | 6-20-38 | 1,000; 20. Depth-to-water measurement not possible with pump in place. Measurement made in 1938 when well was 116 feet deep. |
| 35dd | U. S. Geol. Survey....... | Mervin Sunyoke.. | 1946 | Dn | 14M | 1¼ | I | Ogallala.......... | N | N | O | ... | Top of pipe...... | 1.0 | 3,901.90 | 13.10 | 5-17-46 | |
| 26-48-22bb | William Riis.......... | Lynn E. Fry..... | 1940 | Dr | 150R | 18 | .. | Sheep Creek and Marsland... | T | N | I | 150 | Top of casing.... | .4 | 4,031.08 | 38.52 | 3-14-46 | Not in use. |
| 31da | Ernest Panwitz.......... | Edw. Thompson... | 1946 | Dr | 400R | 18 | .. | Marsland, Harrison, and Monroe Creek. | N | N | .... | ... | Land surface..... | .0 | 4,114.47 | 101.20 | 3-22-46 | Pump not installed on June 30, 1946. Well to be used for irrigation. |
| 33aa | John Neilson.......... | Lynn E. Fry..... | 1941 | Dr | 285R | 18 | GI | Marsland and Harrison...... | T | D | I | 125 | Top of wood block. | .7 | 4,092.14 | 110.00 | 3- 6-46 | 1,000; 60. 10-inch pump column with 12-inch pump bowls. |
| 36ab | Alliance Land & Investment Co. | Raily Kooser.... | 1944 | Dr | 260R | 18 | BS | Marsland and possibly upper Harrison. | T | E | I | 150 | Land surface..... | .0 | 4,012.80 | 70 | 1944 | 200; 70. Well filled to depth of 235 feet as result of blasting; well inadequate for acreage shown. |
| 36ac | .....do.......... | Lynn E. Fry..... | 1940 | Dr | 225R | 12 | BS | Lower part of the Ogallala and the Marsland. | T | E | I | 166 | Bottom of steel pump base. | 4.0 | 4,010.14 | 67.17 | 3- 6-46 | 1,000; 28. Well originally cased only 20 feet; reamed and cased entire depth in 1945 by H. C. Minnick. |

Table 7.--Summary of well records, Box Butte County, Nebr.--Continued

| Well number | Property owner or tenant | Driller | Year completed | Type of well | Depth of well (feet) | Diameter of well (inches) | Type of casing | Principal aquifer | Method of lift: Type of pump | Method of lift: Kind of power | Use of water: Use | Use of water: Acreage irrigated | Measuring point: Description | Measuring point: Distance above land surface (feet) | Measuring point: Height above mean sea level (feet) | Depth to water level below measuring point (feet) | Date of measurement | Remarks (Yield given in gallons a minute; drawdown in feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26-48-36ba | Alliance Land & Investment Co. | George Naeve.... | 1946 | Dr | 396M | 18 | BS | ......................... | T | E | I | ... | Land surface..... | 0.0 | 4,020.60 | 75.12 | 6-20-46 | 800; 67. |
| 26-49-13dc | Arnata C. Mabin.......... | ................ | .... | Dr | 139M | 6 | .. | Marsland.................. | N | N | A | ... | Top of wood platform. | .6 | 4,137.01 | 91.16 | 3-29-46 | |
| 19aa | Peter F. Johnson......... | Tom Tuchek...... | 1938 | Dr | 240R | 30-18 | .. | Marsland and Harrison...... | T | D | I | 130 | Hole in pump base. | .7 | 4,227.82 | 121.58 | 3-19-46 | 1,300; 54. |
| 21db | Donald Pierce............ | H. C. Minnick... | 1939 | Dr | 458R | 18 | GI | Marsland, Harrison, and Monroe Creek. | T | D | I | 100 | Top of hole in pump base. | .8 | 4,202.53 | 123.72 | 3-19-46 | 1,150; 40. |
| 26-50-12dc | Mrs. L. A. Rosenberg..... | ................ | .... | Du | 105M | 48 | C | ......................... | Cy | W | N | ... | Top surface of platform. | 1.0 | 4,232.51 | 102.71 | 6-18-38 | |
| 17cd | John H. Donovan.......... | H. C. Minnick... | 1945 | Dr | 241R | 18 | GI | Harrison.................. | T | D | I | 120 | Hole in pump base. | 1.3 | 4,283.71 | 107.30 | 3-29-46 | 1,000; 50. |
| 26-51-25bc | O. T. Wilkins............ | ................ | .... | Dr | 108M | 4 | GI | ......................... | N | N | .... | ... | Top of casing.... | .3 | 4,299.74 | 96.45 | 2-27-46 | |
| 26-52-10bc | G. E. Dyer............... | ................ | .... | Dr | 198R | 24 | .. | Harrison.................. | T | O | I | ... | Top of 1-inch pipe. | .0 | 4,436.00 | 98.89 | 4-12-46 | 722; 32. Chemical analysis. |
| 17ab | Lew Bair................. | ................ | .... | Dr | 103M | ...... | .. | .....do................... | .. | . | .... | ... | Top of pump base. | 1.0 | ........ | 74.79 | 5-13-46 | |
| 27-47-12da | Frank Krejci............. | Frank Krejci.... | 1930 | Dr | 19R | 6 | GI | ......................... | N | N | A | ... | Bottom of pipe clamp. | .6 | ........ | 8.31 | 6- 5-46 | |
| 17db | C. R. Fentress........... | Tom Tuchek...... | 1942 | Dr | 160R | 18 | ... | Marsland.................. | T | T | I | ... | Hole in pump base. | .4 | 3,984.10 | 75.33 | 4-12-46 | Chemical analysis. |
| 23ba | Bud Walker............... | ................ | .... | Dr | 64M | 6 | GI | Harrison.................. | .. | . | A | ... | Top of casing.... | 1.0 | 3,890.77 | 21.51 | 2-28-46 | |
| 25dc | R. A. Kittelman.......... | R. A. Kittelman. | 1938 | Dr | 80R | 24 | .. | Lower part of the Ogallala. | Cy | G | I | ... | .....do.......... | .5 | 3,891.00 | 28.19 | 4-12-46 | |
| 27-49-7dd | Town of Hemingford....... | William Rose.... | 1914 | Dr | 300R | 14 | BS | Marsland and Harrison...... | T | E | PS | ... | Land surface..... | .0 | 4,284.80 | 160 | 1946 | |
| 18aa | .....do.................. | .....do......... | 1919 | Dr | 300R | 8 | .. | .....do................... | P | E | PS | ... | .....do.......... | .0 | 4,267.30 | 130 | 1946 | |
| 21cb | E. S. Wildy.............. | Buck Lyman...... | .... | Dr | 156R | ...... | GI | Arikaree group............ | .. | . | A | ... | Bottom of hole in casing. | .6 | 4,230.50 | 118.60 | 2-27-46 | |
| 26cd | Cecil Vickers............ | Tom Tuchek...... | 1939 | Dr | 396R | 36 | GI | Marsland, Harrison, and possibly Monroe Creek. | T | D | I | 140 | Top of hole in pump base. | .2 | 4,009.74 | 116.14 | 3-29-46 | 1,150; 70. |
| 27-50-20aa | ......................... | ................ | .... | Dr | 210R | ...... | .. | ......................... | .. | . | .... | ... | Hole in platform. | 2.0 | 4,371.45 | 175.99 | 2-27-46 | |
| 27-51-6bb1 | L. Homrighausen.......... | Squibb & Hunziger. | 1906 | Dr | 223R | 6 | GI | Harrison.................. | N | N | A | ... | Top of concrete platform. | .3 | 4,493.87 | 220.97 | 4- 1-46 | |
| 6bb2 | .....do.................. | ................ | 1945 | Dr | 300R | 4 | BS | .....do................... | Cy | W | S | ... | Land surface..... | .0 | 4,497.20 | 222 | 1945 | |
| 27-52-30cd | W. W. Dyer............... | Tom Tuchek...... | 1940 | Dr | 260R | 18 | GI | .....do................... | T | O | I | 100 | Top of hole in pump base. | .4 | 4,517.20 | 134.60 | 4-12-46 | 650; 25. |
| 28-51-6da | John R. Hughes........... | H. C. Minnick... | 1938 | Dr | 325R | 6 | GI | Monroe Creek and possibly Gering sandstone. | T | G | I | 15 | Top of beam over well sump. | .2 | 4,128.10 | 19.11 | 8- 3-38 | 150; 25. Used only occasionally. Water level could not be measured on 5-17-46. |
| 6dd | University of Nebraska... | O. J. Scherer... | 1935 | Dn | 11M | 1 | GI | ......................... | N | N | O | ... | Top of 1-inch pipe. | 1.5 | 4,116.88 | 3.52 | 2-27-46 | |
| 8bc | W. T. Gregg.............. | Luther Clark.... | .... | Dr | 102R | 6 | GI | ......................... | .. | . | .... | ... | Top of casing.... | 1.4 | 4,200.57 | 87.00 | 2-27-46 | |
| 29-46-30cb (Sheridan County) | T. L. Hughes............. | H. C. Minnick... | 1938 | Dr | 180R | 18 | GI | ......................... | T | T | I | 30 | .....do.......... | 1.1 | ........ | 28.80 | 5-15-46 | 1,500; 20. |

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