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GEOLOGICAL SURVEY CIRCULAR 70

April 1950

RECONNAISSANCE OF THE GROUND-WATER RESOURCES OF THE WHEATLAND FLATS AREA, WYOMING

BY

ROBERT T. LITTLETON

Compiled as part of program of
Interior Department
for development of the
Missouri River Basin

U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
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UNITED STATES DEPARTMENT OF THE INTERIOR
Oscar L. Chapman, Secretary
GEOLOGICAL SURVEY
W. E. Wrather, Director

WASHINGTON, D. C.

Free on application to the Director, Geological Survey, Washington 25, D. C.

GPO D FSO

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RECONNAISSANCE OF THE GROUND-WATER RESOURCES OF THE WHEATLAND FLATS AREA, WYOMING

By Robert T. Littleton

ABSTRACT

The Wheatland Flats area is an independent geologic entity within the Laramie River Basin and the North Platte drainage system. The ground- and surface-water hydrology and agricultural economy of this area, however, are tied in closely to the over-all system of storage and distribution of irrigation water throughout the Laramie River Basin. The greatest problem faced by water users on Wheatland Flats is the shortage of water for late-season irrigation during years of low runoff in the Laramie River Basin.

The irrigated lands are situated on four terraces. The terrace deposits are of Quaternary age and consist of relatively permeable gravel; they rest on an irregular surface of fine-grained Tertiary sediments which have a relatively low permeability and a relatively high porosity. Reconnaissance geologic mapping indicates that the main canals and laterals are in the permeable gravel for a considerable part of their aggregate length. Water is thus lost by percolation and ultimately is discharged as return flow to the natural surface drainageways on and surrounding the flats or is added to storage in the Tertiary sediments.

Unconfined ground water is contained in both the Quaternary gravel and the fine-grained Tertiary sediments; the zones of saturation in these two aquifers are almost everywhere continuous. The zones of saturation are recharged by seepage from irrigation, canal losses, and, to a less extent, precipitation. The vastly different hydrologic properties of the two rock units, together with the irregular deposition of the gravel and the configuration of the Tertiary bedrock surface, have created barriers to uniform ground-water movement. As a result, the water table has risen in some local areas to the extent that waterlogging of the land has occurred and cultivation is no longer feasible.

Both the fine-grained bedrock and the gravel terrace and alluvial deposits are utilized as sources of water supply for domestic and stock use.

INTRODUCTION

PURPOSE AND SCOPE OF THE INVESTIGATION

This investigation of ground-water conditions in the Wheatland Flats area was made because of the excessive loss in the delivery of irrigation water in this area. The primary objectives of the study were to determine which stretches of the canals and laterals are seated in permeable materials and to determine the feasibility of augmenting present supplies of irrigation water by pumping from the ground-water reservoir.

A description of the topography and geology as they relate to ground-water conditions and records of domestic and stock wells drilled in the area are included in this report. The writer was in the area from August 22 to September 15, 1948, and thereafter visited the area weekly until November 1, 1948.

The investigation was under the general supervision of A. N. Sayre, geologist in charge of the Ground Water Branch of the Geological Survey, and of George H. Taylor, regional engineer in charge of ground-water investigations under the Missouri River Basin development program; S. W. Lohman, district geologist for Colorado and Wyoming, closely supervised the field investigations. John R. Rapp, geologist in the Cheyenne office, aided in preparing the illustrations and made periodic water-level measurements in observation wells. The manuscript of this report was critically reviewed by S. W. Lohman, T. G. McLaughlin, and Ray Bentall.

LOCATION AND EXTENT OF THE AREA

The area covered by this report is a small segment of the High Plains lying at the foot of the east slope of the Laramie Range and at the extreme west edge of the Great Plains physiographic province. (See fig. 1.) It lies within Townships 23 to 25 North and Ranges 67 to 69 West in central Platte County and is an area of about 100 square miles. The geologic mapping extends beyond the irrigated area to flat lands just west of Sybille Creek and those lying between the Laramie and North Laramie Rivers.

On Wheatland Flats proper about 50,000 acres of land was under cultivation in 1944. Water has been appropriated to approximately 63,560 acres of land under direct flow rights and existing reservoir agreements; however, rarely is enough water available to insure seasonal irrigation for this much land.

PREVIOUS INVESTIGATIONS

An early report by Smith (1903)[1] covers the geology of the eastern two-thirds of the Wheatland project. A report by Adams (1902) discusses the geology and topography of a similar area to the east, with relation to the coming of irrigation under the Desert-Lands Act of 1877, the Carey Act of 1894, and an act providing for the construction of reservoirs on public lands for watering livestock. The only published work

1 See references at end of report.

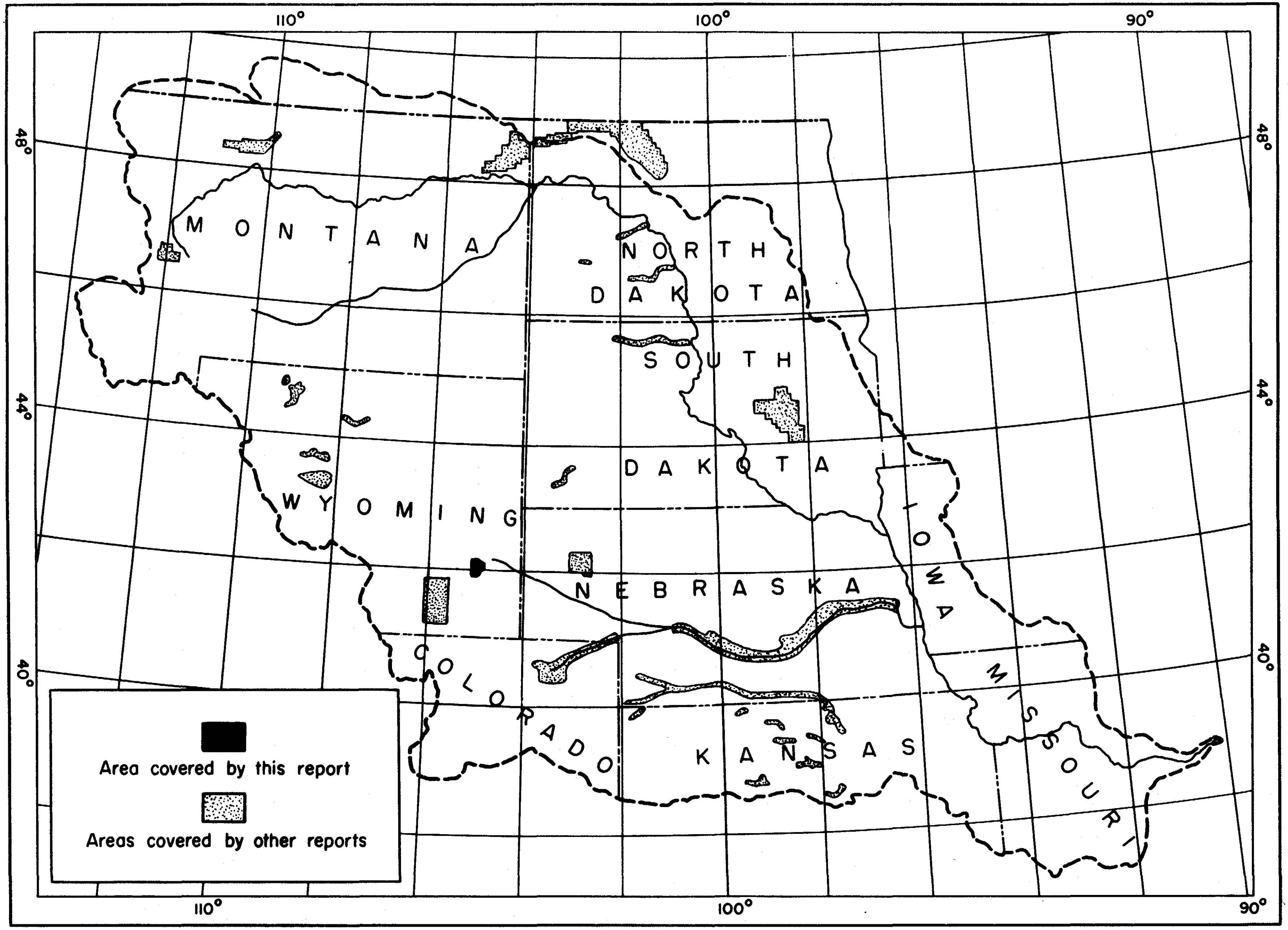

Figure 1 .—Map of the Missouri River Basin showing areas in which ground-water studies have been made under Missouri Basin program.

specifically concerned with ground water in this area is a report by Edwards (1941)--a thesis presented to the Department of Geology, University of Wyoming, in partial fulfillment of requirements for the degree of Master of Arts.

Considerable geophysical work has been done recently in the area by several of the major oil companies. Many logs of shot holes put down during the seismic surveys contain abundant shallow subsurface information, and an effort is being made to obtain the logs for use in any more detailed investigation that may follow. The results of investigations by the Soil Conservation Service on the soils and drainage in this area have not been published.

ACKNOWLEDGMENTS

The writer expresses appreciation to all those who aided him in this study. Many residents in the area supplied information about their wells. Ross W. Davis, driller, gave information on the wells drilled by him in the area and pertinent data about the water-bearing characteristics of the Tertiary rocks. R. D. Dirmeyer and C. H. Humphrey of the U. S. Bureau of Reclamation gave helpful advice and suggestions.

John Whiting and other officials of the Wheatland Irrigation District permitted access to past records of irrigation in the area, and officials of the Great Western Sugar Corp. supplied general information about the deeper water wells in the area. L. C. Bishop, Wyoming State Engineer, made available records of irrigated acreage and surface-water measurements.

GEOGRAPHY

TOPOGRAPHY AND DRAINAGE

The Wheatland Flats area comprises four terraces that slope gently northeastward and are separated by low gentle slopes. Erosion of the terraces has produced a gently rolling plain. The terraces range in altitude from 4,800 feet above mean sea level at the southwest end of the area to 4,500 feet at the northeast end; the differences in altitude between terrace levels range from 5 to about 35 feet.

Steep-sided, flat-bottomed valleys 50 to 75 feet below the terrace levels border the area on the west, north, and east. The area immediately south of Wheatland Flats is a gentle slope up to a highland of Paleozoic and Mesozoic rocks. This highland extends 15 miles northeastward from the Laramie Range.

The Laramie River flows eastward along the north edge of Wheatland Flats. It is joined by the North Laramie River in sec. 20, T. 25 N., R. 67 W., whence it continues eastward to its confluence with the North Platte River in the vicinity of Fort Laramie, Wyo.

Sybille Creek rises in the Laramie Range 30 miles southwest of Wheatland Flats and flows along the west side of the area to its confluence with the Laramie River. Chugwater Creek, another tributary of the Laramie River, rises in the Laramie Range 35 miles south-southwest of the area and flows along the east side of Wheatland Flats. Rock Creek, also called Wheatland Creek, provides the natural surface drainage on Wheatland Flats proper. It has become a perennial stream since irrigation was begun, except near its mouth where the flow is absorbed by the alluvium along the flood plain of the Laramie River.

CLIMATE

Weather information was recorded by the United States Weather Bureau at Wheatland as early as 1897, but precipitation records have been kept continuously only since 1931. The average annual precipitation in Wheatland Flats is 13.70 inches. (See fig. 2.) The precipitation is sporadic and occurs generally in spring, summer, and autumn. Rains or snowstorms of 1 or 2 days' duration in the spring and early or middle autumn bring the most beneficial amounts of precipitation. Local meteorological conditions in late spring and early summer cause thundershowers and hailstorms that amount to several inches of precipitation within a few hours. The flood and hail damage caused by these storms may offset the advantages of the moisture.

The mean temperature of the area is 48.8° F.; the highest recorded temperature is 109° F. and the lowest is -36° F. In most years the length of the growing season is between 104 and 150 days. Killing frosts occur as late in spring as June 4 and as early in autumn as September 7. A killing frost on July 31, 1913, shortened the growing season that year to 68 days.

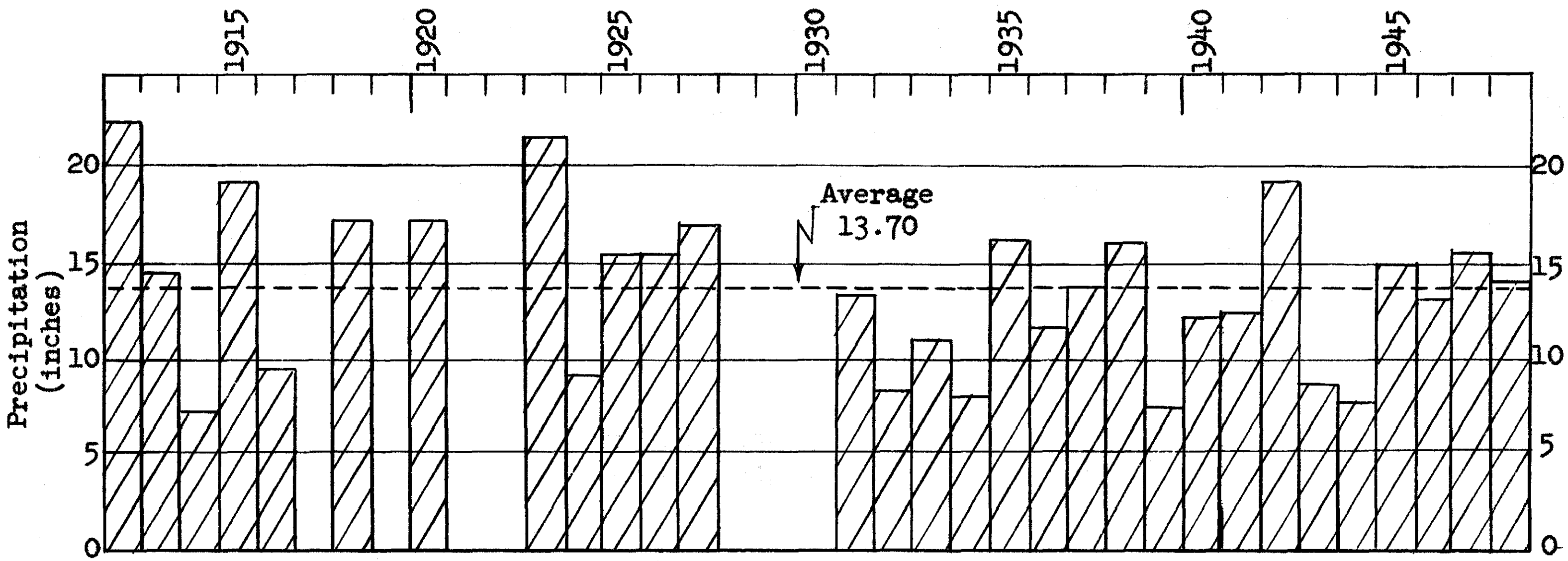

Figure 2.--Graph showing annual precipitation at Wheatland, Wyo. (From records of the U. S. Weather Bureau.)

AGRICULTURE

The present agricultural economy of the Wheatland Flats area has been developed through irrigation. This economy is not entirely stabilized and, like that of many other irrigated areas in the Rocky Mountain area, is beset with problems of seepage and variable climate. However, the most pressing problem to farmers on the Wheatland Flats is the shortage of water for late-season irrigation. This shortage occurs during years of low runoff in the Laramie River Basin and is alleviated or magnified by the amount of precipitation during the growing season. J. A. Elliot (1944), formerly an engineer with the Wheatland Development Co., estimated that $4,000,000 had been lost to farmers as a result of water shortages on the Flats between the years 1930 and 1940. This estimate may be high, but losses are of such magnitude that considerable effort could be expended within sound economic limits toward increasing existing water supplies for irrigation. To date very little attention has been given to the possibility of augmenting surface-water supplies by pumping from the ground-water reservoir.

The irrigated lands are suitable for grasses, grains, and row crops. There are several small apple orchards, but climatic conditions make large-scale fruit raising impractical. In 1930 the Great Western Sugar Corp. built a sugar mill near Wheatland at considerable cost, after which much of the Wheatland Flats was planted with sugar beets. The acreage of sugar beets now is restricted because of recurrent droughts when the supply of irrigation water is not sufficient to insure a satisfactory yield. The mill has been idle since 1939 because of the lack of beets. Many farmers interested in raising sugar beets moved from this area during the last part of the drought of 1931-44, and in recent years most of the farm lands of Wheatland Flats have been planted with hay, corn, and small grains. The bean acreage has increased sharply owing to the present high market.

GEOLOGY AND WATER SUPPLY

PRE-CAMBRIAN IGNEOUS AND METAMORPHIC ROCKS

Igneous and metamorphic rocks of pre-Cambrian age crop out a short distance west of the Wheatland Flats area; one such outcrop southwest of the area is shown on plate 1. These rocks consist of granite, gneiss, and schist and are genetically related to the crystalline rock mass of the Laramie Range. Acid magmas were intruded into pre-Cambrian sediments at depths that allowed slow cooling of the magmas and the formation of coarse texture. Intruding granite masses locally exhibit uniform lines of flowage; their linear axes trend from northeast, in the vicinity of Laramie Peak, to east, at the foot of the Laramie Range near Wheatland Flats.

SEDIMENTARY ROCKS

Stratified rocks of Tertiary age and largely unstratified rocks of Quaternary age are exposed in the Wheatland Flats area. Smith (1903) mapped all exposures of Tertiary rocks in the eastern two-thirds of the area as the Arikaree formation (Miocene), but Edwards (1941) mapped these Tertiary sediments as belonging to the White River group, into which he placed the Chadron and Brule formations of Oligocene age and the Arikaree sandstone of Miocene age.

Within the time available for this investigation the writer was not able to differentiate the Tertiary sediments satisfactorily. By comparison of the hydrologic properties of the Tertiary units with those of other areas, notably western Nebraska, it seems probable that the Arikaree sandstone underlies all of Wheatland Flats. Detailed geologic mapping some distance beyond the area covered by this report will be required to establish the proper correlation of the Tertiary rocks.

The Tertiary sediments rest unconformably against pre-Cambrian rocks and on sedimentary rocks of Cretaceous age. No pre-Tertiary sediments are exposed in the Wheatland Flats area, and their occurrence beneath the Flats has not been explored. General Petroleum Corporation's deep oil-test well in sec. 15, T. 24 N., R. 66 W., 6 miles east of Wheatland Flats, passed through 3,982 feet of Mesozoic and Paleozoic sediments before entering pre-Cambrian rocks.

Tertiary System

General features.--Sedimentary rocks of Tertiary age crop out on three sides of Wheatland Flats. They are also exposed on the Flats proper as inliers surrounded by Quaternary deposits.

The Tertiary sediments consist of fine-grained calcareous sandstone, claystone, and thin chalky limestone. The beds of sandstone range in thickness from a few feet to 10 feet, and they are poorly to firmly cemented. They appear to be well stratified on the weathered outcrop; close inspection reveals marked facies changes within short distances. The claystone is composed of a silty clay matrix containing grains of fine sand.

Drillers' logs reveal that the minimum thickness of these Tertiary sediments is 500 feet; greater thicknesses are a result of irregularities in the configuration of the erosion surface on which the Tertiary sediments were deposited.

Water supply.--The Tertiary sediments beneath Wheatland Flats contain ground water which in the upper strata is unconfined and is almost everywhere continuous with the saturated zone of the overlying unconsolidated deposits. Thin beds of limestone or tightly cemented fine-grained sandstone may locally serve as confining beds, but they seemingly are not persistent enough to produce widespread artesian conditions.

The principal source of recharge to the Tertiary rocks is the irrigation water applied to the overlying terrace deposits. Saturated alluvium along the larger streams may also be a source of recharge where it is in contact with the Tertiary rocks.

Most of the domestic and stock wells obtain small supplies of water from the Tertiary rocks. These wells are drilled to depths ranging from 25 to 300 feet, and most are 4 to 6 inches in diameter. Several wells of large diameter have been drilled into the Tertiary rocks beneath Wheatland Flats. Well 24-68-13ca, drilled by the town of Wheatland to augment the public supply, yields about 600 gallons a minute, but at this rate some sand is pumped with the water. The sand causes extreme wear on parts of the pump, and caving around the casing sometimes occurs. To overcome these difficulties the well is pumped only for short periods at a rate of about 400 gallons a minute.

The Great Western Sugar Corp. drilled five wells at its beet processing mill. These wells produced from Tertiary rocks, and their combined yield was reportedly 7 second-feet, or 3,136 gallons a minute. Officials of the firm are attempting to locate more complete records on these wells and if successful will make the records available.

The depth to water in wells producing from Tertiary rocks generally increases with the depth of the horizon that is tapped. The water level is less than 10 feet below the surface in many of the shallow wells. The upper zones of water generally are cased off in the deeper wells and consequently the depth to water is considerably greater. The depth to water in well 24-68-25ad is about 188 feet.

Water issues from seeps in the Tertiary rocks at the west and southeast edges of the Wheatland Flats. Along the east and north edges of the Flats, some water probably moves from Tertiary rocks into the alluvium and alluvial fans. The ground water in the Tertiary rocks moves generally northeast in the direction of the general topographic slope, but local topographic and geologic conditions control the direction of movement near the edges of the Wheatland Flats.

Quaternary System

Pleistocene Terrace Deposits

General features.--Terrace deposits of coarse gravel and sand cover most of Wheatland Flats and the flat lands to the west and north. The source of these unconsolidated deposits is the igneous and metamorphic rocks of the Laramie Range; the materials were transported to the area principally by Sybille Creek and the Laramie River. The different terrace levels represent successive stages of channeling and downcutting to the present channel and gradient of the streams. These successive cycles of deposition and erosion resulted in an undulating bedrock surface and irregular deposits of unconsolidated material. The terraces have been slightly eroded and their lithology is not everywhere as uniform as surface expression suggests. The thickness of the terrace deposits ranges from a few feet to a reported 50 feet.

Water supply.--The lower part of the unconsolidated materials is saturated almost everywhere on Wheatland Flats. Exceptions to this condition are the higher and well-preserved terrace deposits that form a low, rounded ridge trending northeast through secs. 33, 27, and 23, T. 24 N., R. 68 W., and higher terrace deposits trending north to northeast through sec. 19, 18, and 8, T. 24 N., R. 67 W. These terrace deposits lie above the water table and are not saturated.

Long-time residents in the area report that the unconsolidated rocks contained little water prior to irrigation. Continued irrigation on Wheatland Flats has partly saturated the deposits and caused the water table to rise. The depth to the water table varies with the topography and ranges from a few inches to about 10 feet. Many stock wells obtain water from the unconsolidated deposits, but the yield of these wells is small because of the thinness of the gravel bed penetrated. No chemical analyses were made of the water but many residents expressed the opinion that water of better quality is contained in the underlying Tertiary rocks. Recharge to the unconsolidated deposits is from irrigation and canal losses, and in small part from precipitation.

The movement of water in the terrace deposits is generally northeastward in the direction of the topographic slope. The irregular Tertiary bedrock surface upon which the unconsolidated materials were deposited results in marked differences in thickness of the deposits along the path of ground-water movement and, hence, changes in the hydraulic gradient. These conditions force the ground water to the surface in places and thus cause the land to become waterlogged. Much of the ground water in the unconsolidated deposits eventually emerges as return flow into Rock Creek.

Alluvium and Alluvial Fans

General features.--Alluvium underlies the flood plains of Sybille and Chugwater Creeks and the Laramie and the North Laramie Rivers. It consists chiefly of coarse sand and gravel derived from the terrace deposits and from igneous and metamorphic rocks of the Laramie Range, but considerable fine sand, silt, and clay derived from the Tertiary sediments exposed in the valley walls are mixed with the coarser materials. Reworked terrace deposits on Wheatland Flats along and near Rock Creek have been classified as alluvium. These reworked terrace deposits also contain finer clastics derived from Tertiary rocks. The contact between the alluvium and the terrace deposits is not everywhere sharp and in many places must be inferred on the basis of topography and hydrology. The thickness of the alluvium is varied and, according to Edwards (1941), ranges from a few feet in some places to about 30 feet in the valley of Laramie River.

Alluvial fans have been deposited at the mouths of gullies tributary to the principal streams. These fans consist of finer materials eroded from the Tertiary sediments and some reworked gravel. During periods of heavy runoff they are built up on the edge of the flood plain where silt-laden water emerges from the confinement of the gully walls.

Water supply.--Zones of saturation in the alluvium underlying the flood plains of the principal streams supply water to stock and domestic wells. Edwards (1941) compiled information on 23 wells on the flood plains of Chugwater Creek and the Laramie and North Laramie Rivers.

The depth of the wells that obtain water from the alluvium ranges from 8 to 30 feet. Saturated alluvium is a source of recharge to underlying Tertiary rocks.

The alluvial fans do not contain permanent zones of saturation.

GEOLOGIC STRUCTURE

The Tertiary rocks underlying Wheatland Flats dip gently eastward. The structure of the area is not known clearly as it has been complicated by a post-Miocene uplift immediately south, southeast, and east. The Brule formation of Oligocene age is exposed at higher elevations just south of the area, a condition that is the result of faulting or strong dips, or a combination of both. Beds of sandstone, which are believed to occur near the base of the Arikaree sandstone, dip northwestward beneath Wheatland Flats at the southeast corner of the area. Beds of Arikaree sandstone that crop out a short distance east of Chugwater Creek dip steeply westward. The strike of these beds is north-northeast through secs. 34, 26 and 24, T. 24 N., R. 67 W. Detailed inspection of this vicinity may disclose faulting associated with these steep dips. It is apparent from the mapping done during this investigation that the Wheatland Flats area is lower structurally than the areas immediately south, southeast, and east.

EFFECT OF IRRIGATION ON GROUND WATER

Previous to irrigation there was very little recharge to the ground-water reservoir, but the rising water table in recent years indicates that recharge from irrigation exceeds the ground-water discharge. Sizable areas on Wheatland Flats have become waterlogged and as a result some previously cultivated acreage is no longer productive. It has become necessary to construct both surface and subsurface drains in some tracts. A north-south tile drain, reported to be $3\frac{1}{2}$ miles long, was constructed about 1931 in secs. 8, 17, 20, and 29, T. 24 N., R. 68 W., by the Logan Irrigation District (now defunct). Test drilling prior to laying the tile indicated an adequate thickness of gravel. The drain serves a double purpose; it relieves waterlogging and is tapped in several places to supply irrigation water. Tile drains on Wheatland Flats are not feasible where the underlying bedrock is close to the surface.

A cut along the new U. S. Highway 87 at the southeast edge of Wheatland Flats taps the zone of saturation in Tertiary rocks. Water now flows down both sides of the roadway and construction of a drain will be necessary to protect the road foundation. It is interesting to note that the rock is very fine grained--almost a claystone--and is hard where dry; where saturated, however, this material acts as a quicksand. The drainage provided by this cut has relieved waterlogged farm land immediately east of the highway.

WATER LOSS FROM CANALS AND LATERALS

The main canal and laterals are in rocks of varying hydrologic properties. (See pl. 1.) Some water loss occurs all along the canals and laterals. The loss in stretches underlain by Tertiary rocks is believed to be negligible, but the loss in stretches underlain by the permeable unconsolidated materials is believed to be considerable. These losses can be checked only by lining the present canals and laterals.

POSSIBILITIES OF DEVELOPING ADDITIONAL IRRIGATION WATER FROM WELLS

In view of the increase to ground-water storage resulting from the application of irrigation waters on Wheatland Flats, it seems advisable to investigate in detail the possibility of augmenting the water supply by additional irrigation pumping from wells in areas where critical shortages occur. At the same time the waterlogged condition in some parts of the area might be remedied.

A detailed ground-water investigation of the Wheatland Flats area would be required to determine the feasibility of irrigation from wells. This investigation should include (1) a detailed inventory of all existing wells; (2) periodic measurement of the water level in observation wells; (3) geologic mapping of the Wheatland Flats and surrounding area in sufficient detail to allow correlation and understanding of the Tertiary water-bearing beds; (4) test drilling of Tertiary rocks and terrace deposits to determine their thickness, character, lateral extent, and water-bearing properties; (5) construction of a map showing the shape and slope of the water table, direction of ground-water movement, and areas of ground-water recharge and discharge; (6) determination, by means of pumping tests on wells constructed for the purpose, of the yield, drawdown, and permeability of the water-bearing materials, and hence, the feasibility of pumping water for irrigation; and (7) analysis of representative samples of the ground water to determine the chemical suitability of the water for irrigation.

WELL-NUMBERING SYSTEM

Wells are numbered in this report according to their location within the land subdivisions of the General Land Office survey of the area. A graphical explanation of this method of well identification is shown by figure 3. The first numeral of a well number indicates the township, the second the range, and the third the section in which the well is located. The lower-case letters following the section number indicate the location of the well within the section. The first letter denotes the quarter section and the second the quarter-quarter section. The letters are assigned in a counterclockwise direction beginning in the northeast quarter of the section or quarter-quarter section.

WELL-NUMBERING SYSTEM

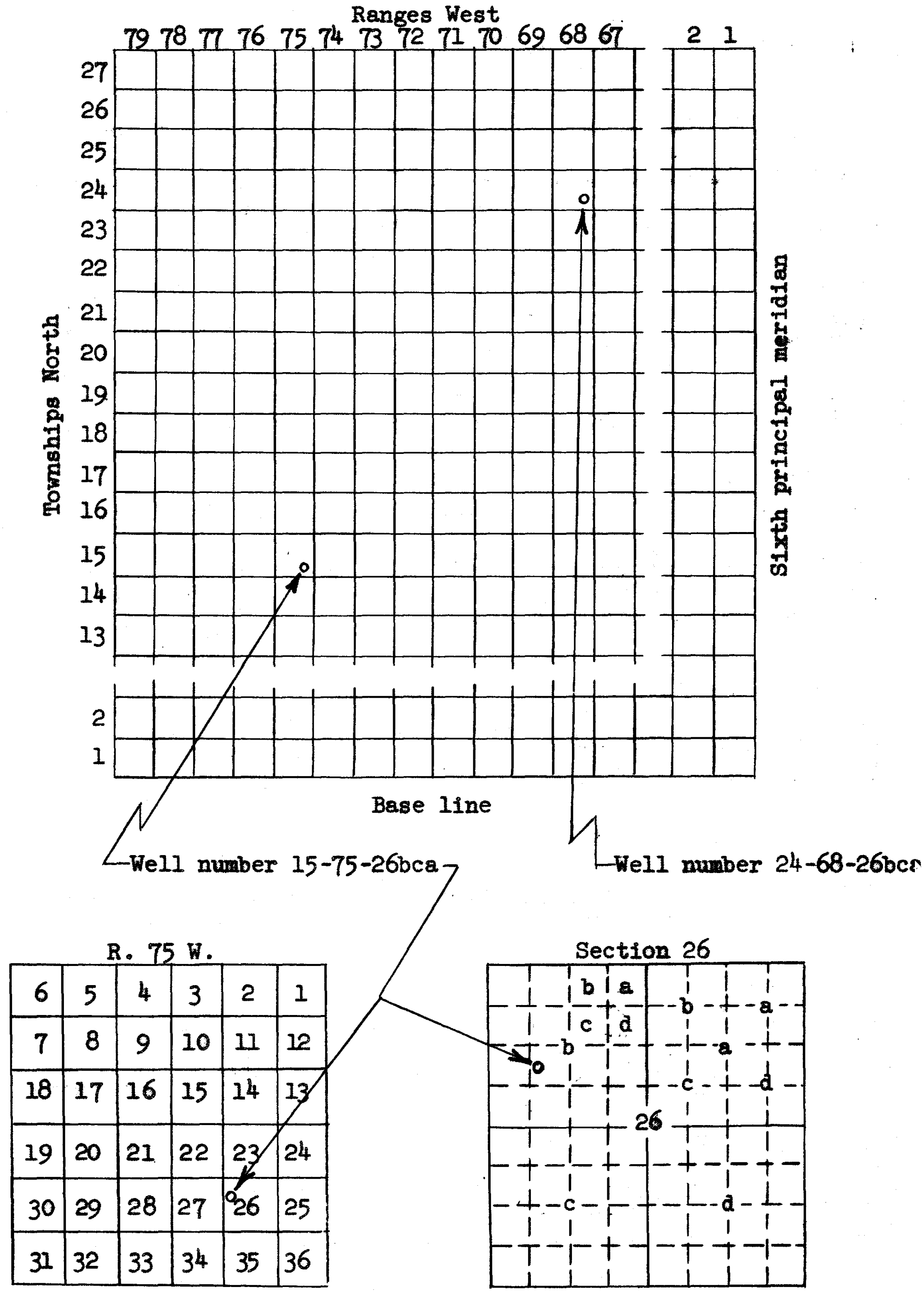

Figure 3.--Sketch showing well-numbering system

WATER-LEVEL MEASUREMENTS

Periodic measurements of the depth to water in 30 observation wells are given in table 1. These water-level measurements indicate the seasonal rise and fall of the water levels in the Wheatland Flats area. Records of all observation wells are given in table 2 and the locations of all wells are shown on plate 1.

Table 1.--Water levels in observation wells, in feet below land surface

23-68-3cc.

Date	Water level	Date	Water level	Date	Water level
Sept. 24, 1948	9.79	Dec. 7, 1948	11.08	Apr. 28, 1949	12.43
Oct. 13	10.35	Mar. 3, 1949	13.13		

23-68-7bc.

Aug. 25, 1948	4.46	Dec. 7, 1948	3.96	Apr. 29, 1949	3.82
Oct. 13	3.85				

23-68-9bb.

Oct. 14, 1948	8.38	Apr. 29, 1949	11.36		

23-68-15cc.

Aug. 24, 1948	4.88	Dec. 7, 1948	5.19	Apr. 28, 1949	6.34
Oct. 14	5.01	Mar. 3, 1949	6.29		

23-68-18cc.

Aug. 23, 1948	13.51	Dec. 7, 1948	22.94	Apr. 28, 1949	28.62
Oct. 13	19.01	Mar. 3, 1949	28.57		

Table 1.--Water levels in observation wells, in feet below land surface --Continued

23-68-19ab.

Date	Water level	Date	Water level	Date	Water level
Aug. 24, 1948	7.61	Dec. 7, 1948	7.68	Apr. 28, 1949	8.75
Oct. 13	7.34	Mar. 3, 1949	8.44		

24-67-6dc.

Sept. 8, 1948	56.60	Dec. 8, 1948	55.27	Apr. 29, 1949	59.24
Oct. 15	53.67	Mar. 4, 1949	58.04		

24-67-18da.

Sept. 8, 1948	142.14	Dec. 8, 1948	140.48	Apr. 29, 1949	140.57
Oct. 15	140.97	Mar. 4, 1949	140.58		

24-68-4cb.

Oct. 1, 1948	1.03	Dec. 7, 1948	11.35	Apr. 29, 1949	15.22
Oct. 14	7.22	Mar. 4, 1949	14.57		

24-68-6ab.

Sept.13, 1948	1.77	Dec. 7, 1948	3.63	Apr. 29, 1949	5.69
Oct. 14	2.23				

24-68-8bb.

Aug. 31, 1948	2.18	Dec. 7, 1948	3.62	Apr. 29, 1949	3.98
Oct. 14	2.37	Mar. 4, 1949	4.64		

24-68-10ba.

Sept.24, 1948	6.78	Dec. 7, 1948	6.69	Apr. 29, 1949	7.41
Oct. 14	6.70	Mar. 4, 1949	7.82		

Table 1.--Water levels in observation wells, in feet below land surface --Continued

24-68-11cd.

Date	Water level	Date	Water level	Date	Water level
Aug. 31, 1948	1.19	Dec. 7, 1948	1.57	Apr. 28, 1949	3.10
Oct. 14	1.10	Mar. 4, 1949	2.69		

24-68-15ab.

Aug. 31, 1948	6.60	Dec. 7, 1948	7.78	Apr. 28, 1949	10.82
Oct. 14	6.34	Mar. 4, 1949	9.50		

24-68-15db.

Sept. 24, 1948	27.19	Dec. 7, 1948	25.28	Apr. 28, 1949	29.26
Oct. 14	26.74	Mar. 4, 1949	31.74		

24-68-19dc.

Sept. 14, 1948	3.18	Mar. 4, 1949	10.15	Apr. 28, 1949	12.60
Dec. 7, 1948	6.02				

24-68-20bb.

Aug. 31, 1948	8.03	Dec. 7, 1948	9.15	Apr. 28, 1949	9.90
Oct. 14	8.18	Mar. 4, 1949	10.04		

24-68-21bb.

Aug. 31, 1948	7.97	Dec. 7, 1948	10.88	Apr. 28, 1949	15.20
Oct. 14	8.84	Mar. 4, 1949	13.11		

24-68-25ad.

Sept. 8, 1948	187.36	Dec. 8, 1948	196.30	Mar. 4, 1949	Sealed
Oct. 15	186.99				

Table 1.--Water levels in observation wells, in feet below land surface --Continued

24-68-26cc.

Date	Water level	Date	Water level	Date	Water level
Sept.10, 1948	61.66	Dec. 7, 1948	56.64	Apr. 28, 1949	Pumping
Oct. 14	61.09	Mar. 4, 1949	57.81		

24-68-32ba.

Aug. 25, 1948	29.92	Dec. 7, 1948	Pumping	Apr. 28, 1949	Pumping
Oct. 14	26.72	Mar. 4, 1949	do		

24-68-35dd.

Sept.10, 1948	46.99	Dec. 7, 1948	47.38	Apr. 28, 1949	47.18
Oct. 14	46.30	Mar. 4, 1949	41.21		

24-69-1ab.

Aug. 31, 1948	17.77	Oct. 14, 1948	12.51	Mar. 4, 1949	21.43
Sept.21	15.23	Dec. 7	16.40	Apr. 29	24.28

25-67-27cc.

Sept. 8, 1948	83.62	Dec. 8, 1948	84.35	Apr. 29, 1949	Pumping
Oct. 14	83.06	Mar. 4, 1949	87.25		

25-67-31aa.

Sept. 8, 1948	62.34	Dec. 8, 1948	58.37	Apr. 29, 1949	Pumping
Oct. 14	56.50	Mar. 4, 1949	Pumping		

25-67-31cc.

Sept. 4, 1948	12.34	Dec. 8, 1948	16.99	Apr. 29, 1949	21.01
Oct. 14	13.70	Mar. 4, 1949	19.44		

Table 1.--Water levels in observation wells, in feet below land surface --Continued

25-67-33dc.

Date	Water level	Date	Water level	Date	Water level
Sept. 4, 1948	3.49	Dec. 8, 1948	5.74	Apr. 29, 1949	11.43
Oct. 14	5.16	Mar. 4, 1949	Pumping		

25-68-32aa.

Sept. 14, 1948	3.80	Dec. 8, 1948	2.92	Apr. 29, 1949	3.12
Oct. 14	3.14	Mar. 4, 1949	2.25		

25-68-33dc.

Sept. 4, 1948	1.94	Dec. 8, 1948	1.16	Apr. 29, 1949	1.64
Oct. 14	1.54	Mar. 4, 1949	1.41		

25-68-35dd.

Sept. 4, 1948	5.17	Dec. 8, 1948	4.05	Apr. 29, 1949	4.80
Oct. 14	3.78	Mar. 4, 1949	4.95		

RECORDS OF WELLS

Records of 58 representative wells were obtained during the field investigation and are given in table 2. These wells represent only a small fraction of all the wells in the area. Many other wells were visited but, because information concerning them is lacking or scanty, they are not included in the table of well records. Much information about wells on Wheatland Flats is available in the files of R. W. Davis, driller at Wheatland, Wyo., and can be utilized when time is available to obtain the records and check the exact location of the wells.

Table 2.--Records of wells in Wheatland Flats area, Wyo.

Well number: See text for description of well-numbering system.
Type of well: B, bored well; Dr, drilled well; Du, dug well; Dn, driven well.
Depth of well: Reported depths below land surface are given in feet; measured depths are given in feet and tenths below measuring points.
Type of casing: C, concrete; Gal, galvanized steel; R, rock; S, steel; T, tile; W, wood.
Geologic source: Qal, alluvium; Qt, terrace deposits; Tu, Tertiary rocks.
Method of lift: Cy, cylinder pump; E, electric motor; G, gasoline or diesel engine; H, hand; J, jet pump; N, none; T, turbine pump; W, wind.
Use of water: D, domestic; I, irrigation, M, municipal; N, none; S, stock.
Depth to water: Reported depths to water level are given in feet; measured depths to water level are given in feet, tenths, and hundredths.

Well number	Owner or tenant	Type of well	Depth of well	Diameter of well (in.)	Type of casing	Geologic source	Method of lift	Use of water	Measuring point: Description	Measuring point: Height above land surface (ft.)	Depth to water level below measuring point (ft.)	Date of measurement
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
23-68- 3cc	....	Dr	.....	4	S	Qal	Cy,H	N	Top of casing	0.9	10.69	9-24-48
3dd	Marlin Baker	Dr	110	4	S	Qal	J,E	D,S	Land surface	.0	40	1943
4ad	Henry Kinel	Dr	90	8	S	?	J,E	D,S	......do.........	.0	32	9-23-48
7bc	Alex Stugart	Du	11	48	W	Qt	Cy,H	N	Top of wood cover	.0	4.46	8-25-48
8ad	C. Nickel	Du	28	6	S	Tu	Cy,E	D,S	Land surface	.0	22	3-21-48
8dd	Fred Ryff	Du	28	..	...	Qt	Cy,W,H	D,S	Top of concrete curb	.5	10.14	9-23-48
9bb	G. E. Grafty	Du	.....	48	...	Tu	......	N	Top of 2x4 board below cover	.0	8.38	10-14-48

23-68-10da	....	Du	.....	..	...	Qt	......	N	Crack in cover	.9	7.94	9-23-48
10dd	School Dist.	Dr	.....	6	S	Qt	Cy,H	N	Top of casing	.8	17.03	10- 1-48
11da	Richard Timms	Du	25	..	...	Qal	Cy,E	D,S	Inside concrete curb	.0	3.04	9-10-48
14cd	W. C. Howard	Dr	82.5	8	S	Tu	Cy,G	S	Top of casing	.9	29.97	9-10-48
15cc	Bertha Kenty	Du,Dr	47	..	...	Qal	Cy,H	D	Top of board cover	.7	5.58	8-24-48
16ab	A. A. Juscka	Dr	53	4	S	Qal	J,E	D,S	Land surface	.0	9	4-28-49
18aa	C. C. Beck	Du	.....	12	T	Qt	Cy,H	D,S	Top of platform below pump	.5	11.30	9-14-48
18cc	K. V. Howe	Du	40	48	S,C	Qt	......	N	Top of wood cover	.1	13.61	8-23-48
19ab	L. L. Bowen	Dn,Du	15	48	R,C	Qt	......	N	.......do........	.1	7.71	8-24-48
19dc	R. Chase	Dr	42.8	4	S	Qt	J,E	D	Top of casing	1.2	7.50	8-24-48
21bc	M. Echelburger	Dr	62	6	S	Qt	J,E	D	Land surface	.0	40	3- 3-49
22ba	Dr. Corman	Dr	82	6	S	Qt	Cy,E	D	......do.........	.0	25	3-21-49
29bb	L. L. Bowen	Dr	38	6	S	Qt	Cy,W,H	D	Base of pump	.8	12.15	8-24-48
24-67- 5dc	Grace Tolman	Dr	136	4	S	Tu	Cy,E	D,S	Top of casing	.7	56.93	10-28-48
6dc	W. Rains	Dr	300	6	S	Tu	......	N	Top of board cover	.2	56.80	9- 8-48
8cc	....	Dr	147	6	Gal	Qt?	Cy	N	Top of casing	3.2	106.00	3-21-49
17bb	Albis Marshall	Dr	313	4	S	Tu	J,E	D,S	.......do........	2.7	123.46	9-24-48
18cd	W. W. Wolfe	Dr	217	6	S	Tu	......	N	Top of concrete shelter	.7	142.75	9- 8-48
18da	Lambert Riff	Dr	309	6	S	Tu	......	N	Hole in shelter	.5	142.64	9- 8-48
24-68- 3aa	C. R. Pool	Du	.....	36	R	Tu	......	N	Top of wood cover	.7	4.35	10-14-48
4cb	Edmond Leuth	Du	.....	36	C	Qt	Cy,H	D	Top of main board cover	1.4	2.43	10- 1-48
5ba	Guy Holmes	Du	18	36	T	Qt	Cy,H	N	Top of casing	.3	14.81	3- 4-49
6ab	....	Du	.....	36	Gal	Qt	......	N	Top of lower wooden cover	.6	2.37	9-13-48
8bb	G. W. Goodrich	Dr	.....	..	...	Qt	J,E	D,S	Edge of beam inside house	.5	2.68	8-31-48
9ba	A. J. Deines	Du	35	..	...	Qal	Cy,G	D,I	Top of concrete curb	.8	4.98	8-31-48
9bb	Herman Schmidt	Dr	.....	4	S	Tu?	J,E	D	Land surface	.0	15	3- 3-49

Table 2.--Records of wells in Wheatland Flats area, Wyo.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
24-68-10ba	G. C. Laurence	Du	13	48	S	Qt	Cy,H	D	Top of board curb	1.0	7.78	9-24-48
11cd	A. F. Bowen	Du	.....	36	R	Qt?	Cy,H	N	Top of board cover	.9	2.09	8-31-48
13ca	Town of Wheat-land	Dr	335	12	S	Tu	T,E	M	Land surface	.0	40	6- -48
15ab	Roger Mills	Du	.....	36	Gal	Qt	Cy,H	N	Top of board cover	.9	7.50	8-31-48
15db	Clarence Stump	Dr	90	4	S	Tu	Cy,E	D,S	Top of casing	-3.4	23.79	9-24-48
18aa	George Bower	Dr	57	4	S	Qt	J,E	D,S	Land surface	.0	7	3- 4-49
19aa	H. Cochran	Du	40	48	W	Qt	Cy,E	D,S	Top of casing	1.1	12.50	3- 4-49
19dc	....	Dr	.....	6	S	Qt	Cy,H	S	Bolt hole in pump base	.7	3.88	9-14-48
20bb	R. A. Brown	Dr	35	6	S	Qt	Cy,E	D,S	Top of casing	.8	8.83	9-31-48
21bb	....	Dr	40	6	S	Qt	Cy,E	S	Top of board cover	.5	8.47	9-31-48
25ad	T. Thor	Dr	244	6	S	Tu	Cy,W	D,S	Top of casing	.6	187.96	9- 8-48
26cc	Rachel Gear-hart	Dr	120	6	S	Tu	Cy,W	D,S	.......do........	.8	62.46	9-10-48
27aa	Don Hunten	Dr	140	6	S	Tu?	Cy,E	D,S	Land surface	.0	120	9-23-48
32ba	Walter Norvel	Dr	60	10	S	Qt?	Cy,W	D,S	Top of casing	1.4	31.32	8-25-48
34ba	Mr. Rutz	Dr	150	4	S	Tu	Cy,E	D,S	Land surface	.0	80	3-21-49
35dd	W. A. Beran	Dr	265	..	...	Tu	J,E	N	Top of casing	-5.2	41.79	9-10-48
24-69- 1ab	....	Dr	.....	6	S	Qt	......	N	Top of blocks on casing	1.9	19.67	8-31-48
12dc	James Maguire	Dr	.....	6	S	Qt	Cy,G	D,S	Top of casing	.5	3.61	3-21-49
24aa	G. J. Ryan	Du	.....	6	S	Qt	Cy,H	D	Top of board cover	.6	4.54	8-31-48
25-67-27cc	Lester Cobb	Dr	150	6	S	Tu	Cy,W	S	Top of casing	.5	84.12	9- 8-48
31aa	Claude Foulk	Dr	126	6	S	Tu	Cy,E	D	Hole in base of pump	.3	62.64	9- 8-48
31cc	E. T. Hall	Du,Dr	28	36	C	Qt	J,E	D	Top of steel rim	.4	12.74	9- 4-48
32dc	Wm. Eichler	Dr	100	4	S	Tu	Cy,E	D	Land surface	.0	20	3-21-49
33dc	John Geringer	Du	21	24	S	Qt	T,E	D,S	Top of board cover	.7	4.19	9- 4-48

25-68-32aa	F. A. Beard	Du	10	16	Gal	Qt	Cy,H	...	Base of pump	.4	4.20	9-14-48
33dc	Lester Pitts	Du	8	24	C	Qt	Cy,H	N	Top of board cover	.5	2.44	9- 4-48
35dd	J. Foos, Jr.	Du	.....	24	C	Qt	Cy,H	D	........do.......	.2	5.37	9- 4-48

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