UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PUMPAGE DATA FROM IRRIGATION WELLS IN EASTERN LARAMIE COUNTY, WYOMING, AND KIMBALL COUNTY, NEBRASKA

By Charles Avery

Open-File Report 83-29

Cheyenne, Wyoming

1983

UNITED STATES DEPARTMENT OF THE INTERIOR

JAMES G. WATT, Secretary

GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information
write to:

District Chief
U.S. Geological Survey
2120 Capitol Avenue
P.O. Box 1125
Cheyenne, WY 82003

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CONTENTS

ILLUSTRATIONS

TABLES

CONVERSION FACTORS

Factors for converting inch-pound units to metric units of the terms used in this report are listed below.

Multiply	By	To obtain
acre	0.4047	square hectometer
foot (ft)	0.3048	meter
gallon per minute (gal/min)	0.06309	liter per second
inch (in.)	25.40	millimeter

PUMPAGE DATA FROM IRRIGATION WELLS IN EASTERN LARAMIE COUNTY, WYOMING, AND KIMBALL COUNTY, NEBRASKA

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ABSTRACT

Quantitative information concerning pumpage by irrigation wells is an integral component of the U.S. Geological Survey High Plains Regional Aquifer-System Analysis. Thus, operation time, discharge rate, and irrigated acreage were measured at approximately 450 randomly selected irrigation wells within ten areas of the High Plains during the 1980 irrigation season. The data were used to estimate the seasonal mean application of water to crops and to project total pumpage by irrigation wells in 1980 throughout the High Plains area.

As part of the sampling effort, 50 irrigation wells were randomly chosen from the area of eastern Laramie County, Wyoming, and Kimball County, Nebraska. Required information was collected on only 40 of the wells. For these wells, the seasonal mean application of water on the irrigated land was 15.2 inches. For the major crop types, the seasonal mean application, in inches, were as follows: alfalfa, 19.8; corn, 15.4; potatoes, 13.8; beans, 12.8; and small grains, 10.2.

INTRODUCTION

During 1980, pumpage data were collected at 40 irrigation wells in eastern Laramie County, Wyo., and Kimball County, Nebr. (fig. 1). This study was one of ten simultaneous studies conducted in Colorado, Kansas, Nebraska, New Mexico, Oklahoma, Texas, and Wyoming. Approximately 450 randomly selected irrigation wells were inventoried in the ten areas. Operation time, discharge rate, and the irrigated crop acreage associated with each well were measured in order to estimate application of water to crops. The methods for collecting the required information were evaluated using data collected from two test areas on the High Plains in 1979 (Heimes and Luckey, 1980).

The data collection was initated by the U.S. Geological Survey for the High Plains Regional Aquifer-System Analysis, which will evaluate the response of the aquifer system to ground-water-management alternatives (Weeks, 1978). The evaluation will be accomplished by computer simulations of the response of the aquifer system to imposed stresses. Pumpage as an imposed stress is an integral component of these simulations. The collected data aided in estimating the total pumpage by irrigation wells in the High Plains area for the 1980 season.

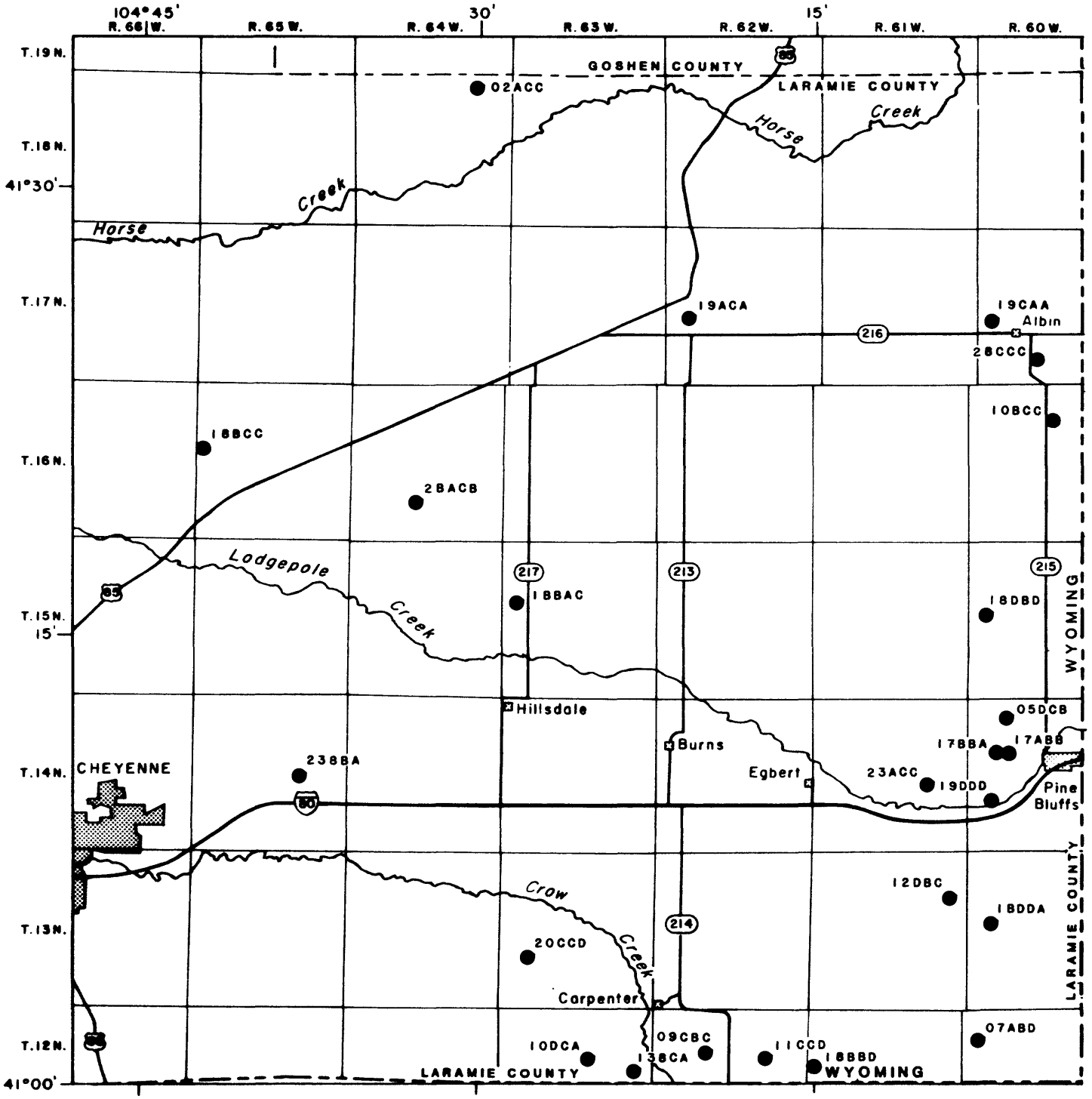
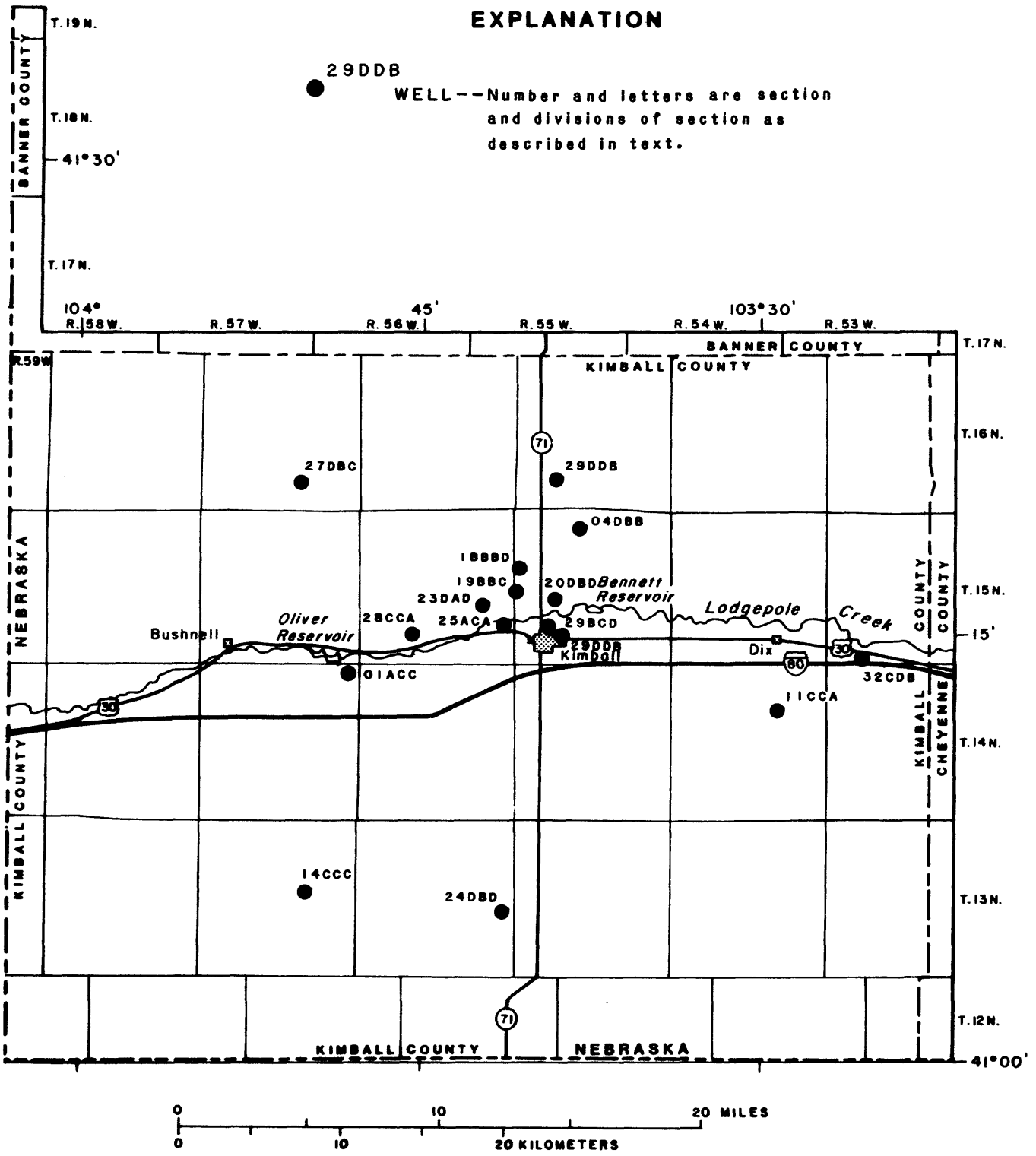


Figure 1.--Location of pumpage-data-collection sites in eastern Laramie County, Wyoming, and Kimball County, Nebraska.


EXPLANATION
29DDB
WELL--Number and letters are section and divisions of section as described in text.
T.19N.
BANNER COUNTY
T.18N.
41°30'
T.17N.
104°
45'
103°30'
R.58W.
R.57W.
R.56W.
R.55W.
R.54W.
R.53W.
R.59W
BANNER COUNTY
KIMBALL COUNTY
T.17N.
T.16N.
T.15N.
15'
T.14N.
T.13N.
T.12N.
41°00'
NEBRASKA
KIMBALL COUNTY
KIMBALL COUNTY
CHEYENNE COUNTY
27DBC
29DDB
04DBB
18BBD
19BBC
20DBD
23DAD
28CCA
25ACA
29BCD
29DDB
01ACC
11CCA
32CDB
14CCC
24DBD
Bennett Reservoir
Lodgepole Creek
Oliver Reservoir
Bushnell
Kimball
Dix
71
30
80
0 10 20 MILES
0 10 20 KILOMETERS

Acknowledgments

The author thanks all the people who permitted access to their irrigation systems. In many cases, additional information was required and was willingly given by the irrigators. Robert E. Hahn, District Manager of the South Platte Natural Resources District, located current owners of several wells which had changed ownership since their registration with the State of Nebraska. Harold L. (Toby) Miskimins, Water Commissioner for Division 1, District 1, also located current owners of several wells which had changed ownership since their registration with the Wyoming State Engineer's Office. Martin Ferguson of Carpenter, Wyo., allowed his inline flowmeter to be removed from his well and calibrated at a test facility. The Wyoming State Engineer's Office and the Nebraska Department of Natural Resources provided lists of irrigation wells within the study area.

Well-Numbering System

Wells cited in this report are numbered by a method based on the U.S. Bureau of Land Management system of land subdivision (fig. 2). The first number indicates the township, the second the range, and the third the section in which the well is located. The N following the township number indicates that the township lies north of the regional baseline, and the W following the range number indicates that the range lies west of the regional Sixth Principal Meridian. Uppercase letters following the section number indicate the position of the well in the section. The first letter denotes the quarter section, the second letter the quarter-quarter section, and the third letter the quarter-quarter-quarter section (10-acre tract). The subdivisions of a section are lettered A, B, C, and D in a counterclockwise direction, starting in the northeast quarter. If more than one well is listed in a 10-acre tract, consecutive numbers starting with 01 follow the uppercase letter of the well number. If a section does not measure 1-mile square, it is treated as a full section with the southeast section corner serving as the reference point for the subdivision of the section.

METHODS OF DATA COLLECTION

Seventy-five wells were randomly selected from a listing of all irrigation wells in the study area. Wells from the random list were included in the program until 50 wells satisfied the following criteria: A distinct acreage was irrigated only by the selected well, the owner expressed the intention to use the well during the season, and permission to collect pumpage data was granted by the well owner. Ten of the wells were later dropped from the program because water commingled with other water sources during the season, the well was not pumped, a discharge measurement could not be made, or the operation-time information was not collected.

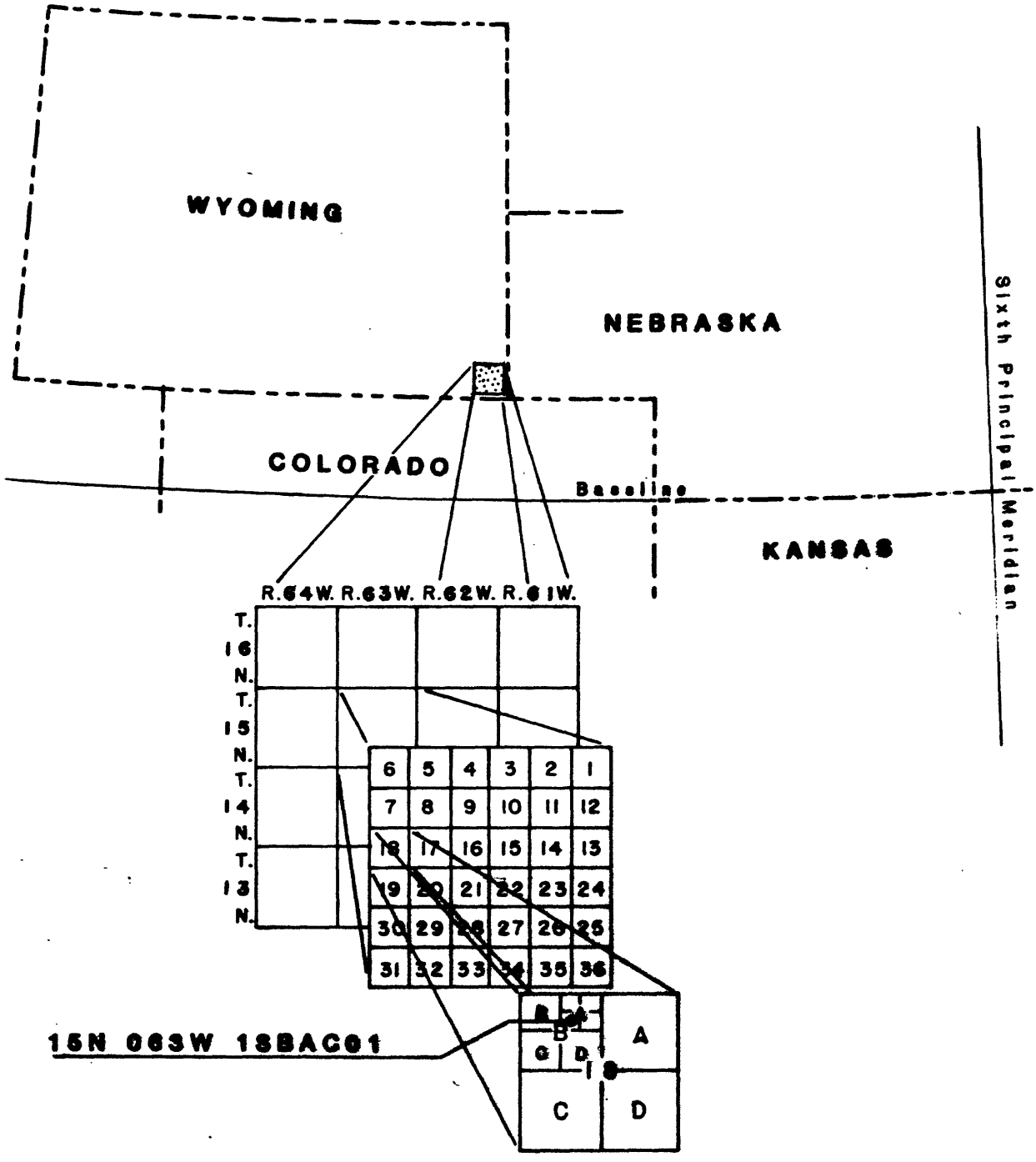


Figure 2.--Well-numbering system.

Operation time of each well was collected with a vibration-time totalizer, otherwise called a sentry. A sentry is activated by the vibration of an operating pump and registers the time by an electrochemical process. The operation time was also collected from other available means such as electric meters, inline flowmeters, and engine-hour meters. The time of operation was obtained from the engine-hour meter by reading the elapsed time directly from the meter. The operation time was obtained from the electric meter or the inline flowmeter by reading the elapsed kilowatt-hours of electricity used and dividing by the instantaneous kilowatt demand or by noting the volume of water pumped and dividing by the discharge rate.

At each well, discharge rates were measured at least once with a transient-time flowmeter. With this meter, ultrasonic pulses are passed through the water between two transducers held against the outside wall of the discharge pipe. An analog computer in the meter calculates the travel time of the sound waves in the downstream and upstream directions and computes a discharge rate. To accurately measure the flow, the transient-time flowmeter requires a full pipe of water with few entrained air bubbles and a straight unobstructed length of pipe at least five times the diameter of the pipe. Because the meter operates outside the pipe, it is ideal for measuring flows in closed-pipe systems. Further discussion of the instrument is given by Luckey and others (1980).

Discharge rates were measured by several other methods to compare with the measurements obtained from the transient-time flowmeter and to provide a discharge measurement when one could not be obtained by the transient-time flowmeter. At wells equipped with inline flowmeters, a discharge rate was computed from the inline flowmeter at the time of the transient-time flowmeter measurement. The inline flowmeter at well 12N 062W 09CBC01 was removed from the well prior to the irrigation season and calibrated at a test facility. This was done to provide a reliable check of the measurements made with the transient-time flowmeter. The measurements by the transient-time flowmeter were within 1 percent of the inline-flowmeter measurement except for the July 14 measurements which were within 5 percent.

At wells where the water was discharged to an open ditch, the trajectory method was used to estimate the discharge. This method involves measuring the distance at which a stream of water falls 12 inches from the line of the discharge pipe (Anderson, 1977, p. 156). At well 13N 060W 18DDA01, a trajectory estimate was made along with the transient-time-flowmeter measurement except on September 2 when the discharge had declined such that a full pipe of water could not be maintained for a transient-time-flowmeter reading. At that time, only the trajectory estimate was made.

A volumetric method was used to obtain an additional measurement on gated-pipe systems. This method, sometimes called the bucket-and-stopwatch method, involves measuring the time required to fill a bucket of known volume with water from at least 10 percent of the open gates. An estimate is made of the total discharge from the well by multiplying the discharge at the sample gates by the total number of gates. At well 14N 057W 01ACC01, the discharge was measured on August 1 by only the volumetric method because there was too much entrained air in the discharge pipe for the transient-time flowmeter to operate properly.

EXPLANATION OF DATA

Pumpage data, including information on well depth, type of power, operation time, discharge, type of crop, irrigated acreage, and the estimated application to the crop, are given in table 1 (eastern Laramie Co., Wyo.) and in table 2 (Kimball Co., Nebr.) at the back of this report.

The average discharge was the average of the measurements made with the transient-time flowmeter. Discharge measurements made by the other methods were used for three wells when the measurement was critical in defining a variation or trend in discharge.

The estimated operation time per crop was obtained from the average accumulated time on two sentries attached side by side at each well except for two wells. The sentries at two wells failed to register any time, and the time determined from the electric meter was used to estimate the operation time per crop. If the sentries were kept on a well continuously throughout the season, the estimated time per crop was the operation time multiplied by the ratio of the acreage of one crop to the total acreage irrigated by the system. Two intervals of operation-time record were created if multiple crops with different seasonal water requirements were irrigated from the same well. The sentries were not always read exactly when the irrigation schedule changed, and corrections were made to the estimated operation time per crop for each particular crop from information supplied by the irrigator. This information, in addition to other pertinent information, is noted in the remarks columns in tables 1 and 2.

The estimated application is the average depth of water distributed to the crop in a particular field. The estimated application was calculated as follows:

$$\text{Estimated application, in inches} = \frac{\text{average discharge (gal/min)} \times \text{estimated time per crop (hours)}}{\text{irrigated area (acres)} \times 452.6}$$

This is not a determination of consumptive irrigation requirement, although for some operations the water applied may have approximated the requirement for that crop.

SUMMARY OF DATA

Operation time, discharge rate, and the irrigated crop acreage associated with 40 wells were measured during 1980 in eastern Laramie County, Wyo., and Kimball County, Nebr. This information was used to calculate the seasonal mean application for the major crops and for all land irrigated by the 40 wells. Multiple crops irrigated with water from one well or land with successive crop plantings were common in this study area. The best possible attempt, however, was made to determine the operation time associated with each crop or the estimated time per crop.

The seasonal mean application of water for the major crops is the arithmetic mean of the estimated application for the crops at all 40 wells during the entire growing season. Winter wheat crops were not considered because the same crop watered during 1980 also may have been watered after planting in the fall of 1979. Alfalfa crops were included only when they were grown during the entire season.

The seasonal mean application of water on all irrigated land is the arithmetic mean of the estimated application to all the land irrigated from the 40 wells between April and October 1980. On land with successive crop plantings, the application of water on the land was the total estimated application of water on each crop. For example, water from well 14N 060W 17BBA01 irrigated 22 acres of oats for an estimated application of 8.7 inches. On the same land, the oats were followed by alfalfa, which had an estimated application of 10.3 inches of water. As a result, the same 22 acres of land had a total estimated application of 19.0 inches of water. For well 15N 056W 23DAD01, the estimated application of 34.6 inches of water on 9 acres of alfalfa irrigated only during part of the season was included in the calculation of the seasonal mean value along with the estimated application of 63.3 inches of water on 20 acres of alfalfa irrigated the entire season.

Irrigation systems that distributed the water from each of the 40 wells included ditch, gated-pipe, handpipe-sprinkler, side-roll-sprinkler, and center-pivot-sprinkler systems. The seasonal mean application of water of both center-pivot systems and all irrigation systems on the major crops for 1980 from the 40 irrigation wells with complete pumpage data in eastern Laramie County, Wyo., and Kimball County, Nebr., is shown in the following table:

Major crops	Seasonal mean application of water, in inches	
	All irrigation systems	Center-pivot systems
Alfalfa	19.8	15.2
Corn	15.4	14.8
Potatoes	13.8	13.8
Beans	12.8	9.9
Small grains (Spring wheat, barley, oats)	10.2	8.8
All irrigated land	15.2	12.6

REFERENCES

Anderson, K. E., 1977, Water well handbook (4th ed.): Rolla, Mo., Missouri Water Well and Pump Contractors Association, 281 p.

Heimes, F. J., and Luckey, R. R., 1980, Evaluating methods for determining water use in the High Plains in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming; 1979: U.S. Geological Survey Water-Resources Investigations 80-111, 125 p.

Luckey, R. R., Heimes, F. J., and Gaggiani, N. G., 1980, Calibration and testing of selected portable flowmeters for use on large irrigation systems: U.S. Geological Survey Water-Resources Investigations 80-72, 21 p.

Weeks, J. B., 1978, Plan of study for the High Plains regional aquifer-system analysis in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming: U.S. Geological Survey Water-Resources Investigations 78-70, 28 p.

No page 10

PUMPAGE DATA

No page 12

Table 1.--Pumpage data from eastern Laramie County, Wyoming, 1980.

Type of power: D, diesel fuel; E, electricity; N, natural gas.
Other meter: EH, engine-hours meter; I, inline flowmeter
Method: I, inline flowmeter; T, transient-time meter; Tr, trajectory method
Source of data: M, measured; R, reported

Well number	Well depth (feet)	Water level (feet)	Diameter (inches)	Type of power	Motor horsepower	Interval of operation-time record	Average sentry time (hours)	Electric meter time (hours)	Other meter type	Other meter time (hours)	Discharge (gallons per minute)	Date	Method
12N 060W 07ABD01	125	15	36	E	75	04/22-07/11	457	458	I	434	796	06/11	T
											785		I
						07/11-10/23	[1]454	428	I	400	721	07/11	T
											717		I
12N 061W 18BBD01	140	28	18	E	100	04/21-10/23	[1]1,482	1,685	--	--	681	06/12	T
											706	09/02	T
12N 062W 09CBC01	140	50	20	E	30	04/21-08/25	988	951	I	948	828	06/11	T
											839		I
						08/25-10/23	288	243	I	245	844	06/18	T
											846		I
											820	07/14	T
											866		I

Well number	Type of crop	Irrigation system	Irrigated area (acres)	Source of data	Average discharge (gallons per minute)	Estimated operation time per crop (hours)	Estimated application (inches)	Remarks
12N 060W 07ABD01	Alfalfa	Pivot	44	M	758	495	18.8	Sprinkler passed over the 44-acre fallow field at twice the usual speed. The field of barley was fallow after July 11, but owner estimated 62 hours ran on the bare ground. Also, owner estimated newly planted wheat on the previously 44 acres of fallow was watered 29 hours before Oct. 23.
	Barley		36			169	7.9	
	Fallow		44			156	5.9	
12N 061W 18BBD01	Alfalfa	Pivot	121	R	694	1,482	18.8	
12N 062W 09CBC01	Corn	Pivot	64	M	831	782	22.4	The discharge from the well began to surge in late June and surged through remainder of season. Measurement of July 14 was taken about 20 minutes after pump was started after being shut off for 3 days. The well had not yet started surging.
	Barley		64			494	14.2	

See footnotes at end of table.

Table 1.--Pumpage data from eastern Laramie County, Wyoming, 1980-Continued

Well number	Well depth (feet)	Water level (feet)	Diameter (inches)	Type of power	Motor horsepower	Interval of operation-time record	Average sentry time (hours)	Electric meter time (hours)	Other meter type	Other meter time (hours)	Discharge (gallons per minute)	Date	Method
12N 062W 11CDD01	--	64	--	N	--	04/22-10/23	[1]1,730	--	--	--	510	07/07	T
											534	09/02	T
12N 063W 10DCA01	185	22	16	E	--	04/21-10/23	1,543	--	--	--	829	07/09	T
											789	09/02	T
12N 063W 13BCA01	98	14	18	E	75	04/21-10/23	1,718	1,705	--	--	739	06/18	T
13N 060W 18DDA01	100	49	18	E	15	04/22-10/23	1,869	1,796	--	--	609	06/11	T
											540		Tr
											579	07/09	T
											507		Tr
											332	09/02	Tr

Well number	Type of crop	Irrigation system	Irrigated area (acres)	Source of data	Average discharge (gallons per minute)	Estimated operation time per crop (hours)	Estimated application (inches)	Remarks
12N 062W 11CDD01	Corn	Pivot	131	R	522	1,730	15.2	
12N 063W 10DCA01	Potatoes	Pivot	132	R	809	1,543	20.9	
12N 063W 13BCA01	Corn	Pivot	128	R	739	1,718	21.9	
13N 060W 18DDA01	Pasture	Ditch	45	R	507	1,682	41.9	One million gallons, or about 33 hours of average discharge, was used for drilling operation. Measurement on Sept. 2 was partly filled pipe by the trajectory method but is included in the average discharge figure.
	Sudex		5			154	34.5	

See footnotes at end of table.

Table 1.--Pumpage data from eastern Laramie County, Wyoming, 1980--Continued

Well number	Well depth (feet)	Water level (feet)	Diameter (inches)	Type of power	Motor horsepower	Interval of operation-time record	Average sentry time (hours)	Electric meter time (hours)	Other meter type	Other meter time (hours)	Discharge (gallons per minute)	Date	Method
13N 061W 12DBC01	115	4	16	E	75	04/23-10/23	[1]1,436	1,319	--	--	612	07/21	T
											594	09/10	T
13N 063W 20CCD01	275	71	16	E	75	04/30-10/23	1,665	1,608	--	--	563	06/18	T
											546	07/29	T
											560	09/02	T
14N 060W 05DCB01	80	27	18	E	60	04/23-10/20	([2])	1,135	--	--	940	06/12	Tr
											706	07/29	T

Well number	Type of crop	Irrigation system	Irrigated area (acres)	Source of data	Average discharge (gallons per minute)	Estimated operation time per crop (hours)	Estimated application (inches)	Remarks
13N 061W 12DBC01	Potatoes	Pivot	125	R	603	1,436	15.3	
13N 063W 20CCD01	Alfalfa	Pivot	95	R	556	1,665	21.5	
14N 060W 05DCB01	Corn	Pivot	134	R	706	1,015	11.8	Owner estimated that water was discharged for 120 hours from open pipe to a ditch to irrigate alfalfa. Discharge rates are significantly different between open discharge on June 12 and closed pipe to the pivot on July 29.
	Alfalfa	Ditch	15		940	120	16.6	

See footnotes at end of table.

Table 1.--Pumpage data from eastern Laramie County, Wyoming, 1980--Continued

Well number	Well depth (feet)	Water level (feet)	Diameter (inches)	Type of power	Motor horsepower	Interval of operation-time record	Average sentry time (hours)	Electric meter time (hours)	Other meter type	Other meter time (hours)	Discharge (gallons per minute)	Date	Method
14N 060W 17ABB01	80	26	18	E	100	04/22-07/29	[1]888	--	--	--	860	06/17	T
						07/29-10/20	566	--	--	--	870	09/03	T
						04/22-10/20	--	1,372	--	--			
14N 060W 17BBA01	145	31	26	E	100	04/22-07/28	385	385	--	--	1,030	06/17	T
						07/28-10/20	426	391	--	--	943	09/03	T
14N 060W 19DDD01	120	70	15	E	15	04/23-10/20	634	561	--	--	430	07/07	T
											311	08/01	T

Well number	Type of crop	Irrigation system	Irrigated area (acres)	Source of data	Average discharge (gallons per minute)	Estimated operation time per crop (hours)	Estimated application (inches)	Remarks
14N 060W 17ABB01	Corn	Pivot	60	R	865	415	13.2	
	Potatoes		54			373	13.2	
	Barley	Pivot	130			666	9.8	
14N 060W 17BBA01	Potatoes	Pivot	45	R	986	243	11.8	Owner estimated that potatoes were watered 30 hours before July 28.
	Barley		67			267	8.7	The alfalfa was grown in the field of oats and a third of the field
	Oats		22			88	8.7	of barley after July 28. Only the potatoes and alfalfa were watered
	Alfalfa		45			213	10.3	after July 28.
14N 060W 19DDD01	Corn	Gated pipe	35	R	370	493	11.5	
	Alfalfa		10			141	11.5	

See footnotes at end of table.

Table 1.--Pumpage data from eastern Laramie County, Wyoming, 1980--Continued

Well number	Well depth (feet)	Water level (feet)	Diameter (inches)	Type of power	Motor horsepower	Interval of operation-time record	Average sentry time (hours)	Electric meter time (hours)	Other meter type	Other meter time (hours)	Discharge (gallons per minute)	Date	Method
14N 061W 23ACC01	125	65	21	E	59	04/22-07/29	498	--	--	--	422	08/01	T
						07/29-10/20	758	--	--	--			
						04/22-10/20	--	1,085	--	--			
14N 065W 23BBA01	365	206	12	E	75	04/30-09/02	1,011	1,013	--	--	572	06/18	T
						09/02-10/23	211	203	--	--	540	07/29	T
15N 060W 18DBD01	98	52	18	E	40	04/23-07/08	[1]583	511	--	--	402	06/17	T
											340	07/08	T

Well number	Type of crop	Irrigation system	Irrigated area (acres)	Source of data	Average discharge (gallons per minute)	Estimated operation time per crop (hours)	Estimated application (inches)	Remarks
14N 061W 23ACC01	Barley	Pivot	64	R	422	415	6.0	Owner estimated that potatoes were watered 83 hours before July 29; barley was not watered after July 29; and newly planted wheat was watered for 90 hours before Oct. 20.
	Potatoes		64			751	10.9	
14N 065W 23BBA01	Spring wheat	Pivot	62	M	556	480	9.5	Owner estimated that grass sod was watered 50 hours after shutting off water to spring wheat before Sept. 2.
	Grass sod		62			742	14.7	
15N 060W 18DBD01	Winter wheat	Sprinkler	54	M	371	374	5.7	Owner estimated that crops were watered for 18 hours after July 8.
	Oats		33			227	5.6	

See footnotes at end of table.

Table 1.--Pumpage data from eastern Laramie County, Wyoming, 1980--Continued

Well number	Well depth (feet)	Water level (feet)	Diameter (inches)	Type of power	Motor horsepower	Interval of operation-time record	Average sentry time (hours)	Electric meter time (hours)	Other meter type	Other meter time (hours)	Discharge (gallons per minute)	Date	Method
15N 063W 18BAC01	220	95	16	75	E	04/30-10/20	1,118	1,085	--	--	650	06/18	T
											551	09/03	T
16N 060W 10BCC01	197	15	16	50	E	04/29-10/20	[1]692	673	--	--	172	07/07	T
											214	07/08	T
											196	09/03	T
16N 064W 28ACB01	380	162	--	--	D	04/30-10/20	289	--	--	--	768	06/18	T
16N 065W 18BCC01	365	180	30	--	D	04/29-10/20	1,096	--	EH	1,080	742	06/17	T
											673	07/08	T

Well number	Type of crop	Irrigation system	Irrigated area (acres)	Source of data	Average discharge (gallons per minute)	Estimated operation time per crop (hours)	Estimated application (inches)	Remarks
15N 063W 18BAC01	Corn	Pivot	123	R	600	1,118	12.0	
16N 060W 10BCC01	Alfalfa	Sprinkler	10	M	205	577	26.1	The well has two pump settings which results in two distinct discharge rates. The owner estimated that the alfalfa was watered twice as long per acre as the wheat and at the higher discharge at which the July 8 and Sept. 3 measurements were made.
	Spring wheat		5		172	115	8.7	
16N 064W 28ACB01	Alfalfa	Pivot	118	M	768	289	4.2	The well was only used early in the summer for one crop of alfalfa.
16N 065W 18BCC01	Alfalfa	Pivot	75	R	708	548	11.4	
	Oats		75			548	11.4	

See footnotes at end of table.

Table 1.--Pumpage data from eastern Laramie County, Wyoming, 1980--Continued

Well number	Well depth (feet)	Water level (feet)	Diameter (inches)	Type of power	Motor horsepower	Interval of operation-time record	Average sentry time (hours)	Electric meter time (hours)	Other meter type	Other meter time (hours)	Discharge (gallons per minute)	Date	Method
17N 060W 19CAA01	446	217	16	E	150	04/29-07/28	916	903	--	--	698	06/17	T
						07/28-10/20	820	781	--	--	599	07/28	T
											586	09/03	T
17N 060W 28CCC03	345	200	16	E	100	04/29-07/28	750	750	--	--	701	06/17	T
						07/28-10/20	638	569	--	--	681	07/29	T
17N 062W 19ACA01	371	270	16	E	125	04/29-08/19	861	866	--	--	626	07/08	T
						08/19-10/20	198	197	--	--	635	08/19	T
18N 064W 02ACC01	260	--	16	D	--	04/29-10/20	360	--	--	--	94	07/07	T

Well number	Type of crop	Irrigation system	Irrigated area (acres)	Source of data	Average discharge (gallons per minute)	Estimated operation time per crop (hours)	Estimated application (inches)	Remarks
17N 060W 19CAA01	Potatoes	Pivot	100	R	592	865	11.3	Discharge measurement of June 17 was made on pivot irrigating barley. The other two measurements, which were significantly different from the June 17 measurement, were made on the pivot irrigating potatoes. Owner estimated that potatoes had 95 hours of water before July 28 and barley had 50 hours of water after July 28.
	Barley	Pivot	126		698	871	10.7	
17N 060W 28CCC03	Potatoes	Pivot	126	M	691	1,013	12.3	Oats were not watered after July 28.
	Oats	Pivot	124			375	4.6	
17N 062W 19ACA01	Alfalfa	Pivot	31	M	630	194	8.7	Alfalfa was planted over 32 acres of oats midway through the season. Therefore, a total of 63 acres of alfalfa was watered after Aug. 19. Owner estimated that the alfalfa was watered for 72 hours after the oats were harvested before Aug. 19. The same 31 acres of alfalfa were irrigated throughout the season and had a total estimated application of 14.7 inches.
	Oats		95			595	8.7	
	Alfalfa		63			270	6.0	
18N 064W 02ACC01	Alfalfa	Sprinkler	19	M	94	360	3.9	The well was only used early in the summer for one crop of alfalfa.

[1] One sentry malfunctioned, one time obtained
[2] Both sentries malfunctioned, no time obtained

Table 2.--Pumpage data from Kimball County, Nebraska, 1980.

Type of power: D, diesel fuel; E, electricity
Method: B, bucket and stopwatch; T, transient-time meter
Source of data: M, measured; R, reported

Well number	Well depth (feet)	Water level (feet)	Diameter (inches)	Type of power	Motor horsepower	Interval of operation-time record	Average sentry time (hours)	Electric meter time (hours)	Engine-hour meter time	Discharge (gallons per minute)	Date	Method
13N 056W 24DBD01	280	228	16	E	100	04/25-10/21	908	823	--	443	08/01	T
13N 057W 14CCC01	100	44	22	E	15	04/25-10/20	1,437	1,487	--	331	06/09	T
										339	06/10	T
										372	07/31	T
14N 054W 11CCA01	290	230	16	D	--	04/24-10/22	1,004	--	--	958	07/30	T
14N 057W 01ACC01	90	58	16	E	50	04/25-10/20	1,447	1,334	--	578	06/11	T
										698	08/01	B

Well number	Type of crop	Irrigation system	Irrigated area (acres)	Source of data	Average discharge (gallons per minute)	Estimated operation time per crop (hours)	Estimated application (inches)	Remarks
13N 056W 24DBD01	Feed grain	Pivot	73	R	443	663	8.9	
	Alfalfa		27			245	8.9	
13N 057W 14CCC01	Corn	Ditch	25	R	347	651	20.0	Owner stated that corn was irrigated five times and alfalfa was irrigated six times during the season. Four hours of water to drilling operation.
	Alfalfa		20			782	30.0	
14N 054W 11CCA01	Beans	2 Pivots	252	M	958	1,004	8.4	
14N 057W 01ACC01	Corn	Pivot	24	M	578	236	12.6	Owner estimated that two-thirds of pumping time spent on pivot. Discharge measurement on June 11 made on closed pipe to pivot. On Aug. 1, measurement was made on open discharge from gated pipe and is significantly different from June 11 measurement.
	Alfalfa		50			492	12.6	
	Beans		24			236	12.6	
	Corn	Gated pipe	16	M	698	322	31.0	
	Beans		8			161	31.0	

See footnotes at end of table.

Table 2.--Pumpage data from Kimball County, Nebraska, 1980--Continued

Well number	Well depth (feet)	Water level (feet)	Diameter (inches)	Type of power	Motor horsepower	Interval of operation-time record	Average sentry time (hours)	Electric meter time (hours)	Engine-hour meter time	Discharge (gallons per minute)	Date	Method
15N 053W 32CDB01	200	78	16	D	--	04/25-10/22	1,414	--	--	593	07/10	T
15N 055W 04DBB01	410	211	16	D	--	04/26-10/20	[1]807	--	729	949	06/10	T
										948	07/31	T
15N 055W 18BBD01	186	76	16	E	60	04/24-10/22	1,363	1,407	--	428	06/10	T
										519	07/31	T
15N 055W 19BBC01	147	87	18	E	30	04/24-10/21	1,124	1,314	--	344	07/30	T
										356		B

Well number	Type of crop	Irrigation system	Irrigated area (acres)	Source of data	Average discharge (gallons per minute)	Estimated operation time per crop (hours)	Estimated application (inches)	Remarks
15N 053W 32CDB01	Corn	Pivot	110	R	593	1,414	16.8	
15N 055W 04DBB01	Beans	Pivot	240	R	948	807	7.0	
15N 055W 18BBD01	Corn	Pivot	35	R	474	540	16.2	After the winter wheat was harvested, the feed grain was planted in the field. Pivot ran four times faster when passing over the 28 acres of winter wheat and later the feed grain than it did over the other 84 acres.
	Alfalfa		49			755	16.1	
	Winter wheat		28			34	1.3	
	Feed grain		28			34	1.3	
15N 055W 19BBC01	Beans	Gated pipe	30	R	344	642	16.3	The owner estimated that alfalfa had 25 percent more water per acre applied.
	Alfalfa		18			482	20.4	

See footnotes at end of table.

Table 2.--Pumpage data from Kimball County, Nebraska, 1980--Continued

Well number	Well depth (feet)	Water level (feet)	Diameter (inches)	Type of power	Motor horsepower	Interval of operation-time record	Average sentry time (hours)	Electric meter time (hours)	Engine-hour meter time	Discharge (gallons per minute)	Date	Method
15N 055W 20DBD01	200	19	16	E	75	04/24-10/21	1,156	1,101	--	702	07/10	T
15N 055W 29BCD01	72	48	18	E	20	04/24-10/21	[1]626	583	--	343	07/10	T
15N 055W 29DDB01	200	48	16	E	50	04/24-10/21	1,907	1,971	--	392	06/10	T
										413	08/01	T
										403	09/10	T
15N 056W 23DAD01	270	70	12.75	E	40	04/25-07/10	[1]853	830	--	533	06/10	T
						07/10-10/21	851	826	--			

Well number	Type of crop	Irrigation system	Irrigated area (acres)	Source of data	Average discharge (gallons per minute)	Estimated operation time per crop (hours)	Estimated application (inches)	Remarks
15N 055W 20DBD01	Corn	Pivot	63	M	702	573	14.1	
	Beans		64			583	14.1	
15N 055W 29BCD01	Alfalfa	Sprinkler	19	M	343	441	17.6	
	Corn	Ditch	8			185	17.5	
15N 055W 29DDB01	Pasture	Pivot	62	M	403	1,907	27.4	
15N 056W 23DAD01	Oats	Gated pipe	15	R	533	366	28.7	Oats were not watered after July 10. The 29 acres of alfalfa includes the 20 acres watered before July 10 and an additional 9 acres which was watered from this well after July 10. The 20-acre field of alfalfa had a total estimated application of 63.3 inches.
	Alfalfa		20			487	28.7	
	Alfalfa		29			851	34.6	

See footnotes at end of table.

Table 2.--Pumpage data from Kimball County, Nebraska, 1980--Continued

Well number	Well depth (feet)	Water level (feet)	Diameter (inches)	Type of power	Motor horsepower	Interval of operation-time record	Average sentry time (hours)	Electric meter time (hours)	Engine-hour meter time	Discharge (gallons per minute)	Date	Method
15N 056W 25ACA01	180	10	16	E	40	04/23-10/21	([2])	2,046	--	304	06/09	T
										331	06/11	T
										354	07/31	T
										366	09/10	T
15N 056W 28CCA01	200	97	16	D	--	04/25-10/21	1,073	--	--	637	06/10	T
16N 055W 29DDB01	375	150	18	E	100	04/26-10/22	827	765	--	711	07/30	T
16N 057W 27DBC01	330	255	16	E	100	04/26-10/22	744	815	--	553	06/10	T

Well number	Type of crop	Irrigation system	Irrigated area (acres)	Source of data	Average discharge (gallons per minute)	Estimated operation time per crop (hours)	Estimated application (inches)	Remarks
15N 056W 25ACA01	Alfalfa	Pivot	83	M	339	2,046	18.5	
15N 056W 28CCA01	Alfalfa	Pivot	127	R	637	929	10.3	Owner estimated that corn was irrigated for 144 hours.
	Corn	Gated pipe	20			144	10.1	
16N 055W 29DDB01	Beans	Pivot	62	R	711	413	10.5	
	Spring wheat		62			414	10.5	
16N 057W 27DBC01	Beans	Pivot	44	M	553	248	6.9	Two-thirds of pumping time spent on pivot.
	Corn		44			248	6.9	
	Corn	Gated pipe	12	M		90	9.2	
	Beans		21			158	9.2	

[1] One sentry malfunctioned, one time obtained.
[2] Both sentries malfunctioned, no time obtained.