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Rural Water Supplies in South Dakota : Hand County

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Rural Water Supplies in South Dakota

HAND County

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RURAL WATER SUPPLIES

IN

SOUTH DAKOTA

HAND COUNTY

BY

WALTER V. SEARIGHT

AND

ELMER E. MELEEN

**THIS BOOK DOES
NOT CIRCULATE**

PREPARED BY THE WORK PROJECTS ADMINISTRATION
AS A REPORT ON THE WELL SURVEY CONDUCTED
AS WORK PROJECTS ADMINISTRATION OFFICIAL PROJ-
ECT 665-74-3-126. SPONSORED BY THE EXTENSION
SERVICE AND THE EXPERIMENT STATION SOUTH DAK-
OTA STATE COLLEGE IN COOPERATION WITH THE
STATE GEOLOGICAL SURVEY.

JANUARY 1940

FOREWORD

This study was first proposed as a project of the Mineral Resources Committee of the State Planning Board under the direction of the State Geological survey and undertaken as a Work Projects Administration project sponsored by the State Planning Board, and was continued under the Planning Board until that body was abolished July 1, 1939 by the State Legislature. At that time sponsorship was transferred to the South Dakota Agricultural Experiment Station and the State College Extension Service, South Dakota State College. Field work was begun October 1, 1938 and was practically completed by February 15, 1939. Workers were assigned in the several counties under the supervision and direction of the County Agricultural Agents and Field Supervisors who were employed by the Work Projects Administration. Questionnaires were mailed out from the offices of the County Agents and were checked and tabulated in these offices. The material was then forwarded to the central office for final tabulation and analysis under the direction of Elmer E. Meleen and Walter V. Searight.

Particular credit should be given to the individual County Agricultural Agents in the various counties of the state who arranged the contacts with the individuals from whom these data were collected, furnished a large portion of the necessary supplies for field work, and directed the workers engaged in collecting field data. Without this assistance in gathering basic data, this study could not have been conducted. The value of the report is therefore in direct proportion to the accuracy and adequacy of these basic data.

INTRODUCTION

Purpose

This report on rural water supplies of South Dakota has been prepared to present data recently made available on the types and the sources of water supply, exclusive of stream, lake and dam waters. The information presented is of importance to evaluate present supplies. It should also prove useful as a basis for further development of supplies where they are needed or become necessary. Further, the facts presented should also prove to be of value in any program of water conservation.

SOURCES OF INFORMATION

Questionnaires were sent to all, or essentially all of the farmers of the state, asking for complete data on farm wells and supplementary supplies, with the exception of the supplies above noted. A most gratifying number returned questionnaires, actually 60.1% average for the entire state. The coverage is probably more than 60.1% since it is likely that many unanswered inquiries were those to farmers who were without wells, the type of supply emphasized in the questionnaires. The data thus obtained were supplemented with information contained in the files of the State Geological Survey, the office of the State Engineer, and reports of the United States Geological Survey. This supplementary information, together with that contained in questionnaires was used in making the well location maps included in this report.

PROCEDURE

All data from the questionnaires were tabulated and analyzed statistically by counties, which were made the areal units of study. Within the county,

Acknowledgments - The authors wish especially to acknowledge and commend the conscientious assistance of Mr. E. L. Woodburn, Supervisor, for careful and painstaking supervision of statistical work. The authors also desire to express appreciation for the constant interest and support of this project by Mr. Bob Butts, Director of Research and Records Projects, South Dakota Work Projects Administration.

supplies were allocated as to kind on county maps. Since shallow waters are the most important source of rural supply in South Dakota, wells 200 feet deep and less were plotted on county maps from which maps indicating depths of wells by 50 foot intervals were made. Springs, shown on the well location map, and cisterns were also tabulated as important supplementary supplies, although the latter do not appear on maps or in the tables in this report.

PRESENTATION OF DATA

For convenience and utility, this report has been divided into sections each covering one county, and each county section bound separately. Each county report contains the following material wherever possible.

1. Well Location Map: This map shows the location of all wells and springs within the county, so far as information is now available. These have been plotted in such a manner that artesian and shallow wells can be differentiated readily by the reader. Artesian wells, where they occur, are divided into flowing and pumped. Artesian wells showing decreased flow and those reported as controlled are also indicated by symbols. Shallow wells are differentiated as adequate and inadequate, and dry holes as of 1938 are located. Wells from other sources of information other than questionnaires collected by this survey are shown in blue.

2. Shallow Well Map: This map shows, as accurately as possible, in 50 foot intervals, the depths at which shallow supplies are commonly obtained. Where shallow wells are abundant, as indicated by the well location map, the map is as accurate as the information on which it is based, but where such wells are sparsely distributed errors are likely to occur. In many places reports of shallow wells are absent in which case the area has been left blank.

3. Table of Pumped Wells, from 0 to 200 feet (inclusive) in depths:
This table shows minimum, maximum, and average depths of wells within the county, as reported in the questionnaires. Tabulations are by townships. The general character of the water, hard, medium, and soft, as reported by farm-

ers, and the number of wells suitable or unsuitable for drinking are shown in this table. Further, the adequacy of supply and use for irrigation are shown here.

4. Table of Wells greater in depth than 200 feet: Minimum, maximum, and average depths are indicated. Character, reported as hard, medium or soft is tabulated. Adequacy and use for irrigation are shown as in the preceding table.

5. Table of flowing wells: Minimum, maximum, and average depths are shown together with general character and use for irrigation. The volume of flow as reported, and the number of flowing wells reported as equipped with control valves is also included in this table.

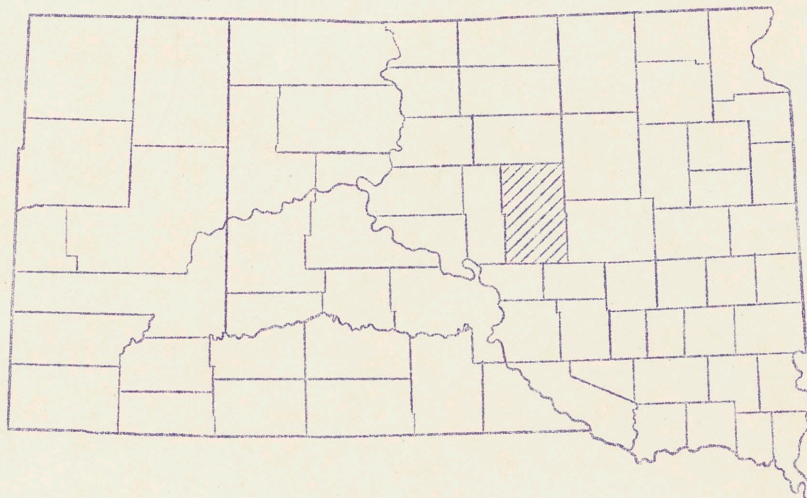
SUMMARY OF STATE SUPPLIES

In the entire state, a total of 48,479 wells were reported in response to questionnaires, returned by 60.1% of the recipients. If those who did not respond have a number of wells in proportion to those who reported, there are approximately 80,000 wells in South Dakota. There are possibly many less than this number since several counties with large numbers of wells returned over 75% of the questionnaires and since many farmers without wells did not reply because they were not requested to do so in the formal questionnaire. Of the wells reported, 16.2% are artesian, including both pumped and flowing wells. Shallow wells are 83.8% of the wells reported. Wells from shallow sources are thus obviously by far the most important means for obtaining water in rural South Dakota.

Important supplementary supplies are cisterns and springs. Roughly, there is more than one cistern to each 40 wells. Many springs are reported, however, in counties with very few wells, so that in some localities they are of considerable importance.

HAND COUNTY

Hand county is located in east central South Dakota, approximately midway between the James and Missouri rivers. It is bounded on the west by Hyde county, on the north by Faulk county, on the east by Spink and Beadle counties and on the south by Jerauld and Buffalo counties.



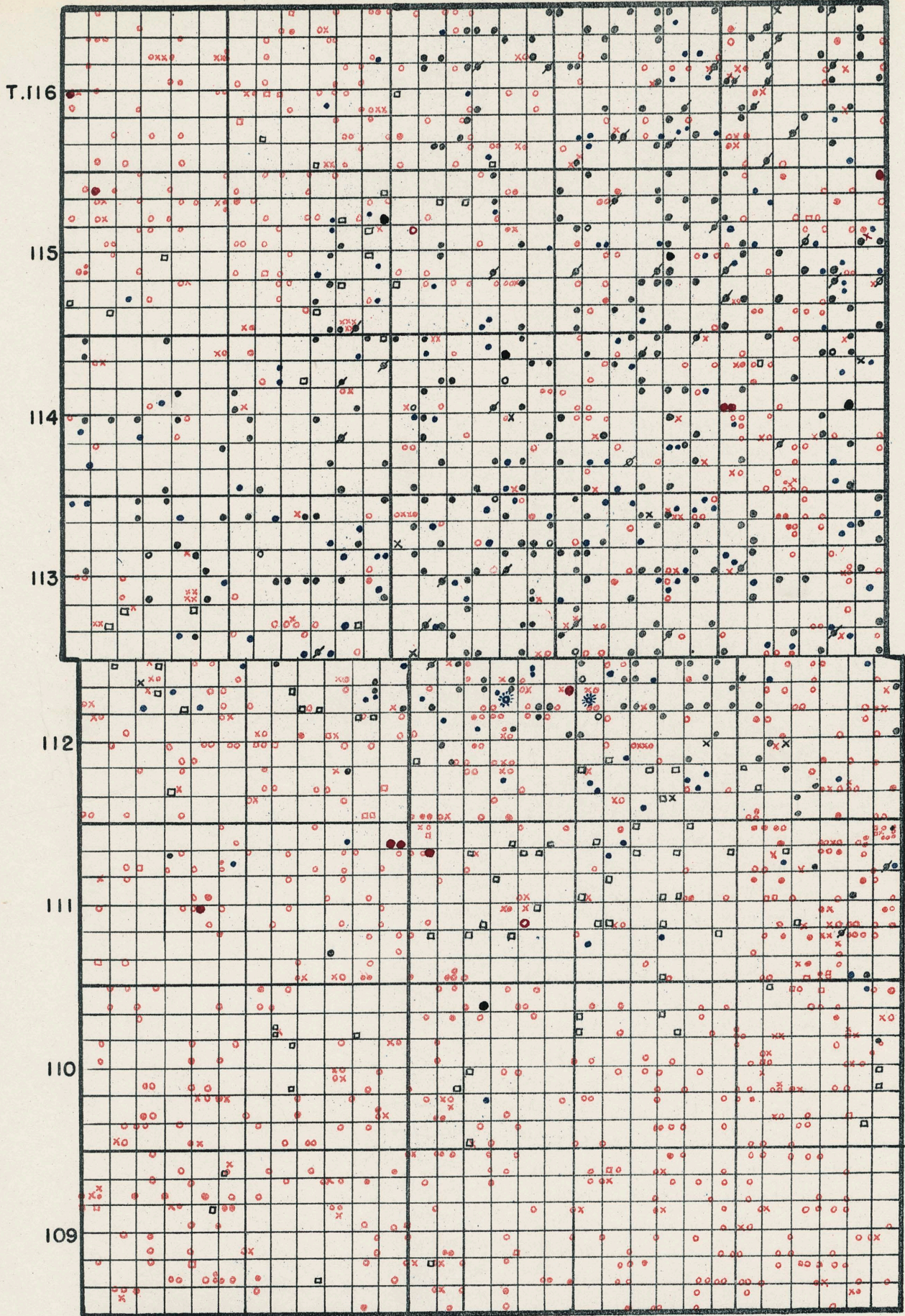
Map of South Dakota showing
location of Hand county

In the main, Hand county is an agricultural county, with 822,668 of the total 912,640 acres, approximately 90.1 per cent, in farms, divided into 1,576 farm units. More than half (55.4%) of the acreage in farms is under cultivation. The major crops, in the order of importance, are corn, barley, wheat, oats and rye. Considerable livestock is also raised, sheep, cattle and hogs being the most important.*

Successful operation of this type of farms necessitates availability of suitable and adequate supplies of underground water at relatively low cost. Supplies of shallow water best meet such needs and in Hand county shallow well water is obtained from most parts of the county, (see shallow well map, page 7 and well location map, page 5) although in some localities difficulties are encountered. (See quotations taken from questionnaires at the end of this report.)

*Data obtained from the "Annual Report of South Dakota Agricultural Statistics" for 1937.

LOCATION OF ARTESIAN AND SHALLOW WELLS IN HAND COUNTY



- | | | | |
|---|------------------------------------|---|--------------------------|
| ○ | ARTESIAN WELLS | ○ | SHALLOW WELLS |
| ● | FLOWING WELLS—STEADY OR INCREASING | ● | ADEQUATE SUPPLY |
| X | FLOWING WELLS—DECREASED FLOW | X | INADEQUATE SUPPLY |
| □ | CEASED FLOWING | □ | DRY WELLS |
| / | PUMPED | □ | SPRINGS |
| / | CONTROLLED WELLS | ☼ | WELLS FROM OTHER SOURCES |
| | | ☼ | CITY WELLS |

On the well location map, all flowing wells and all deep pumped wells obtaining water from the Dakota - Lakota sandstone are shown in black as artesian wells. All other wells are shown in red and are called shallow wells regardless of depth. On all other maps and in the tables the term shallow wells applies only to wells of 200 feet or less in depth, unless otherwise stated. The wells having a depth of over 200 feet are classed as deep wells and include all artesian wells except flowing wells 200 feet or less in depth.

Questionnaires were sent to 1294 farmers of Hand county and 1196 responded with information on 1370 wells and 32 springs throughout the county. Thus the farmers of Hand county returned 92.4% of the questionnaires, the greatest percentage of any county in the state.

DEPTH AND DISTRIBUTION

Shallow wells (200 feet and less in depth): Shallow wells were reported from most parts of the county. These wells were mapped on the basis of fifty foot depth intervals (see shallow well map). More than three fourths of the shallow wells (77.4%) are 100 feet or less in depth, indeed nearly half (43.4%) are 50 feet or less in depth. Somewhat more than one third are between 50 and 100 feet in depth. Further, the shallow wells 100 feet in depth or less comprise nearly half of all wells of the county. Only 14.5% of the shallow wells are between 100 and 150 feet deep and 8.1% are between 150 and 200 feet. The decreased percentage of shallow wells deeper than 100 feet is probably due to greater construction costs of deeper wells.

Few shallow wells are reported in the area of flowing wells and these are mostly fifty feet or less in depth. (See deep well map, page 11). In nine townships along the eastern edge of the area all shallow wells listed were less than 100 feet in depth, (see table below).

T.112N.	R.66W.	T.114N.	R.66W.	T.115N.	R.67W.
113	66	114	67	116	66
113	67	115	66	116	67

HAND COUNTY



SHALLOW WELLS (0-200FT.)

DEPTHS AT WHICH SUPPLIES ARE COMMONLY OBTAINED

PREPARED BY
WORKS PROJECT
ADMINISTRATION
OP 665-74-3-126
WP3636

0-50FT.

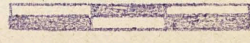
100-150FT.

LAKES

50-100FT.

150-200FT.

MILES



0 2 4 6

In two of these townships, T.116N., R.66W. and T.116N., R.67W., all shallow wells reported were less than 50 feet in depth.

Only 54 of the 179 wells reported from the townships listed above were over 50 feet in depth. Whether shallow water supplies below 100 feet are inadequate, unsatisfactory or too uncertain cannot be stated definitely but these factors apply in some cases and possibly in many. Additional remarks on questionnaires indicate that frequent unsuccessful attempts have been made to obtain shallow wells in this part of the county with only partial success.

In three townships, T.113N., R.70W., T.114N., R.69W., and T.114N., R.70W, conditions are most extreme with no wells reported less than 100 feet deep and only ten shallow wells deeper than 100 feet. As indicated in another place, the deficiency of shallow well supplies in these townships is compensated by deep wells.

In other townships, to which specific reference has not been made, shallow wells are of fairly even distribution and are reported at various depths of 200 feet and less, although the majority obtain water within the first 100 feet below the surface (see shallow well map).

Two of the wells classified as shallow were reported to be flowing. One of these is in T.111N., R.69W, and is 91 feet deep and the other is in T.111N., R.70W. and is 35 feet deep.

Thus, of the total wells of Hand county, 26.9% of all wells are between 0 and 50 feet in depth, 21% 50 and 100 feet in depth, 8.9% 100 to 150 feet in depth and 6.6% are 150 to 200 feet in depth. All shallow wells make up 63.4% (868) of the total wells (1370) reported.

The percentage of the total wells of Hand county which are shallow is shown by townships in the following table:

Percent of Shallow	Twp.	Rge.	Total Wells	Percent of Shallow	Twp.	Rge.	Total Wells
100	110N.	70W.	27	65.9	112N.	69W.	29
100	111	69	30	63.6	114	66	44
100	111	70	20	59.3	115	68	27
100	116	70	25	58.6	111	68	29
97.4	112	70	31	56.5	115	66	46
96.4	109	68	28	56.1	113	66	41
95.	109	69	21	52.4	116	68	42
94.4	109	70	34	42.1	114	67	38
94.1	116	69	34	40.	113	69	25
90.3	115	70	31	35.3	114	70	17
89.5	109	67	38	34.9	116	66	43
87.5	109	66	40	32.6	112	67	43
87.3	111	66	63	32.6	113	67	43
84.8	110	67	32	31.	115	67	42
83.	110	66	41	30.6	116	67	36
81.5	110	69	27	28.1	114	68	32
73.3	112	66	46	24.	111	67	25
72.8	110	68	29	21.1	113	70	19
68.3	115	69	41	20.5	113	68	39
67.3	112	68	52	15.	114	69	20

Deep wells (wells more than 200 feet deep): Deep wells, both pumped and flowing are widely distributed over Hand County and occur in all but four of the forty townships. The percentage is indicated by subtraction of the percentage of shallow wells from 100 in the preceding table. Deep wells total 502 wells or 36.6% of the 1370 wells reported for the county and range in depth from 210 feet to 1535 feet. (See table 2, page 20). Deep wells make up more than one third of all of the wells of the county since 36.6% (502) of the total (1370) are more than 200 feet deep. In general, the deep wells of the southern half of the county are much less in depth than those of the northern half of the county. Nearly three fourths of the deep wells of 15 townships of the southern half (21 or 72.4%) range between 200 and 300 feet in depth. Only eight wells of these 15 townships are between 300 and 800 feet in depth and these are distributed at random.

Twp.	Rge.	Number Wells	Twp.	Rge.	Number Wells	Twp.	Rge.	Number Wells
109N.	66W.	5	110N.	68W.	5	112N.	67W.	1
109	67	4	111	67	4	112	68	1
			112	70	1			

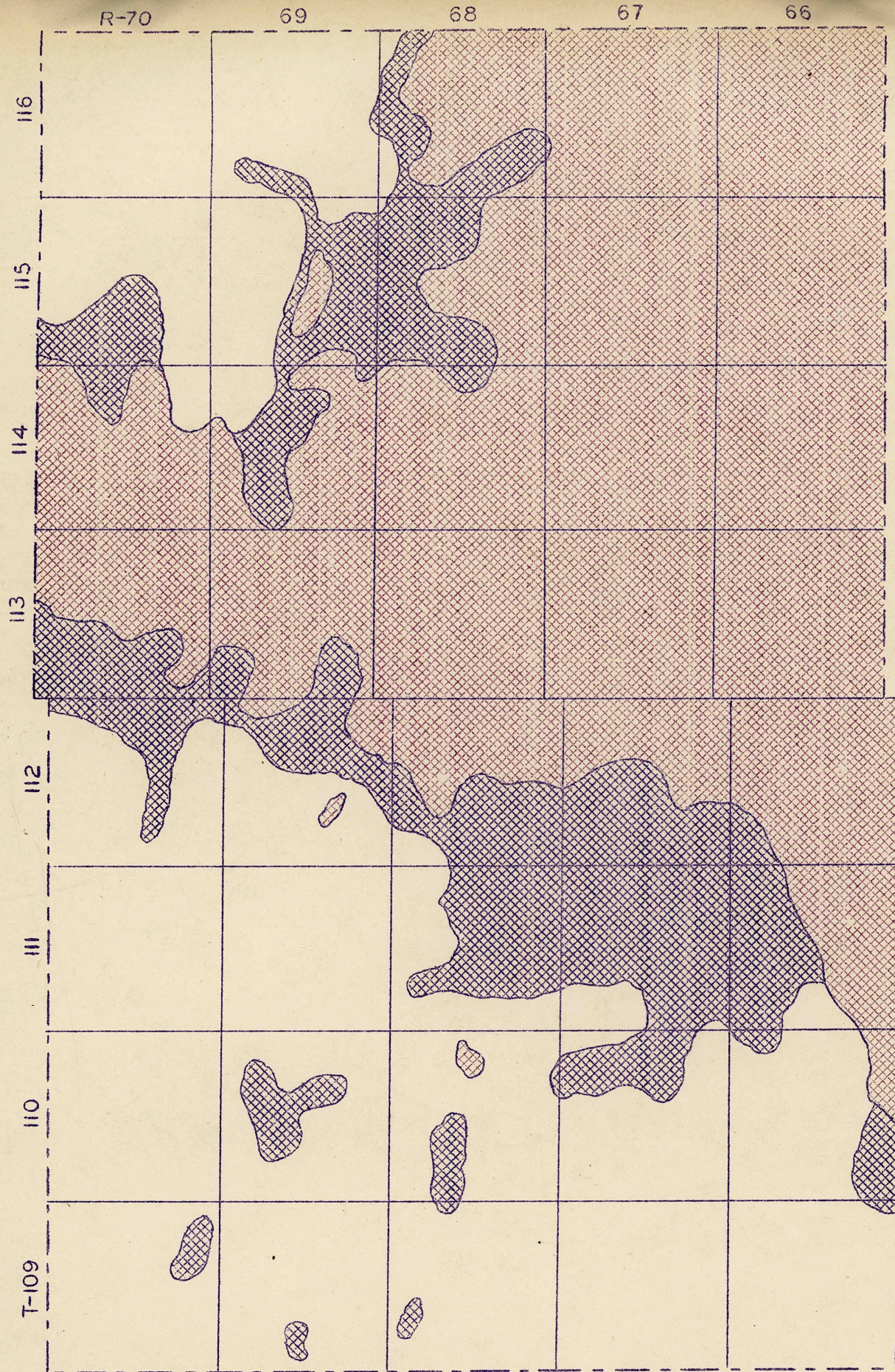
Only two wells are reported between 800 and 900 feet in depth. These are in T.115N., R.66W., and T.116N., R.66W. in the northeast corner of the county where one flowing well is reported for each township.

Over the remainder of the county relatively few wells are reported between 200 and 900 feet since only 6.1% (31 wells) of the total deep wells are within these depth limits, and these represent a very small percent of the wells in each township. The remaining 93.9% of the deep wells occur at depths ranging from 900 to 1535 feet and comprise a total of 471 wells or 34.4% of the total 1370 wells reported in the county. The location and minimum and maximum depths reported are listed as follows:


Location		Number Wells	Depth		Location		Number Wells	Depth	
Twp.	Rge.		Min.	Max.	Twp.	Rge.		Min.	Max.
109N.	68W.	1	1200		113N.	68W.	31	1060	1300
109	69	1	1360		113	69	14	1140	1375
109	70	2	1450	1500	113	70	15	1200	1460
110	66	5	1043	1317	114	66	16	900	1200
110	67	4	1340	1380	114	67	22	990	1147
110	68	4	1320	1530	114	68	22	1000	1290
110	69	5	1400	1530	114	69	17	1180	1400
111	66	8	1000	1280	114	70	10	1222	1470
111	67	15	1208	1380	115	66	19	907	1140
111	68	11	1245	1535	115	67	29	981	1180
112	66	13	900	1260	115	68	11	1306	1500
112	67	28	1000	1343	115	69	14	1100	1365
112	68	15	1112	1334	115	70	3	1302	1450
112	69	10	1100	1332	116	66	27	900	1283
112	70	5	1300	1500	116	67	25	900	1108
113	66	18	940	1190	116	68	20	1000	1396
113	67	29	998	1285	116	69	2	1280	1300


This table shows the minimum and maximum depth by townships from which the more important deep well water supplies are reported.

Flowing wells: Most of the deep wells of Hand county are flowing wells. Indeed, 80.5% (379 wells) of all of the deep wells were reported flowing as of 1938. The distribution of these wells and their relation to deep pumped wells is shown on the artesian well map (page 11) and the relation of these areas to those of the surrounding counties and the state is shown on the artesian well map of South Dakota (page 12).

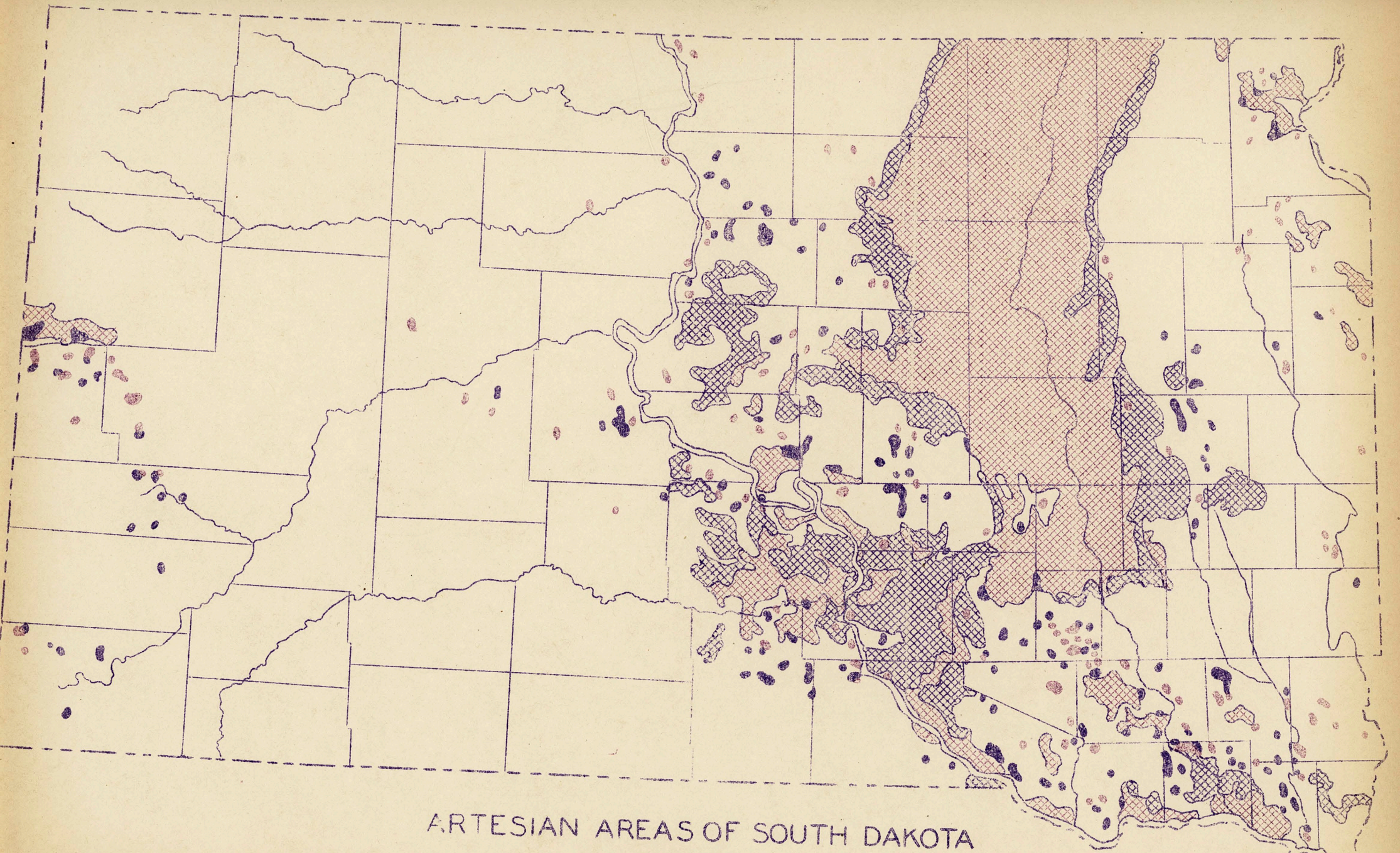


HAND COUNTY
ARTESIAN AREAS - 1938

 FLOWING

 PUMPED

PREPARED BY



ARTESIAN AREAS OF SOUTH DAKOTA

1938

PREPARED BY
WORK PROJECTS ADMINISTRATION
OP 665-74-3-126
WP 3636

■ FLOWING WELLS
■ PUMPED ARTESIAN WELLS

The approximate average flow by townships ranges from 2.7 gallons to 11.2 gallons per minute. For individual wells the rate of flow varies from one gallon per minute up to 40 gallons per minute. In Hand county 55 wells are reported to be equipped with control valves and 47 of these are said to be in use.

The flow of 304 wells is reported to be decreasing and four are reported to have increased the flow. A total of 13 flowing wells are reported to flow steadily without modification of volume. These reports are significant since they indicate that the rate of flow of 95 per cent of the flowing artesian wells in Hand county has decreased.

CHARACTER OF WELL WATERS

The general character of well waters of Hand county is indicated by the responses made by farmers to questionnaires. On the questionnaires, the farmers were asked whether they considered the water from their wells to be hard, medium or soft. Although most farmers do not have accurate chemical analyses of water supplies on which to base their opinions usage is probably a fairly good criterion of general character and quality and must suffice until accurate chemical analyses are available.

Users of shallow farm well waters agree, as shown by replies, that these waters tend to be hard, since 51.1 per cent are listed as hard. So few are listed as definitely soft (7.1%) that those listed as moderately hard (41.8%) probably are more closely related in character to hard water than to soft. The pronounced tendency of the shallow waters to be hard is indicated by the total percentage of hard and moderately hard which is approximately 93 per cent. Further, it is unlikely that future exploration will develop supplies of soft water at depths less than 200 feet.

In wells over 200 feet, including both pumped and flowing, a pronounced

tendency toward production of soft water rather than hard is definitely indicated since more than a third (35.8%) report soft water whereas only 11.1 report water which is definitely hard. There is the possibility that those listed as medium (53.1%) tend toward soft rather than hard water.

In the northeastern part of the county wells of 900 to 1200 feet in depth produce more soft water than from other depths or localities. Indeed, only a small percent of the wells in this part of the county below 900 feet report hard water, the majority being medium. Two townships report almost half of the wells at this depth as being soft (T.115N., R.67W. and T.116N., R.67W.) and in two townships, T.116N., R.68W. and T.116N., R.66W. 75 per cent report soft water.

The southern and western portion of the deep wells area, (deep wells map), reports greater tendency to hardness. The water reported as medium predominates in all parts of the county with the greatest percentage in the central section between the hard and soft areas. Thus a gradation from hard to soft in deep well waters is suggested by the changes from the southwest to the northeast parts of the county:

According to the reports most of the well water of Hand county is suitable for drinking. Of the 1370 wells reported (both shallow and deep) there were only 106 reported as unsuitable for drinking. Of these 80 are shallow wells and 26 are deep wells. The shallow wells reported as unsuitable are scattered over the county and vary with the number of wells except in four townships: T.109N., R.70W., T.111N., R.66W., T.111N., R.68W. and T.112N., R.68 W. These report 31 of the total of 80 unsuitable wells listed. Thus approximately 22% of the shallow wells listed in these townships were reported as unsuitable.

The deep wells listed as unsuitable, like the shallow, are widely distributed, 11 (9%) being reported among the deep pumped wells (over 200 feet) and fifteen (4%) among the flowing wells. Thus, although most well water in

Hand county is suitable for drinking, a relatively small part is not. Water unsatisfactory for drinking seems more likely to be obtained from shallow wells than from deep or from flowing wells. Possibly contamination or other objectionable material derived from the surface or near the surface is responsible for this condition. It may be that other objectionable or injurious ingredients may occur in other waters than those listed. These can be determined, however, only by analysis.

ADEQUACY OF WELL WATERS

On the whole, wells of Hand county supply water adequate for current farm needs. Many wells, however, 163 out of the total of 1370 reported inadequate supplies in 1938. The greater proportion were shallow and include a total of 122 with 26 flowing wells inadequate and 15 deep pumped wells furnishing insufficient supplies.

The greatest percent of inadequate shallow wells was reported along the eastern border of the county in range 66, north of township 110 and in township T.109N., R.70W in the southwest corner. In these areas almost 40% of the wells less than 50 feet in depth were listed as having supplies insufficient for current needs in 1938. In these areas, inadequate wells comprise approximately 23% of all the inadequate wells reported for the county, indicating that supplies in this area from 0 to 50 feet in depth are more likely to be inadequate than in other parts of the county. In other parts of the county, shallow inadequate wells are scattered and are of various depths ranging from 0 to 200 feet.

A greater proportion of inadequate wells is reported among deep pumped wells than among those which were flowing and these are evenly distributed over the county. Only one township, however, T.114N., R.69W. reported over 2 inadequate deep wells per township and these were flowing wells.

Regarding adequacy of supply, it is emphasized that only current needs

are considered and that changes or expansions requiring more or less water for farm use will render an unpredictable number of supplies inadequate.

Irrigation: Seventy-five shallow wells were reported to be used for irrigation. Use is mostly for garden plots, ranging in size from 1/8 to 2 acres which make up a total of 16 acres.

Only four of the deep pumped wells are used for irrigation, and these were used to irrigate 3/8 of an acre. Flowing wells are reported to have been used to irrigate 51 3/4 acres in plots ranging from 1/8 to 20 acres per well (see table pages 20 and 21).

ADDITIONAL AND SUPPLEMENTARY WATER SUPPLIES

Springs are not in use to a considerable degree in Hand county and only 32 are noted on questionnaires. Most of these are in the south half of the county where they are used for the watering of livestock. They are locally an important supplementary source, as most of them are reported in areas which do not have flowing wells and when shallow water wells are inadequate or unsatisfactory. The springs reported are located as follows:

Twp.	Rge.	Number of Springs	Twp.	Rge.	Number of Springs
109N.	67W.	1	111N.	68W.	1
109	68	2	111	70	2
109	70	3	112	69	6
110	66	5	115	69	1
111	66	6	115	66	1
			116	69	4

All of the 32 springs are reported as being adequate for the needs for which they are used. Reports on character state that 9 produce hard water, 10 moderately hard, while three produce soft water. Reports on the character of the others were not made. Twenty-two springs were reported to be suitable for domestic purposes, although only 7 were actually thus used.

Cisterns are a most important supplementary water supply in any area such as much of Hand county, in which hard water wells predominate. Most of them are used for laundry purposes but a few are used for drinking and cooking.

As may be expected a greater number of cisterns are in use in areas of shallow wells than where artesian wells are abundant. Farmers utilizing shallow wells report 219 cisterns of which 213 are used for laundry purposes and 24 for drinking and cooking. Users of artesian water report only 92 cisterns of which 85 are used for laundry purposes and three are in use for drinking and cooking. Spring users report only 5 cisterns which are used exclusively for laundry purposes. There is approximately one cistern to each four wells in the county.

HAND COUNTY

Table 1.

DATA ON PUMPED WELLS FROM 0 TO 200 FEET (INCL.) IN DEPTH

LOCATION		Number of Wells	DEPTH OF WELLS			CHARACTER OF WATER					ADEQUACY OF SUPPLY			
Twp.	Rge.		Min.	Max.	Ave.	Hard	Med.	Soft	Corrode Casing	Unsuitable for Drinking	Adequate	Inadequate	Number used for Irrigation	Approximate Acres Irrigated
109	66	35	6	200	97	11	17	5	1	1	34	1	4	1/2
109	67	34	20	200	114	11	20	3	-	4	29	5	3	1/2
109	68	27	6	200	85	13	10	4	5	3	24	3	1	1/8
109	69	20	16	120	76	6	11	3	1	2	16	4	-	-
109	70	32	10	120	58	14	15	2	1	8	22	10	1	1/4
110	66	34	8	176	58	15	10	3	2	2	31	3	3	3/8
110	67	27	14	150	108	11	12	4	1	-	26	1	3	1/2
110	68	21	19	200	111	12	5	4	1	1	18	3	4	3/4
110	69	22	25	156	81	12	7	3	6	3	20	2	1	-
110	70	27	11	163	71	13	12	2	-	-	23	4	3	1/8
111	66	55	10	110	36	41	11	2	1	8	38	17	2	5/8
111	67	6	43	195	78	3	2	1	-	1	6	-	-	-
111	68	17	8	200	105	8	8	1	1	5	14	3	-	-
111	69	29	30	200	106	13	14	2	-	1	24	5	1	1/4
111	70	19	10	110	42	8	9	1	2	2	15	4	-	-
112	66	33	10	65	38	13	19	1	6	4	25	8	2	1/2
112	67	14	30	175	93	7	6	1	-	-	14	-	1	1/8
112	68	35	4	200	95	22	12	1	2	10	28	7	2	3/8
112	69	19	14	172	73	9	8	1	3	2	18	1	-	-
112	70	24	15	133	62	8	15	1	-	1	24	-	-	-
113	66	23	12	90	45	10	11	1	-	3	19	4	6	3
113	67	14	20	82	45	7	7	-	-	3	13	1	-	-
113	68	8	10	105	40	6	2	-	-	-	8	-	-	-
113	69	10	16	160	94	6	4	-	-	1	9	1	-	-
113	70	4	125	140	132	2	1	1	-	-	4	-	-	-
114	66	28	9	80	50	11	13	-	2	1	23	5	-	-
114	67	16	32	60	39	10	6	-	-	-	16	-	3	1
114	68	9	26	168	66	6	3	-	-	1	9	-	-	-
114	69	3	48	180	120	2	1	-	-	-	3	-	-	-
114	70	6	125	170	161	1	5	-	-	-	6	-	1	1/2

HAND COUNTY

Table 1. (Continued)

DATA ON PUMPED WELLS FROM 0 TO 200 FEET (INCL.) IN DEPTH

LOCATION		Number of Wells	DEPTH OF WELLS			CHARACTER OF WATER					ADEQUACY OF SUPPLY			
Twp.	Age.		Min.	Max.	Ave.	Hard	Med.	Soft	Corrode Casing	Unsuitable for Drinking	Adequate	Inadequate	Number used for Irrigation	Approximate Acres Irrigated
115	66	26	14	65	39	19	6	1	3	3	22	4	4	1/2
115	67	13	12	76	45	10	3	-	-	1	11	2	-	-
115	68	16	7	160	58	9	6	-	-	-	14	2	2	3/8
115	69	27	25	141	76	11	13	2	-	-	25	2	3	1/4
115	70	28	15	160	65	13	11	3	4	3	23	5	5	1 1/2
116	66	15	13	40	24	8	5	1	-	1	9	6	-	-
116	67	11	20	45	33	6	5	-	1	1	11	-	-	-
116	68	22	30	120	60	19	2	1	2	1	20	2	6	1 1/8
116	69	32	10	150	55	13	13	2	2	3	27	5	7	1
116	70	25	10	192	50	12	12	1	1	-	23	2	7	2 1/2
Total		866				431	352	60	48	80	744	122	75	16 3/4

HAND COUNTY

Table 2.

DATA ON PUMPED WELLS OVER 200 FEET IN DEPTH

LOCATION		Number of Wells	DEPTH OF WELLS			CHARACTER OF WATER					ADEQUACY OF SUPPLY			
Twp.	Rge.		Min.	Max.	Ave.	Hard	Med.	Soft	Corrode Casing	Unsuitable for Drinking	Adequate	Inadequate	Number used for Irrigation	Approximate Acres Irrigated
109	66	5	212	284	239	3	2	-	-	1	4	1	-	-
109	67	4	240	258	250	1	1	2	-	-	4	-	1	1/8
109	68	1	-	-	1200	-	1	-	-	-	1	-	-	-
109	69	1	-	-	1360	-	1	-	1	-	1	-	-	-
109	70	2	1450	1500	1475	1	-	1	1	1	-	2	-	-
110	66	6	350	1317	883	2	2	2	-	-	6	-	-	-
110	67	5	300	1380	1146	-	5	-	1	-	5	-	-	-
110	68	7	210	1530	781	-	4	3	1	-	7	-	-	-
110	69	5	1400	1530	1489	4	1	-	1	-	5	-	-	-
111	66	2	1115	1280	1215	-	1	1	1	-	1	1	-	-
111	67	19	210	1380	1085	4	13	2	-	3	19	-	-	-
111	68	12	400	1535	1281	4	7	1	5	-	12	-	1	1/8
112	66	2	1065	1260	1163	1	1	-	-	-	2	-	-	-
112	67	8	210	1343	922	2	4	-	-	1	6	2	-	-
112	68	2	370	1334	852	-	2	-	-	1	2	-	-	-
112	69	5	1200	1332	1238	1	3	1	2	-	5	-	-	-
112	70	7	230	1500	1257	-	5	2	-	1	6	1	1	1/8
113	67	1	-	-	1000	-	-	-	-	-	-	1	-	-
113	68	2	1115	1140	1128	-	-	-	-	-	-	2	-	-
113	69	2	230	1300	765	-	2	-	-	-	2	-	-	-
113	70	3	1310	1373	1351	-	1	2	1	-	3	-	-	-
114	66	2	1060	1100	1080	-	1	-	-	-	1	1	-	-
114	68	1	-	-	-	-	-	-	-	-	-	1	-	-
114	69	2	1200	1250	1225	-	1	1	1	-	1	1	-	-
114	70	1	-	-	215	-	1	-	1	-	1	-	-	-
115	68	3	1200	1288	1233	-	1	2	1	1	3	-	-	-
115	69	6	1200	1409	1313	1	5	-	1	-	6	-	1	-
116	66	1	-	-	1100	-	-	1	-	-	-	1	-	-
116	68	2	1000	1190	1095	1	-	1	1	1	1	1	-	-
116	69	2	1280	1300	1290	-	1	1	1	1	2	-	-	-
Totals		121				25	66	23	20	11	106	15	4	3/8

Note: No wells reported for the following townships and ranges for this group:

T.110N., R. 70W; T.111., R. 69,70W; T.113N., R. 66W; T.114N., R. 67W; T.115N., R. 66,67W; T.115N., R.70; T.116N., R.70 and 67W.

HAND COUNTY

Table 3.

DATA ON FLOWING WELLS

LOCATION		Number of Wells	DEPTH OF WELLS			CHARACTER OF WATER					ADEQUACY OF SUPPLY					
Twp.	Rge.		Min.	Max.	Ave.	Hard	Med.	Soft	Corroded Casing	Unsuitable for Drinking	Adequate	Inadequate	Number used for Irrigation	Approx. Acres Irrigated	Ave. Gallon Per Min	Number Controlled
110	66	1	-	-	1052	-	-	1	1	-	1	-	-	-	7.00	-
110	68	1	-	-	1320	-	1	-	-	-	1	-	-	-	8.00	-
111	66	6	1000	1150	1083	3	3	-	3	-	5	1	1	20	13.5	2
111	69	1	-	-	91	-	1	-	-	-	1	-	-	-	-	-
111	70	1	-	-	35	1	-	-	-	-	1	-	-	-	-	-
112	66	11	900	1100	1027	4	7	-	1	-	10	1	4	3 3/4	3.9	-
112	67	21	1000	1300	1139	-	9	12	2	-	21	-	3	-	4.25	-
112	68	15	1112	1320	1204	1	10	4	4	1	13	2	3	10 3/8	5.46	1
112	69	5	1100	1256	1187	-	5	-	-	-	4	1	-	-	4.40	-
113	66	18	900	1300	1038	6	9	3	3	1	16	2	6	2 1/2	11.17	2
113	67	28	998	1285	1084	-	18	10	-	-	26	2	4	3/4	5.42	2
113	68	29	1060	1300	1155	5	14	9	6	-	27	2	3	2 5/8	7.10	3
113	69	13	1140	1375	1283	-	7	6	2	-	13	-	1	1/8	5.91	1
113	70	12	1200	1400	1345	2	7	3	4	2	11	1	1	-	5.43	-
114	66	14	900	1200	1010	2	11	1	-	-	12	2	1	1/4	8.92	1
114	67	22	990	1147	1055	2	12	8	6	-	22	-	3	2 1/4	6.39	3
114	68	22	1000	1290	1166	-	11	9	2	4	19	3	5	1 3/8	4.93	1
114	69	15	1180	1400	1277	-	7	8	2	-	13	2	1	1/4	3.77	3
114	70	10	1222	1470	1323	1	6	3	1	1	9	1	-	-	4.25	-
115	66	20	800	1140	998	4	12	4	6	-	19	1	4	2 1/8	5.19	5
115	67	29	979	1180	1039	-	15	14	1	-	29	-	4	3 5/8	8.41	4
115	68	8	1036	1500	1238	-	5	3	1	-	7	1	1	1/4	5.00	1
115	69	8	1100	1315	1238	-	7	1	3	1	6	2	1	1/2	2.78	1
115	70	3	1302	1400	1384	-	-	3	-	-	3	-	-	-	-	-
116	66	27	825	1300	1058	-	7	20	2	1	27	-	2	1/4	6.14	11
116	67	25	900	1108	1027	-	9	16	3	2	25	-	1	1/2	10.04	4
116	68	18	1000	1396	1113	1	2	15	2	2	16	2	1	1/4	8.56	2
Totals		383				32	195	153	55	15	357	26	50	51 3/4		47

Note: No wells reported for the following townships and ranges for this group:
 T.109N., R.66,67,68,69,70W: T.110N., R.67,69,70W: T.111N., R.67,68W: T.112N., R.70W: T.116N., R.69,70W.

HAND COUNTY - WELL NOTES

The following are comments made on the questionnaires by farmers. These are included for the bearing they may have on local conditions.

Bates Twp. 109N-Rge. 67W.

NE $\frac{1}{4}$ Sec. 7 186 feet - "Well has plenty water but sand is fine and cuts the pump leathers out bad."

Pleasant Valley Twp. 109N-Rge. 68W.

NW $\frac{1}{4}$ Sec. 2 170 feet - "The only difficulty we have had in digging a well on this farm is finding the vein."

Mondamin Twp. 109N-Rge. 69W.

NE $\frac{1}{4}$ Sec. 15 106 feet - "Tried for deep wells but couldn't obtain water."

Como Twp. 109N-Rge. 70W.

NE $\frac{1}{4}$ Sec. 13 110 feet - "All wells north and west are artesian wells and it has been difficult getting water here as there is very little shallow water, just enough for domestic use. Although my stock well has furnished enough water the past 4 years and can be depended on for one tank (10 foot) per day."

Como Twp. 109N-Rge. 70W.

NE $\frac{1}{4}$ Sec. 14 1500 feet - "Artesian well never flowed, difficult to get shallow wells."

Rose Hill Twp. 110N-Rge. 66W.

SE $\frac{1}{4}$ Sec. 3 40 feet - "I have paid for 100 feet in 2 foot holes from time to time in the past 30 years without success of dependable wells. The spring has flown since 1893 up until the past 10 years it would water 250 to 300 head of stock, but the past 7 years 40 head is limit it would water during hot weather and is on high ground nearly $\frac{1}{2}$ mile from farm buildings."

Rose Hill Twp. 110N-Rge. 66W.

SE $\frac{1}{4}$ Sec. 20 34 feet - "The well is slowly going dry. 20 years ago, 6 ft. water; now 2 feet."

Hiland Twp. 110N-Rge. 67W.

NW $\frac{1}{4}$ Sec. 34 143 feet - "The NE $\frac{1}{4}$ 34-110-67 had well but didn't furnish enough water. Now dry."

Ohio Twp. 110N-Rge. 68W.

SW $\frac{1}{4}$ Sec. 33 1485 feet artesian - "There is one other well on farm 18 ft. deep. Very dangerous. Is full of water now."

Glendale Twp. 110N-Rge. 69W.

SW $\frac{1}{4}$ Sec. 33 1530 feet artesian - "Common tubular well, will not supply enough water."

Glendale Twp. 110N-Rge. 69W.

SW Sec. 25 25 feet - "Cannot get sufficient water."

- Hulbert Twp. 111N-Rge. 66W.
SE Sec. 3 30 feet - "Water is very hard and has a salty taste. It is good water for livestock but is not very good for drinking. It seems to have a lot of lime in it."
- Hulbert Twp. 111N-Rge. 66W.
NE Sec. 10 30 feet - "Good shallow wells cannot be obtained in this locality."
- Hulbert Twp. 111N-Rge. 66W.
NE Sec. 27 1100 feet - (Artesian) "Difficulty in getting shallow wells."
- Hulbert Twp. 111N-Rge. 66W.
NE $\frac{1}{4}$ Sec. 5 24 feet - "Shallow well water is hard to get."
- Pearl Twp. 111N-Rge. 67W.
NW $\frac{1}{4}$ Sec. 18 1335 feet (artesian) "Dug for shallow wells but didn't have any success. Had to drill 200 feet through rock to get artesian water."
- Logan Twp. 111N-Rge. 68W.
NE Sec. 6 8 feet - "We have no water except for a well we dug under a cement bridge in the road."
- Logan Twp. 111N-Rge. 68W.
NE Sec. 30 1428 feet - (artesian) "difficulty getting water years ago."
- Spring Hill Twp. 111N-Rge. 70W.
SE Sec. 14 40 feet - "The well furnished enough water for about half the capacity of the pasture in animal units."
- Spring Hill Twp. 111N-Rge. 70W.
NE Sec. 18 32 feet (dry hole) - "I dug the well in 1933 but it held out only two years and then dried up, but I believe if we could get 15 feet deeper there would be plenty of water. We only got down 32 feet and the sand was so fine we could not get it out."
- Grand Twp. 112N-Rge. 66W.
NE Sec. 20 1100 feet (artesian) - "Ceased flowing in 1935 because pipes corroded. Have not sufficient funds to recase. I now haul water from 1 mile south."
- Grand Twp. 112N-Rge. 66W.
SW Sec. 27 40 feet - "We have to haul all our drinking water and for cooking and sometimes for the stock. Can't get over ten gallons of water at a time and then wait awhile and get ten more or so on through the day."
- Grand Twp. 112N-Rge. 66W.
SW Sec. 33 1061 feet (artesian) - "Bored wells are almost impossible."
- St. Lawrence Twp. 112N-Rge. 67W.
NW Sec. 15 1180 feet - "cannot get shallow wells."

St. Lawrence Twp. 112N-Rge. 67W.

NE Sec. 32 85 feet - "The old artesian well gave out and this is a new tubular well just put down. It is doing all right now but can't say whether it will hold out or not until it has been tried out."

St. Lawrence Twp. 112N-Rge. 67W.

NE Sec. 34 1300 feet (artesian) - "Was a flowing well but has to be pumped. Flowed for about two years. There was a flowing well on the farm before this but stopped flowing; water in old well very salty."

Midland Twp. 112N-Rge. 69W.

SE Sec. 12 1177 feet (artesian) "Bored shallow hole fall of 1915 to depth of 140 feet. Found some wet sand at 100 feet but failed to get water."

Ree Heights Twp. 112N-Rge. 70W.

NE Sec. 9 1500 feet (artesian) "Never has flowed. Quicksand was reason other wells were not a success."

Gilbert Twp. 113N-Rge 66W.

SW Sec. 4 12 feet - "Quicksand has caused some trouble in constructing wells."

Gilbert Twp. 113N-Rge. 66W.

SE Sec. 13 48 feet - "The well on this farm is a shallow well of exceptionally good quality as drinking water and there is an unlimited supply if pumped slowly; some coal has been taken from it when cleaned out, as sand comes up and it has to be cleaned about every two years."

Howell Twp. 115N-Rge. 68W.

SW Sec. 1 50 feet - "Old well caved in last year - was hand dug about 40 years ago - never pumped dry. Has watered as high as 150 head of cattle. New well seems just as good as we had an engine on it for 2 days and couldn't lower the water more than 6 inches."

Howell Twp. 115N-Rge. 68W.

NE Sec. 18 70 feet - "Quicksand is our difficulty in construction of wells on this farm."

Howell Twp. 115N-Rge. 68W.

NW Sec. 30 1228 feet (artesian) - "salty water."

Plato Twp. 116N-Rge. 66W.

NW Sec. 4 1100 feet (artesian) "Our well stopped flowing last spring. We hauled water all summer for all our use."

Linn Twp. 116N-Rge. 67W.

NW Sec. 26 1046 feet (artesian) "I dug 5 surface wells from 10 to 80 feet. The 80 foot hole was dry. The rest gave some water but not enough."

Linn Twp. 116N-Rge. 67W.

SE Sec. 31 1000 feet (artesian) "In the years before the artesian, it was not too easy to find water on this farm; some dry holes were dug and drilled but have now been filled with dust and dirt."

Park Twp. 116N-Rge. 68W.

SE Sec. 35 64 feet -"Difficulty in getting good wells, had been fine sand at water level."

Spring Twp. 116N-Rge. 69W.

SW Sec. 3 70 feet -"It had been difficult to get water on the farm - only a small supply can be found in each hole."

Spring Twp. 116N-Rge. 69W.

SE Sec. 15 50 feet -"I think we would have plenty water if it was dug 10 feet deeper because it stops above hard shale. There was a well here in early years that watered 100 head cattle."

Spring Twp. 116N-Rge. 69W.

NE Sec. 19 21 feet. -"Several wells were bored before this one. Some of the water was unfit for stock even."

Spring Twp. 116N-Rge. 69W.

SW Sec. 34 1300 feet- (artesian) "There has been about 12 shallow wells dug on this farm but failed to be any good. Depth from 70 to 120 feet. The artesian has to be pumped; the water is good when it is clear, but generally is very muddy or sandy. Not always fit for drinking."

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