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DEPARTMENT OF MINES
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GEOLOGICAL SURVEY OF CANADA
WATER SUPPLY PAPER No. 175

PRELIMINARY REPORT
GROUND-WATER RESOURCES
OF THE
RURAL MUNICIPALITY OF DEER FORKS
NO. 232
SASKATCHEWAN

By
B. R. MacKay, H. H. Beach and R. Johnson



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DEPARTMENT OF MINES
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GEOLOGICAL SURVEY

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OF DEER FORKS
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GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY

OF DEER FORKS, NO. 232

SASKATCHEWAN

INTRODUCTION

Lack of rainfall during the years 1930 to 1934 over a large part of the Prairie Provinces brought about an acute shortage both in the larger supplies of surface water used for irrigation and the smaller supplies of ground water required for domestic purposes and for stock. In an effort to relieve the serious situation the Geological Survey began an extensive study of the problem from the standpoint of domestic uses and stock raising. During the field season of 1935 an area of 80,000 square miles, comprising all that part of Saskatchewan south of the north boundary of township 32, was systematically examined, records of approximately 60,000 wells were obtained, and 720 samples of water were collected for analyses. The facts obtained have been classified and the information pertaining to any well is readily accessible. The examination of so large an area and the interpretation of the data collected were possible because the bedrock geology and the Pleistocene deposits had been studied previously by McLearn, Warren, Rose, Stansfield, Wickenden, Russell, and others of the Geological Survey. The Department of Natural Resources of the Saskatchewan and local well drillers assisted considerably in supplying several hundred well records. The base maps used were supplied by the Topographical Surveys Branch of the Department of the Interior.

Publication of Results

The essential information pertaining to the ground water conditions is being published in reports, one being issued for each municipality. Copies of these reports are being sent to the secretary treasurers of the municipalities and to certain Provincial and Federal Departments, where they can be consulted by residents of the municipalities or by other persons, or they may be obtained by writing direct to the Director, Bureau of Economic Geology, Department of Mines, Ottawa. Should anyone require more detailed information than that contained in the reports such additional information as the Geological Survey possesses can be obtained on application to the director. In making such request the applicant should indicate the exact location of the area by giving the quarter section, township, range, and meridian concerning which further information is desired.

The reports are written principally for farm residents, municipal bodies, and well drillers who are either planning to sink new wells or to deepen existing wells. Technical terms used in the reports are defined in the glossary.

How to Use the Report

Anyone desiring information about ground water in any particular locality should read first the part dealing with the municipality as a whole in order to understand more fully the part of the report that deals with the place in which he is interested. At the same time he should study the two figures accompanying the report. Figure 1 shows the surface and bedrock geology as related to the ground water supply, and Figure 2 shows the relief and the location and type of water wells. Relief is shown by lines of equal elevation called "contours". The elevation above sea-level

is given on some or all of the contour lines on the figure.

If one intends to sink a well and wishes to find the approximate depth to a water-bearing horizon, he must learn: (1) the elevation of the site, and (2) the probable elevation of the water-bearing bed. The elevation of the well site is obtained by marking its position on the map, Figure 2, and estimating its elevation with respect to the two contour lines between which it lies and whose elevations are given on the figure. Where contour lines are not shown on the figure, the elevations of adjacent wells as indicated in the Table of Well Records accompanying each report can be used. The approximate elevation of the water-bearing horizon at the well-site can be obtained from the Table of Well Records by noting the elevation of the water-bearing horizon in surrounding wells and by estimating from these known elevations its elevation at the well-site.¹ If the water-bearing horizon is in bedrock the depth to water can be estimated fairly accurately in this way. If the water-bearing horizon is in unconsolidated deposits such as gravel, sand, clay, or glacial debris, however, the estimated elevation is less reliable, because the water-bearing horizon may be inclined, or may be in lenses or in sand beds which may lie at various horizons and may be of small lateral extent. In calculating the depth to water, care should be taken that the water-bearing horizons selected from the Table of Well Records be all in the same geological horizon either in the glacial drift or in the bedrock. From the data in the Table

¹ If the well-site is near the edge of the municipality, the map and report dealing with the adjoining municipality should be consulted in order to obtain the needed information about nearby wells.

of Well Records it is also possible to form some idea of the quality and quantity of the water likely to be found in the proposed well.

GLOSSARY OF TERMS USED

Alkaline. The term "alkaline" has been applied rather loosely to some ground-waters. In the Prairie Provinces, a water is usually described as "alkaline" when it contains a large amount of salts, chiefly sodium sulphate and magnesium sulphate in solution. Water that tastes strongly of common salt is described as "salty". Many "alkaline" waters may be used for stock. Most of the so-called "alkaline" waters are more correctly termed "sulphate waters".

Alluvium. Deposits of earth, clay, silt, sand, gravel, and other material on the flood-plains of modern streams and in lake beds.

Aquifer or Water-bearing Horizon. A water-bearing bed, lens, or pocket in unconsolidated deposits or in bedrock.

Buried pre-Glacial Stream Channels. A channel carved into the bedrock by a stream before the advance of the continental ice-sheet, and subsequently either partly or wholly filled in by sands, gravels, and boulder clay deposited by the ice-sheet or later agencies.

Bedrock. Bedrock, as here used, refers to partly or wholly consolidated deposits of gravel, sand, silt, clay, and marl that are older than the glacial drift.

Coal Seam. The same as a coal bed. A deposit of carbonaceous material formed from the remains of plants by partial decomposition and burial.

Contour. A line on a map joining points that have the same elevation above sea-level.

Continental Ice-sheet. The great ice-sheet that covered most of the surface of Canada many thousands of years ago.

Escarpment. A cliff or a relatively steep slope separating level or gently sloping areas.

Flood-plain. A flat part in a river valley ordinarily above water but covered by water when the river is in flood.

Glacial Drift. The loose, unconsolidated surface deposits of sand, gravel, and clay, or a mixture of these, that were deposited by the continental ice-sheet. Clay containing boulders forms part of the drift and is referred to as glacial till or boulder clay. The glacial drift occurs in several forms:

(1) Ground Moraine. A boulder clay or till plain (includes areas where the glacial drift is very thin and the surface uneven).

(2) Terminal Moraine or Moraine. A hilly tract of country formed by glacial drift that was laid down at the margin of the continental ice-sheet during its retreat. The surface is characterized by irregular hills and undrained basins.

(3) Glacial Outwash. Sand and gravel plains or deltas formed by streams that issued from the continental ice-sheet.

(4) Glacial Lake Deposits. Sand and clay plains formed in glacial lakes during the retreat of the ice-sheet.

Ground Water. Sub-surface water, or water that occurs below the surface of the land.

Hydrostatic Pressure. The pressure that causes water in a well to rise above the point at which it is struck.

Impervious or Impermeable. Beds, such as fine clays or shale, are considered to be impervious or impermeable when they do not permit of the perceptible passage or movement of the ground water.

Pervious or Permeable. Beds are pervious when they permit of the perceptible passage or movement of ground water, as for example porous sands, gravel, and sandstone.

Pre-Glacial Land Surface. The surface of the land before it was covered by the continental ice-sheet.

Recent Deposits. Deposits that have been laid down by the agencies of water and wind since the disappearance of the continental ice-sheet.

Unconsolidated Deposits. The mantle or covering of alluvium and glacial drift consisting of loose sand, gravel, clay, and boulders that overlie the bedrock.

Water Table. The upper limit of the part of the ground wholly saturated with water. This may be very near the surface or many feet below it.

Wells. Holes sunk into the earth so as to reach a supply of water. When no water is obtained they are referred to as dry holes. Wells in which water is encountered are of three classes.

(1) Wells in which the water is under sufficient pressure to flow above the surface of the ground. These are called Flowing Artesian Wells.

(2) Wells in which the water is under pressure but does not rise to the surface. These wells are called Non-Flowing Artesian Wells.

(3) Wells in which the water does not rise above the water table. These wells are called Non-Artesian Wells.

NAMES AND DESCRIPTIONS OF GEOLOGICAL FORMATIONS, REFERRED
TO IN THESE REPORTS

Wood Mountain Formation. The name given to a series of gravel and sand beds which have a maximum thickness of 50 feet, and which occur as isolated patches on the higher parts of Wood Mountain. This is the youngest bedrock formation and, where present, overlies the Ravenscrag formation.

Cypress Hills Formation. The name given to a series of conglomerates and sand beds which occur in the southwest corner of Saskatchewan, and rests upon the Ravenscrag or older formations. The formation is 30 to 125 feet thick.

Ravenscrag Formation. The name given to a thick series of light-coloured sandstones and shales containing one or more thick lignite coal seams. This formation is 500 to 1,000 feet thick, and covers a large part of southern Saskatchewan. The principal coal deposits of the province occur in this formation.

Whitemud Formation. The name given to a series of white, grey, and buff coloured clays and sands. The formation is 10 to 75 feet thick. At its base this formation grades in places into coarse, limy sand beds having a maximum thickness of 40 feet.

Eastend Formation. The name given to a series of fine-grained sands and silts. It has been recognized at various localities over the southern part of the province, from the Alberta boundary east to the escarpment of Missouri coteau. The thickness of the formation seldom exceeds 40 feet.

Bearpaw Formation. The Bearpaw consists mostly of incoherent dark grey to dark brownish grey, partly bentonitic shales, weathering light grey, or, in places where much iron

is present, buff. Beds of sand occur in places in the lower part of the formation. It forms the uppermost bedrock formation over much of western and southwestern Saskatchewan and has a maximum thickness of 700 feet or somewhat more.

Belly River Formation. The Belly River consists mostly of non-marine sand, shale, and coal, and underlies the Bearpaw in the western part of the area. It passes eastward and northeastward into marine shale. The principal area of transition is in the western half of the area where the Belly River is mostly thinner than it is to the west and includes marine zones. In the southwestern corner of the area it has a thickness of several hundred feet.

Marine Shale Series. This series of beds consists of dark grey to dark brownish grey, plastic shales, and underlies the central and northeastern parts of Saskatchewan. It includes beds equivalent to the Bearpaw, Belly River, and older formations that underlie the western part of the area.

WATER-BEARING HORIZONS OF THE MUNICIPALITY

The rural municipality of Deer Forks covers an area of approximately 282 square miles in the western part of southern Saskatchewan. It is bounded on the west by the Alberta-Saskatchewan boundary and on the north by South Saskatchewan river. The municipality consists of four full townships, townships 19, 20, 21, and 22, range 28; four fractional townships each of approximately 32 square miles i.e., townships 19, 20, 21, and 22, range 29; and parts of two townships, i.e., that part of township 23, range 28, lying south of South Saskatchewan river, and that part of township 23, range 29, lying south of Red Deer river; all west of the Third meridian.

The Lemsford section of the Canadian Pacific railway extends in an east-west direction along South Saskatchewan valley to cross the river in the northeast corner of township 22, range 29. It then follows up the south side of Red Deer river and leaves the municipality in the northwest corner. The hamlet of Estuary is located on this railway in sec. 2, tp. 23, range 28. The Burstall branch of the same railway extends in a southwesterly direction from the northwest corner of township 20, range 28, to the southwestern corner of the municipality. The hamlets of Gascoigne, Burstall, and Charmian are located on this railway within the boundaries of the municipality.

South Saskatchewan river enters the municipality in the southwestern corner of township 22, range 29. It flows in a semicircular course and leaves the municipality at a point some 2 miles north. It again enters the municipality in section 30 of the same township and flows eastward to leave in sec. 12, tp. 23, range 28. Red Deer river, forming the northern boundary of the western part of the municipality, enters the area in the northern part of sec. 16, tp. 23, range 29, and joins the South

Saskatchewan in the northeast corner of township 22, range 29. The point of confluence is known as Red Deer Forks.

A hilly upland area extends along the southern boundary of the municipality. From elevations of 2,450 to 2,500 feet above sea-level on this upland, the ground surface slopes northward in a gently rolling plain to elevations of 2,250 to 2,300 feet along the southern edge of South Saskatchewan River valley. The river valley is steep sided and narrow in the western part of the municipality, but becomes wider toward the east. The valley is about 350 to 400 feet deep, the water-level at Red Deer Forks being approximately 1,900 feet above sea-level. Only a narrow upland area occurs between South Saskatchewan and Red Deer rivers, the valley of the Red Deer being fairly wide. Low sand hills cover a large area in the central part of the municipality, small areas between Red Deer and South Saskatchewan rivers, and the semicircular area west of South Saskatchewan river, in the southwestern part of township 22, range 29.

South Saskatchewan and Red Deer rivers provide water for stock pasturing in their valleys in the northern part of the municipality. Residents to the south of South Saskatchewan River valley haul water from the river for both household and stock requirements when wells yield inadequate supplies. A few sloughs and dugouts excavated by farmers in the southern part of the municipality provide some water for stock in wet seasons.

Most of the water used in the region is obtained from wells. In the southern part of the area small supplies for household use are obtained from shallow wells, but wells between 40 and 130 feet deep, in the glacial drift, provide most of the water for stock. In the sand hill areas in the central part of the municipality adequate supplies are obtained from shallow wells and dugouts excavated in the sand. Toward the north shallow seepage wells are common, but in dry seasons many residents are

forced to haul water from the river or from more productive wells in the sand hills. In a few places wells have been drilled to depths of 275 to 400 feet, and obtain large supplies of water in sand beds of the Belly River bedrock formation.

Water-bearing Horizons in the Unconsolidated Deposits

The unconsolidated deposits consist of stream sands covering the flats in the river valleys, dune sands forming the sand hills, and glacial deposits of various types covering the remainder of the area. The stream sands were deposited by the rivers during periods of flood, whereas the dune sands were formed by the action of the prevailing winds on beds of lake sands. The glacial deposits were laid down by a great continental ice-sheet that many thousands of years ago advanced and retreated over the province of Saskatchewan. The glacial deposits, collectively referred to as drift, are of three types, differentiated by their mode of deposition, the character of the component sediments, and the type of topographic relief they present. As the ice-sheet advanced and retreated it laid down a layer of material composed essentially of compact, bluish grey boulder clay, through which are interspersed irregular beds and pockets of sands and gravels that are generally water bearing. The boulder clay or glacial till presents a flat or gently rolling land surface and is designated as till plain. In this area the till is largely concealed by a covering of more recent lake sands and clays. However, a fairly large area of till is exposed in the southern part of the municipality, and smaller areas occur along the slopes of the river banks in the northern parts.

In areas where the retreating ice front paused for a considerable length of time, a thicker and a more porous type of drift known as moraine was deposited. The moraine is also comprised largely of sandy boulder clay interspersed with beds

and lenses of sands and gravels. The surface of the moraine is irregularly rolling, with many low knolls and intervening, undrained depressions. Most of the hilly uplands along the southern boundary of the municipality are covered by moraine.

As the waters from the melting ice accumulated in depressions and drainage courses blocked by the ice large lakes were formed in the low-lying land. Into these lakes were washed fine silts grading into coarser sands around the margins. The areal extent of one of these glacial lakes is marked by a deposit of lake clays that cover the large area immediately to the south of the river valley, and of lake sands that cover the central part of the municipality and smaller areas nearer the river valleys. Subsequent wind erosion of these sands has formed the sand hills that cover large areas in this municipality. The areal distribution of these various types of deposits is indicated on Figure 1, of the accompanying map.

In the dune and lake sand-covered areas, water is generally obtainable at shallow depths at or near the base of the sand. Water percolates freely downward from the surface and collects in the sand filling depressions in the surface of the underlying, impervious boulder clay. Shallow wells sunk to the base of the sand where these depressions occur will yield water. The supplies obtained depend on the thickness and porosity of the sand, and the extent of the catchment area surrounding the depressions. In the lake sand area the surface of the underlying boulder clay conforms to some extent to the ground surface. Hence, wells sunk in depressions and valleys are more likely to be productive than wells sunk on higher lands. As a rule in the lake sand area of this municipality the supplies available from the sand are small and wells have been sunk to greater depths in the underlying glacial drift in order to obtain sufficient water for stock. In the dune sand area the sands are generally

thicker and more porous, and little difficulty has been experienced in obtaining ample supplies of water for range stock by sinking shallow wells or even excavating dugouts in the sand. The water obtained from the dune and lake sands as a rule is soft or only moderately hard, and is well adapted to domestic use.

The lake clay seldom contains porous sand pockets and, consequently, only small seepages of water can be expected from it. A few residents in the northern part of the municipality obtain small supplies from shallow seepage wells in the lake clay. The water is only moderately hard and can be used in the household.

Localized pockets of sand and gravel occur interspersed in the upper part of the boulder clay, comprising both the glacial moraine and the till. Shallow wells, 40 feet or less in depth, tapping these pockets, both in areas where the boulder clay occurs at the surface and where it underlies the lake sands and clay, will yield at least small supplies of water. Several residents are obtaining adequate yields for local requirements from one or more of these shallow wells. In most places, however, wells have been sunk to greater depths to obtain the larger yields required for stock. The water from the shallow wells varies in quality from soft to hard and "alkaline", but is seldom unfit for drinking. Hence, these wells are used in many places to provide domestic supplies, where water from deeper wells is highly mineralized. Several test holes may be necessary in order to locate productive pockets of sand or gravel at shallow depth. The use of test augers greatly facilitates the prospecting.

In the southern part of the municipality adequate supplies of water have for the most part been obtained at depths of 40 to 130 feet, from beds of sand and gravel in the lower parts of the glacial drift. In some places these porous beds may extend continuously over areas of a few square miles, but the

greater number appear to be local in extent. In this area, however, very few holes have been sunk to any great depth without finding water. In the northern part of the municipality only a few wells have been sunk to depths exceeding 40 feet. Water has been obtained in these wells, but in most places the supplies are very limited. However, larger supplies might be obtained at other sites at depths of less than 130 feet.

Very little information is available regarding the thickness of the glacial drift over this municipality. A log of a 335-foot well in Burstall, in the southern part of the municipality, indicates a probable thickness of the drift of 200 feet. Other deep wells have been drilled in township 22, range 28, in the northern part of the municipality, but no logs are available to indicate the position of the drift-bedrock contact. However, in township 22, range 27, in the adjoining municipality to the east, logs of deep drilled wells indicate a probable thickness of drift of 160 to 180 feet. These findings suggest that the drift in this municipality, except in the river valleys, probably is between 150 and 200 feet thick. In the river valley large variations in the thickness of the drift can be expected. An outcrop of bedrock occur in the east side of the river valley, at the bend in the west-central part of township 22, range 29. In other parts, however, the river may be following an old pre-glacial channel in which the drift may be even thicker than on the uplands.

In places, sands and gravels may occur at the base of the glacial drift, from which fairly large supplies of water could be obtained. However, the wells drilled in the area below this horizon apparently did not encounter any appreciable supply of water at the contact.

Water-bearing Horizons in the Bedrock

Two bedrock formations, known as the Bearpaw formation and the Belly River formation, immediately underlie the glacial drift in different parts of this municipality. As only at one point on the river, in township 22, range 29, is the bedrock exposed at the surface its variation in character throughout the municipality is practically unknown. It is presumable that the upper of the two formations, the Bearpaw, at one time extended over the entire area. Erosion prior to the deposition of the glacial deposits has limited its areal extent so that it is now probably confined to the uplands along the southern border. The Belly River formation underlies the Bearpaw wherever it is present, and immediately underlies the glacial drift throughout the remainder of the municipality. The log of the well in Burstall would seem to indicate that the Bearpaw formation is absent at this place. Even under the higher lands it is probably less than 150 feet thick. The Bearpaw is composed mostly of compact, dark grey to nearly black, marine shales from which little or no water can be expected.

The Belly River formation is composed of shales interbedded with massive beds of coarse sands and occasional seams of lignite coal. These sands are sufficiently porous to form reservoirs for large accumulations of ground water. In the eastern part of township 22, range 28, wells between 276 and 400 feet deep, tapping sand beds in the formation, are yielding large supplies of hard, highly mineralized water. Similar supplies are to be expected within the same range of depths throughout the northern part of the municipality. The individual sand beds may not extend over large areas, but are considered to be sufficiently numerous to ensure water being found at most places.

In the southern part of the municipality, where surface elevations are higher, the depth of well necessary to reach productive

beds might be greater. The 335-foot well in Burstall apparently entered the Belly River formation at a depth of 200 feet, and below this depth 135 feet of clay (possibly shales) was reported to have been penetrated. A supply of water, estimated at 250 gallons an hour was obtained, but the information available does not indicate whether all or part of this water came from the base of the well or from a sand bed penetrated at a depth of 120 feet in the glacial drift. In township 20, range 27, in the adjoining municipality to the east, wells have been drilled to depths of 375 to 475 feet to obtain water from the Belly River formation. Similar depths of wells might be necessary to reach productive beds in the southern part of this municipality.

The drilling of deep wells is expensive. Therefore, farmers of limited means, who are unable to obtain sufficient water at depths of 130 feet or less, will probably find that the construction of dugouts or dams for the conservation of surface supplies, where feasible, will provide a more dependable source of supply, with less capital expenditure, than would the sinking of deep wells.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 19, Range 28

The southwestern part of the township and a small area in its northeastern corner are steeply rolling. Along the northern and eastern boundaries of the area the land forms a relatively flat plain, at slightly lower elevations than the more rolling land. The greater part of the township is covered by glacial drift in the form of till plain. The till grades into moraine in the southwestern corner of the township, and is covered by glacial lake sands and clays in small areas in the northwestern and southeastern corners.

Small supplies of water have been obtained at depths of 30 feet or less from the lake sands, where they are present, or from scattered pockets of sand and gravel in the upper part of the glacial drift, both where it occurs at the surface as till and moraine and where it is covered by lake sands and clays. Only a few residents have obtained sufficient water for stock requirements at these depths. These shallow wells are nevertheless necessary on most farms as the soft or only moderate hard water they yield is much more satisfactory for household purposes than the highly mineralized water from deeper wells.

Most of the water being used in the township is obtained from wells between 40 and 120 feet deep. Sands and gravels form the aquifers, and in most places yield adequate supplies of water. In some parts of the township these porous beds may be continuous over areas of a few square miles, but for the most part they appear to be local in extent. However, no dry holes of appreciable depth are reported, indicating that the water-bearing beds will be present at practically all sites. In a few places only thin, porous beds have been encountered, and only small seepages of water were obtained. The water is

usually hard and highly mineralized, and occasionally sufficient amounts of iron are present to give the water a yellowish colour. These waters are being used for domestic purposes where supplies of better quality have not been located at shallow depths.

Where wells of these depths fail to yield sufficient water, deep drilling down to the base of the glacial drift or into the underlying Bearpaw or Belly river formations might prove productive. No definite information is available regarding the thickness of the drift, but it may be between 200 and 250 feet.

In some places water-bearing sands and gravels might occur at the contact of the drift and the underlying Bearpaw formation. The Bearpaw formation is composed mostly of compact, dark grey, marine shales, from which little or no water can be expected. However, it probably nowhere exceeds 150 feet in thickness, and is underlain by the Belly River formation which contains many extensive beds of porous sands. Wells that have been sunk in areas to the north and east indicate that water might be obtained from this formation at depths of 300 to 500 feet.

In places where water supplies from wells 130 feet or less in depth prove inadequate, excavation of dugouts and construction of small dams, where practicable, is probably more advisable than the drilling of deep wells.

Township 19, Range 29

The southern part of this township consists of a hilly, moraine-covered upland. Toward the north the surface drops slightly to a gently rolling plain, covered by till in the area adjacent to the moraine and by lake sands in the northern sections. The lake sand is probably not more than 20 feet thick at any point.

A few, shallow, dug wells produce small supplies of water suitable for domestic use from the lake sands. In most places, however, it has been necessary to extend wells down into porous beds in the underlying boulder clay. Many of these scattered pockets

of sand and gravel in the boulder clay have been penetrated at depths of less than 40 feet, both where the boulder clay underlies the lake sand and where it is exposed at the surface as till plain and moraine. A few residents obtain adequate supplies of water for local farm requirements from one or more shallow wells, and on other farms they are used along with deeper wells producing more highly mineralized waters suitable only for stock.

At greater depths in the glacial drift more extensive beds of sand and gravel have been encountered. Wells sunk to depths between 40 and 130 feet have penetrated porous beds, and in most cases yield adequate supplies of hard, mineralized water. These beds appear to be localized and irregular in their occurrence, but no dry holes have been reported in the area, indicating that water will be obtained at most sites. The water is generally unsatisfactory for domestic use, but is being used in some places, where water of better quality is not available. Sufficient water for domestic use can in most places be obtained by careful prospecting at shallow depths.

In Burstall, in section 35, a well was drilled to a depth of 335 feet. Quicksand and water were encountered at a depth of 120 feet, and the base of the glacial drift is believed to have been reached at a depth of 200 feet. At 210 feet coal was reported, indicating that at least the base of the well has penetrated the upper part of the Belly River formation. If these observations are reliable, it would appear that the Bearpaw formation is absent at this site. At depths between 200 and 314 feet, clays (possibly shales) were reported to have been penetrated. The production of the well was reported to be 150 gallons an hour, but no information is available to indicate whether this water came from the sand bed at 120 feet, or from a porous bed at the base of the well. In areas to the east and north the Belly River formation has been found to contain many sandy beds,

and fairly large supplies of water have been obtained from them at depths of 300 to 500 feet. It is possible that deeper drilling into this formation in this township will produce larger supplies of water, at least suitable for stock. However, if water has not been found within 100 to 130 feet from the surface the construction of dams or excavation of dugouts for the conservation of surface supplies should be considered before deep drilling is undertaken.

Township 20, Range 28

The bedrock of the entire township is covered by glacial drift which is composed mostly of boulder clay. The drift occurs at the surface as till plain, in the southeastern corner of the township. In the remainder of the area it is covered by glacial lake sands, which in the southwestern sections have been reworked by the prevailing winds to form a range of low sand hills. The lake and dune sands are seldom more than 25 feet thick.

In the sand hills, adequate supplies of water for range stock can in most places be obtained from shallow wells and dugouts excavated in the sand, particularly where they are located in depressions. In the lake sand area to the southeast the sands are less productive, being thinner and interspersed with considerable amounts of clay. Sufficient water for household needs can in most places be obtained at depths of 35 feet or less, either in the sand or in localized pockets of sand and gravel in the upper part of the underlying boulder clay. Where the sands are absent, in the southeastern corner of the township, the porous pockets in the boulder clay form the only source of supply at shallow depths. In some places, adequate supplies of water for local farm requirements are obtained from one or more of these shallow wells. The lake sands are more likely to be productive in valleys and depressions than on higher lands. The water obtained

from shallow wells, particularly in the lake and dune sand covered regions, is soft or moderately hard, and well adapted to household use.

In order to obtain sufficient water for stock, most residents of the area have sunk wells to depths of 40 to 100 feet in the glacial drift. Water-bearing sands and gravels were encountered in most of these wells, and adequate supplies were obtained. However, in a few places, only small seepages are obtained from thin beds of fine sands. In the NE. $\frac{1}{4}$, section 12, and SW. $\frac{1}{4}$, section 14, several dry holes were sunk to depths ranging between 50 and 90 feet. However, water was eventually encountered in wells tapping isolated beds at depths of 65 and 93 feet, respectively, on the two sections. At nearly all places these porous beds can be expected to be of local character, and no assurance can be given that adequate supplies will be obtained at any site. However, the sinking of one hole will generally indicate the presence or absence of productive beds in any vicinity. The water obtained at depths of more than 40 feet in the glacial drift is, in most places, hard, highly mineralized, and unsatisfactory for domestic use. Careful prospecting at shallow depths is advisable at places where these waters cannot be used for drinking.

Should wells 130 feet or less in depth fail to yield sufficient water, deep drilling may prove more productive. The most probable source of adequate supply is in the sand beds of the Belly River formation. In adjoining townships to the east and northeast, fairly large supplies of water have been obtained from this formation at depths of 300 to 500 feet. The water may prove to be too highly mineralized for domestic use, but is suitable for stock.

Township 20, Range 29

The northern and east-central parts of this township are covered by low sand hills, and the southern part consists of a gently rolling, lake sand-covered plain. The glacial drift underlying these deposits is probably 150 or more feet thick. The sands comprising both the sand hills and the lake sands have even greater thicknesses. The sand hills area is not suited to farming and no records were obtained of any wells having been sunk in this part of the township. Should water be required for range stock it will probably be found by sinking shallow wells or excavating dugouts in the sand. The lake sands in the southern parts are interspersed with clay layers and are, consequently, less productive. However, small supplies of soft or moderately hard water for household use can be obtained at most places at depths of 40 feet or less in the sand, or in the localized pockets of sand and gravel interspersed in the upper part of the underlying boulder clay. In this part of the township water for stock is obtained chiefly from wells, between 60 and 105 feet in depth, tapping beds of sand and gravel in the lower part of the glacial drift. The sands and gravels encountered at these depths are not considered to form continuous aquifers over the entire area, but productive beds will probably be penetrated at depths between 40 and 130 feet in most parts of the township. The water from these wells is hard and highly mineralized, and is rarely used for drinking, but it is suitable for stock. Sufficient water for household use can generally be obtained from shallow wells, although careful prospecting may be required to locate the productive beds.

Should the supplies available at depths of 130 feet or less prove inadequate, large supplies might be obtained by deep drilling. The most probable source of adequate supply in drilled wells is in the sand beds of the Belly River formation at depths

between 300 and 500 feet. However, since no test holes have been sunk to these depths within a considerable distance of this area, no definite assurance can be given that water will be obtained by deep drilling.

Township 21, Range 28

A layer of glacial drift, believed to be 150 or more feet thick in most places, overlies the bedrock of this area. It is composed mostly of boulder clay, and is in turn overlain by a thin layer of glacial lake sands. Over large areas in the southern and northern parts of the township the upper lake sands have been reworked by wind action to form dunes or low sand hills. In the intervening areas the uneroded lake sands form a nearly level plain. The combined thickness of the dune sand and lake sand is probably nowhere more than 25 feet. In the areas of sand hills adequate supplies of water for range stock are obtained from shallow wells and dugouts sunk in the sands. In the intervening areas of lake sands the supplies of water obtained from the sand as a rule are smaller, but a few residents derive sufficient water for farm requirements by using two or more of these shallow wells. The water from the sand is only moderately hard, and well adapted to household uses.

On farms where the sands have proved unproductive small supplies of water may be expected by extending wells to slightly greater depths to encounter the localized pockets of sand and gravel that are interspersed through the upper part of the underlying boulder clay. Water from this latter horizon may be more highly mineralized than water from the sand, but it will rarely be unfit for drinking.

In order to obtain water for stock, several residents have sunk wells to depths of 50 to 100 feet in the glacial drift. Beds of sand or gravel were encountered in all these wells, and

in most places adequate supplies are being obtained. Some of these beds of sand and gravel may be continuous over areas of a few square miles, but for the most part they appear to be local in extent. The water obtained is almost invariably hard, and contains appreciable quantities of mineral salts in solution. However, where it is unsuitable for drinking, shallow wells can be expected to produce sufficient water for household use.

Should the wells sunk to depths of 130 feet or less prove inadequate, larger supplies might be obtained by deep drilling into the Belly River formation. Indications from wells in adjoining townships to the east and north suggest that these productive beds might be encountered at depths of 300 to 500 feet. Water from these bedrock aquifers will probably be too highly mineralized for drinking, but should be suitable for stock.

Township 21, Range 29

Dune sands cover slightly more than the southern half of this township, and as the land is unsuited to farming, no wells, so far as known, have been sunk in this part of the township. The northern sections lie in a gently rolling plain, covered in the northeastern part by lake sands. These sands grade into clay that covers the area over to the edge of the river valley in the extreme northwest corner of the township. The Recent dune sands, the lake sands, and the lake clay, are underlain by at least 150 feet of bluish grey boulder clay which in turn rests upon the Belly River bedrock formation. The thickness of the dune sands and lake sands is everywhere expected to be less than 25 feet.

In the sand hills water for range stock should be readily obtainable by sinking shallow wells or excavating dugouts in the sand. The lake sands are evidently more compact than the dune sands, as they do not yield as large supplies.

Nevertheless, residents of the area obtain all of their water from wells less than 30 feet deep. Some of the water comes from the lake sand, but many of the wells have tapped localized pockets of sand in the upper part of the underlying boulder clay. On many farms the use of even two or more of these wells provides only barely sufficient water for stock requirements in dry seasons. Little or no water can be expected from the lake clay covering the northwestern corner of this area but porous pockets may occur in the upper part of the underlying boulder clay, from which small supplies of hard, drinkable water could be obtained. A 30-foot well located on the NW. $\frac{1}{4}$, section 20, yields an adequate supply of water as seepage from the boulder clay. In sections 33 and 34 wells were sunk to greater depths in the glacial drift. In section 33 moderately large supplies of water are being obtained from 48- and 58-foot wells, which tap sand beds. In section 34 only small seepages are being derived from the boulder clay at depths of 40, 50, and 87 feet. From a consideration of wells in townships to the south and east, it seems probable that sands and gravels will be encountered in the glacial drift at depths of 130 feet or less, and these beds should yield sufficient water for stock. One test hole will usually indicate the presence or absence of productive water-bearing beds in any vicinity, at depths exceeding 40 feet.

Should sufficient water for local requirements not be obtained at depths of 130 feet or less, deep drilling might prove more productive. The most probable source of supply in drilled wells is in the sandy beds of the Belly River formation. Wells would probably have to be drilled to depths of 300 to 500 feet in this area to test this source. The water, if present, would probably be too highly mineralized for drinking, but should be satisfactory for stock.

Township 22, Range 28

The southern third and the north-central part of this township are covered by glacial lake sands, forming a nearly level plain. In the intervening area the sands grade into more compact lake clay. Wind action in the southern lake sands region has formed small areas of sand dunes. Boulder clay underlies the lake sands and lake clay, and in a narrow area extending along the northeastern part the boulder clay is exposed as a gently rolling area of till plain. Boulder clay is also exposed along the river banks in the extreme northwest corner of the township.

Most residents of the area obtain their water from shallow wells, which in most places yield only small supplies of water. During dry years many of these wells do not yield sufficient water and supplies are hauled from South Saskatchewan river, from more productive wells in the sand hills, or from the deeper wells in the area.

In places where the lake and dune sands are sufficiently thick to form reservoirs they yield water at depths of 10 to 25 feet. Some of the dug wells that have been located in depressions yield adequate supplies of water for local farm requirements. In many places, however, the sands are only a few feet thick, and wells must be continued into the underlying boulder clay. Small supplies of water are obtained at depths of 35 feet or less from localized pockets of sand or by direct seepage from the boulder clay itself. In wet seasons most residents have been able to obtain sufficient water for stock requirements from two or more of these wells, but in drought periods the supplies diminish and are usually inadequate. Similar conditions occur in the lake clay and till-covered areas where most of the water is obtained in shallow wells in the clay by seepage. The water obtained from the shallow wells is usually soft or only moderately hard, and

well adapted to household use. In the sand-covered areas wells sunk in depressions or valleys are more likely to be productive than wells sunk on higher ground. In sections 1 and 18 wells were sunk to depths of 100 and 65 feet in the glacial drift. The well in section 1 yields a very small supply as seepage from the clay. The well in section 18 has encountered thin lenses of gravel, but the supply is not appreciably greater than from the well on section 1. More productive beds of sand and gravel might be encountered in the glacial drift at depths of 40 to 150 feet, at other sites in the township, but the porous beds are evidently of rather sparing occurrence and undoubtedly at many sites wells sunk within this range of depths will be unproductive.

The most certain source of adequate water supply is in the sand beds of the Belly River formation. In sections 12, 13, 15, and 24 large supplies of water have been obtained from sand beds in this formation at depths of 276 to 400 feet. The water is hard and highly mineralized, but quite suitable for stock. In sections 12 and 24 the water is being used for domestic purposes in the absence of water of better quality. Wells sunk to depths between 300 and 400 feet in all parts of this township should be productive of supplies similar to those from the above four wells. The bedrock aquifers may not be individually continuous over large areas, but should be sufficiently numerous at most points in the township to ensure finding water within the range of depths suggested.

Township 22, Range 29

South Saskatchewan river enters the southwestern corner of this township and flows in a crescent-shaped course through sections 6, 5, 8, and 17, to pass out of the township again in section 18. It re-enters the township in section 30, and flows

in an easterly direction to join Red Deer river in section 36. The river valley in this township is narrow and steep sided, except on the west side of the bend in the southwestern corner. The uplands that lie south and east of the river valley are relatively flat and covered by glacial lake clay except in the southeastern corner where the clay grades into lake sand. These sands and clays are underlain at depths probably not exceeding 20 feet by glacial drift composed mostly of boulder clay. The boulder clay is exposed at the surface along the steep sides of the river valley. In the semicircular area west of the river in the southwestern corner of the township, the lowland plain is covered by Recent stream sands, and dune sand occurs on the north of the river valley, in the northwestern corner of the township. Except in the eastern part of the township, south of the valley, the region is largely devoted to grazing. No wells have been sunk in this area as the river provides a readily accessible supply of water. Should more conveniently located supplies of water be required for domestic purposes on the upper slopes of the valley, shallow wells located in the bottoms of tributary coulées should provide drinkable water. In the dune sand areas water could probably be obtained with very little prospecting in the sand. In the river valley water-bearing sands and gravels washed from the uplands would probably be encountered at shallow depths at the bases of steep slopes and at the bottoms of ravines. All wells that have been sunk to date in the township are confined to the eastern sections. In these sections, water is being derived from wells not exceeding 35 feet in depth. Some of these wells tap localized pockets of sand in the upper part of the boulder clay underlying the lake clay, and others derive their supplies as seepage from the clays themselves. The yields are small and diminish considerably in dry seasons. Some residents have been able to secure an adequate

supply at all times by using one or more of these wells, but others have been forced to haul at least part of their supply during dry seasons from the river or from the more productive wells. The water is usually soft or only moderately hard, and well adapted to domestic use.

The possibilities of obtaining water at greater depths in the glacial drift cannot be considered particularly encouraging. In some places water-bearing beds of sand and gravel might occur interspersed in the boulder clay at depths of between 40 and 120 feet, but the deeper wells in townships along the river to the east indicate that the lower part of the drift is by no means a certain source of supply.

Deep drilled wells, 300 to 400 feet deep, tapping beds of sand in the Belly River formation might yield fairly large supplies of highly mineralized water, suitable for stock. The depths necessary to reach productive beds in this formation might in some places be more or less than the range given, but wells in townships to the east indicate that these are the most likely depths at which water will be obtained.

Township 23, Range 28

The part of this township lying within this municipality comprises an area of approximately 7 square miles. The greater part of the area lies on the southern slope of South Saskatchewan River valley. The banks are not exceptionally steep along this part of the valley. The flats adjacent to the river are covered by Recent stream sands. Eroded drift occurs at the surface on the slopes extending away from these flats. Lake sands cover the drift in a small area south of the railway.

Very little farming is carried on in the valley and the river provides a readily accessible supply of water for range stock in the vicinity. In the village of Estuary water supplies are obtained mostly from shallow wells sunk into the porous,

eroded drift. Sands and gravels appear to be quite numerous at shallow depths in this area. One well sunk to a depth of 52 feet, in the town, yields a fairly large supply of hard, "alkaline" water. The water from the shallow wells is soft or only moderately hard. Near the river, in section 10, a 25-foot well sunk into the stream sands, yields a supply of hard, highly mineralized, iron-bearing water. Water of better quality for house use is obtained from the river, and most of the water for stock is obtained from this source.

In general, little difficulty should be experienced in obtaining adequate supplies of drinkable water at shallow depths in this area, providing tests are made in areas where the natural slope of the land lends to the concentration of surface and near surface supplies.

Township 23, Range 29

This part of the township consists of an area of approximately 5 square miles bounded on the west by the Saskatchewan-Alberta boundary and on the northeast by Red Deer river. It is situated mostly in the river flats and on the slopes of the south bank of the river valley. Boulder clay is exposed along the banks of the valley, and is covered by Recent stream sands in the flats adjacent to the river. Dune sands and lake clays cover the boulder clay on the small upland area in the southwestern corner of the township.

No wells have been reported in the area. However, in view of the sandy nature of the surface sediments, it is believed that little prospecting would be necessary to locate adequate supplies at shallow depths. The river provides a readily accessible supply of water for stock, and the water is well adapted to household use.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF DEER FORKS, NO. 232, SASKATCHEWAN

Township Range	19	19	20	20	21	21	22	22	23	23	Total No. in muni- cipality
	28	29	28	29	28	29	28	29	28	29	
West of 3rd mer.											
<u>Total No. of Wells in Township</u>	62	58	44	21	40	18	55	14	5	0	317
No. of wells in bedrock	0	1	0	0	0	0	4	0	0	0	5
No. of wells in glacial drift	62	56	33	21	40	18	51	14	5	0	300
No. of wells in alluvium	0	1	11	0	0	0	0	0	0	0	12
<u>Permanency of Water Supply</u>											
No. with permanent supply	61	57	37	20	40	18	51	14	5	0	303
No. with intermittent supply	0	1	1	1	0	0	1	0	0	0	4
No. dry holes	1	0	6	0	0	0	3	0	0	0	10
<u>Types of Wells</u>											
No. of flowing artesian wells	0	0	0	0	0	0	0	0	0	0	0
No. of non-flowing artesian wells	31	24	10	6	4	0	4	0	0	0	79
No. of non-artesian wells	30	34	28	15	36	18	48	14	5	0	228
<u>Quality of Water</u>											
No. with hard water	53	48	24	16	38	14	42	11	2	0	248
No. with soft water	8	10	14	5	2	4	10	3	3	0	59
No. with salty water	0	0	1	0	0	0	1	0	0	0	2
No. with "alkaline" water	31	25	13	5	9	3	7	1	3	0	97
<u>Depths of Wells</u>											
No. from 0 to 50 feet deep	25	34	20	11	28	17	49	14	3	0	201
No. from 51 to 100 feet deep	32	21	24	8	12	1	2	0	2	0	102
No. from 101 to 150 feet deep	5	2	0	2	0	0	0	0	0	0	9
No. from 151 to 200 feet deep	0	0	0	0	0	0	0	0	0	0	0
No. from 201 to 500 feet deep	0	1	0	0	0	0	4	0	0	0	5
No. from 501 to 1,000 feet deep	0	0	0	0	0	0	0	0	0	0	0
No. over 1,000 feet deep	0	0	0	0	0	0	0	0	0	0	0
<u>How the Water is Used</u>											
No. usable for domestic purposes	52	45	32	13	32	18	47	13	5	0	255
No. not usable for domestic purposes	9	13	6	8	8	0	5	1	2	0	52
No. usable for stock	60	53	38	21	40	18	52	14	3	0	299
No. not usable for stock	1	5	0	0	0	0	0	0	2	0	8
<u>Sufficiency of Water Supply</u>											
No. sufficient for domestic needs	61	56	34	20	35	18	44	13	5	0	286
No. insufficient for domestic needs	0	2	4	1	5	0	8	1	0	0	21
No. sufficient for stock needs	45	42	38	17	20	13	24	5	5	0	209
No. insufficient for stock needs	16	16	0	4	20	5	28	9	0	0	98

ANALYSES AND QUALITY OF WATER

General Statement

Samples of water from representative wells in surface deposits and bedrock were taken for analyses. Except as otherwise stated in the table of analyses the samples were analysed in the laboratory of the Borings Division of the Geological Survey by the usual standard methods. The quantities of the following constituents were determined; total dissolved mineral solids, calcium oxide, magnesium oxide, sodium oxide by difference, sulphate, chloride, and alkalinity. The alkalinity referred to here is the calcium carbonate equivalent of all acid used in neutralizing the carbonates of sodium, calcium, and magnesium. The results of the analyses are given in parts per million--that is, parts by weight of the constituents in 1,000,000 parts of water; for example, 1 ounce of material dissolved in 10 gallons of water is equal to 625 parts per million. The samples were not examined for bacteria, and thus a water that may be termed suitable for use on the basis of its mineral salt content might be condemned on account of its bacteria content. Waters that are high in bacteria content have usually been polluted by surface waters.

Total Dissolved Mineral Solids

The term "total dissolved mineral solids" as here used refers to the residue remaining when a sample of water is evaporated to dryness. It is generally considered that waters that have less than 1,000 parts per million of dissolved solids are suitable for ordinary uses, but in the Prairie Provinces this figure is often exceeded. Nearly all waters that contain more than 1,000 parts per million of total solids have a taste due to the dissolved mineral matter. Residents

accustomed to the waters may use those that have much more than 1,000 parts per million of dissolved solids without any marked inconvenience, although most persons not used to highly mineralized water would find such waters highly objectionable.

Mineral Substances Present

Calcium and Magnesium

The calcium (Ca) and magnesium (Mg) content of water is dissolved from rocks and soils, but mostly from limestone, dolomite, and gypsum. The calcium and magnesium salts impart hardness to water. The magnesium salts are laxative, especially magnesium sulphate (Epsom salts, $MgSO_4$), and they are more detrimental to health than the lime or calcium salts. The calcium salts have no laxative or other deleterious effects. The scale found on the inside of steam boilers and tea-kettles is formed from these mineral salts.

Sodium

The salts of sodium are next in importance to those of calcium and magnesium. Of these, sodium sulphate (Glauber's salt, Na_2SO_4) is usually in excess of sodium chloride (common salt, $NaCl$). These sodium salts are dissolved from rocks and soils. When there is a large amount of sodium sulphate present the water is laxative and unfit for domestic use. Sodium carbonate (Na_2CO_3) "black alkali", sodium sulphate "white alkali", and sodium chloride are injurious to vegetation.

Sulphates

Sulphates (SO_4) are one of the common constituents of natural water. The sulphate salts most commonly found are sodium sulphate, magnesium sulphate, and calcium sulphate ($CaSO_4$). When the water contains large quantities of the sulphate of sodium it is injurious to vegetation.

Chlorides

Chlorides are common constituents of all natural water and are dissolved in small quantities from rocks. They usually occur as sodium chloride and if the quantity of salt is much over 400 parts per million the water has a brackish taste.

Iron

Iron (Fe) is dissolved from many rocks and the surface deposits derived from them, and also from well casings, water pipes, and other fixtures. More than 0.1 part per million of iron in solution will settle as a red precipitate upon exposure to the air. A water that contains a considerable amount of iron will stain porcelain, enamelled ware, and clothing that is washed in it, and when used for drinking purposes has a tendency to cause constipation, but the iron can be almost completely removed by aeration and filtration of the water.

Hardness

Calcium and magnesium salts impart hardness to water. Hardness of water is commonly recognized by its soap-destroying powers as shown by the difficulty of obtaining lather with soap. The total hardness of a water is the hardness of the water in its original state. Total hardness is divided into "permanent hardness" and "temporary hardness". Permanent hardness is the hardness of the water remaining after the sample has been boiled and it represents the amount of mineral salts that cannot be removed by boiling. Temporary hardness is the difference between the total hardness and the permanent hardness and represents the amount of mineral salts that can be removed by boiling. Temporary hardness is due mainly to the bicarbonates of calcium and magnesium and iron, and permanent hardness to the sulphates and chlorides of calcium and magnesium. The permanent hardness

can be partly eliminated by adding simple chemical softeners such as ammonia or sodium carbonate, or many prepared softeners. Water that contains a large amount of sodium carbonate and small amounts of calcium and magnesium salts is soft, but if the calcium and magnesium salts are present in large amounts the water is hard. Water that has a total hardness of 300 parts per million or more is usually classed as excessively hard. Many of the Saskatchewan water samples have a total hardness greatly in excess of 300 parts per million; when the total hardness exceeded 3,000 parts per million no exact hardness determination was made. Also no determination for temporary hardness was made on waters having a total hardness less than 50 parts per million. As the determinations of the soap hardness in some cases were made after the samples had been stored for some time, the temporary hardness of some of the waters as they come from the wells probably is higher than that given in the table of analyses.

Water from the Unconsolidated Deposits

South Saskatchewan and Red Deer rivers provide water for stock in the northern part of the municipality, and water is hauled from them by residents of the northern townships for both household and stock use. No analyses were made of water from these rivers, but analyses made of the river water in the vicinity of Saskatoon should be fairly indicative of its mineral character. The dissolved solid content varies seasonally, generally between 200 and 400 parts per million, and the total hardness between 100 and 250 parts per million. The permanent hardness, due to the presence of calcium and magnesium sulphates (CaSO_4 and MgSO_4), rarely exceeds 100 parts per million. Since the river valley is not thickly settled in this region widespread pollution of the water is not to be expected. As an additional safeguard, however, residents could procure water less likely to be contaminated, and free of sediment in suspension, by taking drinking water from shallow wells sunk beside the rivers rather than directly from the stream.

No analyses were made of any waters in this municipality. The few generalizations that follow are based upon reports of residents in the area, observations at well sites, and analyses made of waters from adjoining municipalities in which the source beds are similar to those occurring in this area.

Waters derived from the porous dune sands and lake sands, as a rule, contain between 400 and 900 parts per million of dissolved mineral salts, and have a total hardness of between 200 and 500 parts per million. This water is not excessively hard and the concentrations of the laxative acting salts, magnesium sulphate (MgSO_4 , Epsom salts) and sodium sulphate (Na_2SO_4 , Glauber's salt), are not sufficiently high to affect the quality of the water for drinking. In a few lowland places continued surface evaporation

has caused the salts to become fairly highly concentrated, but in few places is the water from the sands thought to be too highly mineralized to be used for domestic purposes. The character of the upper 30 or 40 feet of the glacial drift varies considerably even within small areas, and similar variations may be expected in the quality of the water obtained from shallow wells only short distances apart. The boulder clay, and to a lesser extent the lake clay, in areas in which they are present are considered to be the main sources of the objectionable sulphate salts present in varying amounts in waters from the drift. Hence, beds of sands and gravels not covered by any appreciable thickness of clay yield water that is soft or only moderately hard, whereas waters from porous beds under 30 feet or more of clay are typically excessively hard and "alkaline". The total dissolved mineral salt content of the waters from many of the glacial deposits is not expected to exceed 1,500 parts per million. Glauber's salt (Na_2SO_4), Epsom salts (MgSO_4), and calcium sulphate are present in the greatest concentrations, together with minor amounts of calcium and possibly magnesium carbonate. Glauber's salt and, to a greater extent, Epsom salts are laxative acting, and the concentration in which they are present determine the suitability of the water for domestic use and for stock.

Waters in which the combined sulphates are less than 2,000 parts per million and sodium sulphate (Na_2SO_4) is in excess over the magnesium sulphate (MgSO_4) are being used for drinking with no apparent ill effects, although water with total solid contents reaching this upper limit would undoubtedly prove objectionable to persons not accustomed to "alkaline" waters. The total dissolved solid content increases appreciably at greater depths in the glacial drift. The total solid content usually

exceeds 2,000 parts per million, and may exceed 4,000 or even 5,000 parts per million. Such water cannot be used for drinking, and when the magnesium sulphate content is high the water will tend to create scour in stock and should not be used if water of better quality is obtainable.

Iron forms an objectionable impurity in many of the waters from the glacial drift. The iron may be in a large part removed by allowing the water to come in contact with the air in an open container. The iron forms a brown precipitate in contact with the air and will settle to the bottom of the container as a brown sediment. Agitation of the water or allowing it to flow in a thin stream over baffle boards is helpful in removing iron.

Water from the Bedrock

No water is definitely known to be derived from the compact shales of the Bearpaw formation in this municipality. Any water that might be found in the shales is expected to contain large concentrations of sodium sulphate (Na_2SO_4) and common salt (NaCl), together with other sulphates and carbonates, and would be unfit for drinking and probably unfit for watering stock.

Waters derived from the deep wells penetrating the Belly River formation are all reported to be hard and "alkaline", and water from a 400-foot well drilled on the SE. $\frac{1}{4}$, sec. 15, tp. 22, range 28, contains sufficient quantities of common salt to give the water an objectionable salty taste. No analyses of these waters have been made, but observations over wide areas would indicate that water from this source is not usually satisfactory for domestic use, although it can be used for watering stock. Supplies from the uppermost beds of the Belly River

formation may be drinkable, but at greater depths the sodium sulphate, sodium chloride, and sodium carbonate content of the water is expected to increase. Sodium carbonate, "black alkali", tends to give the water a flat, soda taste, and is harmful to vegetation. Water from deep wells in which any large amounts of sodium carbonate are known to be present should not be used for watering gardens.

WELL RECORDS—Rural Municipality of

DEER FORMS, NO. 232, SASKATCHEWAN.

WELL No.	LOCATION					TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE		PRINCIPAL WATER-BEARING BED			CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	¼	Sec.	Tp.	Rge.	Mer.				Above (+) Below (-) Surface	Elev.	Depth	Elev.	Geological Horizon				
1	NE.	2	19	28	3	Bored	42	2,450	- 32	2,428	32	2,428	Glacial gravel	Hard	45	D, S	Sufficient supply; also a 30-foot well; soft water.
2	SE.	3	"	"	"	Bored	78	2,470	- 50	2,420	76	2,392	Glacial sand	Hard, iron	44	D, S	Sufficient supply.
3	NE.	4	"	"	"	Bored	94	2,458	- 50	2,408	45	2,413	Glacial drift	Hard, iron	44	D, S	Sufficient supply.
4	SW.	4	"	"	"	Bored	85	2,510	- 76	2,434	76	2,434	Glacial gravel	Hard, "alk- aline"	44	#	Sufficient supply; another 18-foot well; soft water.
5	SW.	6	"	"	"	Bored	95	2,450	- 35	2,415	95	2,355	Glacial quicksand	Hard, iron, "alkaline"	44	D, S	Sufficient supply; also a 15-foot well; a dry hole 56 feet deep.
6	NW.	7	"	"	"	Bored	63	2,420	- 43	2,377	63	2,357	Glacial quicksand	Hard, iron	47	D, S	Sufficient supply; a similar well.
7	NE.	7	"	"	"	Bored	85	2,430	- 45	2,385	85	2,345	Glacial drift	Hard, iron, "alkaline"	44	D, S	Insufficient supply.
8	NE.	8	"	"	"	Bored	95	2,420	- 45	2,375	95	2,325	Glacial gravel	Hard, iron, "alkaline", yellow	44	D, S	Sufficient supply.
9	SE.	9	"	"	"	Bored	94	2,458	- 50	2,408	50	2,408	Glacial drift	Hard, iron	44	D, S	Sufficient supply.
10	NW.	10	"	"	"	Bored	70	2,400	- 40	2,420	70	2,390	Glacial sand	Hard, iron, "alkaline"	45	D, S	Sufficient supply.
11	SE.	10	"	"	"	Bored	130	2,498	-120	2,378	120	2,378	Glacial drift	Hard, iron, "alkaline"	44	S	Insufficient supply; two other wells 50 and 80 feet deep; one soft water.
12	NW.	11	"	"	"	Bored	50	2,510					Glacial drift			N	Bad effect on cattle.
13	NE.	12	"	"	"	Bored	80	2,374	- 40	2,334	80	2,294	Glacial gravel	Hard, iron	45	D, SS	Sufficient supply.
14	SE.	13	"	"	"	Bored	90	2,400	- 45	2,355	90	2,310	Glacial sand	Hard, iron, "alkaline"	44	D, S	Sufficient supply.
15	NE.	14	"	"	"	Bored	40	2,450	- 10	2,440	30	2,420	Glacial drift	Hard, iron, "alkaline"	45	D, S	Sufficient supply.
16	SE.	15	"	"	"	Bored	65	2,480	- 20	2,468	65	2,423	Glacial sand	Hard, iron, "alkaline"	45	D, S	Sufficient supply.
17	NE.	15	"	"	"	Bored	38	2,475	- 30	2,445	38	2,437	Glacial drift	Hard, iron, "alkaline"	46	D, S	Sufficient supply; laxative; makes humans ill.
18	SW.	15	"	"	"	Bored	73	2,408	- 20	2,388	73	2,335	Glacial gravel	Hard, iron	45	D, S	Sufficient supply.
19	NW.	16	"	"	"	Bored	95	2,420	- 50	2,370	95	2,325	Glacial gravel	Hard, iron, "alkaline", yellow	44	D, S	Sufficient supply.
20	NE.	17	"	"	"	Bored	100	2,430	- 53	2,377	100	2,330	Glacial gravel	Hard, "alk- aline"	44	D, S	Sufficient supply; a 20-foot well; soft water for house use only.
21	NE.	18	"	"	"	Bored	70	2,420	- 63	2,357	70	2,350	Glacial sand and gravel	Hard, "alk- aline"	44	D, S	Sufficient supply.
22	NW.	18	"	"	"	Bored	95	2,430	- 65	2,365	95	2,335	Glacial gravel	Hard, iron, "alkaline", yellow	44	D, S	Sufficient supply.
23	SE.	19	"	"	"	Bored	89	2,420	- 29	2,391	89	2,331	Glacial drift	Hard, iron, "alkaline"	45	D, S	Sufficient supply.
24	SE.	20	"	"	"	Bored	100	2,430	- 50	2,380	100	2,330	Glacial gravel	Hard, "alk- aline"	44	D, S	Sufficient supply.
25	SW.	21	"	"	"	Bored	100	2,410	- 60	2,350	100	2,310	Glacial sand	Hard, iron, "alkaline"	44	D, S	Sufficient supply.
26	SE.	22	"	"	"	Bored	80	2,485	- 30	2,455	40	2,445	Glacial drift	Hard, iron, "alkaline"	45	S	Sufficient supply; a 30-foot well, soft water for house use.

NOTE—All depths, altitudes, heights and elevations given above are in feet.

(D) Domestic; (S) Stock; (I) Irrigation; (M) Municipality; (N) Not used.
(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of

WELL No.	LOCATION					TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE		PRINCIPAL WATER-BEARING BED			CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	¼	Sec.	Tp.	Rge.	Mer.				Above (+) Below (-) Surface	Elev.	Depth	Elev.	Geological Horizon				
27	NE.	22	19	28	3	Bored	40	2,400	- 30	2,370	30	2,370	Glacial drift	Hard, "alkaline"	46	D	Sufficient supply.
28	NE.	22	"	"	"	Bored	120	2,400	-100	2,300	100	2,300	Glacial drift	Hard, iron, red	44	S	Sufficient supply.
29	NE.	23	"	"	"	Bored	70	2,435	- 20	2,415	70	2,365	Glacial sand	Hard, iron, "alkaline", yellow	45	D, S	Sufficient supply; a 14-foot well with soft water.
30	NE.	24	"	"	"	Bored	62	2,410	- 55	2,355	55	2,355	Glacial sand	Hard, iron, "alkaline", yellow	44	D, S	Sufficient supply.
31	NW.	24	"	"	"	Bored	102	2,390	- 22	2,368			Glacial drift	Hard, "alkaline"	44	D, S	Sufficient supply.
32	SE.	25	"	"	"	Bored	78	2,400	- 6	2,394	78	2,322	Glacial green sand	Hard, iron, "alkaline"	44	D, S	Sufficient supply.
33	SW.	25	"	"	"	Bored	95	2,444	- 29	2,415	95	2,349	Glacial sand	Hard, iron, "alkaline"	44	D, S	Sufficient supply.
34	SE.	26	"	"	"	Bored	125	2,410	-100	2,310	125	2,285	Glacial sand	Hard, iron	44	S	Sufficient supply.
35	NE.	26	"	"	"	Bored	107	2,430	- 17	2,413	75	2,355	Glacial sand	Hard, iron, "alkaline", yellow	45	D, S	Sufficient supply.
36	NE.	28	"	"	"	Bored	90	2,420	- 45	2,375	90	2,330	Glacial quick-sand	Hard, iron, "alkaline"	44	D, S	Sufficient supply.
37	SW.	31	"	"	"	Bored	71	2,370	- 8	2,362	71	2,299	Glacial gravel	Hard, "alkaline"	46	S	Sufficient supply; 14-foot and 10-foot wells with soft water for house.
38	NE.	31	"	"	"	Dug	18	2,350	- 16	2,344	16	2,344	Glacial quick-sand	Hard	47	D, S	Sufficient supply; a similar well.
39	NW.	32	"	"	"	Dug	16	2,350	- 14	2,346	10	2,350	Glacial quick-sand	Soft	47	D, S	Insufficient supply; other similar wells 12 and 18 feet deep.
40	SE.	33	"	"	"	Dug	28	2,400	- 20	2,380	28	2,372	Glacial gravel	Hard, "alkaline"	46	D, S	Sufficient supply.
41	NE.	33	"	"	"	Dug	18	2,400	- 14	2,386	14	2,386	Glacial drift	Hard, "alkaline"	47	D, S	Insufficient supply; a 16-foot well, similar water.
42	NE.	34	"	"	"	Dug	24	2,400	- 20	2,380	24	2,376	Glacial sand	Soft, iron	47	D	Sufficient supply.
43	NE.	34	"	"	"	Bored	30	2,500	- 28	2,472	28	2,472	Glacial sand	Hard, "alkaline"	48	D	Sufficient supply.
44	NE.	35	"	"	"	Bored	80	2,465	- 50	2,415	80	2,385	Glacial sand	Hard, iron, "alkaline", yellow	44	S	Sufficient supply; a 4-foot well for house use.
45	SW.	36	"	"	"	Bored	90	2,455	- 87	2,379	87	2,379	Glacial drift	Hard, iron, yellow	44	S	Sufficient supply; another 18-foot well for house use.
1	SW.	2	19	29	3	Dug	18	2,485	- 15	2,470	18	2,467	Glacial sand and gravel	Soft		D, S	Sufficient supply.
2	SW.	3	"	"	"	Bored	45	2,450	- 30	2,420	45	2,405	Glacial drift	Hard		D, S	Sufficient supply.
3	NE.	3	"	"	"	Bored	80	2,455	- 40	2,425	80	2,385	Glacial sand	Hard, "alkaline"		D, S	Sufficient for 60 head stock.
4	NE.	4	"	"	"	Bored	50	2,470	- 50	2,420	50	2,420	Glacial drift	Hard, cloudy, "alkaline"		D, S	Sufficient supply.
5	NW.	4	"	"	"	Bored	24	2,430	- 17	2,413	17	2,413	Glacial sand	Hard		D	Sufficient supply.
6	SE.	5	"	"	"	Bored	39	2,465	- 26	2,439	26	2,439	Glacial sand	Hard		D, S	Sufficient supply.
7	SE.	5	"	"	"	Bored	40	2,465	- 18	2,447	40	2,425	Glacial gravel	Hard, iron		S	Sufficient supply; another similar well.

NOTE—All depths, altitudes, heights and elevations given above are in feet.

(D) Domestic; (S) Stock; (I) Irrigation; (M) Municipality; (N) Not used.
(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of DEER FORKS, NO. 232, SASKATCHEWAN.

WELL No.	LOCATION					TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE		PRINCIPAL WATER-BEARING BED			CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	¼	Sec.	Tp.	Rge.	Mer.				Above (+) Below (-) Surface	Elev.	Depth	Elev.	Geological Horizon				
8	NE.	8	19	29	3	Bored	32	2,400	- 12	2,446	32	2,428	Glacial sand	Soft		D, S	Sufficient supply.
9	SE.	9	"	"	"	Dug	47	2,415	- 46	2,369	46	2,369	Glacial gravel	Soft		D, S	Insufficient supply.
10	NW.	12	"	"	"	Bored	58	2,410	- 28	2,382	58	2,352	Glacial "sea-mud"	Hard, iron, "alkaline"	46	N	Sufficient supply; a 20-foot well; soft water for house.
11	NW.	13	"	"	"	Bored	90	2,390	- 85	2,305	90	2,300	Glacial sand	Hard, iron, "alkaline"	44	D, S	Sufficient supply.
12	SW.	14	"	"	"	Bored	42	2,446	- 27	2,419	27	2,419	Glacial sand	Soft		S	Insufficient supply; a 22-foot well and a 24-foot well, small supplies.
13	NE.	14	"	"	"	Bored	93	2,400	- 80	2,320	80	2,320	Glacial "sea-mud"	Hard, iron, "alkaline"	44	S	Sufficient supply; a 20-foot well; soft water for house.
14	NE.	15	"	"	"	Bored	78	2,412	- 28	2,384	78	2,334	Glacial sand	Hard, "alkaline"		D, S	Sufficient supply.
15	NW.	15	"	"	"	Bored	27	2,372	- 23	2,349	23	2,349	Glacial gravel	Hard, "alkaline"		D, S	Sufficient supply.
16	SW.	16	"	"	"	Dug	20	2,402	- 16	2,446	16	2,446	Glacial gravel	Hard, "alkaline"		D, S	Sufficient supply.
17	SE.	17	"	"	"	Bored	102	2,470	- 30	2,440	102	2,368	Glacial quicksand	Hard, iron, "alkaline", amber colour		S	Sufficient supply.
18	SE.	18	"	"	"	Bored	132	2,477	- 00	2,417	132	2,345	Glacial quicksand	Hard, iron, "alkaline"		S	Sufficient supply.
19	SE.	19	"	"	"	Bored	24	2,480	- 12	2,468	12	2,468	Glacial sand	Soft		D, S	Sufficient supply.
20	NE.	20	"	"	"	Bored	00	2,400	- 12	2,388	12	2,388	Glacial sand	Soft		D, S	Sufficient supply.
21	NE.	21	"	"	"	Dug	9	2,355	+ 6	2,349	6	2,349	Glacial quicksand gravel	Hard, "alkaline"		S	Sufficient for 8 head stock,
22	NW.	21	"	"	"	Dug	18	2,350	- 12	2,338	12	2,338	Glacial drift	Hard, "alkaline"		D	Sufficient supply.
23	NW.	21	"	"	"	Bored	85	2,350	- 20	2,330	20	2,330	Glacial drift	Hard, "alkaline"		S	Sufficient supply.
24	SW.	23	"	"	"	Bored	45	2,422	- 25	2,397	25	2,397	Glacial sand and gravel	Hard, "alkaline"		D, S	Sufficient supply.
25	NE.	23	"	"	"	Bored	35	2,430	- 23	2,407	23	2,407	Glacial sand	Soft		D, S	Insufficient supply; another well, similar water.
26	NE.	24	"	"	"	Bored	40	2,408	+ 34	2,374	34	2,374	Glacial drift	Hard, "alkaline"	46	D, S	Insufficient supply.
27	NW.	24	"	"	"	Bored	90	2,410	- 20	2,390	90	2,320	Glacial sand	Hard, iron, "alkaline"	44	D, S	Sufficient supply.
28		26	"	"	"	Bored	65	2,412	- 35	2,377	65	2,347	Glacial gravel	Hard, yellow		S	Sufficient supply; laxative.
29	SW.	27	"	"	"	Bored	90	2,300			90	2,270	Glacial sand	Hard, "alkaline"		S	Sufficient supply; a shallow well 18 feet deep; intermittent supply for house.
30	SE.	29	"	"	"	Bored	71	2,300	- 12	2,348	00	2,300	Glacial drift	Hard, "alkaline"		D, S	Supplies 40 head stock; laxative.
31	NW.	29	"	"	"	Dug	65	2,460	- 10	2,470	65	2,415	Glacial drift	Hard, "alkaline"		S	Sufficient supply; bad for stock and humans.
32	SW.	33	"	"	"	Bored	75	2,392	- 50	2,342	75	2,317	Glacial sand	Hard		S	Sufficient supply; a 26-foot well for house.
33	NE.	33	"	"	"	Bored	60	2,400	+ 30	2,370	00	2,340	Glacial sand	Hard, iron, "alkaline", cloudy		D, S	Sufficient supply.

NOTE—All depths, altitudes, heights and elevations given above are in feet.

(D) Domestic; (S) Stock; (I) Irrigation; (M) Municipality; (N) Not used.
(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of DEER FORKS, NO. 232, SASKATCHEWAN.

WELL No.	LOCATION					TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE		PRINCIPAL WATER-BEARING BED			CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	¼	Sec.	Tp.	Rge.	Mer.				Above (+) Below (-) Surface	Elev.	Depth	Elev.	Geological Horizon				
34	SW.	34	19	29	3	Bored	75	2,305	- 28	2,337	75	2,290	Glacial black sand	Hard, "alk- aline"		S	Sufficient supply; a 29-foot well; good supply for house use.
35	NE.	34	"	"	"	Bored	60	2,412	- 30	2,382	60	2,352	Glacial drift	Hard, "alk- aline"		S	Sufficient supply; an 18-foot well, good supply for house.
36		35	"	"	"	Drilled	335	2,390	- 19	2,371	123	2,267	Belly River quicksand	Hard		N	Good supply; poor water.
37	SW.	36	"	"	"	Dug	55	2,395	- 37	2,358	55	2,340	Glacial drift	Hard, "alk- aline"		D, S	Insufficient supply.
38	NW.	36	"	"	"	Bored	80	2,393	- 60	2,333	80	2,313	Glacial drift	Hard, iron, "alkaline"	44	N	Sufficient supply; six other wells with hard and soft water; 24 feet deep.
39	SE.	36	"	"	"	Bored	75	2,390	- 45	2,345	75	2,215	Glacial sand	Hard, "alk- aline"	46	S	Sufficient supply; a 40-foot well, soft water.
40	NE.	36	"	"	"	Bored	50	2,342	- 25	2,317	25	2,317	Recent alluvium sand	Hard, iron	45	D, S	Sufficient supply; another 60-foot well, hard water for stock.
1	NW.	1	20	28	3	Bored	52	2,445	- 40	2,405	52	2,393	Glacial gravel	Hard, iron, yellow	45	S	Sufficient supply; another well 20 feet deep; soft water.
2	SE.	2	"	"	"	Bored	75	2,450	- 55	2,395	75	2,375	Glacial sand	Hard, iron	44	S	Sufficient supply; 20-foot well, soft water.
3	SE.	3	"	"	"	Bored	20	2,410	- 10	2,400	10	2,400	Glacial drift	Soft	47	D, S	Sufficient supply.
4	SW.	3	"	"	"	Dug	30	2,455	- 20	2,435	20	2,435	Glacial drift	Soft		D, S	Sufficient supply.
5	NE.	4	"	"	"	Bored	25	2,360	- 23	2,337	23	2,337	Glacial sand	Hard, "alk- aline"	46	D, S	Sufficient supply.
6	SE.	5	"	"	"	Bored	25	2,345	- 21	2,324	21	2,324	Recent alluvium sand	Soft	47	D, S	Sufficient supply.
7	NE.	5	"	"	"	Bored	64	2,344	- 44	2,300	44	2,300	Recent alluvium sand	Hard, iron, "alkaline"	45	D, S	Sufficient supply.
8	SE.	6	"	"	"	Dug	12	2,350	- 9	2,341	9	2,341	Recent alluvium sand	Soft	47	D, S	Sufficient supply; a similar well.
9	SE.	7	"	"	"	Dug	20	2,345	- 18	2,327	18	2,327	Recent alluvium sand	Soft	46	D, S	Sufficient supply.
10	NW.	7	"	"	"	Bored	45	2,354	- 35	2,319	45	2,309	Glacial drift	Hard, salty		N	Insufficient supply; another 20-foot well, soft water.
11	SE.	10	"	"	"	Bored	60	2,415	- 10	2,405	60	2,355	Glacial quick-sand	Hard, "alk- aline"	42	S	Sufficient supply.
12	SW.	12	"	"	"	Bored	35	2,470	- 30	2,440	30	2,440	Glacial sand	Hard, "alk- aline"	46	D, S	Sufficient supply.
13	NE.	12	"	"	"	Bored	65	2,530	- 40	2,490	60	2,470	Glacial quick-sand	Soft	45	D, S	Sufficient supply; two dry holes 70 and 80 feet.
14	SW.	14	"	"	"	Bored	94	2,440									Dry hole in glacial drift.
15	SW.	14	"	"	"	Bored	93	2,453	- 87	2,366	87	2,366	Glacial quick-sand	Soft	44	D, S	Insufficient supply; dry holes 48 to 96 feet deep.
16	NW.	14	"	"	"	Bored	90	2,460	- 80	2,380	80	2,380	Recent alluvium sand	Hard, "alk- aline"	44	D, S	Insufficient supply.
17	SE.	15	"	"	"	Bored	35	2,415	- 30	2,385	30	2,385	Recent alluvium sand	Soft	46	D, S	Insufficient supply; another similar well.
18	SW.	16	"	"	"	Bored	70	2,362	- 35	2,327	35	2,327	Recent alluvium sand	Hard	44	D, S	Sufficient supply.
19	NE.	20	"	"	"	Bored	38	2,300	- 18	2,342	12	2,348	Recent alluvium sand	Hard, "alk- aline"	46	D, S	Sufficient supply; two wells 60 to 66 feet in sand for stock.
20	SE.	21	"	"	"	Bored	72	2,512	- 50	2,462	72	2,440	Recent alluvium sand	Hard, iron, "alkaline"	44	S	Sufficient supply; another well 22 feet deep for house.
21	NE.	23	"	"	"	Dug	20	2,405					Glacial sand	Soft	46	D, S	Sufficient supply.

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(D) Domestic; (S) Stock; (I) Irrigation; (M) Municipality; (N) Not used.
(#) Sample taken for analysis.

WELL No.	LOCATION					TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE		PRINCIPAL WATER-BEARING BED			CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	¼	Sec.	Tp.	Rge.	Mer.				Above (+) Below (-) Surface	Elev.	Depth	Elev.	Geological Horizon				
22	NW.	23	20	26	3	Bored	55	2,530	- 63	2,467	63	2,467	Recent alluvium quicksand	Hard, iron	45	D, S	Sufficient supply.
23	NE.	24	"	"	"	Bored	76	2,370	- 63	2,307	76	2,294	Glacial quicksand	Hard, iron, "alkaline"	44	S	Sufficient supply.
24	E.	24	"	"	"	Bored	75	2,300	- 09	2,291	09	2,291	Glacial quicksand	Hard, "alkaline"	45	S	Insufficient supply; a 63-foot well and a 76-foot dry hole.
25	SW.	25	"	"	"	Bored	52	2,340	- 42	2,298	52	2,288	Glacial sand	Hard, "alkaline"	46	D, S	Sufficient supply.
26	NE.	25	"	"	"	Dug	28	2,350	- 26	2,324	26	2,324	Glacial drift	Hard, iron, "alkaline"	47	D, S	Intermittent supply.
27	NE.	33	"	"	"	Bored	80	2,370	- 65	2,305	80	2,290	Recent alluvium sand	Hard, iron, pale yellow		S	Sufficient supply; laxative on humans.
28	SE.	35	"	"	"	Dug	20	2,380	- 18	2,362	18	2,362	Glacial sand	Soft, iron, "alkaline"	47	D, S	Sufficient supply.
29	SE.	36	"	"	"	Dug	62	2,350	- 24	2,326	60	2,290	Glacial gravel	Hard, iron, "alkaline"	45	S	Sufficient supply; another well 20 feet deep; hard water for house.
1	SW.	2	20	29	3	Bored	90	2,410	- 70	2,340	70	2,340	Glacial drift	Hard		S	Sufficient supply; laxative; a seepage well 12 feet deep for house use.
2	SE.	3	"	"	"	Bored	105	2,410	- 60	2,350	60	2,350	Glacial drift	Hard, "alkaline"		S	Sufficient for stock.
3	SE.	4	"	"	"	Dug	26	2,430	- 21	2,409	26	2,404	Glacial sand	Soft		D, S	Sufficient supply.
4	SW.	4	"	"	"	Bored	80	2,420	- 50	2,370	80	2,340	Glacial sand	Hard		D, S	Sufficient supply.
5	SE.	5	"	"	"	Bored	80	2,410	- 24	2,386	74	2,336	Glacial sand	Hard, cloudy		S	Sufficient for stock; laxative; a 22-foot well for house use.
6	SW.	5	"	"	"	Dug	18	2,410	- 10	2,400	10	2,400	Glacial sand	Soft		D, S	Sufficient supply; two other similar wells.
7	NW.	8	"	"	"	Dug	19	2,430	- 18	2,412	18	2,412	Glacial drift	Soft		D, S	Insufficient supply.
8	SE.	9	"	"	"	Bored	60	2,360	- 30	2,330	30	2,330	Glacial drift	Hard, yellow, "alkaline"		S	Sufficient supply; a 30-foot well is used for house; soft water.
9	SW.	9	"	"	"	Bored	85	2,420	- 55	2,365			Glacial drift	Hard		S	Sufficient supply; a 35-foot well for house use.
10	NE.	10	"	"	"	Bored	90	2,320	- 50	2,270	90	2,230	Glacial sand	Hard		S	Sufficient supply.
11	NE.	11	"	"	"	Bored	28	2,370	- 21	2,349	21	2,349	Glacial sand	Soft		D, S	Insufficient, intermittent supply.
12	NW.	11	"	"	"	Bored	105	2,395	- 65	2,330	65	2,330	Glacial drift	Hard, yellow, "alkaline"		S	Sufficient supply; a 22-foot well for house.
13	SW.	15	"	"	"	Bored	78	2,365	- 38	2,327	38	2,327	Glacial sand	Hard, iron, "alkaline"		S	Sufficient supply; laxative.
14	NW.	16	"	"	"	Dug	90	2,410	- 70	2,340	90	2,320	Glacial drift	Hard, "alkaline"		S	Sufficient supply.
1	SE.	2	21	28	3	Dug	84	2,300	- 50	2,310	50	2,310	Glacial gravel and quicksand	Hard		D, S	Sufficient supply.
2	NW.	2	"	"	"	Bored	58	2,200	- 42	2,218	42	2,218	Glacial sand	Hard, iron, rusty		D, S	Sufficient supply.
3	NE.	4	"	"	"	Dug	90	2,350	- 72	2,278			Glacial sand	Hard, iron, rusty		S	Large supply; 50-foot well also used.
4	NE.	7	"	"	"	Bored	80	2,300	- 45	2,255	79	2,221	Glacial quicksand	Hard, "alkaline"		S	Insufficient supply; several shallow wells used for stock.
5	NW.	11	"	"	"	Dug	15	2,390	- 9	2,381	9	2,381	Glacial sand	Hard, "alkaline"		S	Barely sufficient for 25 head stock; laxative; a 12-foot well for house.

NOTE—All depths, altitudes, heights and elevations given above are in feet.

(D) Domestic; (S) Stock; (I) Irrigation; (M) Municipality; (N) Not used.
(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of DEER FORKS, NO. 232, SASKATCHEWAN.

WELL No.	LOCATION					TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE		PRINCIPAL WATER-BEARING BED			CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	¼	Sec.	Tp.	Rge.	Mer.				Above (+) Below (-) Surface	Elev.	Depth	Elev.	Geological Horizon				
6	SW.	12	21	28	3	Dug	81	2,380	- 66	2,314	66	2,314	Glacial sand	Hard, iron, rusty	S	Sufficient supply; also a 40-foot well.	
7	NE.	13	"	"	"	Dug	30	2,365	- 23	2,342	23	2,342	Glacial drift	Hard, "alkaline"	S	Sufficient supply; also 16-foot well, "alkaline" water.	
8	SE.	14	"	"	"	Dug	21	2,355	- 17	2,338	17	2,338	Glacial quick-sand	Hard	S	Insufficient supply; also a 20-foot well.	
9	NE.	16	"	"	"	Bored	90	2,320	- 50	2,270	80	2,240	Glacial drift	Hard, iron, rusty	S	Sufficient for 50 head stock; also 12-foot well with soft water.	
10	SE.	16	"	"	"	Dug	80	2,230	- 50	2,180	80	2,150	Glacial quick-sand	Hard, iron	S	Sufficient for 50 head stock; also a 12-foot well with soft water.	
11	NE.	20	"	"	"	Dug	10	2,300	- 12	2,288	12	2,288	Glacial sand	Hard, iron, "alkaline"	D, S	Sufficient supply; a 10-foot well for stock.	
12	NE.	21	"	"	"	Dug	12	2,354	- 3	2,351	3	2,351	Glacial quick-sand	Hard	D, S	Sufficient supply; a 15-foot well in quick-sand; "alkaline" water.	
13	SE.	22	"	"	"	Bored	71	2,395	- 61	2,334	61	2,334	Glacial	Hard, "alkaline"	D, S	Sufficient for 20 head stock.	
14	SW.	23	"	"	"	Dug	86	2,420	- 81	2,339	81	2,339	Glacial drift	Hard, iron, rusty	D, S	Sufficient supply.	
15	SW.	24	"	"	"	Dug	15	2,320	- 9	2,311	9	2,311	Glacial drift	Hard, "alkaline"	D, S	Sufficient supply with aid of another well.	
16	SE.	25	"	"	"	Dug	17	2,320	- 14	2,306	14	2,306	Glacial sand	Hard	D, S	Insufficient supply; three other wells, insufficient supply.	
17	SE.	27	"	"	"	Dug	10	2,400	- 7	2,393	7	2,393	Glacial sand	Hard	D	Sufficient supply.	
18	SW.	27	"	"	"	Dug	90	2,400	- 85	2,315	85	2,315	Glacial sand	Hard	S	Sufficient supply.	
19	SW.	29	"	"	"	Bored	100	2,300	- 64	2,236	64	2,236	Glacial quick-sand	Hard, "alkaline"	S	Insufficient supply; five other wells 10 feet deep; all insufficient.	
1	NE.	13	21	29	3	Dug	20	2,365	- 16	2,349	16	2,349	Glacial sand	Hard	D, S	Insufficient supply; another 10-foot well similar.	
2	SE.	20	"	"	"	Dug	17	2,355	- 12	2,343	12	2,343	Glacial quick-sand	Hard, iron, rusty	S	Sufficient supply.	
3	NW.	20	"	"	"	Dug	30	2,336	- 15	2,323	15	2,323	Glacial sand	Soft	D, S	Sufficient supply.	
4	NW.	21	"	"	"	Dug	20	2,350	- 12	2,338	12	2,338	Glacial sand	Soft	D, S	Sufficient for house only; also a 14-foot well.	
5	NE.	25	"	"	"	Dug	31	2,375	- 28	2,347	28	2,347	Glacial drift	Hard, "alkaline"	S	Insufficient supply; a 14-foot and a 12-foot well, soft water.	
6	NW.	27	"	"	"	Bored	20	2,370	- 23	2,347	23	2,347	Glacial quick-sand	Hard	D	Sufficient supply for house.	
7	NE.	33	"	"	"	Bored	58	2,300	- 45	2,315	45	2,315	Glacial drift	Soft	D, S	Sufficient for 18 head stock; another 48-foot well, soft water.	
8	NW.	34	"	"	"	Bored	50	2,390	- 42	2,348	42	2,348	Glacial drift	Hard, "alkaline"	S	Insufficient supply; two other wells 87 and 40 feet deep.	
9	NE.	36	"	"	"	Dug	22	2,375	- 19	2,356	19	2,356	Glacial drift	Hard, "alkaline"	D	Insufficient supply; two other wells 12 and 8 feet deep.	
1	SW.	1	22	28	3	Bored	100	2,295	- 85	2,210	85	2,210	Glacial drift	Hard	S	Insufficient supply; an 18-foot well for house use.	
2	NE.	2	"	"	"	Dug	36	2,295	- 28	2,267	28	2,267	Glacial drift	Hard, iron	S	Insufficient supply; a 23-foot well with intermittent supply.	
3	NW.	5	"	"	"	Dug	10	2,315	- 9	2,306	9	2,306	Glacial sand	Hard, iron	D, S	Sufficient supply.	
4	NE.	7	"	"	"	Dug	24	2,310	- 12	2,298	12	2,298	Glacial sand	Soft	D, S	Sufficient supply; another well 26 feet deep.	

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(D) Domestic; (S) Stock; (I) Irrigation; (M) Municipality; (N) Not used.
(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of DEER FORKS, NO. 232, SASKATCHEWAN.

WELL No.	LOCATION					TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE		PRINCIPAL WATER-BEARING BED			CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	¼	Sec.	Tp.	Rge.	Mer.				Above (+) Below (-) Surface	Elev.	Depth	Elev.	Geological Horizon				
5	NW.	9	22	28	3	Dug	13	2,285					Glacial sand	Hard, "alkaline"	D, S	Sufficient supply; with aid of two other wells.	
6	NE.	10	"	"	"	Dug	18	2,305	- 15	2,290	15	2,290	Glacial quicksand	Soft	D, S	Insufficient supply; two other wells aid supply.	
7	SE.	12	"	"	"	Dug	16	2,290	- 12	2,278	12	2,278	Glacial drift	Soft	D, S	Insufficient supply; two other wells similar.	
8	NW.	12	"	"	"	Drilled	300	2,290	-200	2,030	270	2,020	Belly River quicksand	Hard, "alkaline"	S	Sufficient supply.	
9	NE.	13	"	"	"	Drilled	270	2,205	-220	2,039	270	1,989	Belly River sand	Hard, iron, "alkaline"	D, S	Large supply.	
10	SE.	15	"	"	"	Drilled	400	2,320					Belly River formation	Hard, salty	S	Sufficient supply.	
11	NW.	16	"	"	"	Dug	23	2,310	- 18	2,292	18	2,292	Glacial drift	Soft	D, S	Insufficient for 11 head stock,	
12	SW.	17	"	"	"	Dug	25	2,290	- 11	2,279	11	2,279	Glacial sand	Hard	D, S	Insufficient supply.	
13	SE.	18	"	"	"	Bored	30	2,290	- 29	2,261	29	2,261	Glacial drift	Hard	D	Sufficient for house; two other wells; small supply for stock.	
14	NW.	18	"	"	"	Dug	05	2,320	- 03	2,257	03	2,257	Glacial gravel	Hard	D, S	Insufficient supply; a 15-foot well; soft water for house.	
15	NW.	20	"	"	"	Dug	17	2,200	- 13	2,247	13	2,247	Glacial quicksand	Soft	D, S	Sufficient supply.	
16	NW.	21	"	"	"	Dug	25	2,280	- 21	2,259	21	2,259	Glacial drift	Hard	D, S	Insufficient supply; several other wells similar.	
17	NE.	22	"	"	"	Dug	21	2,255	0	2,255	0	2,255	Glacial drift	Soft	D, S	Insufficient supply.	
18	NW.	23	"	"	"	Dug	17	2,255	- 15	2,240	15	2,240	Glacial drift	Hard	D, S	Insufficient supply; another similar well.	
19	NW.	24	"	"	"	Drilled	346	2,255					Belly River	Hard, iron, "alkaline"	D, S	Sufficient supply.	
20	SW.	26	"	"	"	Dug	22	2,265	- 14	2,251	14	2,251	Glacial drift	Hard, "alkaline"	D, S	Insufficient supply; two other wells similar.	
21	NW.	26	"	"	"	Dug	32	2,250	- 24	2,226	24	2,226	Glacial drift	Hard, "alkaline"	S	Insufficient supply; four other wells also insufficient.	
22	NE.	27	"	"	"	Dug	30	2,220	- 25	2,195	25	2,195	Glacial sand	Hard, "alkaline"	D, S	Insufficient supply.	
23	NW.	27	"	"	"	Dug	12	2,250	- 6	2,244	6	2,244	Glacial drift	Soft	D, S	Sufficient for 8 head stock.	
24	NW.	28	"	"	"	Dug	24	2,260	- 10	2,250	10	2,250	Glacial drift	Hard	D, S	Sufficient supply; another similar well.	
25	SE.	29	"	"	"	Dug	7	2,255	- 12	2,243	12	2,243	Glacial quicksand	Hard	D, S	Sufficient supply.	
26	NE.	32	"	"	"	Dug	20	2,265	- 17	2,248	17	2,248	Glacial sand	Soft	D, S	Sufficient for 17 head stock.	
27	SE.	33	"	"	"	Dug	20	2,210	- 15	2,195	15	2,195	Glacial sand	Soft	D, S	Insufficient supply; several dry holes up to 20 feet.	
28	SW.	34	"	"	"	Dug	15	2,220	- 11	2,209	11	2,209	Glacial drift	Hard	D, S	Insufficient supply; a 12-foot well; small supply.	
29	NE.	34	"	"	"	Spring	0						Glacial drift	Hard	S	Sufficient for stock.	
1	SE.	1	22	29	3	Dug	30	2,375	- 25	2,350	25	2,350	Glacial drift	Hard	D, S	Insufficient supply.	
2	SW.	3	"	"	"	Dug	32	2,300	- 26	2,334	26	2,334	Glacial sand	Hard	D, S	Sufficient for 10 head stock,	

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of DEER FORKS, No. 232, SASKATCHEWAN.

WELL No.	LOCATION					TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE		PRINCIPAL WATER-BEARING BED			CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
	¼	Sec.	Tp.	Rge.	Mer.				Above (+) Below (-) Surface	Elev.	Depth	Elev.	Geological Horizon				
3	SE.	10	22	29	3	Dug	32	2,290	- 30	2,260	30	2,260	Glacial drift	Hard		D, S *	Sufficient for house.
4		11	"	"	"	Dug	25						Glacial drift	Hard			Sufficient supply.
5	NW.	12	"	"	"	Dug	35	2,295	- 7	2,288	7	2,288	Glacial quick-sand	Soft		D, S	Insufficient supply.
6	NE.	13	"	"	"	Dug	20	2,290	- 17	2,273	17	2,273	Glacial sand	Hard		D, S	Insufficient supply.
7	NW.	14	"	"	"	Dug	28	2,270	- 8	2,262	8	2,262	Glacial quick-sand	Soft		D, S	Sufficient supply.
8	NE.	23	"	"	"	Dug	26	2,285	- 23	2,262	23	2,262	Glacial drift	Hard		D, S	Insufficient supply; two other wells 23 and 26 feet deep.
9	NW.	24	"	"	"	Dug	18	2,250	- 13	2,237	13	2,237	Glacial quick-sand	Soft		D, S	Sufficient supply.
10	NE.	24	"	"	"	Dug	20	2,260	- 17	2,243	17	2,243	Glacial drift	Hard, "alkaline"		D, S	Insufficient supply; a 30-foot well; hard, "alkaline" water.
11	SE.	25	"	"	"	Dug	14	2,260	- 11	2,249	11	2,249	Glacial quick-sand	Soft		D, S	Insufficient supply.
1	NW.	2	23	28	3	Dug	52	2,000	- 44	1,956	44	1,956	Glacial sand	Hard, "alkaline"		N	Fair supply; another similar well; several other wells in town; soft water.
2	NW.	10	"	"	"	Dug	25	1,925	- 19	1,906	19	1,906	Glacial quick-sand	Hard, iron, "alkaline"		S	Sufficient supply.

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(D) Domestic; (S) Stock; (I) Irrigation; (M) Municipality; (N) Not used.
(#) Sample taken for analysis.