CANADA

DEPARTMENT OF MINES

AND

TECHNICAL SURVEYS

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WATER SUPPLY PAPER No. 126

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF RODGERS NO. 133 SASKATCHEWAN

By

B. R. MacKay, H. H. Beach and J. M. Cameron

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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 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

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[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 age.

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 Rodgers covers an area of 324 square miles in the south-central part of Saskatchewan. It is comprised of nine townships, described as tps. 13, 14, and 15, ranges 1, 2, and 3, W. 3rd mer. The hamlet of Courval, situated near the centre of the municipality, lies 32 miles west and 15 miles south of Moose Jaw. The Archive-Hak branch of the Canadian Pacific railway extends in a general east-west direction across the central part of the municipality, and on it are located the stations of Lake Johnstone, Courval, and the village of Coderre.

Johnstone lake is a shallow, "alkali" body of water that covers an extensive area, 40 square miles of which is included in the southeastern part of the municipality. Wood river flows from the southwest corner of the municipality in a northeasterly direction to empty into lake Johnstone in township 14, range 2. Chaplin creek, a small, intermittent, southeasterly flowing stream, provides the drainage in township 14, range 3, and joins Wood river in the southeastern corner of this township. Broad flats having an approximate elevation of 2,250 feet above sea-level extend westward from Johnstone lake. Away from the stream valleys in the southern townships the land surface is a rolling plain, and elevations range from 2,250 feet to 2,400 feet. The northern townships lie on the western slopes of Missouri coteau. The land surface of the coteau is rugged and many of the hills located along the southern boundary of township 15, ranges 1 and 2, and in the northeastern corner of township 15, range 3, are over 2,400 feet above sea-level. The drainage in this part of the area is poorly developed, and undrained depressions intervening between the hills are occupied by sloughs.

The area covered by Johnstone lake varies considerably from year to year with the variations in the annual precipitation. Surface evaporation has so concentrated the mineral salts brought in solution by streams into the lake that the water is unfit for drinking or for watering stock. Wood river contains water throughout all but the driest years and provides a pasture supply of water for the stock of nearby residents. Chaplin creek is a small, sluggish stream that provides water for stock, during only the wet seasons of the year. Dugouts excavated in the gravels of the stream bed, however, provide water for stock over considerably longer periods of time. Small ponds, sloughs, dugouts and dams, constructed across creeks and coulees, are used in many places in the municipality to supplement the supplies for stock, obtained from springs and wells. The greater number of the springs occur in the northern parts of township 14, ranges 1 and 2, and the southern parts of township 15, ranges 2 and 3, along the southern edge of the moraine forming Missouri coteau. The yield from these springs is large, and hence they become important sources of supply, since in this district large numbers of stock are raised. The conditions causing each of these springs are local and they do not indicate any widespread artesian basin. Surface water percolating down through the porous drift of the hills collects on the top of more impervious beds and follows along them to come out at the surface as seepage springs.

The wells of the municipality derive their supplies from two general sources, namely, the Recent deposits bordering the creeks and the mantle of glacial drift that covers the remainder of the municipality. The bedrock underlying the greater part of the area is unproductive, and in such areas, where it is considered that it might be sufficiently porous to yield water, no deep drilling has been done to date.

Throughout the greater part of the municipality adequate supplies of water are obtained from wells, although the number of stock on some farms has necessitated the construction of dugouts and dams. In the highlands of the northern parts, however, where large herds of range stock are to be watered, conditions are more acute, and all possible sources of ground water and methods for the accumulation and storage of all available surface water must be considered.

Water-bearing Horizons in the Unconsolidated Deposits

The Recent deposits consist of beds of sands, silts, and gravels deposited along the bottoms of the stream valleys. The thickness of these deposits seldom exceeds 10 or 20 feet. During such times when the streams are flowing small seepage supplies suitable for household use are available by sinking shallow wells in these deposits. Water from such a source is easily contaminated and when being used for a household supply the utmost care should be exercised to keep the catchment area free from sewage and other decaying organic material.

Several more or less distinct types of glacial deposits are found in the area, namely, till, moraine, interbedded interglacial silts and sands, glacial lake clays and sands, and glacial outwash sands and gravels. These deposits were laid down by a great continental ice-sheet that many thousands of years ago passed over the province of Saskatchewan, and by the waters issuing from the melting ice. The areal distribution of the different types of deposit is shown on the map (Figure 1) accompanying this report. As the ice-sheet advanced and retreated, it deposited over the surface of the bedrock a layer of drift, consisting largely of bluish grey boulder clay. The boulder clay is, in most places, too compact to form reservoirs for any large supplies of ground water.

Pockets and occasionally beds of water-sorted sand and gravels occur scattered irregularly through the boulder clay, and where encountered in wells generally yield water in sufficient quantities for farm requirements. The supply depends upon the areal extent, thickness, and porosity of the individual sand deposit. In places where the drift has a flat or gently rolling surface it is referred to as boulder clay or till plain. Such an area occurs only in a narrow belt extending along the southern parts of township 13, ranges 1 and 2. The retreating ice-sheet is believed to have remained stationary for a considerable period of time over the greater part of the municipality, and consequently much greater thicknesses of drift accumulated forming moraines. The ground surface of these extensive moraine-covered areas is irregularly rolling and characterized by many low knolls, hills, gravel ridges, and intervening undrained depressions. The sand and gravel pockets that occur scattered through the moraine and till are the only sources of water supply in these deposits. Most wells tap pockets within 30 feet of the surface, but in a few places wells have encountered productive beds in the boulder clay at depths as great as 120 feet. The yields from the pockets are generally not large and in many places the supply is inadequate for stock requirements. In the rolling, upland country of the northern parts the locating of shallow wells in coulée bottoms, and depressions near the bases of steep slopes, even on or near low gravel ridges has proved successful in many places. A more stable supply is obtained from the deeper porous beds, as their supply is not so seriously affected by drought conditions. The amount of mineral salts in solution in water from the glacial pockets in the drift varies considerably and is generally found to increase with the depth of the pocket from the surface. Water from many of the wells tapping the deeper pockets is unsuitable for domestic use.

A peculiar and interesting condition exists in occurrence of ground water in the drift, within the area outlined by the "A" line in the southern part of this municipality. Nearly all residents who have sunk wells to the lower part of the glacial drift in this area have encountered beds of fine grey sands, and silts, immediately overlying gravels. In these silts, in many places, fossil shells, pieces of coal branches, and twigs of plants are found. When wet this silt has the plasticity of mud and is known generally throughout the district as "sea-mud". Such beds are probably interglacial deposits. It is considered that the ice-sheet advanced and retreated at least twice over this area, depositing a layer of till with each advance and retreat. Many thousands of years lapsed between successive advances and during such times warmer climate conditions were favourable in these lowlands for the formation of swamps and lakes over the first deposited till sheet. The later advance of the ice covered these deposits with further layers of boulder clay. These interglacial beds are sufficiently porous to form sources of large supplies of ground water which is in many places of good quality. These beds do not all occur at the same elevations, but near the lake many lie at the horizon slightly below the level of the present lake surface. Others possibly deposited in glacial stream channels are encountered at depths as great as 90 feet below lake-level. It is improbable that these deposits form continuous beds over large areas, but they occur rather as isolated pockets. Such variations in elevations and their occurrences, as have been noted, will be discussed under the sections of this report dealing with townships. Sufficient information has not been accumulated to date to make possible the accurate tracing of the buried channels.

Waters issuing from the melting ice-sheet accumulated deposits of outwash sands and gravels in certain places. Within this municipality these glacial outwash deposits are confined to two small areas; one, a narrow strip extending from Tennex northwesterly along the eastern side of Chaplin creek in the northern part of township 14, range 3, and the southern part of township 15, range 3; and the other an area of about 2 square miles in the east-central part of township 14, range 1. Due to their porosity these deposits generally form excellent reservoirs for water accumulation. Several springs also occur within these areas. Shallow wells sunk in the deposits generally obtain large supplies of hard, drinkable water. In some places, however, the deposits are thin and are correspondingly less productive. In these places wells are sunk to tap water-bearing pockets in the underlying boulder clay. Thorough prospecting of the deposits is recommended, however, before resorting to the deeper drilling.

When the continental ice-sheet retreated from this region, water resulting from the melting ice formed a large lake extending over the greater part of the southern half of this municipality, and along Wood River and Chaplin Creek valleys, into the adjoining municipality to the west. Johnstone lake is all that remains of this large glacial lake. The areal extent of the glacial lake is indicated by the presence of sediments that were deposited in the lake bottom. The glacial lake deposits in an area of approximately 17 square miles extending west from the western end of Johnstone lake, are composed largely of light bluish grey, compact lake clays, but in the remainder of the flat area occupied by the old lake are composed of sands. In the lake sand-covered area, wells

sunk 20 to 50 feet deep generally tap porous sand and gravel pockets from which are obtained adequate supplies of water for the stock needs of the residents. The water, however, is highly mineralized, and from most wells is unsuitable for household use. The lake clays are usually too compact to yield more than very small seepages of ground water. However, wells less than 30 feet deep obtain large supplies of drinkable water from sand and gravel pockets lying immediately below the clays, and on top of the underlying boulder clay. Few wells have been sunk in this area to date, and it is probable, as has been experienced in other areas covered by a similar type of deposit, that the sand beds at the contact are of limited individual extent, rather than that they are continuous over large areas. Within that part of the area covered by the lake clays, and the lake sands lying within the "A" line, it may be advisable to sink wells to the drift bedrock contact, should shallow wells fail to give an adequate supply of water.

Water-bearing Horizons in the Bedrock

Any study of the ground water conditions existing in the bedrock underlying the glacial deposits in this township has been rendered particularly difficult by the entire absence of exposures of bedrock at the surface, either in this or adjoining areas and by the paucity of wells sunk sufficiently deep to encounter the bedrock. The Ravenscrag, Eastend, and Bearpaw formations are each considered to underlie the glacial drift in different parts.

The Ravenscrag formation, being uppermost of the three, is thought to underlie the thick mantle of moraine in the north-central and northeastern uplands. No wells have penetrated through the drift in this rolling area and no estimate

of the thickness of the drift over this part can be given. The Ravenscrag is composed of sands and coal seams interbedded in shales and clays. As in nearly all areas where the Ravenscrag occurs in this part of the province it is water-bearing, it is presumed that if wells are sunk sufficiently deep in this part of this municipality water will probably be found.

The Ravenscrag is underlain at an approximate elevation of 2,300 feet above sea-level by fine, grey sands and silts of the Eastend formation. This latter formation is considered to extend for a distance of approximately 4 miles south and southwest of the area covered by the Ravenscrag.

The Eastend is in turn underlain by the Bearpaw formation which underlies the drift throughout the remainder of the municipality. This formation consists almost entirely of dark grey to black, compact marine shales. The shale may be differentiated from the overlying boulder clay by its more soapy feel, its darker colour, the lack of boulders or pebbles in it, and by the small, roughly cubical fragments into which it crumbles upon drying. These shales are generally too compact and impervious to form reservoirs for any large supplies of ground water, and such supplies as it does contain in this region are almost invariably too highly mineralized to be used for any farm requirements. The few wells that have penetrated into the shale in this area were entirely dry.

Careful prospecting of the glacial drift is strongly recommended instead of deep drilling in this municipality; as stated above, the Ravenscrag and possibly the Eastend may be water-bearing, but the depth of well necessary to reach the bedrock and the consequent expenditure of money and time may not be warranted by the supply obtained. Drilling should be suspended ~~when the~~ shales of the Bearpaw are reached.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 13, Range 1

The greater part of this township is covered by Johnstone lake. The land area, consisting of about eleven sections in the southwest corner of the township, is covered by glacial till, which is exposed at the surface in sections 5, 6, and 7, but elsewhere is covered by a layer of glacial lake sands. Water in the lake is too highly mineralized for farm use, and other sources of surface water are scarce in the area. The water supply of the area is obtained almost entirely from wells sunk to tap sand and gravel pockets in these glacial deposits. A few springs occur in depressions or at the bases of some of the slopes in the area, and provide household and stock water supplies in some places.

Throughout the area covered by lake sands, little difficulty should be experienced in obtaining an adequate supply of water for stock use, at depths ranging from 15 to 60 feet. The high concentration of mineral salts in the water, however, renders it unfit for domestic use. Springs or very shallow seepage wells seem to offer the only possibilities of obtaining domestic supplies, other than the accumulation of rainfall in cisterns. It is improbable that deeper drilling will yield water of much better quality.

Water obtained at shallow depths in the till-covered area is of good quality. It is soft to moderately hard, and although in some places somewhat "alkaline" it is not unsuited to domestic use. Water found at greater depths in the till is more highly mineralized, but suitable for watering stock.

The glacial deposits are underlain by the shales of the Bearpaw formation. This formation is not a source of good supplies of water, and drilling into the formation is not

recommended. The depth to the formation is largely unknown. The "soapstone" recorded as being encountered at 40 feet in a well on the NE.$\frac{1}{4}$, section 7, may probably mark the top of the bedrock at this point, although the 60-foot well on section 6 is still in drift.

Township 13, Range 2

The northeastern corner of this township was at one time covered by lake Johnstone. The level of the lake has fallen considerably and this area is now dry pasture land. Wells in the township are sunk into the four types of glacial deposits, namely, lake sands, lake clay, till, and moraine, which overlie different parts of the area, the areal distribution of each type being shown on the accompanying map (Figure 1). Sloughs in the undrained depressions in the southern half of the township provide pasture supplies for stock in some places.

Wells, in the flats area in the central part of the township, covered by glacial lake sands, are generally between 20 and 45 feet deep. They obtain in most places supplies adequate for stock purposes. The water, however, is generally too highly mineralized to be suitable for household use. The few shallow wells in the low-lying, lake clay-covered flats in the northern part of the township, obtain water that is generally soft and of good quality, from sand and gravel beds that occur immediately below 15 to 30 feet of clay. The yields are reported to be adequate for household and stock purposes.

Moraine covers the southern and southwestern parts of the township and the land surface is characterized by many knolls and ridges with numerous, intervening, undrained depressions. A small area of till occurs in the southeastern corner of the township. The till and moraine have an approximate thickness of 80 feet and consist largely of boulder clay.

Water supplies are obtained from sand and gravel pockets scattered through the boulder clay. Wells tap those pockets at depths between 30 and 80 feet and, depending on the size of the productive pocket encountered, obtain supplies adequate for 5 or 10, to more than 60, head of stock. The water is hard, highly mineralized, and except in a few of the shallower wells is not suitable for domestic use. The construction of dams across coulées, to conserve surface water, is suggested as a means of maintaining an adequate stock supply in this area. Shallow wells located beside the impounded waters would derive a small seepage supply of water suitable for household use.

Within the area bounded by the "A" line in the northwest corner of the township, it is considered that wells sunk to elevations ranging from 2,150 to 2,100 feet would encounter "sea-mud", from which fairly large supplies of water usable for drinking are to be expected.

The Bearpaw bedrock formation underlies the glacial deposits throughout the township. This formation is not a source of good water supplies and drilling into it is not recommended. The depth to the formation is unknown, although a 110-foot hole on the NW.¼, section 2, is reported as encountering "soapstone", probably the Bearpaw shales, at its base, at an elevation of approximately 2,200 feet. If this is correct it is probable that the formation will be encountered at approximately similar elevations throughout the township.

Township 13, Range 3

Wood river crosses from the southwest to the northeast corner of this township. The river contains water throughout all but the driest years, and provides a pasture supply of water for the stock of nearby residents. Springs

flow in places along the banks of the river and residents near the valley use them for a year round stock supply. The main sources of water are wells sunk into the glacial deposits that mantle the area. Sloughs, ponds, and dugouts are used in many places to supplement stock supplies derived from wells.

Recent deposits consisting of sands and silts, rarely exceeding 15 feet in thickness, occur along the course of Wood river. As far as known no wells have as yet been sunk in these deposits, but it is believed that sand and gravel pockets that would yield small quantities of water suitable for domestic purposes occur scattered through the silts at shallow depths.

The glacial deposits covering the township range in thickness from 60 to 110 feet. Three types, namely glacial lake sands, glacial lake clays, and moraine occur. The areal distribution of each type is shown on the accompanying map (Figure 1).

A few wells in the township tap water-bearing sand and gravel pockets scattered in the upper 30 feet of the glacial deposits except the lake clays. Most of these wells obtain an adequate supply for stock needs, but in some places several such wells may be necessary to meet stock requirements. In all cases the water is of good quality and suitable for household use.

Most wells in the township are between 50 and 110 feet deep, and those located west of Wood river tap fine sand ("sea-mud") and silt beds that are believed to represent the interglacial deposit described in an earlier section of the report. In this township these beds occur fairly uniformly at an average elevation of 2,170 feet above sea-level. Wells tapping them obtain supplies of water of good quality, adequate for household and stock needs. These productive aquifers are present only in isolated places east of the river, and a 93-foot

well located on the NE.$\frac{1}{4}$, section 5, is the only well known to have tapped them in this part of the township. This well obtains an adequate stock supply. Other wells east of the river usually obtain smaller supplies of more highly mineralized water, from random sand and gravel pockets in the glacial drift. They range in depth from 50 to 95 feet and the water is generally used only for stock. A 90-foot hole on the SE.$\frac{1}{4}$, section 5, and a 20-foot hole on the SE.$\frac{1}{4}$, section 9, which were sunk in the boulder clay, did not encounter a productive pocket.

The Bearpaw bedrock formation underlies the glacial drift throughout the township. It is not a source of good supplies of water and drilling into the formation is inadvisable. Prospecting for water supplies should be confined to the glacial drift to locate either isolated water-bearing sand or gravel pockets or the productive interglacial sand beds lying within the area bounded by the "A" line.

Township 14, Range 1

The southern third of the township is covered by Johnstone lake. The lake is shallow, and the "alkaline" water is not suitable even for watering stock. The remainder of the area, except for a small, flat strip bordering the lake, is rolling and is not suitable for farming. Settlement is confined to the eastern side of the township. Water supplies are obtained from springs, from sloughs, and from wells, sunk into the glacial deposits. The springs occur along the edge of the hills, and since they flow throughout the year they provide large supplies suitable for stock and in localities where the water is not highly mineralized suitable also for household use. Sloughs occur in undrained depressions, and although the water in some is "alkaline" many of them during wet seasons of the year provide

supplies of water suitable and adequate for stock.

The distribution of the various kinds of glacial deposits is shown on the map (Figure 1) accompanying the report. Glacial outwash gravels and sands occur in sections 13, 14, 23, and 24, and where sufficiently thick to form reservoirs provide an excellent source of water supplies. The 6-foot well on the NW.$\frac{1}{4}$, section 24, obtains a large yield from this source. Wells on the SW.$\frac{1}{4}$, section 13, and the NE.$\frac{1}{4}$, section 14, encountered only thin beds of glacial gravels and hence failed to obtain a supply at shallow depths. The wells were deepened into the underlying glacial till to depths of 45 and 110 feet, respectively, where they tap water-bearing pockets. The yield from the 45-foot well is sufficient for 12 head of stock, but from the 110-foot well it is insufficient for the local stock needs. The water from both wells is highly mineralized and is not suitable for domestic purposes. It is believed advisable to prospect thoroughly the sands and gravels close to the surface before undertaking deep drilling.

Two wells, 54 and 50 feet deep, located on the NW.$\frac{1}{4}$, section 12, and the NE.$\frac{1}{4}$, section 11, are sunk into glacial lake sands. Both wells obtain an adequate supply of water for stock needs, but the water is characteristic of supplies from the lake sands in the municipality, and is too highly mineralized to be suitable for household use. Other wells sunk to similar depths in these deposits would probably be equally productive. Residents in the moraine-covered areas in the northern half of the township derive their supplies in many places from springs, but water-bearing sand and gravel pockets are fairly widespread in the moraine and supplies are readily obtained by sinking shallow wells. Supplies from such wells will probably be adequate for 20 or more head of stock, and the water generally is of good quality and suitable for domestic use.

The Bearpaw bedrock formation underlies the glacial deposits in all parts of the township, with the possible exception of a narrow belt along the northern boundary where sands of the Eastend formation are thought to occur intervening between the boulder clay and the Bearpaw shales. The Bearpaw is not considered a source of good water supplies. The depth to bedrock is unknown and the recorded log of the 110-foot well located on the NE.$\frac{1}{4}$, section 14, is not of sufficient detail to determine whether or not this well penetrated the bedrock.

Township 14, Range 2

Johnstone lake occupies the southeastern corner of this township. It has dried up considerably and the lake water is highly mineralized, and unsuitable for watering stock. Wood river, flowing through the southern sections of the township, contains water throughout all but the driest years and provides a pasture supply of water for stock of nearby residents. Wells in the township are sunk into the lake clays and silts, that mantle the lower southern flats, and into the moraine covering the uplands. Flowing springs are common in the rolling, moraine-covered area, particularly along the edges of the hills and knolls. These springs provide larger supplies of water and residents in the hills obtain the greater part of their household and stock supplies from them. One of these springs provides the water supply for the village of Courval. Sloughs lying in undrained depressions in the hills during wet seasons supplement stock supplies available from springs and wells.

Shallow wells, sunk in the thin beds of Recent sands and silts that lie along the bottom of Wood River valley, would possibly obtain by seepage supplies of water adequate for small

household requirements. No wells have been sunk in the glacial lake sands and clays occurring in the flats bordering Wood river and Johnstone lake. It is probable that moderately large supplies of water are obtainable at depths less than 30 feet. This water cannot, however, be expected to be particularly suitable for domestic use. Wells located on section 1, 14, 15, and 16 have been sunk to depths of 100, 105, and 110 feet, respectively, and have encountered interglacial beds of "sea-mud", at elevations between 2,135 and 2,100 feet above sea-level. The water is of good quality and the supplies from the wells on sections 14 and 16 are sufficient for all requirements on the farms upon which they are situated. Two wells sunk to the "sea-mud" horizon are necessary to satisfy the water requirements on section 15. Two wells 127 and 140 feet deep, on the NW.$\frac{1}{4}$ and the NE.$\frac{1}{4}$, section 19, also reached interglacial water-bearing beds at elevations of 2,163 and 2,135 feet above sea-level. They yield hard, drinkable water in sufficient quantities for the household needs, and for 25 to 40 head of stock. In the absence of more extensive drilling the areal extent of these interglacial beds can only be surmised, but it seems probable that wells sunk to depths not exceeding 150 feet throughout the southern half of the township north of Wood river will encounter these beds within the range of elevations given above and find them to be equally productive. Just how far north into the moraine-covered area these porous beds extend is not known. The depth to the Bearpaw shales underlying the area has not been determined, but it may be 100 feet or more in the lowlands. On the rolling, moraine-covered area the depth probably varies. Drilling into the shales is not recommended in this township.

Township 14, Range 3

Chaplin creek flows through a broad, shallow valley across the township, from the northwest to the southeast corner of the township. The creek is dry except in wet seasons of the year, but dugouts excavated in the gravels along its bed provide a supply of water for the stock of nearby residents. Wells in the township are sunk into the Recent stream deposits, the glacial lake sands mantling the greater part of the lowland stream area, and into the moraine that covers the uplands of the northeast and southwest corners. Shallow wells sunk into the Recent sands, silts, and gravels, lying along the valley of Chaplin creek, would probably obtain small quantities of water suitable for a domestic supply, during the time of the year that the stream contains water and possibly for a short period afterwards.

Residents located on the flat area covered by glacial lake sands generally obtain adequate water supplies from wells less than 20 feet deep. One well, however, in this area, sunk to a depth of 80 feet, is at present dry. It is believed that shallow prospecting at most places within the lake sand-covered areas would find at least sufficient water for domestic needs, and a few head of stock.

Thin beds of glacial outwash sands and gravels cover a small area extending northwest from Tennex post office. A well 12 feet deep, sunk into these outwash sands and gravels on the NE.$\frac{1}{4}$, section 32, obtains an adequate supply of good water for household and stock needs, and it is believed that shallow wells sunk elsewhere in these deposits would be similarly productive.

Some residents in the moraine-covered areas obtain water from sand and gravel pockets within 60 feet of the surface.

Supplies are not large, but the water is of good quality and suitable for domestic use. Most of the residents of this township, however, have sunk deeper wells to tap water-bearing beds of fine sands and gravels that form interglacial deposits in the lower part of the glacial drift. The wells, 100 to 175 feet in depth, obtain adequate stock supplies. The water is hard, slightly "alkaline", but except from the wells located on the SW.$\frac{1}{4}$, section 5, and the SE.$\frac{1}{4}$, section 6, it is suitable for domestic use. The water from the 175-foot well located on the NE.$\frac{1}{4}$, section 14, has a swampy odour but is being used for drinking. Occasionally fragments of rushes and other swamp vegetation, characteristic of the interglacial deposits are reported from the base of this well. Deeper drilling in this township may find water at the contact between the boulder clay and the shales of the underlying Bearpaw formation. No wells are known to have reached this horizon, however, and no assurance can be given that the water found will be suitable for farm use. Still deeper drilling into the shales is not recommended.

Township 15, Range 1

This township owes its rough, rolling topography to the mantle of moraine that covers the entire area. Sloughs occurring in depressions intervening between the low knoll ridges provide stock water supplies during wet seasons of the year. Wells in the area are less than 20 feet in depth, and are located mainly in depressions or near the bases of hill slopes. The gravel deposits in the moraine vary greatly, both in individual areal extent and thickness. A 15-foot well dug on the NW.$\frac{1}{4}$, section 22, yields 6,000 gallons of water a day. Most of the wells, however, strike smaller pockets, or else derive supplies by seepage from nearby sloughs or ponds. In

many places several such wells are necessary to provide an adequate stock supply. The water from these wells is hard, but not highly mineralized, and hence generally suitable for domestic use. Water from a few wells, however, has dissolved a considerable amount of sulphate salts from the clays, and consequently cannot be used for drinking.

The Ravenscrag bedrock formation is believed to underlie the glacial deposits in the northern part of this township. The Eastend formation underlies the Ravenscrag, where it occurs and extends under the glacial drift in the southern part of the township. No wells, so far as known, have been sunk into these formations in the township, but as water-bearing beds occur in both the Ravenscrag and the Eastend formations in other parts of Saskatchewan it is possible that they are productive in this area. Due to the thick mantle of moraine, wells 100 to 150 feet deep would probably be necessary in order to tap this source. Careful prospecting of the drift to locate gravel pockets in the boulder clay, however, appears preferable to sinking deep wells to unproved horizons.

Township 15, Range 2

Moraine with rough, rolling land surface covers the entire township, and ground water conditions are in general similar to those existing in the township to the east. Springs occur in many of the valleys of the southern part of this township. They flow throughout the year and provide a permanent stock supply for many of the residents of the area. The existing wells in the township are sunk into the moraine. Sloughs and dugouts supplement stock supplies available from wells.

Water-bearing sand and gravel pockets occur scattered through the moraine. In many places little or no evidence of the occurrence of these beds in the clay appears at the surface, and in the northern sections of this township, where the pockets are not extensive considerable difficulty has been experienced in locating them. Hence several dry holes may be drilled before a sufficiently productive bed is penetrated. In the southern sections the supplies obtained are generally adequate for stock needs, but in the northern sections several such wells, or a well and a dugout, are generally necessary to provide a supply. Several wells in the northern sections are sunk to depths between 90 and 118 feet of the surface, and with the exception of the 90-foot well, located on the NW.$\frac{1}{4}$, section 28, they obtain adequate stock supplies. The water from glacial pockets is hard, highly mineralized, and as a rule not suitable for domestic use.

The glacial deposits are believed to be underlain by the Ravenscrag formation in the northeast corner, by the Eastend formation throughout the central sections, and by the Bearpaw formation in the southwest corner. The area underlain by each formation is shown on the accompanying map (Figure 1). The bedrock cannot be considered a source of water supplies in this area. A well 180 feet deep, located on the SE.$\frac{1}{4}$, section 35, probably penetrates the Ravenscrag and obtains only a small supply of highly mineralized, unusable water. Residents are advised to confine prospecting for water supplies to the upper 50 feet of glacial drift, and if such prospecting proves unsuccessful, to excavate dugouts or construct dams to conserve surface water rather than to sink wells 150 feet or more in depth, to reach horizons that probably would not yield water sufficiently low in dissolved mineral salts to be used for household or stock-raising requirements.

Township 15, Range 3

The northern part of this township is rolling and is given over largely to pasture land. The surface levels off to a plain in the southeast corner. This part of the township, occupied in part by the basin of pre-glacial Lake Chaplin, is more thickly populated. Sloughs occurring in depressions in the northern sections and shallow seepage wells sunk beside them provide water supplies in this part of the township. In the south water supplies are obtained from springs and from wells, sunk into the glacial drift that mantles the area. A spring flowing on the NE.¼, section 6, supplies the household needs of ten farmers and 200 head of stock. A similar spring located on the SW.¼, section 4, that at one time yielded a good supply, was dry during 1935.

Three types of glacial deposits, namely, outwash sands and gravels, lake sands, and moraine, occur in this township, the areal distribution of each being shown on the accompanying map (Figure 1). In the area overlain by glacial outwash sands and gravels good supplies of water can be expected at shallow depths, and it is probably from these deposits that the springs in this neighbourhood obtain their supply. The glacial lake sands underlying the flat sections 5, 6, and 7 are also thought to be productive at shallow depths, but at present no wells are known to have been sunk in them. Sand and gravel pockets scattered through the moraine are water-bearing and several wells tapping them obtain supplies of water of good quality, adequate for household and stock needs. Some of the pockets are small, however, and two wells, 32 and 65 feet deep, located on the NW.¼, section 10, and the NW.¼, section 7, respectively, obtain only small supplies. From the 65-foot well, the water is highly mineralized and unfit for household use. Prospecting carried out to cover as wide an area as possible within 65 feet of the surface would

probably locate productive pockets in the moraine deposits. The glacial deposits are underlain by the Eastond formation in the northeast corner of the township, and by the Bearpaw formation throughout the remainder of the area. Neither of these formations is believed to be productive in this area, and drilling below the glacial drift that here has a probable thickness of 100 to 150 feet is not considered advisable.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF RODGERS, NO. 133, SASKATCHEWAN

Township	13	13	13	14	14	14	15	15	15	Total No. in municipality
West of 3rd meridian — Range	1	2	3	1	2	3	1	2	3	
Total No. of Wells in Township	21	47	37	12	13	39	16	90	6	281
No. of wells in bedrock	0	1	2	0	0	0	0	1	0	4
No. of wells in glacial drift	21	46	35	12	13	39	15	89	6	276
No. of wells in alluvium	0	0	0	0	0	0	1	0	0	1
Permanency of Water Supply										
No. with permanent supply	16	40	28	11	13	34	9	34	6	191
No. with intermittent supply	2	4	5	1	0	4	2	4	0	22
No. dry holes	3	3	4	0	0	1	5	52	0	68
Types of Wells										
No. of flowing artesian wells	0	0	0	3	0	0	0	0	1	4
No. of non-flowing artesian wells	3	6	10	0	8	13	0	15	2	57
No. of non-artesian wells	15	38	23	9	5	25	11	23	3	152
Quality of Water										
No. with hard water	16	40	32	10	13	34	9	35	6	195
No. with soft water	2	4	1	2	0	4	2	3	0	18
No. with salty water	1	0	1	0	0	2	0	1	0	5
No. with "alkaline" water	14	16	13	5	3	6	2	9	1	69
Depths of Wells										
No. from 0 to 50 feet deep	18	34	17	10	4	24	16	81	4	208
No. from 51 to 100 feet deep	3	12	19	1	5	7	0	5	2	54
No. from 101 to 150 feet deep	0	1	1	1	4	5	0	3	0	15
No. from 151 to 200 feet deep	0	0	0	0	0	3	0	1	0	4
No. from 201 to 500 feet deep	0	0	0	0	0	0	0	0	0	0
No. from 501 to 1,000 feet deep	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
How the Water is Used										
No. usable for domestic purposes	8	28	27	11	12	31	11	29	6	163
No. not usable for domestic purposes	10	16	6	1	1	7	0	9	0	50
No. usable for stock	14	40	33	12	13	38	11	36	6	203
No. not usable for stock	4	4	0	0	0	0	0	2	0	10
Sufficiency of Water Supply										
No. sufficient for domestic needs	18	34	31	11	13	34	10	33	6	190
No. insufficient for domestic needs	0	10	2	1	0	4	1	5	0	23
No. sufficient for stock needs	14	22	24	10	12	26	[illegible]	25	4	146
No. insufficient for stock needs	4	22	9	2	1	10	4	13	2	67

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 differance between the total hardness and the permanent hardness and represents the amount of mineral salts that ban 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 excesss 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.

Analyses of Water Samples from the Municipality of Rodgers, No. 133, Saskatchewan.

LOCATION						Depth of Well, Ft.	Total dis'vd solids	HARDNESS			CONSTITUENTS AS ANALYSED						CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS									Source of Water
No.	Qtr.	Sec.	Tp.	Rge.	Mer.			Total	Perm.	Temp.	Cl.	Alkalinity	CaO	MgO	SO_4	Na_2O	Solids	$CaCO_3$	$CaSO_4$	$MgCO_3$	$MgSO_4$	Na_2CO_3	Na_2SO_4	NaCl	$CaCl_2$	
1	NE.	7	13	1	3rd	23	3,020											(5)	(1)		(2)		(3)		(4)	*1
2	NE.	1	13	2	3	42	1,000											(3)	(1)		(2)		(4)		(5)	*1
3	NE.	8	13	3	3	56	2,800	050	400	250	7	025	140	101	1,493	1,000	2,819	251		211		130	2,210	17		*1
4	NW.	32	13	3	3	48	991											(3)	(1)		(2)		(4)		(5)	*1
5	NW.	22	15	1	3	15	520	550	220	330	8	235	80	50	150	75	453	143		77	63		157	13		*1
6	NE.	9	15	2	3	39	980	600	500	100	17	330	110	68	410	257	937	197		113	42		557	28		*1
7	SE.	10	15	2	3	29	1,280	850	700	150	42	280	230	115	582	150	1,138	280	177		343		269	69		*1
8	NW.	24	15	2	3	50	6,100											(4)	(1)		(3)		(2)	(5)		*1
9	SE.	27	15	2	3	118	4,260	2,500	2,000	500	190	420	490	382	2,295	773	3,889	420	620		1,138		1,399	312		*1
10	NW.	32	15	2	3	106	3,920	1,800	1,400	400	70	415	290	259	2,132	950	3,545	415	141		773		2,091	125		*1
11	From Johnstone lake																6,265		126		1,288		4,842			

Water samples indicated thus, *1, are from glacial drift or other unconsolidated deposits.
Analyses are reported in parts per million; where numbers (1), (2), (3), (4), and (5) are used instead of parts per million, they represent the relative amounts in which the five main constituents are present in the water.
Hardness is the soap hardness expressed as calcium carbonate ($CaCO_3$).
Analyses Nos. 1, 2, and 4, by Provincial Analyst, Regina; Analysis No. 8, by V.A. Vigfusson, Saskatoon; Analysis No.11, by Mines Branch, Dept. of Mines, Ottawa.
For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

An analysis of water from Johnstone lake, made by the Mines Branch, Department of Mines, Ottawa, is listed as No. 11 on the accompanying analysis table. The excessive amounts of 4,842 and 1,288 parts per million of sodium sulphate (Na_2SO_4) and magnesium sulphate ($MgSO_4$), respectively, which this water contains, render it unfit for either household or stock use. No analyses are available of the waters of Wood river or Chaplin creek, but it is believed that these waters are suitable at least for watering stock except during the seasons of the year when the streams are stagnant.

Shallow wells sunk in the Recent sands, silts, and gravels lying along the stream courses derive small supplies of water by seepage from the streams, and from the drift covering the uplands. The water does not contain a large amount of mineral salts in solution and as a rule may be used in the household without ill effects. Water from such a shallow source is easily polluted, however, and care should be exercised in keeping the catchment area free from decaying animal and vegetable matter.

Six samples of ground water from various sources in the glacial deposits were collected and analysed by the Geological Survey. These, together with the results of four other analyses of waters from similar sources made by the Provincial Analyst of Saskatchewan, are included in the accompanying table. The following generalizations are based upon these analyses, upon observations at the well sites, and upon analyses of water from similar sources in adjoining municipalities.

Water contained in the glacial lake sand deposits bordering the lake is generally highly mineralized. It is presumable that the same processes of evaporation and concentration of salts that have affected the waters in the lake have caused the

large amounts of salts to be present in the sediments of the bordering lowlands. This condition is particularly noticeable in undrained depressions and in places where the lake sands fill depressions in the surface of the more impervious underlying bouldor clay.

The first analysis on the accompanying table is of water from a comparatively shallow well sunk entirely in lake sands. This water has a total solid content of 3,620 parts per million, made up mainly of sulphate salts. It has a harmful effect when drunk by human beings, but is used satisfactorily for stock.

Large variations in the character of ground waters from the glacial till and moraine are noted throughout the region and often within small areas. One well may yield a moderately hard, drinkable water, whereas another well sunk to a similar depth only a few hundred feet away may give a supply too highly charged with dissolved sulphate salts to be fit even for watering stock. It is not to be inferred, therefore, that if water of poor quality is found in one well such conditions must of necessity exist over an extensive area.

The type of drift from which the water is obtained is important in relation to the amount of mineral salts the water contains. Boulder clay is regarded as being the source of the sulphate salts found so commonly in waters from the drift. Hence waters derived from wells sunk entirely in bouldor clay contain the largest amounts of dissolved salts and may be unfit for any farm use. Water from sands and gravels as a rule contains lesser amounts, although the quantity is largely dependant upon the thickness, porosity, and depth of the porous bed. Of these, the depth is possibly the most important factor in that it determines the thickness of overlying bouldor clay, through which the water must percolate before reaching the gravel and sand bed.

Analysis No. 5 may be considered typical of a water taken from a sand or gravel bed lying under only a few feet of boulder clay. The water has a total salt content of 520 parts per million, made up of small amounts of sodium sulphate, calcium carbonate, magnesium carbonate, magnesium sulphate, and sodium chloride. This water is hard, but since none of the salts present is in sufficient concentration to be harmful it is of excellent quality for drinking. Analyses Nos. 2, 4, 6, and 7 are of waters from porous beds under greater thicknesses of clays. The total dissolved salt contents of these waters range from 980 to 1,280 parts per million, but since none of the salts present is in harmful concentration these waters are suitable for domestic use. Analyses No. 8 is of water from a thin gravel bed lying under 50 feet of compact boulder clay. The total salt content of this water is 6,100 parts per million, consisting, mainly in the order of their abundance, of calcium sulphate, sodium sulphate, and magnesium sulphate. This amount of salts in a water ordinarily renders it unfit even for stock use, but as in this case the total is largely made up of the relatively harmless calcium sulphate the resident uses it for watering his stock. Greater relative concentrations of magnesium sulphate or sodium sulphate would render such water unfit for any farm use. The third analysis is of water from a 56-foot well located on the NE.$\frac{1}{4}$, sec. 8, tp. 13, range 3, believed to be derived from interglacial silt and gravel beds. It will be noted that this analysis is similar in general to waters from other deep wells in the drift as exemplified by analyses 9 and 10. The predominate difference is that in waters from the interglacial deposits not only of this, but adjoining, municipalities the magnesium sulphate is either absent or present in only minor amounts. Despite the fact that the total solid content of this water is 2,800 parts per million, the salts present are not particularly injurious to health and the water is used for domestic purposes. This water also contains 130 parts

of sodium carbonate (black alkali) a salt that is harmful to vegetation. However, in this water it is believed not to be in sufficient concentration in itself to cause it to be harmful, but as it is combined with 2,210 parts of sodium sulphate the water is not considered suitable for irrigation.

Analyses 9 and 10 show greater concentrations of dissolved salts, namely 4,260 and 3,920 parts per million. The analyses show a similarity to the analysis of the water of Johnstone lake. It is improbable that any particular connexion exists between these deep aquifers and the lake, but rather that both the lake basin and the porous beds near the base of the drift present similar opportunities for the gradual concentration of mineral salts. The total solid content of waters analysed from these deep wells ranges from 2,800 to 4,260 parts per million. Sodium sulphate is the predominant salt in each case, having concentrations of 1,399 and 2,091 parts per million. Magnesium sulphate is present as 1,138 and 773 parts, respectively, rendering the water suitable only for watering stock.

Iron forms an objectionable feature in many waters of this municipality. Much of this iron may be removed by allowing the water to stand for a period of time in a trough or container having a large water surface exposed to the air. Agitation of the water is also helpful in removing the iron. One method that has proved successful is to allow the water to pass over a sheet of corrugated, galvanized iron suspended between the pump and the trough. The iron after coming in contact with the air settles out as a red precipitate on the bottom of the trough.

Water from the Bedrock

As far as known no water is obtained from the bedrock in this municipality. Any water obtained from the Ravenscrag or Eastend formations that underlie the northeastern part of the area, unless modified to an undue extent by water percolating through from the glacial drift, would probably be fairly soft. It would contain fairly large concentrations of sodium sulphate and sodium carbonate, but only small amounts of the sulphates of calcium and magnesium. Such waters are generally suitable for household and stock use, but unsuited for irrigation.

Only small seepages of water are obtained from the shales of the Bearpaw formation and these would probably contain salts in excess of 5,000 parts per million, made up largely of sodium sulphate or sodium chloride. Generally, waters from this source are unfit for any ordinary farm purposes.

WELL RECORDS—Rural Municipality of RODGERS NO. 133, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
1	NW.	3	13	1	3	Spring	0	2,180					Glacial sand	Hard, clear	45	D, S	Sufficient supply.
2	SW.	4	"	"	"	Dug	15	2,220	- 5	2,215	5	2,215	Glacial sand	Soft, clear	48	D, S	Sufficient supply.
3	NE.	5	"	"	"	Bored	22	2,250	- 12	2,238	22	2,228	Glacial sand	Hard, clear, sulphur, iron, salty, "alkaline" odorous	42	S	Sufficient; laxative. A 10-foot dry hole.
4	SE.	6	"	"	"	Bored	50	2,290	- 42	2,248	42	2,248	Glacial sand	Hard, iron, slightly, "alkaline"	45	D, S	Sufficient supply.
5	NW.	6	"	"	"	Bored	48	2,260	- 42	2,218	42	2,218	Glacial drift	Hard, slightly "alkaline"		D, S	Sufficient; 20 barrels a day.
6	SW.	7	"	"	"	Bored	38	2,250	- 26	2,224	38	2,212	Glacial sand	Hard, clear		D, S	Insufficient supply; waters 6 horses in summer. Two dry holes 60 feet deep. A 16-foot well near house very "alkaline" water.
7	NE.	7	"	"	"	Bored	23	2,240	- 15	2,225	15	2,225	Glacial drift	Hard, clear, iron, "alkaline"		S	Insufficient supply; # a 40-foot well too "alkaline" for use. Both wells laxative on humans.
8	NE.	8	"	"	"	Bored	37	2,210	- 30	2,180	37	2,173	Glacial gravel	Hard, clear, "alkaline"		S	Sufficient for 20 head stock.
9	SW.	9	"	"	"	Dug	37	2,210	- 35	2,175	35	2,175	Glacial drift	Hard, clear, "alkaline"	45	S	Intermittent; laxative. A 20-foot well soft water in sand for house use.
10	NE.	9	"	"	"	Bored	24	2,185	- 20	2,165	20	2,165	Glacial black sand	Hard, clear, "alkaline"	42	S	Insufficient supply; use spring for house. Several wells too "alkaline" for stock.
11	NW.	17	"	"	"	Bored	30	2,240	- 15	2,225	25	2,215	Glacial sand	Hard, clear, "alkaline"	42	S	Sufficient supply.
12	NE.	18	"	"	"	Bored	55	2,220	- 48	2,172	48	2,172	Glacial drift	Hard, clear, iron, "alkaline" sediment	45	S	Sufficient supply; laxative on humans.
1	NE.	1	13	2	3	Dug	42	2,330	- 38	2,292	38	2,292	Glacial sand and gravel	Hard, "alkaline"			Another well strong supply of "alkaline" water. A seepage well with soft water now dry. #
2	NW.	1	"	"	"		70						Glacial drift	Hard		N, [illegible]	Fair supply.
3	SE.	2	"	"	"	Bored	56	2,350	- 50	2,300	50	2,300	Glacial drift	Hard, clear, iron, "alkaline"		D, S	Intermittent, insufficient supply; a soft well with good supply of poor water.
4	SW.	2	"	"	"	Bored	70	2,350	- 60	2,290	60	2,290	Glacial sand	Hard, clear, "alkaline"	42	S	Insufficient supply.
5	NW.	2	"	"	"	Bored	80	2,320	- 70	2,250	70	2,250	Glacial sand	Hard, clear, iron, "alkaline"		S	Sufficient supply; laxative on humans. A 110-foot dry hole in Bedrock soapstone.
6	SE.	3	"	"	"	Bored	60	2,355	- 50	2,305	60	2,295	Glacial drift	Hard, clear, "alkaline"		S	Sufficient for 15 to 20 head stock; drinking water hauled.
7	SW.	3	"	"	"	Bored	58	2,350	- 50	2,300	50	2,300	Glacial sand	Hard, clear	42	D, S	Insufficient supply.
8	NE.	4	"	"	"	Bored	70	2,365	- 50	2,315	50	2,315	Glacial sand	Hard, "alkaline"	44	S	Sufficient supply.
9	NE.	8	"	"	"	Bored	40	2,300	- 35	2,265	35	2,265	Glacial sand	Hard, iron, "alkaline" clear	[illegible]	D, S	Very insufficient; water stock at a 12-foot well, intermittent.

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 RODGERS NO.133, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
10	N½	9	13	2	3	Bored	45	2,280	- 35	2,145	35	2,145	Interglacial silt	Hard, clear, "alkaline"	42	N	Insufficient supply; very laxative; a 19-foot well for house use, also dry hole.
11	SE.	10	"	"	"	Bored	70	2,325	- 58	2,267	58	2,267	Glacial drift	Hard, clear, "alkaline"		S	Insufficient supply; two other similar wells.
12	NE.	11	"	"	"	Bored	32	2,255	- 18	2,237	18	2,237	Glacial gravel	Hard, clear, "alkaline"	42	S	Sufficient supply; laxative.
13	SE.	13	"	"	"	Dug	10	2,250	- 9	2,241	9	2,241	Glacial drift	Hard, "alkaline"		N	Insufficient supply.
14	NE.	14	"	"	"	Bored	45	2,240					Glacial sand	Hard, clear, iron, "alkaline"		S	Sufficient for 35 head stock.
15	S½	15	"	"	"	Bored	30	2,255	- 17	2,238	17	2,238	Glacial sand	Hard, iron, clear, red sediment	43	D, S	Sufficient supply; a second well in pasture, another well not used. one 30-foot dry hole.
16	N½	15	"	"	"	Bored	40	2,245	- 19	2,226	19	2,226	Glacial drift	Hard, clear, "alkaline"	42	S	Sufficient for stock; haul drinking water.
17	NW.	16	"	"	"	Bored							Glacial drift	"Alkaline" clear		S	Sufficient for 21 head stock.
18	SE.	17	"	"	"	Bored	40	2,280	- 28	2,252	40	2,240	Glacial drift	Medium soft, clear		D, S	Sufficient for 60 head stock; a 12-foot well with house supply only.
19	NE.	17	"	"	"	Dug	20	2,275	- 8	2,267	20	2,255	Glacial sand	Hard, clear, iron		D, S	Sufficient supply.
20	SE.	20	"	"	"	Bored	42	2,250	- 30	2,220	30	2,220	Glacial gravel	Hard, clear, "alkaline"	45	S	Haul drinking water.
21	N½	20	"	"	"	Bored	100	2,250			100	2,150	Interglacial? gravel	Hard, iron, "alkaline" brown sediment	43	S	Fair supply locally; also 30-foot well.
22	SW.	21	"	"	"	Dug	20	2,275	- 12	2,263	12	2,263	Glacial sand	Hard, clear	43	D, S	Sufficient for house and few head stock.
23	N½	21	"	"	"	Dug	18	2,250	- 14	2,236	14	2,236	Glacial sand	Hard, clear	43	D, S	Sufficient supply.
24	SE.	22	"	"	"	Dug	20	2,235	- 16	2,219	16	2,219	Glacial sand	Soft, clear		D	Sufficient for house use; also wells 23 feet deep and 18 feet deep; "alkaline" water used for stock.
25	SW.	22	"	"	"	Spring	0	2,225	- 1	2,224			Glacial drift	Hard, clear	45	D, S	Sufficient supply.
26	SW.	22	"	"	"	Dug	25	2,235	- 21	2,211	21	2,211	Glacial sand	Hard		D, S	Sufficient for 12 head stock.
27	SW.	23	"	"	"	Dug	20	2,240	- 19	2,221	19	2,221	Glacial sand	Soft, clear		D	Insufficient supply. A 75-foot well with "alkaline" water caved in.
28	SE.	28	"	"	"	Dug	21	2,240	- 18	2,222	18	2,222	Glacial sand	Soft, clear		D, S	Sufficient supply.
29	NW.	30	"	"	"	Dug	15	2,230	- 10	2,220	10	2,220	Glacial drift	Hard, clear		D, S	Sufficient supply.
30	SW.	30	"	"	"	Drilled	36	2,250	- 24	2,226	36	2,214	Glacial drift	Medium soft, clear		D, S	Sufficient supply.
1	SW.	4	13	3	3	Bored	95	2,300	- 89	2,211	89	2,211	Glacial fine sand	Hard, iron, "alkaline" salty, clear	46	S	Used for stock in winter.
2	SE.	5	"	"	"	Bored	52	2,270	- 42	2,228	42	2,228	Glacial sand	Hard, cloudy, "alkaline"	42	S	Insufficient supply; laxative on humans. Two dry holes 90 feet and 68 feet deep in soapstone.

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 RODGERS NO. 133, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
3	NE.	5	13	3	3	Bored	93	2,250	- 28	2,222	93	2,157	Interglacial sand and gravel	Hard, clear, "alkaline"	43	S	Sufficient supply; laxative on humans. A seepage well also, for house only.
4	NE.	6	"	"	"	Bored	75	2,240	- 20	2,220	75	2,165	Interglacial sand	Hard, clear, iron	42	D, S	Sufficient supply.
5	NE.	8	"	"	"	Bored	56	2,230	- 11	2,219	56	2,174	Interglacial fine sand	Hard, clear	45	D, S	Sufficient supply; another well for house.
6	SE.	9	"	"	"	Dug	20	2,255									Dry hole in glacial drift.
7	NW.	10	"	"	"	Bored	60	2,275	- 48	2,227	48	2,227	Glacial sand	Hard, clear, "alkaline" iron	44	S	Sufficient supply.
8	NW.	16	"	"	"	Bored	97	2,260	- 20	2,240	97	2,163	Interglacial gravel	Hard, clear	45	D, S	Sufficient supply.
9	SE.	17	"	"	"	Bored	68	2,225	- 12	2,213	68	2,157	Interglacial quicksand	Hard, iron, "alkaline"	42	D, S	Sufficient supply.
10	SW.	17	"	"	"	Dug	25	2,240	- 21	2,219	21	2,219	Glacial quick-sand	Hard, clear	45	D, S	Sufficient supply.
11	SE.	19	"	"	"	Bored	100	2,270	- 60	2,210	100	2,170	Interglacial deposits	Hard, clear, iron		D, S	Sufficient supply.
12	SE.	20	"	"	"	Bored	100	2,250	- 85	2,165	85	2,165	Interglacial deposits.	Hard, iron, "alkaline" clear	45	D, S	Sufficient supply.
13	NW.	20	"	"	"	Bored	65	2,250	- 30	2,220	65	2,185	Interglacial gravel	Hard, clear, "alkaline" iron	44	D, S	Sufficient supply.
14	NW.	21	"	"	"	Bored	80	2,270	- 40	2,230	40	2,230	Interglacial "sea-mud"	Hard, iron, "alkaline"	45	S	Drinking water hauled.
15	NE.	23	"	"	"	Bored	30	2,230	- 20	2,210	20	2,210	Glacial drift	Hard, iron, "alkaline" red sediment	45	D, S	
16	NW.	27	"	"	"	Dug	16	2,230	- 8	2,222	8	2,222	Glacial gravel	Soft, clear	45	D, S	Insufficient supply; intermittent ; 3 similar wells yield sufficient water.
17	SE.	28	"	"	"	Bored	70	2,265	- 62	2,203	62	2,203	Glacial sand	Hard, clear, iron		D, S	Insufficient supply.
18	NW.	28	"	"	"	Dug	28	2,270	- 26	2,244	26	2,244	Glacial sand	Hard, iron, clear	42	D, S	Insufficient supply.
19	W½.	30	"	"	"	Bored	90	2,260	- 60	2,200	60	2,200	Interglacial "sea-mud"	Hard, iron, "alkaline"	42	D, S	Sufficient supply; also 40-foot well.
20	NE.	30	"	"	"	Dug	30	2,250	- 17	2,233	17	2,233	Glacial gravel	Hard, clear, "alkaline"	46	D, S	Sufficient supply; another well not used.
21	SW.	32	"	"	"	Bored	98	2,250	- 80	2,170	98	2,152	Interglacial gravel	Hard, clear	44	D, S	Sufficient supply. # A 95-foot well similar partly filled with sand.
22	NW.	32	"	"	"	Bored	48	2,275	- 43	2,232	43	2,232	Glacial drift	Hard, clear			Only town well on this section. #
23	W½.	33	"	"	"	Bored	110	2,265	- 15	2,250	110	2,155	Interglacial deposits.	Hard, iron, "alkaline"	42	S	Sufficient supply. A 90-foot dry hole. A 14-foot well good supply in sand.
24	SW.	34	"	"	"	Drilled	50	2,250	- 30	2,220	30	2,220	Glacial drift	Hard, iron, "alkaline" clear	43	S	Insufficient supply; laxative on humans.
25	SW.	35	"	"	"	Bored	22	2,250	- 18	2,232	18	2,232	Glacial coarse sand	Hard, iron, clear	45	D, S	Sufficient supply.

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

WELL RECORDS—Rural Municipality of RODGERS NO.133, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
1	NE.	11	14	1	3	Bored	50	2,230	- 38	2,192	38	2,192	Glacial drift	Hard, clear, iron, "alkaline" red sediment	45	S	Waters 6 head stock.
2	SE.	11	"	"	"	Dug	12						Glacial drift	Hard		S	Waters 22 head stock.
3	NW.	12	"	"	"	Dug	54	2,230	- 24	2,206	24	2,206	Glacial drift	Hard, clear, "alkaline"	45	S	Waters 25 head stock.
4	SW.	13	"	"	"	Bored	45	2,220	- 39	2,281	39	2,281	Glacial drift	Hard, clear, "alkaline"	45	S	Waters 12 head stock.
5	NE.	14	"	"	"	Bored	110	2,225	-100	2,125	100	2,125	Glacial drift	Hard, clear, "alkaline"		S	Insufficient supply; laxative on humans.
6	NW.	15	"	"	"	Dug		2,215					Glacial drift	Soft, clear		D, S	Intermittent supply.
7	W½.	22	"	"	"	Dug	6	2,245	+ 2	2,247	6	2,239	Glacial drift	Hard, clear, iron		D, S	Sufficient supply.
8	SW.	23	"	"	"	Dug	35	2,230	- 30	2,200	30	2,200	Glacial drift	Hard, clear, iron, red sediment		D, S	Waters 20 head stock.
9	NW.	24	"	"	"	Dug	6	2,245	+ 2	2,247	6	2,239	Glacial drift	Hard, clear, "alkaline" iron		D, S	Sufficient supply; one gallon a minute.
10	NE.	26	"	"	"	Spring							Glacial drift	Hard		D, S	Sufficient for 75 head stock.
11	SE.	35	"	"	"	Dug	8	2,325	- 6	2,319	6	2,319	Glacial gravel	Soft		D, S	Waters 20 head stock.
12	NE.	36	"	"	"	Dug	12	2,300	- 10	2,290	10	2,290	Glacial sand	Hard, clear		D, S	Sufficient supply for 20 head stock.
1	NW.	14	14	2	3	Bored	100	2,200	- 50	2,150	100	2,100	Interglacial "sea-mud"	Hard, clear	42	D, S	Sufficient supply.
2	SW.	15	"	"	"	Bored	105	2,240	- 70	2,170	105	2,135	Interglacial "sea-mud"	Hard, iron, cloudy	42	D, S	Insufficient supply for 70 head stock; another 100-foot well.
3	SW.	16	"	"	"	Bored	110	2,220	- 55	2,165	110	2,110	Interglacial "sea-mud"	Hard, clear, iron, "alkaline" red sediment	45	S	Sufficient for 20 head stock; a seepage well for house use.
4	SW.	18	"	"	"	Bored	55	2,225	- 45	2,180	45	2,180	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient supply for 30 head stock.
5	SE.	18	"	"	"	Bored	65						Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient supply.
6	NW.	18	"	"	"	Bored	60	2,270	- 50	2,220	60	2,210	Glacial drift	Hard, lime, iron, white sediment	45	D, S	Just sufficient for 10 head stock.
7	E½.	19	"	"	"	Bored	140	2,275	-110	2,165	140	2,135	Interglacial "sea-mud"	Hard, iron, cloudy	42	D, S	Sufficient supply.
8	NW.	19	"	"	"	Bored	127	2,290	-102	2,188	127	2,163	Interglacial "sea-mud"	Hard, clear	45	D, S	Sufficient for 40 head stock.
9	NW.	20	"	"	"	Dug	12	2,310	- 6	2,204	12	2,298	Glacial sand	Hard, clear,	43	D, S	Sufficient for 25 head stock.
10	SE.	21	"	"	"	Spring		2,365					Glacial gravel	Hard, clear		D, S	Sufficient supply.
11	NW.	28	"	"	"			2,365					Glacial gravel	Hard, clear		D, S	Sufficient supply.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of RODGERS NO. 133, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
1	SW.	4	14	33	3	Dug	18	2,250	- 10	2,240	10	2,240	Glacial quick-sand	Hard, clear	43	D, S	Sufficient supply.
2	SE.	5	"	"	"	Dug	9	2,260	- 7	2,253	7	2,253	Glacial sand	Hard, clear	45	D, S	Sufficient supply.
3	SE.	5	"	"	"	Dug	10	2,260	- 8	2,252	8	2,252	Glacial gravel	Hard			Sufficient supply.
4	SW.	5	"	"	"	Bored	130	2,300	-105	2,195	130	2,170	Interglacial "sea-mud"	Hard, clear, iron	41	S	Sufficient supply; laxative on humans.
5	SE.	6	"	"	"	Bored	47	2,300	- 22	2,278	47	2,253	Glacial sand	Hard, clear	43	D, S	Sufficient supply.
6	SE.	6	"	"	"	Bored	135	2,300	-100	2,200	135	2,165	Interglacial "sea-mud"	Hard, clear, mineralized	41	S	Sufficient supply; laxative; also a shallow seepage well for house use.
7	SW.	6	"	"	"	Dug	25	2,290	- 20	2,270	20	2,270	Glacial sand	Hard, clear	43	D, S	Sufficient supply.
8	NW.	7	"	"	"	Bored	30	2,300	- 16	2,284	16	2,284	Glacial drift	Hard, clear, "alkaline"	44	D, S	Sufficient supply.
9	SW.	9	"	"	"	Bored	100	2,295	- 80	2,215	100	2,195	Interglacial ? gravel	Hard, clear		D, S	Sufficient supply.
10	SE.	10	"	"	"	Dug	11	2,370	- 6	2,364	6	2,364	Glacial sand	Hard, clear	48	D, S	Sufficient supply.
11	SW.	10	"	"	"	Dug	8	2,370	- 4	2,366	4	2,366	Glacial drift	Hard, clear	48	D, S	
12	NE.	11	"	"	"	Bored	60	2,245	- 52	2,193	60	2,185	Interglacial ? deposits	Hard, iron, "alkaline" cloudy	42	D, S	Sufficient supply.
13	NW.	12	"	"	"	Bored	55	2,220	- 30	2,190	55	2,165	Interglacial ? sandy clay	Hard, cloudy	43	D, S	Sufficient supply.
14	SE.	13	"	"	"	Bored	160						Interglacial ? gravel	Hard		S	Sufficient for 40 head stock.
15	NW.	14	"	"	"	Bored	78	2,255	- 38	2,217			Interglacial ? deposits	Hard, iron, "alkaline" red sediment	45	S	Sufficient supply; laxative on humans.
16	NE.	14	"	"	"	Bored	175	2,250	- 75	2,175	175	2,075	Interglacial "sea-mud"	Hard, clear		D, S	Sufficient supply; # laxative swamp water.
17	E½.	15	"	"	"	Bored	110	2,270	- 90	2,180	110	2,160	Interglacial "sea-mud"	Hard, clear, iron, "alkaline"		S	Insufficient supply; laxative on humans.
18	SW.	15	"	"	"	Dug	6	2,240	- 4	2,236	4	2,236	Glacial sand and gravel	Soft, clear		D, S	Sufficient for 10 head stock.
19	NW.	19	"	"	"	Bored	35	2,300	- 31	2,269	31	2,269	Glacial gravel	Hard, clear	42	D, S	Insufficient supply; several other wells with poor salty water, not used.
20	SW.	19	"	"	"	Dug	12						Glacial drift	Hard		S	Sufficient for stock.
21	NW.	22	"	"	"	Bored	24	2,260	- 21	2,259	21	2,259	Glacial gravel	Hard, clear	42	D, S	Insufficient supply.
22	NW.	23	"	"	"	Bored	130	2,246	- 80	2,166	130	2,116	Interglacial deposits	Hard, "alkaline"		D, S	Sufficient supply.
23	NE.	23	"	"	"	Bored	155	2,270	- 75	2,195	155	2,115	Interglacial "sea-mud"	Hard, clear		D, S	Sufficient supply.
24	SE.	24	"	"	"	Bored	60	2,270	- 50	2,220	50	2,220	Glacial	Hard, clear	43	D, S	Intermittent; insufficient supply.
25	NE.	24	"	"	"	Dug	20	2,270	- 13	2,257	13	2,257	Glacial quick-sand	Soft, clear	45	D, S	Sufficient for 12 head stock.

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(#) Sample taken for analysis.

WELL RECORDS—Rural Municipality of RODGERS NO.133, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
26	SW.	25	14	3	3	Bored	60	2,285	- 55	2,230	55	2,285	Glacial drift	Hard, clear	42	D, S	Intermittent supply.
27	NW.	25	"	"	"	Dug	12	2,310	- 8	2,302	8	2,302	Glacial gravel	Hard, clear	43	D, S	Excellent supply.
28	SE.	27	"	"	"	Dug	22	2,282	- 19	2,263	19	2,263	Glacial quick-sand	Soft, clear	43	D, S	Excellent supply.
29	SE.	27	"	"	"		32	2,303									Dry hole in glacial drift.
30	NE.	27	"	"	"	Bored	134	2,307	-114	2,293	114	2,293	Glacial gravel	Hard, clear	45	D, S	Insufficient supply in summer.
31	SW.	30	"	"	"	Drilled	35	2,280	- 20	2,260	20	2,260	Glacial drift	Hard, clear	45	D, S	Intermittent; insufficient supply.
32	NE.	30	"	"	"	Bored	80	2,260	- 10	2,250	10	2,250	Glacial drift	Hard, clear			Intermittent supply.
33	NE.	32	"	"	"	Dug	12	2,245	- 8	2,237	8	2,237	Glacial sand	Hard, clear	45	D, S	Sufficient supply.
34	SW.	35	"	"	"	Bored	26	2,325	- 14	2,311	26	2,299	Glacial gravel	Hard, clear	42	D, S	Sufficient supply.
35	NE.	35	"	"	"	Dug	26	2,400	- 22	2,378	22	2,378	Glacial sand	Soft, clear	45	D, S	Insufficient supply.
36	SE.	36	"	"	"	Dug	10	2,350	- 6	2,344	6	2,344	Glacial gravel	Hard, clear		D, S	Excellent supply.
1	SE.	16	15	1	3	Dug	20						Glacial drift	Hard		S	Poor supply for 50 head stock.
2	SE.	20	"	"	"	Dug	18	2,365	- 14	2,351	14	2,351	Glacial sand	Hard, iron	42	D, S	Supplies 48 head stock.
3	NW.	22	"	"	"	Dug	15	2,380	- 11	2,269	11	2,269	Glacial sand and gravel	Soft		D, S	Excellent supply; 6,000 gallons a day, 10 barrels an hour. #
4	NE.	22	"	"	"	Dug	10	2,380	- 6	2,374	6	2,374	Glacial clay and sand	Hard, iron, clear, red sediment		D, S	
5	SW.	27	"	"	"	Dug	17	2,370	- 2	2,368	2	2,368	Glacial drift	Hard, clear, "alkaline"		S	Intermittent; insufficient supply; a 10-foot well so insufficient.
6	NE.	30	"	"	"	Dug	15	2,335	- 11	2,324	11	2,324	Glacial sand	Hard, clear	42	D, S	Just sufficient; two other wells have gone dry.
7	SE.	30	"	"	"	Dug	15	2,340	- 12	2,328	12	2,328	Glacial sand	Hard, clear		D, S	Insufficient supply.
8	SW.	30	"	"	"	Dug	13	2,350	0	2,350			Recent alluvium	Hard, clear		S	Barely sufficient for 17 head stock.
9	NW.	30	"	"	"	Dug	11	2,335	- 6	2,329	6	2,329	Glacial sand	Hard, clear		D, S	Insufficient supply; 3 dry holes about 16 feet deep.
10	NE.	33	"	"	"	Dug	16	2,340	- 12	2,328	12	2,328	Glacial gravel	Soft, iron, "alkaline"	40	D, S	Usually sufficient supply.
1	SE.	2	15	2	3	Dug	10	2,310	- 5	2,305	10	2,300	Glacial quick-sand	Hard, clear	48	S	Sufficient supply; also a spring.
2	NW.	2	"	"	"	Bored	18	2,315	- 10	2,305	18	2,297	Glacial gravel	Hard, clear	40	N	
3	SE.	3	"	"	"	Dug	20	2,305	- 1	2,304	20	2,285	Glacial gravel	Hard, clear, iron, red tinge on standing	39	D, S	Sufficient supply; a 14-foot well. A 90-foot dry hole. A 120-foot well with 10 feet of water too "alkaline" for use.
4	NW.	4	"	"	"	Dug	8	2,415	0	2,415	10	2,405	Glacial gravel	Hard, clear	45	D, S	Sufficient supply; several springs.

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 RODGERS NO.133, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
5	NE.	9	15	2	3	Bored	39	2,330	- 12	2,318	39	2,291	Glacial quick-sand	Hard, iron, clear, turns red on standing	40	D, S	Sufficient supply. #
6	SE.	11	"	"	"	Bored	39	2,310	- 9	2,301	39	2,271	Glacial sand	Hard, clear	40	S	A similar well; several dry holes.
7	SE.	15	"	"	"	Dug	10	2,320	- 10	2,310	10	2,310	Glacial rock and sand	Hard, clear	48	S	Intermittent; insufficient supply.
8	SE.	16	"	"	"	Bored	29	2,300	- 9	2,291	9	2,291	Glacial sand	Hard, salty, clear, "alkaline"	40	S	Intermittent supply. #
9	NW.	16	"	"	"	Dug	15	2,310	- 13	2,297	13	2,297	Glacial sand	Hard, cloudy, "alkaline"	40	S	Sufficient supply; two similar wells.
10	SW.	19	"	"	"	Dug	8	2,380	- 8	2,372	8	2,372	Glacial quick-sand	Soft, clear	55	D, S	Sufficient supply.
11	SW.	20	"	"	"	Dug	12	2,350	0	2,350	12	2,338	Glacial quick-sand	Soft	50	D, S	Very strong supply; 12 dry holes.
12	NE.	21	"	"	"	Dug	15	2,315	- 14	2,301	14	2,301	Glacial drift	Hard, muddy	44	S	Intermittent supply.
13	SE.	22	"	"	"	Dug	11½	2,320	- 2	2,318			Glacial quick-sand	Hard, clear	42	D, S	Sufficient supply; 10 dry holes 20 feet deep.
14	SW.	23	"	"	"	Bored	16	2,350	- 8	2,342	8	2,342	Glacial drift	Hard, clear		D, S	
15	NW.	24	"	"	"	Bored	50	2,325	- 25	2,300	50	2,275	Glacial gravel	Hard, clear, taste of salts		S	Sufficient for stock. #
16	SW.	26	"	"	"	Bored	30	2,300	- 12	2,288	12	2,288	Glacial sand	Soft, clear		D, S	Very insufficient supply; two dry holes 90 feet and 60 feet deep.
17	SE.	27	"	"	"	Bored	118	2,290	- 40	2,250	118	2,172	Glacial sand and gravel	Hard, clear, iron, "alkaline"	44	S	Sufficient supply; laxative.
18	NE.	27	"	"	"	Bored	32	2,300	- 16	2,284	16	2,284	Glacial quick-sand	Very hard, iron, clear	45	D, S	Sufficient supply; one dry hole 38 feet deep.
19	NW.	28	"	"	"	Bored	90	2,330	- 50	2,280	90	2,240	Glacial gravel	Very bad "alkaline" cloudy	45	S	Insufficient supply.
20	NE.	32	"	"	"	Bored	53	2,340	- 53	2,287	53	2,287	Glacial gravel	Hard, iron, "alkaline" sulphur, clear	45	S	Insufficient; 4 barrels a day; 4 dry holes 40 to 45 feet deep; shallow well for house.
21	NW.	32	"	"	"	Bored	106	2,320	- 40	2,280	106	2,214	Glacial gravel	"Alkaline"	44	S	Sufficient for stock; a dry hole and several shallow wells.
22	NW.	33	"	"	"	Bored	85	2,320	- 30	2,290	85	2,235	Glacial sand	Hard, iron, clear, "alkaline"		S	Sufficient supply. #
23	SE.	34	"	"	"	Bored	30	2,320	- 10	2,310	10	2,310	Glacial drift	Hard, clear	44	D, S	Insufficient supply; a 90-foot dry hole. Another shallow well, insufficient.
24	SE.	35	"	"	"	Bored	30	2,310	- 20	2,290	20	2,290	Glacial sand	Hard, lime "alkaline"	50	S	Sufficient supply; a 180-foot dry hole in Ravenscrag. 19 dry holes in glacial drift.
25	SW.	35	"	"	"	Bored	20	2,313	0	2,313			Glacial sandy clay	Hard, cloudy	52	S	Intermittent supply; sufficient supply in wet seasons.
1	NE.	6	15	3	3	Spring	0	2,200	+ 8	2,208			Glacial drift	Hard, clear, "alkaline"	45	S	Excellent supply for 200 head stock.

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 RODGERS NO. 133, SASKATCHEWAN

WELL No.	LOCATION ¼	Sec.	Tp.	Rge.	Mer.	TYPE OF WELL	DEPTH OF WELL	ALTITUDE WELL (above sea level)	HEIGHT TO WHICH WATER WILL RISE Above (+) Below (−) Surface	Elev.	PRINCIPAL WATER-BEARING BED Depth	Elev.	Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
2	NW.	7	15	3	3	Dug	65	2,2[illegible]					Glacial quick-sand	Hard		S	Insufficient supply.
3	SE.	10	"	"	"	Dug	15	2,365	5	2,360	0	2,365	Glacial gravel	Hard, clear	44	D, S	Excellent supply.
4	NW.	10	"	"	"	Bored	32	2,344	- 22	2,322	22	2,322	Glacial sand	Hard, clear	42	D, S	Insufficient supply.
5	SE.	15	"	"	"	Bored	30	2,338	- 16	2,322	30	2,308	Glacial sand	Hard, clear		D, S	Sufficient supply.
6	SW.	17	"	"	"	Bored	65	2,300	- 45	2,255	65	2,235	Glacial sand	Hard, clear		D, S	Excellent 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.