CANADA

DEPARTMENT OF MINES

AND

TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

WATER SUPPLY PAPER No. 112

PRELIMINARY REPORT

GROUND-WATER RESOURCES OF THE RURAL MUNICIPALITY OF RENO NO. 51 SASKATCHEWAN

By

B. R. MacKay, H. H. Beach and D. P. Goodall

OTTAWA

1936

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GROUND WATER RESOURCES OF THE RURAL MUNICIPALITY OF RENO, NO. 51, SASKATCHEWAN

INTRODUCTION

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

Rural municipality of Reno, No. 51, occupies an area of 324 square miles near the southwestern corner of Saskatchewan. The municipality consists of nine townships, described as tps. 4, 5, and 6, ranges 25, 26, and 27, W. 3rd mer. The Shaunavon branch of the Canadian Pacific railway extends in a northeast-southwest direction through the southern half of the area. The village of Vidora situated on the railway in the south-central part lies about 26 miles east of the Alberta boundary and 22 miles north of the International Boundary. The villages of Consul and Robsart are also situated on the railway at distances of 5 and 6 miles, respectively, southwest and northeast of Vidora. From Notukeu junction near the southwestern corner of the area a branch line, Climax branch, extends southward to cross the southern border of the municipality in sec. 4, tp. 4, range 27.

As only townships 5 and 6, ranges 25 and 26, have been topographically mapped the relief is not shown by contour lines on the remaining townships on Figure 2, of the accompanying map. The elevations quoted for this part of the municipality were determined entirely by aneroid barometer readings during the course of this investigation and checked where possible by references to railway and topographic bench-marks. As established points of elevation were not conveniently located in all parts of the area, errors are bound to exist, and the elevations in the western and southern townships must be regarded as only approximately correct.

The southern two-thirds of the municipality consists, for the most part, of gently rolling to undulating prairie land with surface elevations ranging from about 3,100 to 3,250 feet above sea-level. An irregularly shaped, lowland area or dry lake basin extends for a mile or more on both sides of the railway line, through the south-central and southwestern parts of the area, and is about 50 feet lower in elevation than the surrounding country. In the northern townships the surface rises abruptly to form a lower, southern extension of the Cypress hills that extend along the northern border of the municipality at elevations ranging from 3,400 to 3,500 feet above sea-level. A deep, flat-bottomed valley extends in an east-west direction along the southern slope of these uplands, the bottom of which lies at an average elevation of about 3,175 feet. In the eastern part of the area, in township 6, range 25, this valley is occupied by Frenchman river, the headwaters of which are formed by Belanger creek, a spring-fed stream that flows down from the north along the western border of this township. For several miles to the west the valley bottom consists of marshy land, then widens and is occupied by Cypress lake, a large body of fresh water that extends westward along the valley for about 7 miles. The valley reaches a maximum width of about 2½ miles in township 6, range 26. From the western end of the lake, the valley continues westward to the border of the municipality, being occupied for a short distance by Oxarat creek, a small stream that flows down from the northern uplands and empties into Cypress lake. Battle creek enters the municipality through this valley from the west, then turns southward and follows an irregularly meandering course through the southern lowlands to cross the southern border of the municipality in sec. 3, tp. 4, range 27.

The farms in the municipality are confined largely to the southern two-thirds of the area. The land surface in the northern townships is deeply dissected, and in some parts is unsuitable for farming. It is, however, well adapted to ranching, as surface waters are generally available either from the small spring-fed streams or from Cypress lake. Throughout the farming settlement adequate surface water supplies are available only from Battle creek, although a few shallow sloughs and dams and dugouts may provide seasonal water supplies for stock at some places. Ground water supplies are obtained almost entirely from wells sunk in the unconsolidated deposits.

Water-bearing Horizons in the Unconsolidated Deposits

Only a few wells are reported to yield water from the Recent stream deposits. These deposits have their greatest distribution in the valley of Battle creek, and along the deep valley of Frenchman river which extends across the northern part of the area. They consist largely of silts and fine sand, interbedded in places by irregular pockets of coarser sands and gravels. The coarser sediments have been washed in from the uplands by tributary streams and generally occur at the confluence of these streams with the main channel. Wells sunk in these deposits, and encountering sand or gravel beds, are expected to yield moderately large supplies of drinkable water from depths not exceeding 25 feet from the surface. Water from wells encountering only clay or fine silts is generally more highly mineralized than that obtained from the gravel and sand aquifers. In the small stream channels the flood deposits are variable in character. In some places where the stream gradient is not steep these deposits may reach a thickness of 20 feet, and under suitable conditions may yield large ground water supplies. It is frequently found necessary, however, to sink several test holes along the coulée bottoms before locating even a moderate water supply. Such waters as are being obtained from these wells are not highly mineralized and are reported to be suitable for household use.

With the exception of the stream deposits in the coulée bottoms, the surface deposits throughout the area consist of glacial drift. The drift was distributed unevenly over the surface of the bedrock by a great continental ice-sheet that advanced in a general southwesterly direction over the province of Saskatchewan many thousands of years ago. The upper weathered zone of the drift consists essentially of light grey to brownish grey boulder clay, but this grades into dark grey to blue-grey boulder clay at depths of 10 to 20 feet. The thickness of the drift varies considerably in different parts of the area. This variation is largely due to the uneven surface of the underlying bedrock. Depressions and old drainage channels carved in the surface of the bedrock prior to the advance of the ice-sheet, seldom show on the surface of the drift, but their presence becomes apparent when wells are sunk to bedrock.

The greatest thickness of drift in this area occurs in the vicinity of Vidora and southeastward to Consul, where wells were sunk in drift to depths of 128 and 180 feet. An irregular lowland area extending through this part of the municipality may be the general location of one of these buried depressions. With the exception of these local variations the surface of the drift conforms generally to that of the bedrock, and its thickness averages about 60 feet. The unconsolidated deposits that form an undulating to moderately rolling plain throughout most of the area are referred to as glacial till. Several small, more irregularly rolling areas, characterized by low hills and intervening, undrained depressions, occur on the higher land south of the river in township 6, range 25, and at isolated points in the northwest, northeast, and southwest corners of township 6, range 27. These greater accumulations of glacial drift are thought to have been formed where the retreating front of the ice-sheet paused for a somewhat longer period than elsewhere. Such deposits are known as "moraines". The moraines generally contain more pockets of sand and gravels interspersed in the boulder clay than does the glacial till. The lowland area that occurs in the vicinity of Vidora and Consul was occupied for some time by a lake formed by the waters from the melting ice-sheet. The surface deposits in this lake bottom were formed of sediments washed into the lake from the surrounding uplands. They consist of fine lake clays extending to depths of 10 to 15 feet. Although little or no water is obtainable from wells sunk in the lake clays, several wells in the village of Consul yield water from beds or pockets of fine sand that occur interbedded with or immediately below the clays. The yield from these wells is small but the water is reported to be suitable for drinking. Small to moderately large yields of drinkable water are also obtained from sand and gravel pockets that occur distributed through the upper 20 feet of drift in other parts of the municipality. These pockets are generally of small individual areal extent and appear to occur more frequently beneath depressions in the land surface or at the bases of steep slopes where material has washed down from the hill-sides. Since wells deriving water from these deposits are usually shallow their yields are materially affected by drought conditions.

The most reliable source of ground water in the municipality lies in extensive beds of gravel, and occasionally sand or silts, that occur at or near the contact of the glacial drift with the underlying bedrock. Except at a few isolated points this horizon has been found to be water bearing from the southern part of townships 6, ranges 25, 26, and 27, southward to within 1 to 3½ miles of the southern border of the municipality. An attempt is made to outline the area in which this horizon is productive as accurately as possible by means of the "A" line shown on Figure 1 of the map accompanying this report. Owing to the erratic distribution of the water-bearing beds on the edges of the area, and to the scarcity in some places of wells sunk sufficiently deep to reach this horizon, this boundary must be considered as only approximate.

Some of these porous beds are thought to have been laid down by flood waters from the uplands lying to the north and northwest prior to the advance of the ice-sheet, and were subsequently buried beneath glacial drift. At some places, particularly in the south-western part of the area, the water-bearing beds consist of sands, sandy clays, and shale fragments, and some of these may possibly form a part of the old weathered surface of the bedrock. All wells drawing their water supply from this horizon are listed in the well logs as being in glacial drift. The hydrostatic pressure encountered in wells indicates that the individual beds have a fairly continuous distribution through large areas. The water is under little or no head in wells situated near the northern edge of the area where the horizon is tapped at relatively high elevations. Toward the south the aquifersdip to lower elevations and the water, confined under the impervious clay covering, is under greater pressure. In Consul village well the water is obtained at the lowest elevation recorded in the township, and here the pressure is sufficient to cause the water to rise in the well 160 feet above the aquifer or to a level 20 feet below the surface. High water pressures are also encountered by wells sunk in a narrow belt extending southeastward from sec. 1, tp. 5, range 27, through the village of Vidora to secs. 18 and 19, tp. 4, range 25, as outlined on Figure 2 of the accompanying map. The water-bearing beds in this area are believed to lie in a depression in the surface of the bedrock 50 to 100 feet deeper than are the deposits encountered in other wells immediately north. The hydrostatic pressure in this basin is sufficient to cause the water to rise in some places 138 feet above the aquifer, or to a point 11 feet above the surface. The area of flowing wells as outlined, may not include the entire artesian basin. This deep aquifer may possibly extend southwestward from the vicinity of Vidora to Consul, or possibly farther south beneath these lowlands. The water pressure may not be everywhere sufficient to cause the wells to flow, but wherever the horizon is encountered an adequate yield may be expected.

The quality of the waters obtained from the base of the drift varies in different localities. Water from most of the wells situated in the southern part of the area contains noticeable amounts of mineral salts in solution, and several wells drawing water from clay or shale aquifers in township 4, range 27, are reported to yield water that is so highly mineralized as to be unsuitable for drinking, although it is being used for watering stock.

Analyses of water from several of the flowing wells are discussed in a later section of this report.

Water-bearing Horizons in the Bedrock

Although few wells are reported to be obtaining water from the bedrock, certain of the formations that occur in the northern part of the municipality are regarded as potential sources of ground water. Four bedrock formations, known as the Cypress Hills, Ravenscrag, Eastend, and Bearpaw formations, immediately underlie the unconsolidated deposits in different parts of the area. All these formations, with the possible exception of the Cypress Hills beds, presumably once extended over the entire municipality, in the descending order given. Erosion, most of which took place prior to the advance of the ice-sheet and the deposition of the drift, has greatly reduced their areal extents, so that the uppermost formation, the Cypress Hills, is now restricted to areas of highest relief, and the Ravenscrag and Eastend formations have slightly greater areal extents at lower elevations. Frenchman River valley in the northwestern part of the area has been eroded so deeply that all the formations are exposed at different levels along the sides, with the Bearpaw formation underlying the valley floor. This formation also underlies the glacial drift over most of the municipality lying to the south of Frenchman river and Cypress lake.

The Cypress Hills beds are composed essentially of alternating layers of medium- to coarse-grained sands and sandstones and hard, cemented, quartzite conglomerates. This formation occurs only on the uplands in the northern part of the area at elevations greater than 3,350 feet above sea-level. As this formation was laid down on an unevenly eroded surface of the underlying bedrock its base does not always occur at the same relative position.

In most places it rests on the Ravenscrag, but in a small area south of Frenchman river in township 6, range 26, the Ravenscrag is absent and it rests here directly upon the Eastend formation, and in the absence of the Eastend in the southern part of township 6, range 25, it rests upon the Bearpaw formation. No wells are reported to be obtaining water from the Cypress Hills beds, although they are probably water bearing in most places where they have sufficiently wide areal extent. Water from this formation is usually hard to moderately soft, and is of excellent quality for drinking.

The Ravenscrag formation is of wider areal extent than the Cypress Hills formation. Its base at most places probably does not occur at elevations lower than 3,400 feet above sea-level, hence it is also confined to the northern part of the municipality. The Ravenscrag beds consist chiefly of shales, sands, and sandstones, and a few seams of lignite coal. The sands are generally grey to greenish grey, but weather to a light grey or buff. The shales range in colour through a series of dark greys, greens, and browns, with the darker colours predominant, particularly in the lower beds. The sand and coal members of this formation are sufficiently porous to form reservoirs for water accumulation. Some of the springs that are reported to occur along Sucker, Belanger, and Davis creeks may have their origin in these beds. The Ravenscrag waters are usually more highly mineralized than waters from the Cypress Hills aquifers, although they are seldom so highly charged with dissolved mineral salts as to be undrinkable.

The Eastend formation is also confined mainly to the northern uplands at elevations greater than about 3,300 feet above sea-level. This formation is composed largely of dark grey shales interbedded with a few thin beds of fine sandstone and sandy shales. The formation is more shaly in its lower part where it gradually merges into the upper beds of the underlying Bearpaw formation. No wells are reported to have been put down in the Eastend in this municipality. It is expected to be water bearing, particularly in the uplands along the northern border where it attains its greatest thickness.

Little if any water can be expected from the Bearpaw formation. This formation is of wide areal extent and underlies the Eastend and the Cypress Hills beds where they occur in the southern part of township 6, range 25. Throughout the remainder of the municipality the Bearpaw immediately underlies the unconsolidated deposits. The thickness of the formation is not definitely known, but it probably reaches a maximum of 700 feet. It consists almost entirely of dark grey clays and shales that are interbedded at irregular intervals with thin beds of ironstone, whereas its upper part may contain scattered beds of fine sands and sandy shales. The Bearpaw shales are designated locally as "soapstone". It may be distinguished from the boulder clay by the absence in it of pebbles or gravel, by its smooth, soapy feel when wet, and by the small, roughly cubical, and frequently iron-stained, fragments into which it crumbles upon drying.

Two wells located in the southern part of township 6, range 25, are reported to be yielding water from the upper sandy beds of the Bearpaw formation. Only one of the wells, however, produces sufficient water for farm requirements. This water is hard and is being used for the household drinking supply. In the southern two-thirds of the area several dry holes have been put down in the Bearpaw shales to depths as great as 100 feet. Deep drilling in this part of the municipality is not recommended, and residents are advised to confine their search for ground water supplies to the more productive deposits in the glacial drift.

GROUND WATER CONDITIONS BY TOWNSHIPS

Township 4, Range 25

Nearly all the wells in this township are yielding water from one horizon in the glacial till that covers the entire area. The water occurs in beds of gravel in the lower part of the drift and is encountered in wells sunk to depths ranging from 36 to 107 feet. In the northeastern part, in sections 35 and 36, they are encountered at elevations of 3,070 to 3,080 feet above sea-level, or at depths ranging from 45 to 55 feet. Toward the southwest and west, through the central and northwestern parts, they occur at slightly lower elevations, averaging about 3,060 feet above sea-level. The land surface is also slightly lower throughout this part of the area, so that the depths of the wells do not vary greatly from an averagedepth of about 60 feet. In the mid-western part of the township, from section 2● to sections 19 and 18, the gravel beds dip westward more steeply to an elevation of about 2,960 feet, which is encountered in wells on sections 18 and 19, sunk to depths of 100 and 107 feet. The hydrostatic pressure in these wells is sufficient to cause the water to flow above the surface at an elevation of about 3,070 feet above sea-level. The exact eastern limit of this artesian basin has not been determined, but it probably extends through the low flats in parts of sections 17, 20, and 21. Water pressures at this horizon are relatively high throughout the central part of the area. In some of the wells it is sufficient to cause the water to rise within 10 feet of the surface. The hydrostatic pressure decreases, however, toward the north where the gravels occur at higher elevations, although at all places the yield from wells is adequate for the farm requirements. In general these waters contain noticeable amounts of mineral salts in solution, but they are being used for drinking as well as for stock. An upland area that forms the northern flank of Old Man on his Back plateau extends through the southern sections of the township. In these uplands the water-bearing gravels are not known to occur at the base of the drift so that the southern limit of these gravels may correspond with the southern border of the central lowlands. As no topographic map is available for this township the "A" line as drawn on Figure 2, showing the southern boundary of the area in which the basal gravels occur, must be considered as only approximate.

Although the deep water-bearing horizon is not known to occur on the uplands moderate supplies of generally drinkable waters are obtainable at shallow depths in some localities. These water supplies are concentrated in sand and gravel pockets that occur sparsely interspersed through the upper part of the glacial drift and along the bottoms of the small coulées. Residents in search of water in this part of the township are advised to sink test holes in the coulée bottoms and along the bases of steep slopes in preference to the ridges or upper slopes.

No wells in the township are known to yield water from the bedrock. The Bearpaw formation is believed to form the bedrock immediately underlying the unconsolidated deposits throughout the township. This formation is composed almost entirely of shales and is not expected to be water bearing in any part of the township.

Township 4, Range 26

A narrow area of flats forming a part of an old lake basin extends on both sides of the railway and occupies a large part of the northern half of this township. The relief in this area is low, with surface elevations ranging from about 3,050 feet above sea-level in section 18, to an average elevation of about 3,080 feet in sections 33 and 36, on the northern border of the township. From this lowland southward the surface rises rather abruptly to form an irregular upland area that occupies most of the southern third of the township. Drainage in the eastern part of the township is poorly developed and the few small streams that occur terminate in undrained depressions southeast of Vidora village. The western part of the township is drained by Battle creek. This stream enters the township from the west in section 30, and after flowing southward again crosses the western border in section 7.

Surface water supplies are confined chiefly to Battle creek. A dam constructed near where the railway crosses the creek in section 20, provides water for locomotives. Streams that occur in other parts of the township carry water only during the early spring.

The lake clays are not known to be water bearing, and it is probable that wells sunk in the clay-covered area would have to be extended into the underlying boulder clay. Ground water supplies are obtained chiefly from wells sunk to water-bearing gravels that occur at or near the contact of the glacial drift with the underlying bedrock. This horizon is a westerly extension of the water-bearing gravels of the township to the east. An artesian area in which flowing wells occur extends in a northwest-southeast direction through the northern part of the township, as roughly outlined on Figure 2 of the accompanying map. A flowing well situated in the village of Vidora in the SW. $\frac{1}{4}$, section 26, struck water in a bed of gravel at a depth of 122 feet, or at an elevation of about 2,951 feet above sea-level. The gravel bed is overlain by blue clay. The hydrostatic pressure at this location was sufficient to cause the water to rise to a point 17 feet above the surface when the well was drilled in 1929. When visited in 1935 the well was flowing at the rate of about 300 gallons an hour from a point 4 feet above the surface. Similar flows have been encountered in other wells in this vicinity. Some of the wells became choked with sand and shale fragments after producing for several years and necessitated the drilling of new wells. The shallowest flowing well in this area is located in the NW. $\frac{1}{4}$, section 26. In this well water was encountered in a bed of loose sand and shale fragments at a depth of 65 feet, or at an elevation of about 3,016 feet. This location is apparently on the northeastern edge of the artesian basin, as relatively low water pressures were encountered in other wells situated in section 35.

Analyses of water from three flowing wells are discussed in a later section of this report. For a more complete description of this artesian area the reader is referred to the section dealing with the water-bearing horizons of the municipality as a whole.

No wells are reported to be obtaining water from the base of the glacial drift south of the artesian basin as outlined. It is very probable, however, that this water-bearing horizon may be found to extend southwest beneath the glacial lake basin to section 18.

In the southern uplands water is obtained chiefly from shallow wells sunk beside dams. In a few places pockets of sand or gravel may occur interspersed through the upper 30 feet of the boulder clay. These aquifers might be capable of yielding household water supplies, but no large yields are to be expected.

The Bearpaw forms the uppermost bedrock formation throughout the area. It is composed chiefly of shales from which little or no water is obtainable at great depths. The upper partly weathered shale immediately underlying the drift may be water bearing in some places. This potential water-bearing horizon is essentially the same as that occurring at the base of the glacial drift, which has been discussed above. Some of the wells in the artesian basin may possibly be obtaining their water from these upper weathered shales, but lacking proof of this they are listed as drift wells. The upper weathered zone of the bedrock in the southern part of the township is apparently dry. Holes sunk to depths of 65 and 96 feet, in sections 1 and 12, failed to encounter water although the shales were penetrated to depths of about 30 feet.

Township 4, Range 27

Battle creek flows in a southeasterly direction across the northeast corner of this township. This stream again enters the township in section 12, and flows southwest through a dry lake basin that extends across the southeastern corner of the township. Surface elevations in the lake basin average about 3,045 feet above sea-level. The land surface throughout the remainder of the southern part of the area is deeply dissected by several intermittently flowing tributaries of Battle creek. The general relief here is about 50 feet higher than that of the lake basin. Throughout the northern half of the area the surface is undulating to moderately rolling, and rises in a general northwesterly direction to an elevation of about 3,190 feet in section 31. Surface water supplies in the township are confined to Battle creek and to a few dams constructed in the small coulées. Most of the farms are situated in the northeastern half of the area. As suitable sites for dams are not plentiful in the farming district, most of the residents have put down wells in search of water supplies.

Recent stream deposits occur in Battle Creek valley and in most of the small tributaries in the southern part of the area. Although no wells are reported to have been put down in these sediments they are thought to contain moderate supplies of drinkable water at depths probably not exceeding 20 feet. Several wells are obtaining water from shallow depths in the glacial till that mantles the remainder of the township. Where located these water supplies are derived from small, discontinuous pockets of sand that occur sparsely interspersed through the boulder clay. Shallow wells sunk through the lake clays in the village of Consul also encounter small supplies of water in sand pockets in the underlying boulder clay at depths of 14 to 18 feet from the surface. The shallow drift waters are generally drinkable, although at some places they contain noticeable amounts of mineral salts in solution. Most of the residents have failed to locate these water supplies and have sunk their wells to a water-bearing horizon that occurs at the contact of the drift with the underlying bedrock. This horizon has not been encountered in the southwestern part of the township, although it may be present in some places. Wells in sections 21 and 22 appear to be situated on the southern border of this water horizon, as dry holes have been put down less than a half a mile south of these locations. The above-mentioned wells obtain their water from porous clays, and probably some of it is derived from the upper, partly weathered surface of the underlying Bearpaw shales. These shales are thought to have been encountered at the base of both wells at depths of 50 and 90 feet. Other wells situated farther north, in sections 28 and 33, are obtaining water from similar clays at depths of 50 to 60 feet. These waters are highly mineralized and are not suitable for drinking, but they are being used for watering stock without imparting any noticeable ill effects. The yield is adequate for the farm requirements at most places, as the water rises in the wells to about 30 feet above the aquifer. Water of better quality and under greater pressure was encountered in an 180-foot well put down by the village of Consul in section 13. The aquifer is reported to overlie a bed of coal at the base of the well. This aquifer may be a southwesterly extension of the artesian aquifer encountered at Vidora and may even extend under the lowlands along Battle creek as far south as the border of the township. In the Consul well the water is not under sufficient pressure to flow, but it rises to within 20 feet of the surface. It is soft and is reported to be quite suitable for domestic use. The coal may possibly occur at or near the base of the glacial drift and may not belong to the Bearpaw formation. It may, however, be of pre-drift origin, having been deposited in a stream channel that was later buried by the ice-sheet. The location of the buried stream channel has not been determined in other parts of the area, but it probably follows nearly the same course as that now followed by Battle creek through the southeastern part of the township.

The Bearpaw formation underlying this township is not known to be water bearing. Residents in search of water supplies are advised to confine their prospecting to the unconsolidated deposits.

Township 5, Range 25

The land surface throughout most of the southern two-thirds of this township is nearly flat with only a few irregularities formed by shallow drainage channels and depressions. Along the southern boundary the surface lies at an elevation of about 3,100 feet above sea-level. The surface rises gradually for the first 4 miles toward the north to an elevation of about 3,200 feet, then more rapidly to an average elevation of 3,300 feet on the northern border. In the northern part the surface relief is less regular.

There are no permanent streams in the township and the drainage is generally poor. Surface waters collect in a few shallow sloughs and supply some water for stock. Dams or dugouts may also be constructed in some of the shallow draws to collect water for stock. Ground water supplies of the township are obtained entirely from wells sunk in the unconsolidated Recent stream deposits and the glacial drift.

Wells obtaining water from the Recent stream deposits are confined to the northern uplands where the stream channels are better developed. Small to moderate yields of hard, drinkable water are obtained from these wells at depths of 10 to 16 feet. The water occurs in small pockets of sand buried under clay in the coulée bottoms.

The glacial till covering the area is reported to produce water from only one horizon. Wells have encountered this horizon at depths ranging from 60 to 90 feet from the surface. The water occurs in beds of gravel lying at or near the contact of the glacial drift and the underlying bedrock. These gravels probably occur in all parts of the township, although they are not everywhere water bearing, particularly in the northern half of the area. Dry holes encountering the gravels at the base of the drift have been sunk into the underlying bedrock to depths ranging from 160 to 170 feet in sections 15, 19, and 30, and only small seepages were obtained from wells in sections 28 and 33. The surface of the bedrock at the base of the drift is possibly irregular in the northern parts and the water may be confined mostly to the buried stream channels or depressions in the pre-glacial **bedrock** surface. As there is little or no indication of these depressions on the present land surface the productive areas can be located only by sinking wells. The "A" line shown on Figure 2 of the accompanying map shows the approximate northern limit of the area in which there is a reasonable possibility of finding water at this horizon. The hydrostatic pressure in the wells increased slightly toward the southwest. The highest pressure is recorded from a well situated in the NW. $\frac{1}{4}$, section 6, in which the water rises 30 feet above the aquifer. All wells located south of the "A" line, with the exception of the dry hole in section 15, yield water supplies adequate for the farm requirements. Most of these waters are hard and at several places the water contains noticeable amounts of mineral salts in solution, but all are being used for the domestic drinking supply as well as for stock. The glacial drift overlying the basal gravels is composed almost entirely of compact blue clays that may be lighter coloured, yellowish grey to brown, in the weathered zone near the surface. Little or no water is obtainable from these clays. Wells sunk in depressions in the land surface at the edges of sloughs may encounter water in sand or sandy clays at shallow depths.

Waters so obtained are generally drinkable, but the supply is variable and the wells can seldom be relied on for a supply in dry seasons or in the winter months.

No wells are known to yield water from the bedrock in this township. The Bearpaw formation is thought to underlie the drift throughout most of the area, although it may be overlain by Eastend formation through a small area in the northeastern part. Both these formations are composed chiefly of shales and contain few beds sufficiently porous to permit of any large water accumulation. The upper beds of the Bearpaw are generally more porous than those of the lower part, but these proved also unproductive in section 33, where a well was put down to a depth of 130 feet, or about 70 feet below the drift. Other dry holes, in sections 15, 19, and 30, have been sunk to depths of 160 to 170 feet, penetrating at least 50 feet into the Bearpaw shales in each case. Deeper drilling in this formation is not recommended for any part of the area.

Township 5, Range 26

The moderately rolling surface of this township rises gradually in a northerly direction from an average elevation of about 3,100 feet above sea-level in the southern part, to elevations ranging from 3,250 to 3,300 feet on the northern border. There are no permanent streams in the area and very few sloughs. Surface waters may be conserved in some places, however, by constructing dams and dugouts in the depressions and small draws. On most of the farms wells have been put down to the base of the glacial drift where an adequate water supply is usually obtainable.

The thickness of the drift varies from about 45 to 100 feet. Part of this variation is due to the uneven accumulation of the glacial drift on a more or less uniform bedrock surface, and part to the irregularities existing in the surface of the underlying bedrock.

At several places, particularly in the northern half of the township, water-bearing sand or gravel pockets have been located at depths of 10 to 20 feet. These pockets are interspersed at irregular intervals through the boulder clay and are more frequently located beneath the depressions in the land surface or at the bases of steep slopes than on the ridges. The yields from these wells vary, but in most of them the supplies are adequate only for household use. The waters are for the most part not highly mineralized, and at several places they are reported to be soft.

Most of the wells sunk to the base of the drift obtain their water from gravel beds. Several wells in the southern part of the area are reported to have struck water in silts or shale. These wells are usually deeper and the water is under greater pressure being sufficient to cause one well to flow. This well is situated in a lowland area that extends through the SE. $\frac{1}{4}$, section 4. Other wells in this vicinity also have a high water-level. The silts and shales forming this aquifer are probably river deposits laid down in a stream channel cut into the old bedrock land surface and subsequently filled in by glacial drift. These sediments are apparently somewhat similar to the deep gravels encountered in other parts of the township, and hence wells encountering them are listed as being in glacial drift. Nearly all wells put down to the base of the drift yield an adequate water supply. Water from gravel aquifers is as a rule harder than that from clay or shale, but none is so highly mineralized as to render it objectionable for drinking.

No wells are known to have been put down in the bedrock to depths of more than a few feet below the base of the glacial drift. Most of the township is thought to be underlain by the Bearpaw formation. Thin beds of sand and sandy shales may occur in the upper part of the formation and may be water bearing, particularly in the northern parts of the area, but sinking wells to depths greater than 200 feet in any part of the township is not recommended.

Township 5, Range 27

Battle creek enters this township from the north, in section 33, and flows southeasterly through a wide, shallow valley to cross the southern border in section 2. This stream and a few reservoirs provide the only surface water supplies in the township. Ground water supplies are obtained entirely from wells sunk in the unconsolidated deposits.

The Recent flood-plain deposits that occur in the bottom of Battle Creek valley are possibly the best potential source of ground water supply at shallow depths of 20 feet or less. The upper 10 to 15 feet of sediments consist of clays from which little or no water is obtainable, but sand and gravel beds are encountered underlying the clays in wells sunk in sections 23 and 33, and are expected to occur elsewhere in the valley bottom. The analysis of water from a well in section 23 is discussed in a later section of this report.

The glacial drift is composed of boulder clay or till plain in which water is seldom located at shallow depths. The lower part of the drift, however, is well supplied with water-bearing sand and gravel beds, some of which lie directly upon the bedrock. Wells encountering this horizon range in depth from 40 to 100 feet. This variation in depth may be considered as being fairly representative of the thickness of the drift, as the bedrock was encountered at several places beneath the gravels. The water contained in these aquifers in the northern part of the township is under little or no hydrostatic pressure. In general the pressure increases toward the south where the horizon occurs at lower elevations. The deepest wells, situated in the north half of section 1, encountered the water-bearing beds at depths of 83 and 100 feet. Here the water is under sufficient pressure to cause it to flow 2 to 3 feet above the surface.

This horizon yields an adequate water supply in nearly all parts of the township. In most places the water is reported to be hard, although soft waters are obtained from some of the deeper wells in the southern part of the area. Most of these waters are of excellent quality and none are reported to be so highly mineralized as to be unsuitable for household use.

The Bearpaw formation is believed to immediately underlie the unconsolidated deposits throughout the entire area. Fortunately there has been little necessity of sinking wells into the bedrock in this township.

The Bearpaw formation is composed chiefly of shales and it is improbable that it will yield any large supplies of ground water. A dry hole sunk to a depth of 178 feet, in section 18, encountered the Bearpaw at 80 feet. This is the only deep test made in the bedrock, although several wells penetrated a few feet of these shales below the water-bearing horizon at the base of the drift.

Township 6, Range 25

The township is situated on the southern edge of Cypress Hills uplands. Frenchman river, flowing in an easterly direction through the central part of the area, occupies a wide valley, the bottom of which lies at an elevation of about 3,150 feet above sea-level. From the valley floor the banks rise abruptly to the general level of the benchland at elevations ranging between 3,300 and 3,400 feet above sea-level. These uplands are deeply eroded in some places by small tributaries of Frenchman river.

Owing to the deeply dissected and rugged topography existing in the vicinity of the river, and in some parts of the uplands, most of the area is given over to ranching. Frenchman river and several spring-fed tributaries from the north supply ample water for stock in this vicinity.

Ground water supplies are obtained chiefly from springs and from wells sunk in the unconsolidated deposits.

Thick deposits of Recent silts and fine sands, interbedded in places with coarser sands and gravels, occur in the bottom of Frenchman River valley. It should be possible to obtain abundant supplies of drinkable water from these deposits at shallow depths of 20 feet or less. The sediments flooring the small coulées on the upland are more variable in character and are not everywhere water bearing. These deposits, with the gravel and sand pockets that occur interspersed through the upper 20 feet of the glacial drift, are the chief sources of ground water supply in the farming settlement, in the southwestern part of the township. The waters obtained range in character from moderately soft to hard and are satisfactory for drinking. No wells are reported to have been put down in the moraine-covered hills south of the river, but these deposits are not expected to differ essentially from those of the till plain that extends over the rest of the township.

Residents in search of water in the unconsolidated deposits are advised to thoroughly prospect with a test auger for a possible site before going to the expense of putting down a well. The thickness of the drift is quite variable, but shallow gravel and sand pockets can usually be located in the depressions between the hills and in the bottoms of the coulées and small draws.

Although only two wells are reported to obtain water from the bedrock, at least the upper formations are considered to be a potential source of water supply. The Cypress Hills formation caps the uplands north and south of the river where the elevations lie above 3,350 feet above sea-level. This formation can generally be relied upon to yield moderate water supplies, if it covers a sufficiently extensive area. However, a well put down to a depth of 154 feet in the

NE. $\frac{1}{4}$, section 5, encountered Cypress Hills conglomerate at shallow depths, but no water was obtained until the well was deepened into the underlying Bearpaw formation. The Cypress Hills beds are expected to be more productive farther north where they have a wider distribution. Waters from this formation are usually of excellent quality.

The Ravenscrag formation underlying the Cypress Hills beds north of Frenchman river may also be water bearing. Some of the springs that occur in Davis and Belanger creeks in the municipality to the north are believed to have their origin in the sands and coal seams of this formation. The spring waters are reported to be of good quality.

The Eastend formation underlies the Ravenscrag north of the river and extends for only a short distance down the lower slopes beyond the borders of the Ravenscrag beds. Although no wells are reported to be yielding from this formation it is expected to be water bearing.

The Bearpaw forms the uppermost bedrock formation in the southern part of the township, with the exception of the small areas where it is overlain by Cypress Hills beds. Two wells are reported to be producing from the Bearpaw formation in the southern part of the township. One of these, situated in section 4, obtained only a small seepage from shale at a depth of 153 feet, or at an elevation of 3,187 feet above sea-level. The other well, situated in section 5, struck a larger supply in shale at a depth of 124 feet, or at an elevation of about 3,241 feet. These wells were not being used in 1935. Beds containing drinkable waters may possibly occur in the upper part of the formation in other parts of the area, but deep drilling is not recommended.

Township 6, Range 26

Cypress lake occupies approximately 6 square miles in the west-central part of this township. The eastern end of the lake narrows to form a belt of marshy land that extends down Frenchman River valley to the eastern border of the area. From the lake shore, at an elevation of 3,188 feet above sea-level, the land surface rises abruptly toward the north and east to an irregularly dissected benchland that extends over the northern and eastern parts of the township. Elevations on these uplands range from 3,300 to 3,500 feet. From the lake southward the surface rises more gradually to form a wide belt of territory extending along the southern border of the area, at an average elevation of about 3,275 feet above sea-level.

The farming community in the township is confined to the southern sections. The area lying north of the lake consists entirely of range-land. Here range stock obtain water from Cypress lake and from springs that flow from the banks of some of the coulées. In the southern parts water is obtained chiefly from wells sunk in the unconsolidated deposits.

Thick flood-plain deposits consisting of silts and sands occur along the valley bottom from the end of Cypress lake to the eastern border of the township. Wells sunk in these deposits may obtain large supplies of water at shallow depths. The flood-plain deposits in the small tributary coulées may also be water bearing at some places, although few large yields can be expected.

Nearly all the wells listed from this township are sunk to sand or gravel beds that occur at the contact of the glacial drift and the underlying bedrock. The surface of the bedrock is very irregular, hence the thickness of the drift varies greatly within short distances. In sections 2, 3, 4, and 10, water is obtained from wells sunk to beds of gravel at depths of 53 to 107 feet. A sandy clay aquifer at what is probably the same horizon supplies water for wells in sections 1, 5, and 12, at depths of 68, 76, and 80 feet, respectively. These waters are moderately soft to hard and are reported to be suitable for household requirements. No wells are reported from the northern part of the township, hence the ground water conditions of the drift deposits in this part remain unknown. It seems probable, however, that the drift may be thinner and that the water-bearing beds may occur more sparingly.

Although no wells are known to have been put down into the bedrock formations these are also considered to be a potential source of ground water, particularly in the northern uplands where the Cypress Hills formation forms the uppermost bedrock under the drift. The base of this formation lies at an elevation of about 3,400 feet above sea-level, and so it may also cap a high hill that occurs in sections 11 and 13. Such waters as occur in this formation are usually of excellent quality and are quite suitable for all farm requirements.

The Ravenscrag formation underlying the Cypress Hills beds is not known to occur south of Cypress lake. This formation is probably water bearing as it is known to contain sands and coal seams that are sufficiently porous to permit ground water accumulation. Some of the springs that are reported to occur in the northern part of the area may have thier origins in these beds.

The Eastend formation underlies the Ravenscrag where it occurs in the northern part of the township, and in the southeast it underlies the Cypress Hills and glacial drift at elevations greater than about 3,300 feet above sea-level. The remainder of the area where surface elevations lie below 3,300 feet is underlain by the Bearpaw formation. No wells are reported to have been put down in either of these formations. The Eastend is probably water bearing, particularly in the northern parts where it attains its greatest thickness.

The Bearpaw formation where it is exposed in outcrops along the south shore of Cypress lake contains thin beds of sandstone and sandy shale. These porous beds may be a source of water supply in other parts of the township. Drilling of deep wells in the Bearpaw formation is not recommended, as few porous beds are expected to occur in these shales at elevations lower than about 3,100 feet above sea-level.

Township 6, Range 27

Most of the southern half of this township is a moderately rolling to level till plain. The edge of a wide flat that extends from the west end of Cypress lake northwest to section 20, then southwest to section 7, forms the northern border of the lowlands. From the flat northward the land surface rises rather abruptly to an irregular benchland that extends over the northern third of the area at elevations ranging from 3,300 to 3,450 feet above sea-level. Oxarat creek and several small unnamed streams flow southeastward from the northern uplands to empty into Cypress lake on the eastern side of the area. The southwestern sections are drained by Battle creek.

As most of this township comprises grazing leases the ground water resources have been developed at only a few isolated points. Surface waters are available for range stock in Battle creek, Cypress lake, and Oxarat creek. Several springs are also reported to occur along the banks of the small coulées.

Flood-plain deposits that occur in the wide valley occupied in part by Battle creek and Oxarat creek are possibly the best potential source of ground water supply in the unconsolidated deposits. The water-bearing beds, consisting of gravel or sand buried under several feet of silt and underlain by Bearpaw shales, form a natural reservoir for the accumulation of water. A 10-foot well put down in section 20, in 1902, was still yielding an adequate supply of hard, drinkable water when visited in 1935. Similar aquifers are expected to occur elsewhere in the township, particularly in the larger stream channels where fairly thick deposits have accumulated.

The glacial drift consists largely of boulder clay laid down as a moderately rolling to even till plain. Three, small, moraine-covered areas occur in the southwestern, northwestern, and northeastern corners of the township. In some places, particularly in the central part, the drift is deeply eroded. The thickness of the glacial drift no doubt varies considerably in different parts of the area, but it is not expected to exceed 80 feet in the southern part and it may be much thinner on the northern uplands. A well situated in section 1 yields a moderate supply of soft, drinkable water from a gravel bed at what is probably the base of the drift, at a depth of 73 feet. This horizon may be water bearing in other parts of the lowlands. Small, discontinuous pockets of water bearing sands and gravels may also occur at shallow depths in the upper part of the glacial drift. Such pockets are usually more plentiful in the moraines and in the depressions or along the bases of steep slopes than on the ridges or more level till plains. The yield from wells drawing their supplies from this type of aquifer is generally variable.

No wells in the township are known to have been put down into the bedrock formations. The Cypress Hills beds may underlie the drift in the northern uplands in section 36. The underlying Ravenscrag formation probably does not extend for more than a quarter mile farther south. The Eastend formation forms the bedrock throughout the remainder of the uplands, extending over the northern third of the township. The unconsolidated deposits throughout the rest of the area are underlain by the Bearpaw formation. Since no tests are known to have been made of the ground water resources of the bedrock in this township or in the immediate vicinity, those interested in the water-bearing possibilities are referred to a discussion of these formations in earlier sections of the report dealing with the municipality as a whole.

STATISTICAL SUMMARY OF WELL INFORMATION IN RURAL MUNICIPALITY OF RENO, NO. 51, SASKATCHEWAN

West of 3rd mer. — Township	4	4	4	5	5	5	6	6	6	Total No. in Municipality
Range	25	26	27	25	26	27	25	26	27	
Total No. of Wells in Township	21	15	17	26	30	32	10	11	4	166
No. of wells in bedrock	0	2	6	4	0	4	2	0	●	18
No. of wells in glacial drift	20	13	11	18	29	25	4	11	2	133
No. of wells in alluvium	1	0	0	4	1	3	4	0	2	15
Permanency of Water Supply										
No. with permanent supply	21	11	10	21	27	28	4	11	4	137
No. with intermittent supply	0	1	1	2	2	0	6	0	0	12
No. dry holes	0	3	6	3	1	4	0	0	0	17
Types of Wells										
No. of flowing artesian wells	2	5	0	0	1	2	0	0	0	10
No. of non-flowing artesian wells	16	1	7	4	5	15	0	0	0	48
No. of non-artesian wells	3	6	4	19	23	11	10	11	4	91
Quality of Water										
No. with hard water	18	6	7	20	17	20	4	8	1	101
No. with soft water	3	6	4	3	12	8	6	3	3	48
No. with salty water	0	2	0	0	0	0	0	0	●	2
No. with "alkaline" water	16	1	7	9	1	7	0	1	0	42
Depths of Wells										
No. from 0 to 50 feet deep	10	6	1●	6	10	17	8	2	3	72
No. from 51 to 100 feet deep	10	5	5	15	18	14	●	6	1	74
No. from 101 to 150 feet deep	1	4	1	2	2	0	0	3	0	13
No. from 151 to 200 feet deep	●	0	1	3	●	1	2	0	0	7
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	21	10	7	20	28	28	5	11	4	134
No. not usable for domestic purposes	0	2	4	3	1	0	5	0	0	15
No. usable for stock	21	11	1●	21	29	28	9	11	4	144
No. not usable for stock	0	1	1	2	0	0	1	0	0	5
Sufficiency of Water Supply										
No. sufficient for domestic needs	21	11	10	19	26	28	4	11	4	134
No. insufficient for domestic needs	0	1	1	4	3	0	6	0	0	15
No. sufficient for stock needs	20	9	5	16	21	26	4	11	2	114
No. insufficient for stock needs	1	3	6	7	8	2	6	●	2	35

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 boilders and tea-kettles is formed from these mineral salts.

Sodium

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

Sulphates

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

Chlorides

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

Iron

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

Hardness

Calcium and magnesium salts impart hardness to water. Hardness of water is commonly recognized by its soap-destroying powers as shown by the difficulty of obtaining lather with soap. The total hardness of a water is the hardness of the water in its original state. Total hardness is divided into "permanent hardness" and "temporary hardness". Permanent hardness is the hardness of the water remaining after the sample has been boiled and it represents the amount of mineral salts that cannot be removed by boiling. Temporary hardness is the difference between the total hardness and the permanent hardness and represents the amount of mineral salts that can be removed by boiling. Temporary hardness is due mainly to the bicarbonates of calcium and magnesium and iron, and permanent hardness to the sulphates and chlorides of calcium and magnesium. The permanent hardness can be partly eliminated by adding simple chemical softeners such as ammonia or sodium carbonate, or many prepared softeners. Water that contains a large amount of sodium carbonate and small amounts of calcium and magnesium salts is soft, but if the calcium and magnesium salts are present in large amounts the water is hard. Water that has a total hardness of 300 parts per million or more is usually classed as excessively hard. Many of the Saskatchewan water samples have a total hardness greatly in excess of 300 parts per million; when the total hardness exceeded 3,000 parts per million no exact hardness determination was made. Also no determination for temporary hardness was made on waters having a total hardness less than 50 parts per million. As the determinations of the soap hardness in some cases were made after the samples had been stored for some time, the temporary hardness of some of the waters as they come from the wells probably is higher than that given in the table of analyses.

Analyses of Water Samples from the Municipality of Reno, No. 51, Saskatchewan

LOCATION				Depth of well Ft.	Total dis'vd. solids	HARDNESS			CONSTITUENTS AS ANALYSED						CONSTITUENTS AS CALCULATED IN ASSUMED COMBINATIONS							
Qtr.	Sec.	Tp.	Rge.			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
NW.	23	4	26	128	1,300	100	10	90	50	125	10	36	537	587	1,308	18		75		337	795	83
SW.	26	4	26	122	1,320	125	15	110	31	395	10	43	578	568	1,301	18		90		286	856	51
	26	4	26	120	1,331*												(3)		(5)	(2)	(1)	(4)
SW.	33	4	26	138	960	200	70	130	16	430	90	40	344	341	959	161		84		179	509	26
SE.	4	5	26	91	1,380	260	100	160	18	585	110	43	541	532	1,416	197		90		298	801	30
SW.	14	5	26	60	1,600	700	600	100	41	550	260	119	738	384	1,656	465		71	253		799	68
SW.	23	5	27	23	620	320	120	200	14	410	100	61	123	140	594	179		127		85	180	23
NE.	1	6	26	110	663*												(2)		(4)	(3)	(1)	(5)

All water samples are from wells in 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 by Provincial Analyst, Regina,

For interpretation of this table read the section on Analyses and Quality of Water.

Water from the Unconsolidated Deposits

Waters from stream deposits of this municipality show a wide variation in the total dissolved solids and in the relative abundance of the individual salts present in solution. Several factors contribute to these variations. The stream sediments are formed largely by the erosion of the glacial boulder clay and, in the larger valleys, of the bedrock formations. Such sediments contain relatively large amounts of readily soluble salts. The porosity of the stream beds also has an important bearing on the concentration of the dissolved salts. Waters contained in the stream sediments are derived largely as seepage from the stream or from direct run-off from the uplands and contain relatively small amounts of the dissolved salts when first entering the valley sediments. Slow circulation of the ground waters through fine sands or silts allows ample opportunity for the salts to be taken into soltuion. The coarser sands and gravels generally contain less soluble salts and allow for faster circulation, hence their waters are as a rule not highly mineralized. Surface evaporation may also concentrate the salts in solution to such an extent that waters found at shallow depths on the wider, undrained flats and marshes may, in some places, be unfit for drinking. The seventh analysis given in the table of water analyses accompanying this report is of water obtained from a gravel bed in the valley of Battle creek. The proportion of the individual salts is considered fairly representative of waters from these stream deposits and from similar beds in Frenchman River valley, although the mineral salt concentration may be much greater in some of the finer sediments. Sodium sulphate (Na_2SO_4) is present in the greatest amounts, and is the most harmful salt present due to its laxative effects on humans and stock. Its concentration in this water is not excessive, however, being only 180 parts per million, and the water is of good quality for household use.

Waters obtained from the glacial drift are also variable. Those obtained from the shallow drift deposits do not differ essentially from waters obtained from the stream sediments. The deeper sand and gravel aquifers lying at the base of the drift, as a rule, yield more highly mineralized waters. They are generally hard and most of them contain an excess of 1,000 parts per million of dissolved solids. The sulphates of sodium (Na_2SO_4) and magnesium ($MgSO_4$) usually predominate, with sodium sulphate in the greater amounts. Sodium sulphate or "Glauber's salt" is nearly tasteless, but has a laxative effect when taken in large amounts. Magnesium sulphate or "Epsom salts" has a bitter taste, a laxative effect of about twice that of sodium sulphate, and it also contributes to the hardness of the water. Concentrations of about 1,000 parts per million for both these salts is usually considered as the upper limit of safe usage for humans, although waters containing greater concentrations are frequently used with no apparent ill effects. Stock are less affected by highly mineralized waters and have been reported to thrive on waters containing an excess of 3,000 parts per million. Analysis No. 6 may be representative of most of the waters obtained from the gravel aquifers that occur at the base of the glacial drift. This water is hard owing to the presence of relatively large amounts of magnesium sulphate and calcium carbonate.

Analyses 1, 2, 3, 4, and 5 are of water from flowing wells in the Vidora artesian area. Although these wells are listed as being in glacial drift their waters are in contact with the underlying bedrock shales and may have derived much of their dissolved mineral salts from this source. These analyses differ from the usual drift waters in the excess of sodium carbonate (Na_2CO_3) and in the absence of magnesium sulphate, and in these particulars they are more characteristic of waters from the upper part of the Bearpaw formation. The low total hardness of 100 to 260 parts per million is largely temporary and is removed by boiling. Concentrations of sodium carbonate or "black alkali" in excess of 200 parts per million in waters used for irrigation is generally regarded as being harmful to vegetation. Water from one of the flowing wells has a sodium carbonate content of 337 parts per million, but is being used for garden irrigation with satisfactory results. It is possible, however, that continued use of this water may eventually affect garden plants.

Water from the Bedrock

As no water samples were taken for analyses from the bedrock in this municipality the following discussion on the general character of waters from the different formations is based upon analyses from other municipalities in the vicinity where the source beds are believed to be similar.

Water obtained from the Cypress Hills formation is usually of excellent quality. The sediments comprising this formation are chiefly quartzite conglomerate cemented by calcium carbonate. As the quartzite is only slightly soluble the water is low in dissolved salts. The carbonates are generally present in sufficient quantity, however, to give the water a slight degree of hardness.

The Ravenscrag waters are variable in character. Their total dissolved solid content may range from 300 to 2,000 parts per million within short distances, due to the lateral variation in character of the source beds themselves. As a rule, waters obtained from the coal seams and from the fine sands or sandy shales are more highly mineralized than from the thick sand beds. Sulphate salts are present in solution, but are usually not in sufficient quantities to render the water unfit for household use.

Waters obtained from the Eastend and Bearpaw formations are less variable in character in different localities, but may show marked variations from different horizons. The sulphate salts are usually present, with sodium sulphate predominating. Sodium carbonate is also a common constituent of these waters. They are frequently soft and similar in character to the Vidora artesian waters. Although drinkable waters may be expected from the sandy beds of the Eastend and the upper part of the Bearpaw, waters from the more compact shales may be so highly charged with dissolved sulphate salts and common salt as to be unfit even for stock use.

WELL RECORDS—Rural Municipality of RENO, NO. 51, SASKATCHEWAN.

B 4-4
1860—10,000

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.	2	4	25	3	Dug	28	3,087	- 25	3,062	25	3,062	Glacial sand	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
2	SW.	5	"	"	"	Dug	11	3,246	- 7	3,239	7	3,239	Recent gravel	Soft, clear		D, S	Sufficient for local needs.
3	NE.	5	"	"	"	Dug	18	3,271	- 9	3,262	9	3,262	Glacial sand	Soft, clear		D	Sufficient for local needs.
4	NE.	15	"	"	"	Bored	40	3,098	- 7	3,091	40	3,058	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
5	NW.	18	"	"	"	Drilled	107	3,069	+ 1	3,070	107	2,962	Glacial gravel	Soft, clear		D, S	Sufficient for local needs.
6	SW.	19	"	"	"	Bored	100	3,069	+ 1	3,070	100	2,969	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
7	NW.	20	"	"	"	Bored	58	3,064	- 8	3,056	58	3,006	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
8	NE.	22	"	"	"	Bored	36	3,100	- 6	3,094	36	3,064	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
9	NW.	23	"	"	"	Bored	50	3,118	- 10	3,108	50	3,058	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
10	NE.	26	"	"	"	Bored	45	3,108	- 10	3,098	45	3,063	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
11	SW.	26	"	"	"	Bored	50	3,110	- 12	3,098	50	3,060	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
12	SW.	27	"	"	"	Dug and Bored	60	3,122	- 8	3,114	60	3,062	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
13	NW.	27	"	"	"	Bored	38	3,110	- 8	3,102	38	3,072	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
14	SE.	30	"	"	"	Bored	66	3,130	- 36	3,094	66	3,064	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
15	NW.	30	"	"	"	Bored	60	3,117	- 22	3,095	60	3,057	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
16		32	"	"	"	Bored	80	3,130	- 6	3,124	80	3,050	Glacial drift	Hard		D, S	Sufficient for local needs.
17	NW.	33	"	"	"	Bored	71	3,112	- 40	3,072	71	3,041	Glacial sand and gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
18	SE.	33	"	"	"	Drilled	63	3,126	- 12	3,114	63	3,063	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
19	NW.	35	"	"	"	Dug	47	3,116	- 30	3,086	47	3,071	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
20	NE.	35	"	"	"	Dug	45	3,120	- 32	3,088	45	3,075	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
21	NE.	36	"	"	"	Bored	55	3,135	- 50	3,085	55	3,080	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
1	SE.	1	4	26	3		97	3,130									Dry hole; base in Bearpaw shale(?).
2	SE.	10	"	"	"	Dug	30	3,145	0	3,145			Glacial drift	Soft, clear		D, S	Intermittent supply; also a 30-foot dry hole.
3	NE.	10	"	"	"	Bored	22	3,118	- 12	3,106			Glacial drift	Hard, clear		D	Sufficient for local needs; another well 22 feet deep is unfit for use.
4	NW.	12	"	"	"	Dug and Bored	55	3,160									Dry hole; base in Bearpaw shale.
5	NW.	20	"	"	"	Bored	22	3,072	- 10	3,062	14	3,058	Glacial sand	Hard, clear, iron, salty		D, S	Sufficient for local needs.
6	NW.	23	"	"	"	Bored	125	3,085	+ 17	3,102	125	2,960	Glacial gravel	Soft, clear		D, S, I	Sufficient for local needs; #.

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 RENO, NO. 51, 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
7	NE.	23	4	26	3	Bored	15	3,075	- 5	3,070			Glacial drift	Hard		D, S	Sufficient supply before, but now filled in.
8	SW.	26	"	"	"	Drilled	122	3,073	+ 17	3,090	122	2,951	Glacial gravel	Soft, clear		D, S	Sufficient supply; flows about 5 gallons a minute; #.
9		26	"	"	"		120	3,075	+ 3	3,078	120	2,955	Glacial sand	Soft		D, S	Sufficient for local needs; #.
10	NE.	26	"	"	"	Bored	65	3,081	+ 3	3,084	65	3,016	Glacial drift	Soft, clear		D, S	Sufficient for local needs.
11	SW.	33	"	"	"	Bored	138	3,137	+ 3	3,140	137	3,000	Glacial drift	Soft, soda, cloudy		D, S	Yields 5,000 gallons a day; #.
12	NE.	34	"	"	"	Bored	65	3,110	- 40	3,070	60	3,050	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
13	SW.	35	"	"	"	Bored	52	3,088	- 49	3,039	49	3,039	Glacial gravel	Hard, clear, "alkaline"		S	Insufficient for local needs.
1	SW.	13	4	27	3	Dug	14	3,040	- 12	3,028	12	3,028	Glacial sand	Hard, clear		D	Intermittent supply.
2	SW.	13	"	"	"	Drilled	180	3,048	- 20	3,028	180	2,868	Glacial drift	Soft, clear, iron		D, S	Sufficient for local needs.
3	NE.	15	"	"	"	Dug	16	3,140	- 8	3,132	8	3,132	Glacial sand	Hard, clear, "alkaline"		S	Insufficient for local needs; also a 123-foot dry hole.
4	NW.	21	"	"	"	Bored	50	3,160	- 15	3,145	50	3,110	Glacial drift	Hard, clear, "alkaline", iron		S	Sufficient for local needs; haul drinking water.
5	S.½	21	"	"	"		50	3,160									Dry hole; base in Bearpaw shale; four other similar wells.
6	SE.	22	"	"	"	Bored	90	3,135	- 60	3,075	90	3,045	Glacial drift	Hard, clear, "alkaline", iron		S	Insufficient for local needs.
7	SW.	25	"	"	"	Bored	37	3,200	- 34	3,166	34	3,166	Glacial sand	Hard, clear, "alkaline"		D, S	Insufficient for local needs.
8	NW.	28	"	"	"	Bored	60	3,202	- 30	3,172	60	3,142	Glacial drift	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
9	SW.	29	"	"	"	Dug	13	3,205	- 12	3,193	12	3,193	Glacial gravel	Hard, clear		D, S	Insufficient for local needs.
10	NW.	31	"	"	"	Bored	52	3,220	- 20	3,200	52	3,168	Glacial sand	Soft, clear		D, S	Insufficient for local needs.
11	SE.	33	"	"	"	Bored	52	3,182	- 16	3,166	52	3,130	Glacial drift	Soft, clear, "alkaline", iron		N	Sufficient supply, but not used.
12	SW.	33	"	"	"	Bored	52	3,182	- 16	3,166	52	3,130	Glacial drift	Soft, clear, "alkaline", iron		D, S	Sufficient for local needs.
1	NW.	1	5	25	3	Dug	56	3,145	- 54	3,091	54	3,091	Glacial gravel	Hard, clear, iron		D, S	Sufficient for local needs.
2	SW.	3	"	"	"	Bored	50	3,136	- 27	3,109	50	3,086	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
3	NW.	6	"	"	"	Bored	65	3,125	- 30	3,095	65	3,060	Glacial gravel	Hard		D, S	Sufficient for local needs.
4	SW.	7	"	"	"	Bored	50	3,128	- 42	3,086	50	3,078	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
5	NE.	10	"	"	"	Dug	60	3,157	- 56	3,101	56	3,101	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
6	NE.	12	"	"	"	Dug	53	3,150	- 51	3,099	51	3,099	Glacial gravel	Soft, clear		D, S	Sufficient for local needs.

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 3 Municipality of RENO, NO. 51, 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	HEIGHT TO WHICH WATER WILL RISE: Elev.	PRINCIPAL WATER-BEARING BED: Depth	PRINCIPAL WATER-BEARING BED: Elev.	PRINCIPAL WATER-BEARING BED: Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in°F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
7	SW.	13	5	25	3	Dug	65	3,160	- 63	3,097	63	3,097	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
8	SE.	15	"	"	"	Bored	64	3,158	- 63	3,095	63	3,095	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
9	NE.	15	"	"	"	Bored	150	3,175									Dry hole; base in Bearpaw shale.
10	W.½	15	"	"	"	Dug	61	3,150	- 59	3,091	59	3,091	Glacial gravel	Soft		D, S	Sufficient for local needs.
11	SW.	16	"	"	"	Dug	60	3,140	- 59	3,081	59	3,081	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
12	NW.	16	"	"	"	Drilled	72	3,140					Glacial gravel	Hard, clear, "alkaline"		N	This well is abandoned.
13	SW.	17	"	"	"	Dug	63	3,161	- 45	3,116	63	3,098	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
14	SE.	18	"	"	"	Dug	60	3,165	- 54	3,111	54	3,111	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
15	SE.	19	"	"	"	Drilled	150	3,180									Dry hole; base in Bearpaw shale.
16	SW.	22	"	"	"	Dug	75	3,170	- 72	3,098	72	3,098	Glacial gravel	Hard,		D, S	Sufficient for local needs.
17	SW.	23	"	"	"	Dug	74	3,204	- 72	3,132	72	3,132	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
18	SE.	24	"	"	"	Dug	77	3,195	- 75	3,120	75	3,120	Glacial gravel	Hard, clear, "alkaline"		D, S	Intermittent supply.
19	NW.	25	"	"	"	Dug	14	3,240	- 10	3,230	10	3,230	Recent sand	Soft, clear		D, S	Sufficient for local needs.
20	SE.	28	"	"	"	Dug	90	3,258	- 50	3,208	50	3,208	Glacial gravel	Hard, clear, "alkaline"		D, S	Insufficient for local needs.
21	NE.	28	"	"	"	Bored	103	3,271	- 60	3,211	60	3,211	Glacial gravel	Hard, clear, "alkaline"		S	Insufficient for local needs.
22	NW.	28	"	"	"	Dug	16	3,260	- 13	3,247	13	3,247	Recent sand	Hard, clear		D	Insufficient for local needs.
23	SE.	30	"	"	"	Bored	170	3,210									Dry hole; base in Bearpaw shale.
24	SW.	33	"	"	"	Dug	14	3,250	- 9	3,241	9	3,241	Recent sand	Hard, clear		D	Insufficient for local needs.
25	NE.	33	"	"	"	Bored	130	3,325	-110	3,215	110	3,215	Eastend sandy clay	Hard, clear, "alkaline"		N	Intermittent supply.
26	SE.	34	"	"	"	Dug	16	3,260	- 10	3,250	10	3,250	Recent sand	Hard, clear		D, S	Sufficient for local needs.
1	NE.	1	5	26	3	Dug and Bored	76	3,125	- 48	3,076	76	3,049	Glacial gravel(?)	Hard		D, S	This well is now abandoned.
2	NE.	3	"	"	"	Bored	94	3,130	- 5	3,125	94	3,036	Glacial gravel	Soft, clear		D, S	Sufficient for local needs.
3	SE.	4	"	"	"	Bored	91	3,080	+ 2	3,082	91	2,989	Glacial gravel	Soft, clear		D, S	Yields 3,600 gallons a day; #.
4	NE.	4	"	"	"	Bored	100	3,100	- 10	3,090	90	3,010	Glacial drift	Soft		D, S	Sufficient supply; but well now abandoned.
5	SW.	7	"	"	"	Bored	74	3,130	- 52	3,078			Glacial drift	Soft		D, S	Intermittent supply; well is not abandoned.
6	NE.	9	"	"	"	Bored	43	3,130	- 7	3,123	7	3,123	Glacial drift	Hard		D, S	Sufficient supply, but well now abandoned.
7	NW.	10	"	"	"	Bored	50	3,140	- 44	3,096	44	3,096	Glacial gravel	Hard, clear, iron		D, S	Sufficient for local needs.

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 RENO, NO. 51, 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
8	SE.	12	5	26	3	Dug	67	3,130	- 52	3,078	67	3,063	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
9	SW.	13	"	"	"	Dug	70	3,170	- 68	3,102	68	3,102	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
10	SW.	14	"	"	"	Bored	60	3,140	- 58	3,082	58	3,082	Glacial gravel	Hard, clear		D, S	Sufficient for local needs; #.
11	SE.	15	"	"	"	Bored	65	3,140	- 62	3,078	62	3,078	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
12	SE.	17	"	"	"	Bored	112	3,150	- 72	3,078	72	3,078	Glacial drift	Hard		D, S	Sufficient for local needs.
13	SE.	18	"	"	"	Bored	93	3,130	- 28	3,102	93	3,037	Glacial sand	Soft, clear		D, S	Sufficient for local needs.
14	NW.	21	"	"	"	Bored	89	3,200	- 87	3,113	87	3,113	Glacial gravel	Hard, clear		D, S	Sufficient supply; two other wells 106 and 69 feet deep have poor supplies; also a dry hole 100 feet deep.
15	SW.	24	"	"	"	Dug	20	3,175	- 10	3,165	10	3,165	Recent sand	Hard, clear, sulphur		D, S	Insufficient for local needs.
16	SW.	24	"	"	"	Dug	85	3,196	- 82	3,114	82	3,114	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
17	SE.	24	"	"	"	Dug	93	3,198	- 91	3,107	91	3,107	Glacial gravel	Soft, clear		D, S	Sufficient for local needs.
18	SW.	26	"	"	"	Drilled	75	3,200	- 71	3,129	71	3,129	Glacial drift	Hard, clear		D, S	Sufficient for local needs.
19	SE.	27	"	"	"	Dug	14	3,200	- 7	3,193	7	3,193	Glacial sand	Hard, clear		D, S	Sufficient for local needs.
20	SW.	27	"	"	"	Dug	18	3,200	- 8	3,192	8	3,192	Glacial sand	Soft, clear		D, S	Sufficient for local needs.
21	NE.	30	"	"	"	Bored	73	3,204	- 68	3,136	68	3,136	Glacial sand and gravel	Soft, clear		S	Sufficient for stock needs; a shallow seepage well is used for domestic needs.
22	SE.	31	"	"	"	Dug	24	3,250	- 6	3,244			Glacial sand	Hard, clear		D, S	Sufficient for local needs.
23	NE.	31	"	"	"	Dug	22	3,203	- 11	3,192	11	3,192	Glacial sand	Soft, clear		D, S	Intermittent.
24	NW.	33	"	"	"	Bored	86	3,250	- 83	3,167	83	3,167	Glacial gravel	Soft, clear		D, S	Sufficient for local needs.
25	NE.	33	"	"	"	Dug	24	3,270	- 21	3,249	21	3,249	Glacial sand	Soft, clear		D, S	Insufficient for local needs.
26	NE.	34	"	"	"	Bored	30	3,318	- 18	3,300	18	3,300	Glacial sand	Soft, clear		D, S	Insufficient for local needs.
1	NE.	1	5	27	3	Bored	100	3,100	+ 3	3,103	100	3,000	Glacial gravel	Soft, clear		D, S	Sufficient for local needs.
2	SW.	1	"	"	"	Bored	85	3,108	- 25	3,083	85	3,023	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
3	NW.	1	"	"	"	Bored	83	3,133	+ 2	3,135	83	3,050	Glacial drift	Hard		D, S	Sufficient supply; but now abandoned.
4	SE.	2	"	"	"	Bored	47	3,130	- 40	3,090	40	3,090	Glacial gravel	Hard, clear, "alkaline", iron		D, S	Sufficient for local needs.
5	SE.	4	"	"	"	Bored	67	3,140	- 12	3,128	67	3,073	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
6	SE.	6	"	"	"	Bored	90	3,195	- 35	3,160	90	3,105	Glacial gravel	Soft, clear		D, S	Sufficient for local needs.
7	SW.	7	"	"	"	Bored	47	3,210	- 27	3,183	47	3,163	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.

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 RENO, NO. 51, 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	HEIGHT TO WHICH WATER WILL RISE: Elev.	PRINCIPAL WATER-BEARING BED: Depth	PRINCIPAL WATER-BEARING BED: Elev.	PRINCIPAL WATER-BEARING BED: Geological Horizon	CHARACTER OF WATER	TEMP. OF WATER (in °F.)	USE TO WHICH WATER IS PUT	YIELD AND REMARKS
8	NE.	7	5	27	3	Dug	43	3,219	- 14	3,205	43	3,176	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
9	SE.	9	"	"	"	Dug	45	3,192	- 15	3,177	45	3,147	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
10	SW.	10	"	"	"	Dug	65	3,192	- 28	3,164	65	3,127	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
11	SE.	10	"	"	"	Bored	48	3,187	- 8	3,179	48	3,139	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
12	NE.	12	"	"	"	Bored	53	3,180	- 33	3,147	53	3,127	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
13	SE.	13	"	"	"	Bored	56	3,170	- 45	3,125	45	3,125	Glacial drift	Soft		D, S	Sufficient supply; but in now abandoned.
14	SW.	13	"	"	"	Dug	45	3,170	- 40	3,130	40	3,130	Glacial drift	Hard, clear		D, S	Sufficient for local needs.
15	NE.	16	"	"	"	Bored	47	3,185	- 27	3,158	47	3,138	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
16	SW.	17	"	"	"	Bored	54	3,212	- 39	3,173	54	3,158	Glacial gravel	Soft, clear, "alkaline"		D, S	Sufficient for local needs.
17	SE.	18	"	"	"	Bored	30	3,257	- 20	3,237	20	3,237	Glacial sand	Hard, clear		D, S	Sufficient for local needs.
18	SE.	18	"	"	"	Bored	40	3,257	- 10	3,247	40	3,217	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
19	SW.	18	"	"	"	Drilled	178	3,251									Dry hole; base in Bearpaw shale.
20	SW.	18	"	"	"	Bored	80	3,251	- 76	3,175	76	3,175	Glacial sand and gravel	Hard, clear		D, S	Insufficient for local needs.
21	NW.	19	"	"	"	Bored	65	3,275	- 25	3,250	65	3,210	Glacial gravel	Soft, clear		D, S	Sufficient for local needs.
22	SW.	23	"	"	"	Bored	23	3,154	- 11	3,143	23	3,131	Recent gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs; #.
23	NW.	23	"	"	"	Bored	20	3,168	- 18	3,150	18	3,150	Recent gravel	Soft, clear		D, S	Sufficient for local needs.
24	NW.	25	"	"	"	Drilled	87	3,198	- 7	3,191	87	3,111	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
25	SE.	30	"	"	"	Bored	52	3,268	- 50	3,218	50	3,218	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
26	NE.	32	"	"	"	Dug	3	3,232	+ 1	3,233			Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
27	NE.	33	"	"	"	Bored	25	3,170	- 18	3,152	18	3,152	Recent gravel	Soft, clear, "alkaline"		D, S	Yields 400 gallons a day; also three dry holes; bases in Bearpaw shale.
28	NW.	35	"	"	"	Dug	30	3,252	- 15	3,237	15	3,237	Glacial sand	Soft, clear		D	Insufficient for local needs.
29	NE.	35	"	"	"	Bored	63	3,209	- 62	3,147	62	3,147	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
1	SE.	4	6	25	3	Bored	155	3,340	-153	3,187			Eastend	Hard		N	Intermittent supply; well not used due to small supply.
2	SE.	5	"	"	"	Dug	20	3,320	0	3,320			Glacial drift	Soft, clear		D, S	Intermittent supply.
3	SE.	5	"	"	"	Dug	19	3,335	- 4	3,331			Glacial drift	Soft, clear		S	Intermittent supply.
4	NE.	5	"	"	"	Bored	154	3,365	-124	3,241	124	3,241	Eastend	Hard, clear		D, S	Sufficient supply, but well has been abandoned and a spring is used.
5	SW.	5	"	"	"	Dug	1[illegible]	3,350	- 4	3,346			Glacial drift	Soft, clear		S	Intermittent 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.

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WELL RECORDS—Rural Municipality of RENO, NO. 51, 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
6	NW.	5	6	25	3	Dug	21	3,350	- 8	3,342			Recent silt	Soft, clear		S	Intermittent supply.
7	NW.	6	"	"	"	Dug	17	3,215	- 7	3,208			Recent silt	Hard, clear		D, S	Sufficient for local needs.
8	SW.	7	"	"	"	Dug	16	3,260	- 4	3,256	7	3,253	Recent sand	Soft, clear		S	Sufficient for local needs.
9	NW.	23	"	"	"	Dug	20	3,375	0	3,375			Recent gravel	Soft, clear		D, S	Intermittent supply.
1	SE.	1	6	26	3	Bored	112	3,300	- 82	3,218	82	3,218	Glacial sandy clay	Soft, clear		D, S	Sufficient for local needs.
2	NE.	1	"	"	"	Bored	110	3,280	- 68	3,212	68	3,212	Glacial sandy clay	Soft, clear		D, S	Sufficient for local needs; #.
3	SE.	2	"	"	"	Bored	110	3,333	-107	3,226	107	3,226	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
4	SW.	2	"	"	"	Dug	100	3,300	- 98	3,202	98	3,202	Glacial gravel	Hard		D, S	Fair supply, but well is now abandoned.
5	SE.	3	"	"	"	Bored	100	3,290	- 70	3,220	70	3,220	Glacial gravel	Hard, clear, "alkaline"		D, S	Sufficient for local needs.
6	SE.	4	"	"	"	Dug	62	3,270	- 59	3,211	60	3,210	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
7	SW.	5	"	"	"	Dug	80	3,250	- 76	3,174	76	3,174	Glacial drift	Soft, clear		D, S	Sufficient for local needs.
8	NE.	6	"	"	"	Dug	16	3,220	- 12	3,208	12	3,208	Glacial sand	Hard		D, S	Well is now abandoned.
9	NE.	10	"	"	"	Bored	57	3,377	- 53	3,324	53	3,324	Glacial gravel	Hard, clear		D, S	Sufficient for local needs.
10	SE.	12	"	"	"	Dug	24	3,264	- 16	3,248	16	3,248	Glacial sand	Hard, clear		D, S	Sufficient for local needs.
11	NE.	12	"	"	"	Bored	100	3,324	- 80	3,244			Glacial drift	Hard, clear		D, S	Sufficient for local needs.
1	NW.	1	6	27	3	Dug	73	3,260	- 67	3,193			Glacial drift	Soft, clear		D, S	Sufficient for local needs.
2	SE.	3	"	"	"	Bored	35	3,218	- 15	3,203	15	3,203	Glacial sand	Soft, clear		D	Insufficient for local needs.
3	NW.	7	"	"	"	Dug	28	3,240	- 22	3,218	22	3,218	Recent gravel	Soft, clear		D, S	Sufficient for local needs.
4	NE.	20	"	"	"	Drilled	10	3,266	- 6	3,260	6	3,260	Recent gravel	Hard		D	Sufficient for local needs.

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.